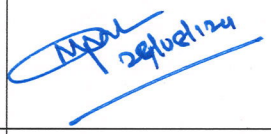
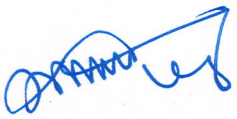
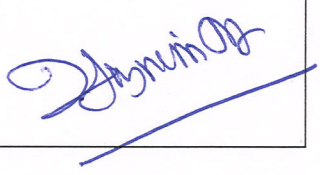
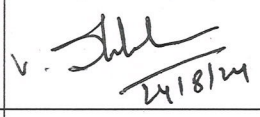
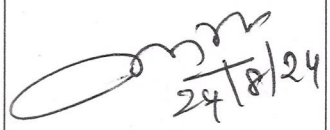
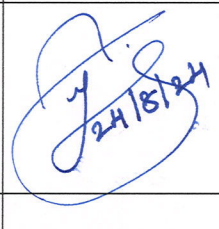
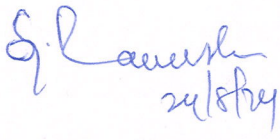
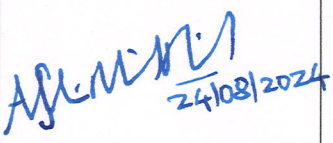
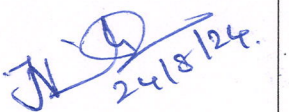
Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

ACADEMIC COUNCIL
ATTENDANCE SHEET FOR 46th MEETING OF
THE ACADEMIC COUNCIL ON 24.08.2024 AT 10.30 am
VENUE: SENATE HALL

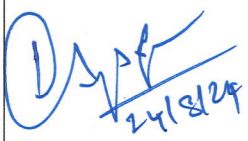
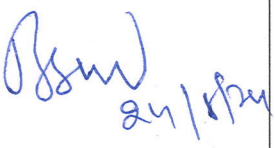
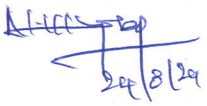
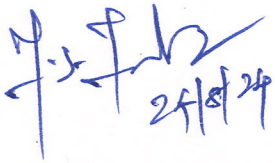
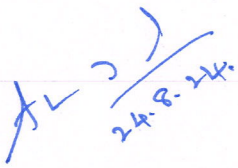
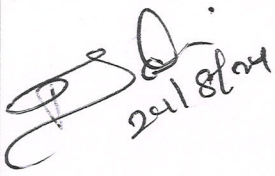
S.No	Name	Position	Signature
1	Prof.S.Salivahanan Vice Chancellor, Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Chairperson	S. Saliv
2	Prof. R.Venkata Rao Vice Chancellor, International University of Legal Education and Research (IIULER) Goa	External Member	24/8/24
3	Mr. K. Balaji Vice President – People and Culture Delphi – TVS Technologies Chennai	External Member	24/8/24.
4	Dr. OR. Nandagopan Director, DRDO Industry Academia, Ramanujan Centre of Excellence, IIT, Madras	External Member	24/8/24
5	Mr. Raghuraman Krishnamurthy Chief Enterprise Architect P&R Practise, Cognizant Chennai.	External Member	Absent
6	Dr. K. Sankaranarayanasamy Professor (HAG), National Institute of Technology (NIT), Tiruchirappalli.	External Member	Present
7	Prof. Dr. Krishnan BASKAR. D.Sc. (KTH-Sweden), FRSC (London). Director, Indian Institute of Technology-Senapati, Manipur (An Institute of National Importance by Act of Parliament, Government of India) Mantripukhri, Imphal – 795002, India.	External Member	Absent

S.No	Name	Position	Signature
	Mobile: +919444125126, E-mail: director@iiitmanipur.ac.in, drbaskar2009@gmail.com		
8.	Dr. S. Raju Professor & Dean - Academics Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
9	Dr. M. Rajeev Kumar, Professor & Dean - Quality Assurance Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology.	Ex-officio	
10	Dr. R.S.Valarmathi Professor & Dean - SoEC Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
11	Dr. P. Chandrakumar Professor & Dean – R&D and Industry Relations Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
12	Dr. G. Guna Sekaran Professor & Dean - FME Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
13	Dr. P. Suresh Professor & Dean - International Relations & HRDC Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
14	Dr.P.Vijayaraman Assistant Professor & Dean (Campus to Corporate) Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	

S.No	Name	Position	Signature
15	Prof. Dr. B. Venugopal Professor & Dean - SoL Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
16	Dr. S. P. Chokkalingam Professor & Dean – SoC Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science andTechnology.	Ex-officio	
17	Dr. M.S.R. Mariyappan, Professor & Dean - SoM Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology	Ex-officio	
18	Dr. E.Suresh Paul Professor & Dean – Media Technology & Communication Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
19	Dr. N. Lenin, Professor & Dean (SoMC) – Dept. of Mechanical Engineering, Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology,	Ex-officio	24/8/24
20	Dr. A.Jayabal Professor & Dean, School of Commerce Dept. of Commerce Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology	Ex-officio	24/8/24
21	Dr. K. Jagajjanani Rao Dean (Academic Research) Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology.	Ex-officio	
22	Dr.R.Sivaraman Professor & Controller of Examinations, Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Permanent Invitee	

S.No	Name	Position	Signature
23	Dr.V.Dhilipkumar Professor & Associate Dean - SoC, Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
24	Dr.R.Jaganraj Associate Professor & HoD – Dept. of Aeronautical Engineering, Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
25	Dr. Amala Justus Selvam Professor & HoD – Dept. of Automobile Engineering, Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
26	Dr.A.Geetha Selvarani, Professor & HoD – Dept. of Civil Engineering, Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
27	Dr. S. Ramesh Professor & HoD – Dept. of Electrical & Electronics Engineering, Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
28	Dr. A. Selwin Mich Priyadharson, Professor & HoD – Dept. of Electronics & Communication Engineering, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology.	Ex-officio	
29	Dr. J Visumathi Professor & HoD – (Information Technology) Dept. of Computer science and Engineering Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
30	Dr. S. Jeyavelu Associate Professor & HoD – Dept. of Mechanical Engineering,	Ex-officio	

S.No	Name	Position	Signature
	Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology,		
31	Dr. K. Ravishankar Professor, HoD – Dept. of Management Studies Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
32	Dr. A. Arumugam Professor & HoD – Dept. of Commerce and Business Administration Vel Tech Rangarajan Dr. SagunthalaR & D Institute of Science and Technology.	Ex-officio	24/8/24
33	Dr. J. Viswanath Professor & HoD – Dept. of Mathematics, Vel Tech RangarajanDr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	24/8/24
34	Dr. Senthil Kumar Associate Professor & HoD – Dept. of Physics, Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	24/8/2024
35	Dr.CH.Hazarathaiah Yadav Professor & HoD – Dept. of Chemistry, Vel Tech Rangarajan Dr. Sagunthala R &D Institute of Science and Technology.	Ex-officio	24/8/24
36	Dr. P.Revathi Head - Dept. of English, Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology	Ex-officio	24/8/24
37	Dr. D. Balasubramaniam Associate Professor & HoD – Dept. of Bio Medical, Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	24 08 24

S.No	Name	Position	Signature
.38	Dr. P. Azhagu Saravana Babu Professor & HoD – Dept. of Bio Technology, Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
39	Dr.B.Someswara Rao Professor & HoD – School of Law, Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Ex-officio	
40	Dr.N Vijayaraj Professor & HoD – CSE Dept. of Computer Science & Engineering Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.		
41	Dr. Muralidhar M S Associate Professor & Assistant HoD – Dept. of Computer Science & Engineering Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology		
42	Dr.S Alex David Professor & HoD – Dept. of Artificial Intelligence and Machine Learning Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Ex-officio	
43	Dr. P Santhi Professor & HoD – Dept. of Artificial Intelligence (AI) and Data Science Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Ex-officio	
44	Dr. R. Parthasarathy Associate Professor & HoD – Dept. of Computer Science and Design Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Ex-officio	

S.No	Name	Position	Signature
45	Dr.Rajendran, Associate Professor & HoD – Department of CSE (Cyber Security) Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology	Ex-officio	
46	Dr.M Gokuldhev Associate Professor & HoD – Department of CSE(Data Science) Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology	Ex-officio	
47	Dr.R.Aruna Professor & HoD for PG programmes Dept. of Computer Science and Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology	Ex-officio	
48	Dr. S. Lalitha, Associate Professor & HoD – Department of CSE (Artificial Intelligence and Machine Learning) Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology	Ex-officio	
49	Dr.C.Viswanathan Professor & HoD (Computer Maintenance Cell) Dept. of Computer Science and Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology	Ex-officio	Absent
50	Dr. Christopher. S Professor Department of Mechanical Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Professor Nominee	S. Christopher. 24/8/2024.
51	Dr. Kavitha T Professor Department of Electronics and Communication Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Professor Nominee	

S.No	Name	Position	Signature
52	Dr. Jana S. Professor Department of Electronics and Communication Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Professor Nominee	
53	Dr. Karunanithi K. Professor Department of Electrical and Electronics Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Professor Nominee	
54	Dr. Prakash A. Professor Department of English Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Professor Nominee	Absent
55	Dr. Kanni Raj A. Professor Department of Chemistry Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Professor Nominee	
56	Dr.R.Srinivasan Professor Department of Computer Science and Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Professor Nominee	
57	Dr.A Bhagyalakshmi Professor Department of Computer Science and Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Professor Nominee	24/8/24
58	Dr.S.Sridevi Professor Department of Computer Science and Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Professor Nominee	24/8/24.

S.No	Name	Position	Signature
59	Dr.M.Kavitha Professor Department of Computer Science and Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Professor Nominee	Absent
60	Dr. Boopathy. G Associate Professor Department of Aeronautical Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Associate Professor nominee	
61	Dr. J. Gajendiran Associate Professor Department of Physics Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Associate Professor nominee	24/08/24
62	Dr. J. Naresh Kumar Associate Professor Department of Mathematics Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Associate Professor nominee	Absent
63	Dr.C.Vijai Associate Professor Department of Commerce and Business Administration, Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Associate Professor nominee	23/8/24
64	Dr. Ajitha E. Associate Professor School of Law Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Associate Professor nominee	
65	Dr. Sai Nandhini R. Assistant Professor Department of Biotechnology Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Assistant Professor nominee	Absent

S.No	Name	Position	Signature
66	Dr. E. Madheswari Assistant Professor Department of Biomedical Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Assistant Professor nominee	
67	Dr.T.Kujani Assistant Professor Department of Computer Science and Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Assistant Professor nominee	24/8/2024
68	Dr.T.Kamaleshwar Assistant Professor Department of Computer Science and Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Assistant Professor nominee	
69	Dr.S.Saran Raj Assistant Professor Department of Computer Science and Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Technology	Internal Member Assistant Professor nominee	
70	Dr.E.Kannan Professor & Registrar Dept. of Computer Science and Engineering Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.	Secretary	24/08/2024

S. Salim

VICE CHANCELLOR

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

46th MEETING
OF
THE ACADEMIC COUNCIL

Saturday, August 24, 2024

MINUTES

No. 42, Avadi-Vel Tech Road, Avadi, Chennai, Tamil Nadu, Pincode-600 062.
Email: registrar@veltech.edu.in, Website: www.veltech.edu.in.

Contents

Prof. S. Salivahanan
Vice Chancellor

S. Salivahanan

List of Tables

S. Salivahanan
Prof. S. Salivahanan
Vice Chancellor

Minutes of the 46th MEETING OF THE ACADEMIC COUNCIL

Saturday, August 24, 2024, at 10.30 a.m.

The Vice Chancellor welcomed all the members and highlighted the acheivements of the Institution.

A. Opening

46.1 To pass and record the condolences to the Respected Foundress President Dr.Sagunthala Rangarajan over her sudden demise on 26.06.2024.

The Chairperson spoke on the profound contributions of the Foundress President, particularly her significant impact on society and her dedication to women's empowerment. In honour of her memory, the Chairperson read the condolence message:

"It is with deep sorrow that we acknowledge the sudden demise of the esteemed Foundress President Dr. Sagunthala Rangarajan. Her Visionary leadership and unwavering commitment to societal betterment and women's empowerment have left an indelible mark on our institution and the community at large. Her compassion, dedication, and service legacy will continue to inspire us all. We extend our heartfelt condolences to her family and loved ones during this difficult time".

After observing a minute's silence as a mark of respect to the noble soul, The BoM passed a resolution as follows:

The Item was moved to place the sad demise of Dr. Sagunthala Rangarajan on record and the condolence note with the heartfelt condolences of the BoM /Executive Council to the bereaved family.

46.2 Call to Order and Approval of Agenda of the 46th meeting of the Academic Council.

The Vice Chancellor called to order and placed the agenda of the 46th meeting of the Academic Council for confirmation which was circulated to members by e-mail.

46.3 Confirmation of the minutes of 45th meeting of the Academic Council held on Saturday, June 08, 2024.

The minutes of the 45th meeting of the Academic Council held on June 08, 2024 were circulated to the members.

The draft minutes of the 45th meeting of the Academic Council can be accessed *here*

Appendix A

Prof. S. Salivahanan
Vice Chancellor

The Minutes of the 45^{th} meeting of the Academic Council held on June 08, 2024 has been confirmed.

46.4 To review the Action Taken Report on the minutes of the 45^{th} meeting of the Academic Council held on Saturday, June 08, 2024.

The Vice Chancellor, placed before the Academic Council to consider the Action Taken Report in respect of the 45^{th} meeting of the Academic Council as described in Table 1.

Table 1: Action Taken Report in respect of 45^{th} meeting of the Academic Council held on June 08, 2024.

S.No	Agenda Item	Decision Taken	Action Taken Report as decided in the ACM.
1	Item No 45.5 – Page 03 To consider and approve the minutes of the Board of Studies of Law - Under Graduate Programmes	Seperate Newsletter for School of Law stating the achievements of Faculty members and Students.	First Issue of Newsletter has been released.
2	Item No 45.5 – Page 03 To consider and approve the minutes of the Board of Studies of Law - Under Graduate Programmes	Conducting Legal Awareness Camp for the rural peoples in and around the University.	2 Awareness camp has been conducted.
3	Item No 45.5 – Page 03 To consider and approve the minutes of the Board of Studies of Law - Under Graduate Programmes	Exploring more funding options from the Govt. Agencies.	In Progress.
4	Item No 45.6 – Page 09 To consider and approve the proposed implementation of evaluation pattern for the courses offered by the experts from Industries /International faculty members for the courses under 7.2.2 Programme Core, 7.2.3 Programme Elective in line with the evaluation of courses coming under Institute/Higher Learning Interactions in Regulations VTR UGE-2021 (Ref. Section 8.3.8)	suggested to include the 1. continuous assessment as part of the evaluation of the courses AND 2. Assignment as compulsory in the continuous Assessment.	1. Already implemented in the current Academic Regulations VTR UGE 2021. AND 2. To be implemented in the New Regulations from the next Academic Year 2025-26.

The Council has taken note on the Action Taken report of the 45^{th} meeting of the Academic Council held on June 08, 2024.

Prof. S. Salivahanan
Vice Chancellor

46.5 To record leave of absence of the members.

The following member have expressed their inability to attend the meeting due to various reasons.

* **Dr.C.Viswanathan**
  Professor & HoD (Computer Maintenance Cell)

* **Dr. Prakash A.**
  Professor & Department of English

* **Dr.M.Kavitha**
  Professor & Department of Computer Science and Engineering

* **Dr. J. Naresh Kumar** Associate Professor & Department of Mathematics

* **Dr. Sai Nandhini R.** Assistant Professor & Department of Biotechnology

The Chair has noted their leave of absence.

The list of members attended the 44th meeting of the Academic Council can be accessed *here*	 **Appendix Attendance**
The Letter for grant of absence can be accessed *here*	 **Appendix Grant of absence**

B. Items for Discussion

46.6 To discuss and approve the minutes of the Board of Studies of Engineering and Technology - Under Graduate & Post Graduate Programmes (all engineering schools).

1. School of Mechanical and Construction

A. Department of Aeronautical Engineering

The Vice Chancellor, placed before the Academic Council to consider the recommendations of the 27th Board of Studies of Under Graduate (UG) and Post Graduate (PG) Programmes under Department of Aeronautical Engineering to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

Prof. S. Salivahanan
Vice Chancellor

Dr. R. Jegan Raj, Associate Professor, Head - Department of Aeronautical Engineering & BoS - Chairman, presented the recommendations of the 27^{th} meeting of the Board of Studies held on April 04, 2024.

The Minutes of the BoS meeting can be accessed here

Appendix AERO

The Summary and presentation of the BoS Minutes can be accessed here.

- **Dr. Nandagopan** suggested to utilize the opportunity to use INS Rajali for the course assessment of Weapon Technology.

Dr. R. Jegan Raj, Associate Professor & Head - Department of Aeronautical Engineering & BoS - Chairman, moved the recommendations of the 27^{th} Board of Studies of Under Graduate (UG) and Post Graduate (PG) Programmes under the Department of Aeronautical Engineering to be implemented with effect from the Summer Semester of the Academic Year 2024-25, be approved.

Dr. S. Ramesh, Professor & Head - Department of Electrical and Electronics Engineering, seconded it.

The motion was carried.

B. Department of Civil Engineering

The Vice Chancellor, placed before the Academic Council to consider the recommendations of the Board of Studies of Under Graduate (UG) and Post Graduate (PG) Programmes under the Department of Civil Engineering to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

Dr. A. Geetha Selvarani, Professor, Head - Department of Civil Engineering & BoS - Chairman, presented the recommendations of the Board of Studies meeting held on June 22, 2024.

The Minutes of the BoS meeting can be accessed here

Appendix Civil

The Summary and presentation of the BoS Minutes can be accessed here.

Dr. A. Geetha Selvarani, Professor, Head - Department of Civil Engineering & BoS - Chairman, moved the recommendations of the Board of Studies of Under Graduate (UG) and Post Graduate (PG) Programmes under the Department of Civil Engineering to be implemented with effect from the Summer Semester of the Academic Year 2024-25, be approved.

Dr. R. Jegan Raj, Associate Professor & Head - Department of Aeronautical Engineering, seconded it.

The motion was carried.

S. Salivah

Prof. S. Salivahanan
Vice Chancellor

C. Department of Mechanical Engineering

The Vice Chancellor, placed before the Academic Council to consider the recommendations of the 39^{th} Board of Studies of Under Graduate (UG) and Post Graduate (PG) Programmes under the Department of Mechanical Engineering to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

The Minutes of the BoS meeting can be accessed here

Dr. S. Jeyavelu, Associate Professor, Head - Department of Mechanical Engineering & BoS - Chairman, presented the recommendations of the 39^{th} meeting of the Board of Studies held on June 22, 2024.

Appendix MECH

The Summary and presentation of the BoS Minutes can be accessed here.

- **Dr. Nandagopan** suggested to utilize the faculty from CVRDE for offering elective courses.

Dr. S. Jayavelu, Associate Professor & Head, Department of Mechanical Engineering, moved the recommendations of the 39^{th} Board of Studies of Under Graduate (UG) and Post Graduate (PG) Programmes under the Department of Mechanical Engineering to be implemented with effect from the Summer Semester of the Academic Year 2024-25, be approved.

Dr. A. Geetha Selvarani, Professor, Head - Department of Civil Engineering, seconded it.

The motion was carried.

2. School of Electrical and Communication

A. Department of Bio Medical Engineering

The Vice Chancellor, placed before the Academic Council to consider the recommendations of the 12^{th} Board of Studies of Department of Bio Medical Engineering to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

The Minutes of the BoS meeting can be accessed here

Dr. D. Balasubramaniam, Associate Professor, Head - Department of Bio Medical Engineering & BoS - Chairman, presented the recommendations of the 12^{th} meeting of the Board of Studies conducted on June 29, 2024.

Appendix BIOMED

The Summary and presentation of the BoS Minutes can be accessed here.

Dr. D. Balasubramaniam, Associate Professor, Head - Department of Bio Medical Engineering & BoS - Chairman, moved the recommendations of the 12^{th} Board of Studies of Department of Bio Medical Engineering to be implemented with effect from the Summer Semester of the Academic Year 2024-25, be approved.

Prof. S. Salivahanan
Vice Chancellor

Dr.S.Ramesh, Professor & Head,Department of Electrical and Electronics Engineering, seconded it.

The motion was carried

B. Department of Biotechnology

The Vice Chancellor, placed before the Academic Council to consider the recommendations of the 12^{th} Board of Studies of Department of Biotechnology to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

Dr. P. Azhagu Saravana Babu, Professor, Head - Department of Biotechnology & BoS - Chairman, presented the recommendations of the 12^{th} meeting of the Board of Studies held on June 26, 2024.

B *The Minutes of the BoS meeting can be accessed here*

Appendix Biotech

The Summary and presentation of the BoS Minutes can be accessed here.

Dr. P. Azhagu Saravana Babu , Professor, Head - Department of Biotechnology & BoS - Chairman, moved the recommendations of the 12^{th} meeting of the Board of Studies of Department of Biotechnology to be implemented with effect from the Summer Semester of the Academic Year 2024-25, be approved.

Dr. A. Selwin Mich Priyadharson, Professor & Head,Department of Electronics & Communication Engineering, seconded it.

The motion was carried

C. Department of Electrical and Electronics Engineering

The Vice Chancellor, placed before the Academic Council to consider the recommendations of the 32^{th} Board of Studies of Under Graduate (UG) and Post Graduate (PG) Programmes under Department of Electrical and Electronics Engineering to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

Dr. S. Ramesh, Professor, Head - Department of Electrical and Electronics Engineering & BoS - Chairman, presented the recommendations of the 32^{nd} meeting of the Board of Studies held on June 29, 2024.

The Minutes of the BoS meeting can be accessed here

Appendix EEE

The Summary and presentation of the BoS Minutes can be accessed here.

- **Dr. Nandagopan** suggested to offer the courses regarding E-Waste Management.

Dr. S. Ramesh, Professor, Head - Department of Electrical and Electronics Engineering & BoS - Chairman, moved the recommendations of the 32^{st} Board of Studies of Under Graduate (UG) and Post Graduate (PG) Programmes under Department of

Prof. S. Salivahanan
Vice Chancellor

Electrical and Electronics Engineering to be implemented with effect from the Summer Semester of the Academic Year 2024-25, be approved.

Dr. P. Azhagu Saravana Babu, Professor & Head, Department of Bio Technology, seconded it.

The motion was carried

D. Department of Electronics and Communication Engineering

The Vice Chancellor, placed before the Academic Council to consider the recommendations of the Board of Studies of Under Graduate (UG) and Post Graduate (PG) Programmes under Department of Electronics and Communication Engineering to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

Dr. A. Selwin Mich Priyadharson, Professor, Head - Department of Electronics and Communication Engineering & BoS - Chairman, presented the recommendations of the Board of Studies meeting held on June 29, 2024.

The Minutes of the BoS meeting can be accessed here

Appendix ECE

The Summary and presentation of the BoS Minutes can be accessed here.

- **Dr. Rajeev Kumar** suggested to use the industry persons as alumni representative not from the Academic Institutions.

Dr. A. Selwin Mich Priyadharson, Professor, Head - Department of Electronics and Communication Engineering & BoS - Chairman, moved the recommendations of the Board of Studies of Under Graduate (UG) and Post Graduate (PG) Programmes under Department of Electronics and Communication Engineering to be implemented with effect from the Summer Semester of the Academic Year 2024-25, be approved.

Dr. D. Balasubramaniam, Associate Professor & Head, Department of Bio Medical, seconded it.

The motion was carried

3. School of Computing

The Vice Chancellor, placed before the Academic Council to consider the recommendations of the Board of Studies of All Under Graduate (UG) and Post Graduate (PG) Programmes under School of Computing to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

Prof. S. Salivahanan
Vice Chancellor

Prof. Dr. S. P. Chokkalingam, Professor, Dean - School of Computing & BoS - Chairman, presented the recommendations of the Board of Studies of All Under Graduate (UG) and Post Graduate (PG) Programmes under School of Computing.

The Minutes of the BoS meeting can be accessed here

Appendix SoC

The Summary and presentation of the BoS Minutes can be accessed here.

Prof. Dr. S. P. Chokkalingam, Professor, Dean - School of Computing & BoS - Chairman, moved the recommendations of the Board of Studies of All Under Graduate (UG) and Post Graduate (PG) Programmes under School of Computing to be implemented with effect from the Summer Semester of the Academic Year 2024-25, be approved.

Dr. Dhilip Kumar, Professor & Associate Dean, Department of Computer Science and Engineering, seconded it.

The motion was carried

46.7 To discuss about the Implementations of National Education Policy (NEP) 2020 from the AY 2025-26 for all Under Graduate (UG) and Post Graduate (PG) Programmes.

The Vice Chancellor, placed before the Academic Council to discuss about the Implementations of National Education Policy (NEP) 2020 from the AY 2025-26 for all Under Graduate (UG) and Post Graduate (PG) Programmes.

Prof. (Dr.) S. Raju, Professor & Dean Academics, presented the concept note on the NEP 2020 adoption from the Academic Year 2025-26.

Prof. (Dr.) S. Raju, Professor & Dean Academics, presented the concept note on the NEP 2020 adoption from the Academic Year 2025-26.

The NEP 2020 Presentation can be accessed here

Appendix NEP 2020

All members have accepted the proposal.

Prof. (Dr.) S. Raju, Professor & Dean Academics, moved that "to discuss about the Implementations of National Education Policy (NEP) 2020 from the AY 2025-26 for all Under Graduate (UG) and Post Graduate (PG) Programmes", be approved.

Dr. M.S.R. Mariyappan , Professor & Dean - School of Management, seconded it.

The motion was carried

S. Salivah
Prof. S. Salivahanan
Vice Chancellor

C. Items for Consideration

46.8 To consider and approve the proposal for the conduct of 14^{th} Convocation to be held in the month of September 2024.

The Vice Chancellor, placed before the Academic Council to consider the proposal for the conduct of 14^{th} Convocation to be held in the month of September 2024.

Dr. E. Kannan, Professor & Registrar, presented the proposal for the conduct of 14^{th} Convocation to be held in the month of September 2024.

Dr. E. Kannan, Professor & Registrar, moved the proposal for the conduct of 14^{th} Convocation to be held in the month of September 2024.

Dr. P. Suresh, Professor & Dean International Relations, seconded it.

The motion was carried.

D. Items for Ratification

46.9 To ratify the admissions of candidates to Doctoral (Ph.D.) level programmes in Engineering and Technology/ Science / Law / Management / Humanities /Arts for Summer Semester of the Academic Year 2024-25.

The Vice Chancellor, placed before the Academic Council to ratify the admissions of Doctoral (Ph.D.) level Programmes in Engineering and Technology / Science /Law / Management/ Humanities / Arts during the Summer Semester of the Academic Year 2024-25.

Dr. K. Jagajjanani Rao, Associate Professor & Dean - Academic Research, presented the admissions of Doctoral (Ph.D.) level Programmes in Engineering and Technology / Science /Law / Management/ Humanities / Arts for Summer Semester of the Academic Year 2024-25.

Table 2: Statistics of Ph.D. Admission AY 2024-25 (Summer Semester)

S.No.	Department	Applied	Attended for Exam	Selected in Interview	Provisionally Admitted		
					Full Time	Part Time	Total
Engineering							
1	AERO	8	8	7	2	1	3
2	BIOMEDICAL	3	2	2	1	1	2
3	BIOTECH	10	5	6	3	0	3
4	CIVIL	11	11	5	2	3	5
5	CSE	36	31	24	2	17	19
6	IT	3	2	2	1	0	1
7	ECE	18	16	11	3	3	6

Prof. S. Salivahanan
Vice Chancellor

Table 2: Statistics of Ph.D. Admission AY 2024-25 (Summer Semester)

S.No.	Department	Applied	Attended for Exam	Selected in Interview	Provisionally Admitted		
					Full Time	Part Time	Total
8	EEE	5	5	1	0	0	0
9	MECH	11	9	7	2	2	4
TOTAL (A)		105	89	65	16	27	43
S&H							
10	CHEMISTRY	9	7	7	2	2	4
11	CSE	5	3	3	2	0	2
12	ENGLISH	16	7	11	5	1	6
13	MATHS	28	8	19	7	10	17
14	PHYSICS	16	14	15	8	4	12
TOTAL (B)		74	39	55	24	17	41
MBA							
15	MBA	9	7	3	0	3	3
TOTAL (C)		9	7	3	0	3	3
OVER ALL TOTAL (A+B+C)		**188**	**135**	**123**	**40**	**47**	**87**

Dr. K. Jagajjanani Rao, Associate Professor & Dean - Academic Research, informed about starting a admission for School of Commerce (SCoM) and School of Media Technology and COmmunication (SoMTC) from this Academic Year 2024-25.

Dr. K. Jagajjanani Rao, Associate Professor & Dean - Academic Research, moved that "the admissions in Doctoral (Ph.D.) level Programmes in Engineering and Technology / Science /Law / Management/ Humanities / Arts during the Summer Semester of the Academic Year 2024-25", be approved.

Dr. M.S.R. Mariyappan , Professor & Dean - School of Management, seconded it.

The motion was carried.

46.10 To ratify the number of students admitted under various programme in the Academic Year 2024-25.

The Vice Chancellor, placed before the Academic Council to ratify the number of students admitted under various UG & PG programmes in the Academic Year 2024-25.

Dr. E. Kannan, Professor & Registrar, presented the details about the number of students admitted under various UG & PG programmes in the Academic Year 2024-25.

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Prof. S. Salivahanan
Vice Chancellor

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Student admitted count in the AY 2024-25 can be accessed here

Appendix Admitted Count

Dr. E. Kannan, Professor & Registrar, presented the details about the number of students admitted under various UG & PG programmes in the Academic Year 2024-25.

Dr. E. Kannan, Professor & Registrar, moved that "the details about the number of students admitted under various UG & PG programmes in the Academic Year 2024-25", be ratified.

Dr. M. Rajeev Kumar, Professor & Dean - Quality Assurance, seconded it.

The motion was carried.

46.11 To ratify the admissions under Institution Transfer category during the Summer Semester of the Academic Year 2024-25.

The Vice Chancellor, placed before the Academic Council to ratify the list of students admitted through "Institution Transfer category" in the Summer Semester of the Academic Year 2024-25.

Dr.E. Kannan, Professor & Registrar, presented the list of students admitted through Institution Transfer category in the Summer Semester of the Academic Year 2024-25.

Table 3: Institution Transfer Students Name List - AY 2024-25

S.No.	VTU No.	Name	Department	Name of the Institute (Transfer From)
1	VTU29711	ARUNAGIRI S	B.Tech. - Electronics and Communication Engineering	Sri Krishna College of Technology
2	VTU29640	POOJA SHREE D	B.Tech. - Biotechnology	Jeppiar College of Engineering
3	VTU30497	VENGADESH M	B.Tech. - Mechanical Engineering	Karpagam Academy of Higher Education
4	VTU30618	PERARASU E	B.Tech. - Electrical and Electronics Engineering	Karpagam Academy of Higher Education
5	VTU30624	A PRAVEEN	B.Tech. - Civil Engineering	Karpagam Academy of Higher Education
6	VTU30644	SHREEDHANYA S	B.Tech. - Electrical and Electronics Engineering	St. Peters College of Engg. and Technology.

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Prof. S. Salivahanan
Vice Chancellor

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(Deemed to be University Estd. u/s 3 of UGC Act 1956)

Dr.E. Kannan, Professor & Registrar, moved that "the list of students admitted through Institution Transfer category in the Summer Semester of the Academic Year 2024-25", be ratified.

Dr. R.S.Valarmathi, Professor & Dean - School of Electrical and Communication, seconded it.

The motion was carried.

46.12 To ratify the admissions under Lateral Entry category during the Summer Semester of the Academic Year 2024-25.

The Vice Chancellor, placed before the Academic Council to ratify the list of students admitted under Lateral Entry category in the Summer Semester of the Academic Year 2024-25.

Dr. E. Kannan, Professor & Registrar, presented that the list of students admitted through Lateral Entry category in the Summer Semester of the Academic Year 2024-25.

Lateral Entry students details can be accessed here

Lateral Entry Students Name list

Table 4: Statistics of Lateral Entry students (Summer Semester AY 2024-25)

S.No	Name of the Programme	Count
1	B.Tech. - Aeronautical Engineering	10
2	B.Tech. - Artificial Intelligence and Machine Learning	9
3	B.Tech. - Artificial Intelligence(AI) and Data Science	4
4	B.Tech. - Biomedical Engineering	1
5	B.Tech. - Civil Engineering	7
6	B.Tech. - Computer Science and Engineering	72
7	B.Tech. - Computer Science and Engineering (Artificial Intelligence and Machine Learning)	3
8	B.Tech. - Computer Science and Engineering (Cyber Security)	5
9	B.Tech. - Computer Science and Engineering (Data Science)	2
10	B.Tech. - Electrical and Electronics Engineering	27
11	B.Tech. - Electronics and Communication Engineering	51
12	B.Tech. - Information Technology	3
13	B.Tech. - Mechanical Engineering	31
	Total	**225**

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Vice Chancellor

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Dr.E. Kannan, Professor & Registrar, moved that "the list of students admitted through Lateral Entry category in the Summer Semester of the Academic Year 2024-25", be ratified.

Dr. E. Suresh Paul, Professor & Dean , School of Media Technology & Communication, seconded it.

The motion was carried.

46.13 To ratify the admissions under Re-Admission category during the Summer Semester of the Academic Year 2024-25.

The Vice Chancellor, placed before the Academic Council to ratify the admissions under Re-Admission category in the Summer Semester of the Academic Year 2024-25.

Dr.E. Kannan, Professor & Registrar, presented that the list of students admitted through Re Admission category in the Summer Semester of the Academic Year 2024-25.

Table 5: Students admitted through Re-Admission in Summer Semester AY 2024-25

S. No	BATCH	VTU NO	NAME OF THE STUDENT	PROGRAMME	DEPAR-TMENT	SEM YEAR	Circular No. and Date
1	2020-21	VTU 20963	S SAHIL	B.TECH.	MECH	III/II	Circular No. 03 dated on 04.07.2024
2	2022-23	VTA 1836	S HARINI	B.COM. LL.B.	-	III/II	Circular No.07 dated on 08.07.2024
3	2020-21	VTU 17907	DESETTI SAI NADU TEJA	B.TECH.	AERO	VI/III	Circular No.24 dated on 08.08.2024
4	2022-23	VTU 24271	AMAN DAS THARU	B.TECH.	AERO	IV/II	Circular No.24 dated on 08.08.2024

Dr.E. Kannan, Professor & Registrar, moved that "the list of students admitted through Re-Admission category in the Summer Semester of the Academic Year 2024-25", be ratified.

Dr.R.Sivaraman, Professor & Controller of Examinations, seconded it.

The motion was carried.

46.14 To ratify the admission under Migration from one Programme to another Programme in respect of the Under Graduate (UG) during the Summer Semester of the Academic Year 2024-25.

The Vice Chancellor, placed before the Academic Council to ratify the list of students "migrated from one programme to another programme category" in Summer Semester of the Academic Year 2024-25.

Dr. E. Kannan, Professor & Registrar, presented the list of students admitted through migrated from one programme to another programme category in Summer Semester of the Academic Year 2024-25.

Prof. S. Salivahanan
Vice Chancellor

Table 6: List of Migrated Students during Summer Semester of the AY 2024-25

S.No	VTU	Registration No	Student Name	Present Programme (studying in)	Migration Applied To
1	27185	23UEEE0011	Giri . Bhavani	EEE	Civil
2	27329	23UEEE0013	Gudichutti Satyamaheswari	EEE	Civil
3	24841	23UECS0377	Mullapudi Jeevan Sri Venkata Vinay	CSE	Civil
4	27064	23UEEE0035	P Divyanjali	EEE	Civil
5	26313	23UECS0808	Mohammad Rayyan	CSE	MECH
6	25286	23UECV0010	Shreemathi Selvam	CIVIL	MECH
7	27065	23UEEE0004	C Gayani	EEE	IT
8	24810	23UEAE0028	M Arjun Kumar	AERO	CSE (DS)
9	24716	23UECL0038	M.Surendra	CSE (AI & ML)	CSD
10	24975	23UEEC0196	M.Dilip	ECE	AI & ML
11	26458	23UEEC0544	Lakkireddy Ganesh Reddy	ECE	CSE
12	27242	23UEME0025	P.Abhinay	MECH	CSE
13	27249	23UEEE0001	Akash Yadav	EEE	ECE
14	27373	23UEEE0039	Ammilu Saladi	EEE	ECE
15	24941	23UEEE0024	Manish Kumar Sharma	EEE	ECE
16	26533	23UECS0405	Nukala Sai Sri Vivek	CSE	CSE (AI & ML)
17	26337	23UECE0026	Kamsali Bunny Preetham Chary	CSD	CSE
18	24921	23UEEC0383	Yeruva. Rupa Lavanya	ECE	CSD
19	26947	23UEEE0047	V. Hima Bindu	EEE	ECE
20	27246	23UEEE0057	Rohit Mandal. N	EEE	ECE

Dr.E. Kannan, Professor & Registrar, moved that "the list of students admitted through migrated from one programme to another programme (*under section 12.2 & 12.3 in Regulations VTR UGE 2021*) in the Summer Semester of the Academic Year 2024-25", be ratified.

Dr. N. Lenin, Professor & Dean - School of Mechanical and Construction, seconded it.

The motion was carried.

46.15 To ratify the Academic Calendar of Post Graduate - Arts (First year) and Post Graduate - Management (First year) programmes for the Academic Year 2024-25.

The Vice Chancellor, placed before the Academic Council to ratify the Academic Calendar for the Academic Year 2024-25 for Under-graduate (UG) and Post-graduate (PG) level programmes.

S. Salivahanan
Prof. S. Salivahanan
Vice Chancellor

Prof. (Dr.) S. Raju, Professor & Dean Academics, presented the Academic Calendars of Post Graduate - Arts (First year) and Post Graduate - Management (First year) programmes for the Academic Year 2024-25.

The Academic Calendar for AY 2023-24 can be accessed here

Appendix Academic Calendar

Prof. (Dr.) S. Raju, Professor & Dean Academics, moved that the "Academic Calendars of Post Graduate - Arts (First year) and Post Graduate - Management (First year) programmes for the Academic Year 2024-25", be ratified.

Dr. K. Jagajjanani Rao, Associate Professor & Dean - Academic Research, seconded it.

The motion was carried.

46.16 To ratify the examination results of Semester End Examinations held during the Winter Semester of Academic Year 2023-24.

The Vice Chancellor, placed before the Academic Council to record the result analysis of the Semester end examination held during Winter Semester of the Academic Year 2023-24.

Dr. R. Sivaraman, Professor & Controller of Examinations, presented the result analysis of the Semester end examination held during Winter Semester of the Academic Year 2023-24.

The Result Analysis can be accessed here

Appendix Result Analysis

Dr. R. Sivaraman, Professor & Controller of Examinations, moved that "the result analysis of the semester end examination held during Winter Semester of the Academic Year 2023-24", be ratified.

Dr. P. Chandrakumar, Professor & Controller of Examinations, seconded it.

The motion was carried.

S. Salivar
Prof. S. Salivahanan
Vice Chancellor

Vel Tech
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R&D Institute of Science and Technology

E. Items for Reporting

46.17 To report the results of the Ph.D. viva voce conducted since last Academic Council held on June 08, 2024.

The Vice Chancellor, placed before the Academic Council to ratify the results of the Ph.D. viva voce examinations conducted since last Academic Council held on June 08, 2024.

Dr. R. Sivaraman, Controller of Examinations, presented the results of the Ph.D. viva voce examinations conducted since last Academic Council held on June 08, 2024.

Ph.D. viva voce list can be accessed here

Appendix Ph.D. viva voce

Dr. R. Sivaraman, Controller of Examinations, moved that "the results of the Ph. D. viva voce examinations conducted since last Academic Council held on June 08, 2024", be reported.

46.18 To record the progression and achievements of the following Schools and divisions:

a) School of Computing.

b) School of Science and Humanities.

c) Office of International Relations.

The Vice Chancellor, placed before the Academic Council to report the progression of School of Computing, School of Science and Humanities and office of International Relations and their academic achievements.

a) School of Computing.

Prof. Dr. S. P. Chokkalingam, Professor & Dean - School of Computing, presented the Progression of School of Computing and their academic acheivements.

Progression of the School of Computing can be accessed here

Prof. Dr. S. P. Chokkalingam, Professor & Dean - School of Computing, moved the Progression of School of Computing and the academic acheivements", be recorded.

S. Salivat

Prof. S. Salivahanan
Vice Chancellor

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b) **School of Science and Humanities.**

Dr. G. Guna Sekaran, Professor & Dean - School of Science and Humanities, presented the Progression of School of Science and Humanities and their academic acheivements.

Progression of the School of Science and Humanities can be accessed here

Dr. G Guna Sekaran, Professor & Dean - School of Science and Humanities, moved the Progression of School of Science and Humanities and their academic acheivements", be recorded.

c) **Office of International Relations.**

Dr. P. Suresh, Professor & Dean - Office of International Relations, presented the Progression of Office of International Relations and their academic acheivements.

Progression of the Office of International Relations can be accessed here

Dr. P. Suresh, Professor & Dean - Office of International Relations, moved the Progression of Office of International Relations and their academic acheivements", be recorded.

D. Closing

46.19 Any other items with the permission of the Chairperson.

1. **Dr. M.S.R. Mariyappan** , Professor & Dean - School of Management has announced that 14 students from the School of Management have successfully completed their internship and credit transfer from Universiti Sains Islam Malaysia, Malaysia. This pertains to two courses: 30212MG150 - Basics of Functional Analytics for Batch I and International Business Management for Batch II, with each course carrying 3 credits.
2. **Dr. N. Lenin**, Professor & Dean - School of Mechanical and Construction requesting to give suggestions and recommendations for starting a new programme.
   - B.Tech. - Aerospace Engineering under the department of Aeronautical.
   - B.Tech. - Electrical Vehicle under the department of Mechanical.
   - M.Tech. - Defense Technology under the department of Aeronautical.

46.20 To decide the date of holding the next meeting of the Academic Council.

47^{th} Regular Meeting of the Academic Council is tentatively scheduled in the **Month of November**.

S. Salivahanan
Prof. S. Salivahanan
Vice Chancellor

46.21 Vote of Thanks.

Dr. E. Kannan, Professor & Registrar, expressed his thanks to all the members of the Academic Council for their presence and valuable contributions.

46.22 Adjournment

The meeting was adjourned at 1.40 PM.

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S. Salivah

Prof. S. Salivahanan
Vice Chancellor

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45th MEETING
OF
THE ACADEMIC COUNCIL

Saturday, June 08, 2024

MINUTES

No. 42, Avadi-Vel Tech Road, Avadi, Chennai, Tamil Nadu, Pincode-600 062.
Email: registrar@veltech.edu.in, Website: www.veltech.edu.in.

Contents

List of Tables

Minutes of the 45th Meeting of the Academic Council

Saturday, June 08, 2024, at 10.30 a.m.

The Vice Chancellor welcomed all the members and highlighted the acheivements of the Institution.

A. Opening

45.1 Call to Order and Approval of Agenda of the 45th meeting of the Academic Council.

The Vice Chancellor called to order and placed the agenda of the 45th meeting of the Academic Council for confirmation which was circulated to members by e-mail.

45.2 Confirmation of the minutes of 44th meeting of the Academic Council held on Saturday, February 24, 2024.

The minutes of the 44th meeting of the Academic Council held on February 24, 2024 were circulated to the members.

The draft minutes of the 44th meeting of the Academic Council can be accessed *here*

Appendix A

The Minutes of the 44th meeting of the Academic Council held on February 24, 2024 has been confirmed.

45.3 To review the Action Taken Report on the minutes of the 44th meeting of the Academic Council held on Saturday, February 24, 2024.

The Vice Chancellor, placed before the Academic Council to consider the Action Taken Report in respect of the 44th meeting of the Academic Council as described in Table 1.

Table 1: Action Taken Report in respect of 44th meeting of the Academic Council held on February 24, 2024.

S.No	Agenda Item	Decision Taken	Action Taken Report as decided in the ACM.
1	Item No 44.6 – Page 10 To consider and approve to conduct arrear examinations for those students who have failed in the (i) Professional Proficiency courses (under the clause 7.3.7)	The members have accepted the proposal and suggested to explore the possibilities of arranging Intensive course for the benefit of failed students	Will be implemented from the May/June 2024 examinations onwards.

1	(ii) Mandatory courses (Constitution of India & Engineer and Society) (under the clause 7.3.8) instead of Re-registration under VTR UGE 2021 (Ref. Section 8.6.4)	immediately after the result and conduct arrear examinations accordingly.	
2	Item No 44.7 – Page 10 To discuss and approve the introduction of the Bucket System for elective courses under the Regulations VTR UGE 2021 from the summer semester of the Academic Year 2024-25.	Members approved the bucket system of elective courses and suggested to conduct workshop to the faculty members	One day workshop on "Implementations of Bucket system of courses" conducted on March 16, 2024. Implementation is under process from present 2nd year onwards from the AY 2024-25.
3	Item No 44.9 – Page 10 To discuss the Multiple Exit options for the students admitted under the Regulations VTR UGE 2021	Members suggested to evolve implementation strategies of multiple exit before the implementations.	The Implementation strategies will be presented in the next ACM.
4	Item No 44.10 – Page 14 To consider and approve the proposal of addition/ reduction of intake in UG PG Programmes for the Academic Year 2024-25.	Members approved the addition/ reduction of intake in UG/PG programmes from the AY 2024-25.	AICTE EoA has been received on May 19, 2024.

The Council has taken note on the Action Taken report of the 44^{th} meeting of the Academic Council held on February 24, 2024.

45.4 To record leave of absence of the members.

The following member have expressed their inability to attend the meeting due to various reasons.

* **Dr. N. R. Rajalakshmi,**
  Professor & HOD,
  Dept. of Aritificial Intelligence and Machine Learning
  Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology.

* **Dr. E. Madhaswari,**
  Assistant Professor & Dept. of Biomedical,
  Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.

* **Dr. T. Kamaleshwar,**
  Assistant Professor & Dept. of CSE,
  Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.

* **Dr. S. Saran Raj,**
Assistant Professor & Dept. of CSE,
Vel Tech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology.

The Chair has noted their leave of absence.

The list of members attended the 44th meeting of the Academic Council can be accessed *here*

Appendix Attendance

The Letter for grant of absence can be accessed *here*

Appendix Grant of absence

B. Items for Discussion

45.5 To consider and approve the minutes of the Board of Studies of the following disciplines:

- Law - Under Graduate(UG) Programmes
- Arts and Science - Under Graduate(UG) and Post Graduate (PG) Programmes
- Management - Post Graduate(PG) Programme

- **Law - Under Graduate Programmes**

a) B.A.,LL.B. and **B.Com., LL.B.**

The Vice Chancellor, placed it before the Academic Council to consider the recommendations of the 11th Board of Studies for **B.A., LL.B. and B.Com., LL.B.** to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

The Minutes of the BoS meeting can be accessed here

Dr. B. Venugopal, Professor & Dean, School of Law, presented the recommendations of the 11th Board of Studies meeting conducted on January 03, 2024.

Appendix LAW

Prof. R. Venkata Rao, External Member, suggested the following,

1. Separate News Letter for School of Law stating the achievements of Faculty members and Students

2. Conducting Legal Awareness Camp for the rural peoples in and around the University
3. Exploring more funding options from the Govt. Agencies

Dr. B. Venugopal , Professor & Dean, School of Law, has thanked the member for the suggestions and agreed to implement the same immediately.

Dr. B. Venugopal , Professor & Dean, School of Law, moved that "the recommendations of the 11^{th} Board of Studies for **B.A., LL.B.** and **B.Com., LL.B.** to be implemented with effect from the Summer Semester of the Academic Year 2024-25", be approved.

Dr. M.S.R. Mariyappan , Professor & Dean - School of Management, seconded it.

The motion was carried.

- **Arts and Science - Under Graduate (UG) Programmes**

a) B.Sc. Multimedia.

The Vice Chancellor, placed it before the Academic Council to consider the recommendations of the 15^{th} Board of Studies for **B.Sc. Multimedia** to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

Dr. E. Suresh Paul, Professor & Dean - School of Media Technology & Communication, presented the recommendations of the 15^{th} Board of Studies meeting conducted on January 03, 2024.

The Minutes of the BoS meeting can be accessed here

Appendix MultiMedia

Dr. E. Suresh Paul, Professor & Dean , School of Media Technology & Communication, moved the recommendations of the 15^{th} Board of Studies for **B.Sc. Multimedia** to be implemented with effect from the Summer semester of the Academic Year 2024-25, be approved.

Dr. R.S.Valarmathi, Professor & Dean - School of Electrical and Communication, seconded it.

The motion was carried.

b) B.Sc. Visual Communication

The Vice Chancellor, placed it before the Academic Council to consider the recommendations of the 15^{th} Board of Studies for **B.Sc. Visual Communication** to be implemented with effect from the Summer semester of the Academic Year 2024-25.

The Minutes of the BoS meeting can be accessed here

Dr. E. Suresh Paul, Professor & Dean - School of Media Technology & Communication, presented the recommendations of the 15^{th} Board of Studies meeting conducted on January 03, 2024.

Appendix Viscom

Dr. E. Suresh Paul, Professor & Dean , School of Media Technology & Communication, moved the recommendations of the 15^{th} Board of Studies for **B.Sc. Visual Communication** to be implemented with effect from the Summer Semester of the Academic Year 2024-25, be approved.

Dr. D. Senthil Kumar, Associate Professor & Head, Department of Physics, seconded it.

The motion was carried.

c) Bachelor of Commerce (B.Com.)

The Vice Chancellor, placed it before the Academic Council to consider the recommendations of the 3^{rd} Board of Studies for **Bachelor of Commerce (B.Com.)** to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

The Minutes of the BoS meeting can be accessed here

Dr. J. Sri Devi, Assistant Professor & Head, Department of commerce and Business Administration, presented the recommendations of the 3^{rd} Board of Studies meeting conducted on December 01, 2023.

Appendix BCom

Dr. J. Sri Devi, Assistant Professor & Head, Department of commerce and Business Administration, moved that "the recommendations of the 3^{rd} Board of Studies for **Bachelor of Commerce (B.Com.)** to be implemented with effect from the Summer semester of the Academic Year 2024-25", be approved.

Dr. E. Suresh Paul, Professor & Dean , School of Media Technology & Communication, seconded it.

The motion was carried.

d) Bachelor of Business Administration (B.B.A.)

The Vice Chancellor, placed it before the Academic Council to consider the recommendations of the 3^{rd} Board of Studies for **Bachelor of Business Administration**

(B.B.A.) to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

Dr. J. Sri Devi, Assistant Professor & Head, Department of commerce and Business Administration, presented the recommendations of the 3^{rd} Board of Studies meeting conducted on December 01, 2023.

The Minutes of the BoS meeting can be accessed here

Appendix BBA

Dr. J. Sri Devi, Assistant Professor & Head, Department of commerce and Business Administration,, moved the recommendations of the 3^{rd} Board of Studies for **Bachelor of Business Administration (B.B.A.)** to be implemented with effect from the Summer Semester of the Academic Year 2024-25, be approved.

Dr. P. Revathi, Assistant Professor & Head, Department of English, seconded it.

The motion was carried.

- **Arts and Science - Post Graduate Programmes**

a) M.A. - English

The Vice Chancellor, placed it before the Academic Council to consider the recommendations of the Board of Studies for **M.A. - English** to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

Dr. P. Revathi, Assistant Professor & Head, Department of English, presented the recommendations of the Board of Studies meeting conducted on December 27, 2023.

The Minutes of the BoS meeting can be accessed here

Appendix ENG

Dr. P. Revathi, Assistant Professor & Head, Department of English, moved "that the recommendations of the Board of Studies for **M.A. English** to be implemented with effect from the Summer Semester of the Academic Year 2024-25", be approved.

Dr. CH. Hazarathaiah Yadav, Professor & Head, Department of Chemistry, seconded it.

The motion was carried.

b) M.Sc. - Mathematics

The Vice Chancellor, placed it before the Academic Council to consider the recommendations of the Board of Studies for **M.Sc. - Mathematics** to be implemented

with effect from the Summer Semester of the Academic Year 2024-25.

Dr. J. Viswanath, Professor & Head, Department of Mathematics, presented the recommendations of the Board of Studies meeting conducted on January 04, 2024.

The Minutes of the BoS meeting can be accessed here

Appendix MATHS

Dr.J. Viswanath, Professor & Head, Department of Mathematics, moved "that the recommendations of the Board of Studies for **M.Sc. - Mathematics** to be implemented with effect from the Summer Semester of the Academic Year 2024-25", be approved.

Dr. D. Senthil Kumar, Associate Professor & Head, Department of Physics, seconded it.

The motion was carried.

c) M.Sc. - Physics

The Vice Chancellor, placed it before the Academic Council to consider the recommendations of the Board of Studies for **M.Sc. - Physics** to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

Dr. D. Senthil Kumar, Associate Professor & Head, Department of Physics, presented the recommendations of the Board of Studies meeting conducted on December 26, 2023.

The Minutes of the BoS meeting can be accessed here

Appendix PHY

Dr. D. Senthil Kumar, Associate Professor & Head, Department of Physics, moved "that the recommendations of the Board of Studies for **M.Sc. Physics** to be implemented with effect from the Summer Semester of the Academic Year 2024-25", be approved.

Dr. J. Viswanath, Professor & Head, Department of Mathematics, seconded it.

The motion was carried.

d) M.Sc. - Chemistry

The Vice Chancellor, placed it before the Academic Council to consider the recommendations of the Board of Studies for **M.Sc. - Chemistry** to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

The Minutes of the BoS meeting can be accessed here

Appendix CHEM

Dr. CH. Hazarathaiah Yadav, Professor & Head, Department of Chemistry, presented the recommendations of the Board of Studies meeting conducted on January 05, 2024.

Dr. CH. Hazarathaiah Yadav, Professor & Head, Department of Chemistry, moved "that the recommendations of the Board of Studies for **M.Sc. - Chemistry** to be implemented with effect from the Summer Semester of the Academic Year 2024-25", be approved.

Dr. P. Revathi, Assistant Professor & Head, Department of English, seconded it.

The motion was carried.

e. M.Sc. - Data Analytics

The Vice Chancellor, placed it before the Academic Council to consider the recommendations of the Board of Studies for **M.Sc. - Data Analytics** to be implemented with effect from the Summer Semester of the Academic Year 2024-25.

The Minutes of the BoS meeting can be accessed here

Appendix M.SC(DA)

Dr. M. S. Muralidhar, Associate Professor & Head, Department of Computer Science & Engineering, presented the recommendations of the 4^{th} meeting of the Board of Studies conducted on January 05, 2024.

Dr. M. S. Muralidhar, Associate Professor & Head, Department of Computer Science & Engineering , moved the recommendations of the 4^{th} Board of Studies for **M.Sc. - Data Analytics** to be implemented with effect from the Summer Semester of the Academic Year 2024-25, be approved.

Dr. R. Parthasarathy, Associate Professor & Head, Department of Computer Science and Design, seconded it.

The motion was carried.

- **Management - Post Graduate Programmes**

a) Master of Business Administration (M.B.A.)

The Vice Chancellor, placed it before the Academic Council to consider the recommendations of the Board of Studies for **Master of Business Administration (M.B.A.)** to be implemented with effect from the summer semester of the Academic Year 2024-25.

The Minutes of the BoS meeting can be accessed here

Appendix MBA

Dr. K. Ravishankar, Professor & Head, Department of Management, presented the recommendations of the 27^{th} Board of Studies meeting conducted on December 11, 2023.

Dr. K. Ravishankar, Professor & Head, Department of Management, moved that "the recommendations of the Board of Studies for **Master of Business Administration (M.B.A.)** to be implemented with effect from the Summer Semester of the Academic Year 2024-25", be approved.

Dr. J. Sri Devi, Assistant Professor & Head, Department of commerce and Business Administration, seconded it.

The motion was carried.

45.6 To consider and approve the proposed implementation of evaluation pattern for the courses offered by the experts from Industries/International faculty members for the courses under 7.2.2 Programme Core, 7.2.3 Programme Elective in line with the evaluation of courses coming under Institute/Higher Learning Interactions in Regulations VTR UGE-2021 (Ref. Section 8.3.8)

The Vice Chancellor, placed it before the Academic Council to consider and approve the proposed implementation of evaluation pattern for the courses offered by the experts from Industries/International faculty members for the courses under 7.2.2 Programme Core, 7.2.3 Programme Elective in line with the evaluation of courses coming under Institute/Higher Learning Interactions in Regulations VTR UGE-2021 (Ref. Section 8.3.8).

Dr. A. T. Ravichandran, Professor & Dean Academics, presented the proposed implementation of evaluation pattern for the courses offered by the experts from Industries/International faculty members for the courses under 7.2.2 Programme Core, 7.2.3 Programme Elective in line with the evaluation of courses coming under Institute/Higher Learning Interactions in Regulations VTR UGE-2021 (Ref. Section 8.3.8).

Dr. Krishnan Baskar & **Dr. Sankaranarayasamy** - External Member, have supported the proposal and suggested to include the continuous assessment as part of the evaluation of the courses.

Dr. Nandagopan - External Member, has suggested to include the Assignment as Compulsory in the Continuous Assessment.

All members have accepted the proposal with the above suggestion.

Dr. A. T. Ravichandran, Professor & Dean Academics, has assured the members that, all the suggestions will be taken in the consideration while preparing the evaluation pattern.

Dr. A. T. Ravichandran, Professor & Dean Academics, moved that " to consider and approve the proposed implementation of evaluation pattern for the courses offered by the experts from Industries/International faculty members for the courses under 7.2.2 Programme Core, 7.2.3 Programme Elective in line with the evaluation of courses coming under Institute/Higher Learning Interactions in Regulations VTR UGE-2021 (Ref. Section 8.3.8) ", be approved.

45.6 a) Proposed to amend in the Regulation VTR UGE 2021 to enable the students to earn the minimum credits required under Open Elective Category (Section 7.2.4) by either Online/Physical or by both.

Dr. A. T. Ravichandran, Professor & Dean Academics, presented the Proposed to amend in the Regulation VTR UGE 2021 to enable the students to earn the minimum credits required under Open Elective Category (Section 7.2.4) by either Online/Physical or by both.

All members have accepted the proposal and the suggested to ensure that, courses offered by NPTEL/Swayam portal shall be considered under the Open Elective as such courses are having the proctored examinations.

Dr. A. T. Ravichandran, Professor & Dean Academics, has accepted the suggestions from the members and assured that, NPTEL/Swayam courses only will be considered for credit transfer. He informed the members that the list of courses offered in NPTEL/Swayam portal that are recommended by various department Board of Studies (BoS) under the open elective category will be also be presented in the next meeting.

Dr. A. T. Ravichandran, Professor & Dean Academics, moved that "the proposal of amending the Regulation VTR UGE 2021 to enable the students to earn the minimum credits required under Open Elective Category (Section 7.2.4) by either Online/Physical or by both", be approved.

Dr. P. Suresh, Professor & Dean International Relations, seconded it.

The motion was carried.

C. Items for Reporting

45.7 To report the Academic Calendars for the Academic Year 2024-25 for the Under Graduate (UG) and Post Graduate (PG) programmes

The Vice Chancellor, placed it before the Academic Council to ratify the Academic Calendar for the Academic Year 2024-25 for Under-graduate (UG) and Post-graduate (PG) level programmes.

Dr. A. T. Ravichandran, Professor & Dean Academics, presented the Academic Calendars for the Academic Year 2024-25 for the Under Graduate (UG) and Post Graduate (PG) programmes.

Academic Calendars for the Academic Year 2024-25 can be accessed here

Appendix Academic Calendar

Dr.A.T. Ravichandran, Professor & Dean Academics, moved that "the Academic Calendar for the Academic Year 2024-25 for Under-graduate (UG) and Post-graduate (PG) level programmes", be reported.

45.8 To report the Extended EoA to various degree programmes by the AICTE for three years from 2024-25 to 2026-27.

The Chair, placed it before the Academic Council to report the Extended EoA to various degree programmes by the AICTE for three years from 2024-25 to 2026-27.

Dr.E. Kannan, Professor & Registrar, presented the report of Extended EoA to various degree programmes by the AICTE for three years from 2024-25 to 2026-27.

AICTE EoA approval for AY 2022-23 can be accessed here

Appendix "AICTE EoA Approval"

Dr.E.Kannan, Professor & Registrar, moved that "the report of Extended EoA to various degree programmes by the AICTE for three years from 2024-25 to 2026-27.", be reported.

45.9 To report the results of the Ph.D. viva voce conducted since last Academic Council held on February 24, 2024.

The Vice Chancellor, placed it before the Academic Council to ratify the results of the Ph.D. viva voce examinations conducted since last Academic Council held on February 24, 2024.

Dr. R. Sivaraman, Controller of Examinations, presented the results of the Ph.D. viva voce examinations conducted since last Academic Council held on February 24, 2024.

Ph.D. viva voce completed candidates list can be accessed here

Appendix Ph.D. viva voce

Dr. R. Sivaraman, Controller of Examinations, moved that "the results of the Ph. D. viva voce examinations conducted since last Academic Council held on February 24, 2024", be reported.

45.10 To record the progression and achievements of the following Schools and divisions:

a) School of Electrical and Communication.

b) School of Management.

c) Office of Industry Relations.

The Vice Chancellor, placed it before the Academic Council to report the progression of School of Electrical and Communication, School of Management, Office of Industry Relations and their academic achievements.

a) School of Electrical and Communication.

SoEC presentation can be accessed here

Dr. R.S.Valarmathi, Professor & Dean - School of Electrical and Communication, presented the Progression of School of Electrical and Communication and their academic achievements.

Appendix SoEC

Dr. R.S.Valarmathi, Professor & Dean - School of Electrical and Communication, moved that "the Progression of School of Electrical and Communication and their academic achievements", be recorded.

b) School of Management.

SoM presentation can be accessed here

Dr. M.S.R. Mariyappan , Professor & Dean - School of Management, presented the Progression of School of Management and their academic achievements.

Appendix SoM

Dr. M.S.R. Mariyappan , Professor & Dean - School of Management, moved that "the Progression of School of Management and their academic achievements", be recorded.

c) Office of Industry Relations.

Office of Industry Relations presentation can be accessed here

Dr. P. Chandrakumar , Professor & Dean – R&D and Industry Relations, presented the Progression of Office of Industry Relations and their academic achievements.

Appendix Industry Relations

Dr. P. Chandrakumar , Professor & Dean – R&D and Industry Relations, moved that "the Progression of Office of Industry Relations and their academic achievements", be recorded.

E. Closing

45.11 Any other items with the permission of the Chairperson.

There is no other item brought to the notice of Chairperson.

45.12 To decide the date of holding the next meeting of the Academic Council.

46^{th} Regular Meeting of the Academic Council is tentatively scheduled in the **Month of September**.

45.13 Vote of Thanks.

Dr. E. Kannan, Professor & Registrar, expressed his thanks to all the members of the Academic Council for their presence and valuable contributions.

45.14 Adjournment

The meeting was adjourned at 2.00 PM.

School of Mechanical and Construction

Department of Aeronautical Engineering

27th Board of Studies Meeting

Wednesday, July 24, 2024

3.00 pm, Department office

Summary of BoS Minutes

Summary of the 27th Board of Studies meeting of the Department of Aeronautical Engineering

The 27th Board of Studies of the Department of Aeronautical Engineering was convened on Thursday, 04th April, 2024, at 2:00 pm in the department office.

The chair informed the board about the following agenda items.

- ✓ Assessment Procedure of the invited professors & industry expert course
- ✓ Feedback analysis and updating curriculum and syllabus
- ✓ Selection of courses under self-learning category in Program Elective and open elective

- Department inviting professors from foreign and experts from industry to deliver program core as well as program elective apart from IHL category courses. The board recommended to consider assessment done by the invited professor / expert as final marks for semester end examination in case to case considerations by Department.
- It is recommended to introduce Theory of Machines as one of the program elective for B.Tech. Aeronautical Engineering under VTR UGE R21.
- It is recommended to replace orbital mechanics with weapon testing under Aerospace & Defense.
- Feedback analysis and discussed in detail and proposed changes of focused tutorial topics, tools based activities. The modified syllabus is recommended.
- It is recommended to consider courses from edx and coursera along with NPTEL courses under self-learning program elective and open elective categories.
- NPTEL & Edx courses for program elective is introduced for both UG and PG.
- It is recommended to explore possibilities to offer M.Tech. Defence Technology Specialization in Aerospace Engineering

S. No	Name	Designation	Signature
1	Dr. R. Jaganraj, Head / Aeronautical Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Inst of Sci & Tech	Chairman	24/7/24
2	Dr. K. M. Parammasivam Professor / Aerospace Engineering, MIT, Chennai	Academic Expert	24/7/2024
3	Dr. Dinesh Manoharan Operations Head – UCAL Fuel Systems, Aerospace Division	Industry Expert	Online
4	Dr. B.L. Jaiswal, Professor of Emeritus / Aeronautical Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Inst of Sci & Tech	Member	Online
5	Dr.J.V.Sai Prasanna Kumar, Professor / Aeronautical Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Inst of Sci & Tech	Member	
6	Dr.Naga Lingeswara Raju, Professor / Aeronautical Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Inst of Sci & Tech	Member	Online
7	Dr.Ganesan, Professor / Aeronautical Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Inst of Sci & Tech	Member	Ganesan
8	Mr. G. Boopathy, Asso. Professor / Aeronautical Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Inst of Sci & Tech	Member	24-07-2024
9	Dr. G. Surendar, Asso. Professor / Aeronautical Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Inst of Sci & Tech	Member	24/7/24
10	Mr. B. Kirubadurai, Asst. Professor / Aeronautical Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Inst of Sci & Tech	Member	
11	Miss. Nithya S, Asst. Professor / Aeronautical Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Inst of Sci & Tech	Member	

27th Board of Studies Meeting

Date: 24th July 24, 2024 **Time: 3.00 pm**

Place: Department office & Hybrid Mode

Agenda for Meeting

27. A. Items for Confirmation

27.1 Action taken report on 26th BoS minutes dated 20th Jan 2024

27.2 Minutes of meeting of the 26th BoS dated 20th Jan 2024

27.3. Leave of absence of the members

27. B. Items for Discussions

27.4. Assessment procedure for invited courses by professor from international universities & industry experts in program elective and program core categories of B.Tech. Aeronautical Engineering under VTR UGE 21 regulation.

27.5 Selection of self-learning courses in program elective and open elective categories for B.Tech. Aeronautical Engineering under VTR UGE 21.

27.6 Revision of the curriculum and syllabus for B.Tech. Aeronautical Engineering under VTUR 2021.

27.7 Revision of the curriculum and syllabus for M.Tech. Aeronautical Engineering under VTR 23 regulation.

27.C. Items for Reporting

27.9 Ratification of Courses, if any

27.D. Closing

27.10. Any other item with the permission of chair

Vote of Thanks

Minutes of Meeting – 27th BOS of Department of Aeronautical Engineering

The chair welcomed all to the meeting. The following agenda items were discussed and recommended action items were finalized.

27. A. Items for Confirmation

27.1 Action taken report on 26th BoS minutes dated 20th Jan 2024

Recommendations	Action Taken
26.4. Specialization courses under "Aerospace & Defense Technology" for B.Tech. Aeronautical Engineering under VTUR 2021. New courses from defence technology shall be increased.	2 courses from defence technology and 4 courses from aerospace is included.
26.5 Revision of the curriculum and syllabus for B.Tech. Aeronautical Engineering under VTUR 2021 for WS 23-24. Proposed courses were modified with members suggestions.	Modifications are incorporated successfully.
26.6 Revision of the curriculum and syllabus for M.Tech. Aeronautical Engineering (Unmanned Aerial Vehicle) under VTR PGE 2023. Proposed courses were modified with members suggestions.	Modifications are incorporated successfully.

27.2 Minutes of meeting of the 26th BoS dated 20th Jan 2024

Members reviewed the minutes of the meeting of the 26th BoS Dated 20th Jan 2024.

27.3. Leave of absence of the members

All are presented

27. B. Items for Confirmation

27.4. Assessment procedure for invited courses by professor from international universities & industry experts in program elective and program core categories of B.Tech. Aeronautical Engineering under VTR UGE 21 regulation.

The courses offered under program elective and program core categories by invited professors from abroad universities and industry experts are discussed in detail. It is recommended to consider the assessment done by the invited experts is sufficient to award the credits for the courses. This helps the students and department to understand international & innovative learning practices followed at different universities and study

them in detail. This also helps the students to understand the international practices in awarding credits.

Action: Recommended to consider the assessment done by invited professors and experts as final grade for awarding credits to the courses under program core and program elective may consider case to case.

27.5 Selection of self-learning courses in program elective and open elective categories for B.Tech. Aeronautical Engineering under VTR UGE 21.

Department offers specialization in Aerospace & Defence, Autonomous Drone Technology and Computational Engineering for B.Tech. Aeronautical Engineering. NPTEL or swayam has minimum courses relevant to these areas and most of the courses were available in program core courses which is listed in NPTEL or swayam. So, committee recommended to consider edx and coursera platforms also to select courses for self-learning mode of study.

Action: Recommended to consider courses from edx and coursera under self-learning courses for elective categories.

27.6 Revision of the curriculum and syllabus for B.Tech. Aeronautical Engineering under VTUR 2021.

The feedback received from various stakeholders is analyzed and recommendations were incorporated. The feedback analysis is given in Annexure I.

It is recommended to add "Theory of Machines" as a program elective for B.Tech. Aeronautical Engineering. This course will help students to understand different mechanisms and its applications & use cases in aerospace field.

Orbital mechanics is replaced with weapon testing in Aerospace & Defense specialization.

The following online courses are added from NPTEL, Edx.

Cat	Name	Credit
MOOC Edx / PE	Thermal-Fluids Engineering 1: Basics of Thermodynamics and Hydrostatics	3
MOOC NPTEL/ PE	Remote Sensing: Principles and Applications	3
MOOC Edx/ PE	Global Media, War, and Technology	3

MOOC Edx/ PE	Sustainable Energy: Design a Renewable Future	3
MOOC NPTEL/ PE	System Design for Sustainability	3
MOOC Edx/ PE	Autonomous Mobile Robots	3
MOOC NPTEL/ PE	UAV in Engineering Applications	3

The following courses are revised course list for maintaining focused tutorial topics and include tools as activity.

Course Title	L	T	P	C
Thermodynamics & Heat Transfer	2	1	0	**3**
Aircraft Propulsion	2	1	0	**3**
Rocket & Space Propulsion	2	1	0	**3**
Engineering Mechanics	1	1	0	**2**
Airplane Performance	1	1	0	**2**
Aircraft Design Rules & Certification	1	0	0	**1**
Fluid Mechanics	1	1	2	**3**
Low Speed Aerodynamics	1	1	2	**3**
High Speed Aerodynamics	1	1	2	**3**
Computational Fluid Dynamics	1	1	2	**3**
Combustion & Gas Dynamics	1	1	2	**3**
Solid Mechanics	1	1	2	**3**
Aircraft Structural Mechanics	1	1	2	**3**
Aircraft Structural Dynamics	1	1	2	**3**
Finite Element Analysis	1	1	2	**3**
Robotics for Aeronautical Engineering	1	0	4	**3**
Linear system Analysis & Control	1	0	2	**2**
Aircraft Systems & Instruments	1	0	2	**2**
Avionics	1	0	2	**2**
Airplane Stability & Control	1	0	2	**2**
Introduction to Aerospace Engineering	1	0	2	**2**
Aircraft Design	1	0	2	**2**
Propulsion Lab	0	0	2	**1**
DIO Lab	0	0	2	**1**

Action: Revised courses are given in Annexure II. It is recommended to incorporate the proposed corrections and modifications in curriculum and syllabus.

27.7 Revision of the curriculum and syllabus for M.Tech. Aeronautical Engineering under VTR 23 regulation.

The following courses are added.

UAV in Engineering Applications	NPTEL/online	3	PE
Remote Sensing: Principles and Applications	NPTEL/online	3	PE
Research Methodology	NPTEL/online	2	Online course
English for Research Paper Writing	NPTEL/online	2	Online course

Action: It is recommended to incorporate the proposed corrections and modifications in curriculum and syllabus.

27.C. Items for Reporting

27.5 Ratification of Courses, if any

Credit course on "Advanced research methodology for industrial revolution 4.0" is going to be offered by Prof. Gupta, from University of Johannesburg, Johannesburg (South Africa) to B.Tech. Aeronautical Engineering students. It is recommended to consider under IHL category.

Action: It is recommended to ratify the IHL course offered to students in WS2324.

27.D. Closing

27.7. Any other item with the permission of chair

- PG Defence Technology – feasibility of offering the program HoD may study
- B.Tech. Aerospace Engineering – feasibility of offering the program HoD may study

The chair expressed sincere thanks to all the members of the BoS.

24/7/24

Dr. R. Jagannaj
Head of the Department
Aeronautical Engineering
Vel Tech

Chairman - BOS
Aeronautical Engineering

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

School of Mechanical and Construction

Department of Aeronautical Engineering

Annexure I - Feedback on Curriculum Analysis – July 2024

Feedback on Program Outcomes for curriculum Revision:

	Percentage Scores & Recommendations														
Stake holder	Apply maths, science & aero	identity, formulate, literature	soln. to meet stds	exp.,interpret, synthesis	tool, software, algorithm	asses responsibility	impact on society & evs	norms / ethics	team play	communication & report	project 1mgt.	lifelong learn	design thinking	conceive ideas	implement, simulate, sense
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS1**	**PS2**	**PS3**
Student	87	80	93	93	87	80	87	87	87	93	87	80	80	93	93
Employer	83	83	100	83	83	83	100	83	83	83	50	83	83	100	83
Alumni	72	72	72	89	78	89	89	89	94	83	78	89	72	72	89
Average	81	78	88	88	83	84	92	86	88	86	72	84	78	88	88
Inferences	Attained	Attained	Attained	Attained	Attained	Attained	Attained	Attained	Attained	Attained	Attained; need improve.	Attained	Attained	Attained	Attained
Action											Orientation topics on projects shall added by PBL				

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

School of Mechanical and Construction

Department of Aeronautical Engineering

Annexure I - Feedback on Curriculum Analysis – July 2024

Feedback on curriculum by various stakeholders:

Stakeholder	Observations of Feedback	Inferences	Action
Student	LSA, FM, TD, SM, EM, CFD, AD ASA, AP – Students felt time is not adequate to learn the topics	More number of numerical problems	Recommend to revisit the topics and be more focused towards outcome alone
Parent	Ethics and rules related to aero need to be added	Already available; need to provide awareness	Not required
Employer	Project management skills need to be improved; user defined functions in ansys;	Students need to be practiced on project management well before the major project.	Recommended to include structured PBL methodology in all courses.
Faculty	TD – time is not adequate to cover the syllabus. Need to include design and analysis tools in courses.	More number of numerical problems in TD Lack of tools in courses	Revisit the tutorial topics and keep them more focused. Include activity by using tools and conduct VAC on tools
Industry	ML, Composite manufacturing, DGCA certification process, rocket propulsion experiments, Testing of fixed wing Drones, mapping, xflr, catia like design and modelling tools	Lack of topics in drone applications Experiment related to rocket propulsion Lack of tools in course level Manufacturing topics is less	Include course on drone applications Experimental development initiation for rocket propulsion Include activity by using tools and conduct VAC on tools
Alumni	Improve communications, business management, tools related to design and analysis	Lack of tools in course level Lack of practice for communication aspects	Include activity by using tools and conduct VAC on tools PBL presentations – add importance for communication

Aero - Vel Tech - Feedback on Curriculum

Department of Aeronautical, Vel Tech (Deemed to be University) invites you to help us to build industry specific, society relevant and futuristic curriculum for our students! Kindly fill the below form to give your valuable inputs!!! link for vision, mission, peo, po & syllabus: www veltech.edu.in/aero
UG curriculum & syllabus : https://drive.google.com/drive/folders/1kdqhXF1mHycDIbSCu3jV-ru7U34p-MqM?usp=sharing
PG Curriculum & Syllabus : https://docs.google.com/document/d/1WvsO6wFtruAT4ZO1fhjSSymojQqUxz0_/edit?usp=sharing&ouid=116537144169323027827&rtpof=true&sd=true

* Indicates required question

1. Email *

2. Name *

3. Mobile Number

4. Designation *

5. Organization *

_____

6. Kindly mention name of the inviter *

_____

7. Giving suggestion for *

Mark only one oval.

- ◯ UG
- ◯ PG

8. Curriculum and syllabus of our department is *

Mark only one oval.

- ◯ Good
- ◯ Need improvements

9. Are you *

Mark only one oval.

- ◯ Employer / External project supervisor *Skip to question 10*
- ◯ Student *Skip to question 26*
- ◯ Alumni *Skip to question 41*
- ◯ Parent *Skip to question 56*
- ◯ Industry Expert *Skip to question 71*
- ◯ Academic Expert *Skip to question 74*
- ◯ Faculty at Vel Tech *Skip to question 77*

Employer / Ext. Project Supervisor - Vel Tech student Works / doing project in my organization

10. Students able to apply engineering knowledge to solve problems *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

11. Students able to analyze and provide solutions *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

12. Students able to design by considering needs of health & safety, cultural, societal, and environmental considerations *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

13. Students able to conduct investigations on selected problem definition *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

14. Students able to use latest tools, techniques in projects *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

15. Students able to identify and follow ethics, rules and regulations related to project *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

16. Students able to understand impact of solutions on environmental and provide sustainable solutions *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

17. Students able to follow norms of engineering practice (ex: ASTM, ISO) *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

18. Students able to demonstrate leadership and team play *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

19. Students able to communicate professionally *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

20. Students able to bargain, budgeting and follow principles project management *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

21. Students demonstrating life long learning skills (ex: online courses, learning required skills by own) *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

22. What skill set required for students. *

_____

23. What tools required for students. *

_____

24. Any specific topics required to be added to syllabus / as course *

_____

25. Name of the student working / doing project *

_____

Student - Presently pursuing education at vel tech

26. Students able to apply engineering knowledge to solve problems *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

27. Students able to analyze and provide solutions *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

28. Students able to design by considering needs of health & safety, cultural, societal, and environmental considerations *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

29. Students able to conduct investigations on selected problem definition *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

30. Students able to use latest tools, techniques in projects *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

31. Students able to identify and follow ethics, rules and regulations related to project *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

32. Students able to understand impact of solutions on environmental and provide sustainable solutions *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

33. Students able to follow norms of engineering practice (ex: ASTM, ISO) *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

34. Students able to demonstrate leadership and team play *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

35. Students able to communicate professionally *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

36. Students able to bargain, budgeting and follow principles project management *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

37. Students demonstrating life long learning skills (ex: online courses, learning required skills by own) *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

38. What courses you feel time is not enough to teach. *

39. What courses you feel content is large *

40. What courses you feel examination is tough *

Alumni of Vel Tech Aero

41. Students able to apply engineering knowledge to solve problems *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

42. Students able to analyze and provide solutions *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

43. Students able to design by considering needs of health & safety, cultural, societal, and environmental considerations *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

44. Students able to conduct investigations on selected problem definition *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

45. Students able to use latest tools, techniques in projects *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

46. Students able to identify and follow ethics, rules and regulations related to project *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

47. Students able to understand impact of solutions on environmental and provide sustainable solutions *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

48. Students able to follow norms of engineering practice (ex: ASTM, ISO) *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

49. Students able to demonstrate leadership and team play *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

50. Students able to communicate professionally *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

51. Students able to bargain, budgeting and follow principles project management *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

52. Students demonstrating life long learning skills (ex: online courses, learning required skills by own) *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

53. What skill set required for your entry level position at your organization *

_____

54. What skill set required for your present designation *

_____

55. Suggest us any tools and topics to be added as course and topics in syllabus *

_____

Parent of Vel Tech Aero Student

56. Students able to apply engineering knowledge to solve problems *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

57. Students able to analyze and provide solutions *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

58. Students able to design by considering needs of health & safety, cultural, societal, and environmental considerations *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

59. Students able to conduct investigations on selected problem definition *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

60. Students able to use latest tools, techniques in projects *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

61. Students able to identify and follow ethics, rules and regulations related to project *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

62. Students able to understand impact of solutions on environmental and provide sustainable solutions *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

63. Students able to follow norms of engineering practice (ex: ASTM, ISO) *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

64. Students able to demonstrate leadership and team play *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

65. Students able to communicate professionally *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

66. Students able to bargain, budgeting and follow principles project management *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

67. Students demonstrating life long learning skills (ex: online courses, learning required skills by own) *

Mark only one oval.

- Strongly Agree
- Neutral
- Strongly disagree

68. What skill set required for your entry level position at your organization *

69. What skill set required for your present designation *

70. Suggest us any tools and topics to be added as course and topics in syllabus *

Industry Expert

71. Please list tools / software requires to join as entry level position at your organization *

72. Please list tools / software requires for your current position at your organization *

73. List any topics to be added to the syllabus or as course *

Academic Expert

74. Please list tools / software requires to join as entry level position at your organization *

75. Please list tools / software requires for your current position at your organization *

76. List any topics to be added to the syllabus or as course *

Faculty of Vel Tech

77. Courses you taught at Vel Tech *

78. Time is not adequate in below courses *

79. COs need to be modified in below courses *

80. Please list tools / software requires to join as entry level position *

81. Please list tools / software requires for mid level jobs *

82. List any topics to be added to the syllabus or as course *

Timestamp	Email Address	Name	Mobile Number	Designation	Organization	Curriculum and syllabus of our department is	Are you	What skill set required for your entry level position at your organization	What skill set required for your present designation
7-17-2024 16.35.52	vtu18323@veltech.edu.in	Ch Sravanth Kumar	9849713121	Student	Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Sciecne and Technology	Need improvements	Alumni	Nil	Nil
7-18-2024 9.31.29	aeror.naveen@gmail.com	Dr. Naveen R	9790796094	ASP	KCG COLLEGE OF TECH	Good	Alumni	Communication and technical	Drone technology
7-21-2024 22.59.26	aakashmandvekar@gmail.com	Aakash Kiran mandvekar	+1 8073573666	Student	Confederation college	Good	Alumni	Some industrial base	Designing auto cad should be implemented in the course
7-21-2024 23.21.34	u.ramakishore@gmail.com	Hemanth Uddagiri		Project Lead	ASML Netherlands	Need improvements	Alumni	Stakeholder management, Communication	Leadership, Project Management
7-22-2024 6.44.52	vtu8604@veltechuniv.edu.in	Balasubramaniyan V	9750602517	Senior Engineer	UCAL LIMITED	Good	Alumni	Design and analysis software CAD/CATIA	Strength of materials and its consideration knowledge
7-23-2024 18.41.02	syedfaris0922@gmail.com	SHAIK SYED FARIS	6302328441	CSD Trainee	Cognizant	Good	Alumni	Java programming, Python programming,	Java programming, Python programming, General aptitude, English

Name	Students able to apply engineering knowledge to solve problems	Students able to analyze and provide solutions	Students able to design by considering needs of health & safety, cultural, societal, and environmental considerations	Students able to conduct investigations on selected problem definition	Students able to use latest tools, techniques in projects	Students able to identify and follow ethics, rules and regulations related to project	Students able to understand impact of solutions on environmental and provide sustainable solutions	Students able to follow norms of engineering practice (ex: ASTM, ISO)	Students able to demonstrate leadership and team play	Students able to communicate professionally	Students able to bargain, budgeting and follow principles project management	Students demonstrating life long learning skills (ex: online courses, learning required skills by own)
Ch Sravanth Kumar	Neutral	Neutral	Neutral	Neutral	Strongly Agree	Neutral	Neutral	Strongly Agree	Strongly disagree	Neutral	Strongly Agree	Neutral
Dr. Naveen R	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Neutral	Neutral	Strongly Agree	Strongly Agree	Strongly Agree
Aakash Kiran mandvekar	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree
Hemanth Uddagiri	Strongly disagree	Strongly disagree	Neutral	Neutral	Strongly disagree	Neutral	Neutral	Neutral	Strongly disagree	Neutral	Strongly disagree	Neutral
Balasubramaniyan V	Neutral	Neutral	Neutral	Strongly Agree	Neutral	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Neutral	Neutral	Strongly Agree
SHAIK SYED FARIS	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree
Strongly Agree	3	3	3	4	4	4	4	4	5	3	4	4
Neutral	2	2	2	2	1	2	2	2	1	3	1	2
Strongly disagree	1	1	1	0	1	0	0	0	0	0	1	0
Score	72	72	72	89	78	89	89	89	94	83	78	89
Remark	Attained; Need further improvement	Attained; Need further improvement	Attained; Need further improvement	Attained	Attained; Need further improvement	Attained	Attained	Attained	Attained	Attained	Attained; Need further improvement	Attained

Timestamp	Email Address	Name	Mobile Number	Designation	Organization	Curriculum and syllabus of our department is	Are you	What skill set required for students.		What tools required for students.	Any specific topics required to be added to syllabus / as course	
7-18-2024 19.34.43	vigneshm1@srmist.edu.in	Dr. M VIGNESH KUMAR	9940785645	Assistant Professor	SRM institute of science and technology	Good	Employer / External project supervisor	Practical application of their theoretical knowledge and prediction		Ansys	Nil	
7-22-2024 19.02.13	emailsmvignesh@gmail.com	Vignesh S M	8248486386	Application Engineer	CADFEM	Need improvements	Employer / External project supervisor	Social Media influencers in LinkedIn & Twitter for engineering		Fluent Aero & Ansys STK	Ansys STK for Lab	
Name	**Students able to apply engineering knowledge to solve problems**	**Students able to analyze and provide solutions**	**Students able to design by considering needs of health & safety, cultural, societal, and environmental considerations**	**Students able to conduct investigations on selected problem definition**	**Students able to use latest tools, techniques in projects**	**Students able to identify and follow ethics, rules and regulations related to project**	**Students able to understand impact of solutions on environmental and provide sustainable solutions**	**Students able to follow norms of engineering practice (ex: ASTM, ISO)**	**Students able to demonstrate leadership and team play**	**Students able to communicate professionally**	**Students able to bargain, budgeting and follow principles project management**	**Students demonstrating life long learning skills (ex: online courses, learning required skills by own)**
Dr. M VIGNESH KUMAR	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree
Vignesh S M	Neutral	Neutral	Strongly Agree	Neutral	Neutral	Neutral	Strongly Agree	Neutral	Neutral	Neutral	Strongly disagree	Neutral
Strongly Agree	1	1	2	1	1	1	2	1	1	1	1	1
Neutral	1	1	0	1	1	1	0	1	1	1	0	1
Strongly Disagree	0	0	0	0	0	0	0	0	0	0	1	0
Score	83	83	100	83	83	83	100	83	83	83	50	83
Action	Attained	Attained	Attained	Attained	Attained	Attained	Attained	Attained	Attained	Attained	Not Attained	Attained

Name	Curriculum and syllabus of our department is	Courses you taught at Vel Tech	Time is not adequate in below courses	COs need to be modified in below courses	Please list tools / software requires to join as entry level position	Please list tools / software requires for mid level jobs	List any topics to be added to the syllabus or as course
Boopathy G	Good	Solid Mechanics, Aircraft Structural Mechanics, Aircraft Structural Dynamics, Aircraft Materials	Nil	Nil	Auto CAD	Catia and Ansys	Nil
Dr Vinothkumar M	Good	Space Exploration	Adequate time	Nil	ICT tools	ALN methods	Nil
Rakeshkumar	Good	Thermodynamics,rocket and space propulsion, electric propulsion, cryogenic engineering	Thermodynamics and heat transfer	Nil	Catia,ansys	Ls DYNA,Abaqus	Nil
Dr.S.Ganesan	Need improvements	Themodynamics and Heat Transfer	Thermodynamics and Heat Transfer	Nil	CATIA and Creo	Ansys, Comsol	Nil

Timestamp	Email Address	Name	Mobile Number	Designation	Organization	For	Curriculum and syllabus of our department is	Are you	Please list tools / software requires to join as entry level position at your organization	Please list tools / software requires for your current position at your organization	List any topics to be added to the syllabus or as course
7-17-2024 16.46.53	aeroramasamy@gmail.com	Ramasamy Muthiah	+91 6384314252	Business Head	Aeroline Enterprises	UG	Good	Industry Expert	CATIA	Hypermesh	Nil
7-17-2024 18.02.34	yddwivedi@gmail.com	Dr.Yagya Dutta Dwivedi	8555815261	Professor	Institute of Aeronautical Engineering	UG	Good	Industry Expert	Catia	Ansys, Hypermesh	OpenFoam
7-17-2024 21.48.55	lakshu.me@gmail.com	Lakshmanan.P	9940644972	Project Manager	Ford Motor Pvt Ltd	UG	Good	Industry Expert	Abaqus, LSDYNA, NX CAD, STARCCM	Lsdyna, Abaqus, starccm	All good
7-21-2024 22.51.39	gullapavan102@gmail.com	G pavan	7993277957	Senior aeronautical engineer	NAATS AVIATION PRIVATE LIMITED	UG	Need improvements	Industry Expert	Catia v5,ansys CFD and structures, XFLR5 performance and stability analysis (UAV's OR aircrafts). Matlab using performance calculation, stability analysis and UAV 3D simulation)	Arudopilot software (mapping , flight log analysis,pid tuning, integration of electronics)	1.Composite manufacturing lab (types of manufacturing process experiment). 2. Mini project (manufacturing and testing of fixed wing UAV's using composite parts). 3. UAV and aircraft certification process (DGCA and easa). 3 syllabus to add in aircraft propulsion (propeller design process) 4. Syllabus to add in Rock propulsion (how to develop real time Rock propulsion and step by step process (solid propulsion and liquid propulsion).
7-22-2024 19.05.09	emailsmvignesh@gmail.com	Vignesh S M	8248486386	Application Engineer	CADFEM	PG	Need improvements	Industry Expert	Ansys STK & ANSYS Fluent & Mechanic	Fluent, Rocky, Chimkin Pro, STK	Flight mechanics for Drone using ANSYS STK

Timestamp	Email Address	Name	Mobile Number	Designation	Organization	For	Curriculum and syllabus of our department is	Are you	Please list tools / software requires to join as entry level position at your organization	Please list tools / software requires for your current position at your organization	List any topics to be added to the syllabus or as course
7-17-2024 21.35.25	aerodhinesh@gmail.com	Dr. S. R. Dhineshkumar	9791797072	HoD & Associate professor	Mahaveer Institute of Science and Technology	UG	Good	Academic Expert	NA	NA	It will be highly beneficial to students if subjects related to manufacturing processes and materials were added to the syllabus
7-17-2024 21.45.17	kumar.vinoth.ae@gmail.com	Vinoth Kumar	0767741990	Research Scholar	ETH zurich	UG	Good	Academic Expert	None	None	Already good
7-21-2024 19.06.20	kannan4028@gmail.com	Kannan		Senior CFD engineer	Valeo	UG	Need improvements	Academic Expert	ANSYS,STAR CCM	ANSYS	Computational fluid dynamics, Artificial intelligence
7-22-2024 7.30.26	vinoth418.ant@gmail.com	Dr. T. VINOTH		Postdoctoral Researcher	UNESP-FEG	UG	Good	Academic Expert	PHD	PHD in LCA	Sustainability Management
7-22-2024 12.13.54	premanand.tp@rajalakshmi.edu.in	PREM ANAND T P	9710560079	Assistant Professor	Rajalakshmi Engineering College	PG	Good	Academic Expert	python programming, MATLAB	MATLAB, anaconda for programming	Machine learning for UAV autonomous control, MEMS in UAV

Timestamp	Email Address	Name	Mobile Number	Curriculum and syllabus of our department is	Are you	What courses you feel time is not enough to teach.	What courses you feel content is large	What courses you feel examination is tough
7-17-2024 17.10.34	vtu17908@veltech.edu.in	Srekar. D	9866041605	Good	Student	Linear systems analysis and control	Aerodynamics	Compressible Flow of Aerodynamics
7-17-2024 20.44.12	vtu22745@veltech.edu.in	Kanaparthi Siva Vighnesh	6301172127	Good	Student	Nil	Nil	Nil
7-22-2024 8.51.51	vtu20034@veltech.edu.in	MOLLETI HARI		Good	Student	FM, TD, SM, EM, CFD	CFD, ASM	FM, TD
7-22-2024 13.00.14	awdheshpalvtu@gmail.com	Awdhesh Pal	9142383365	Good	Student	Aerodynamic, Structure Analysis, Aircraft performance	Aircraft Performance	Aircraft Performance
7-23-2024 11.13.16	vtu12589@veltech.edu.in	Tanniru.venkata krishna	6301969002	Need improvements	Student	No	Yes	Moderate

Name	Students able to apply engineering knowledge to solve problems	Students able to analyze and provide solutions	Students able to design by considering needs of health & safety, cultural, societal, and environmental considerations	Students able to conduct investigations on selected problem definition	Students able to use latest tools, techniques in projects	Students able to identify and follow ethics, rules and regulations related to project	Students able to understand impact of solutions on environmental and provide sustainable solutions	Students able to follow norms of engineering practice (ex: ASTM, ISO)	Students able to demonstrate leadership and team play	Students able to communicate professionally	Students able to bargain, budgeting and follow principles project management	Students demonstrating life long learning skills (ex: online courses, learning required skills by own)
Srekar. D	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Neutral
Kanaparthi Siva Vighnesh	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Neutral	Neutral	Strongly Agree	Neutral	Neutral
MOLLETI HARI	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Strongly Agree	Strongly Agree	Neutral	Strongly Agree
Awdhesh Pal	Strongly Agree	Neutral	Strongly Agree	Strongly Agree	Strongly Agree	Neutral	Strongly Agree	Strongly Agree	Strongly Agree	Neutral	Strongly Agree	Strongly Agree
Tanniru.venkata krishna	Neutral	Neutral	Strongly Agree	Strongly Agree	Neutral	Neutral	Neutral	Strongly Agree	Neutral	Strongly Agree	Strongly Agree	Neutral
SA	3	2	4	4	3	2	3	3	3	4	3	2
N	2	3	1	1	2	3	2	2	2	1	2	3
SD	0	0	0	0	0	0	0	0	0	0	0	0
Score	87	80	93	93	87	80	87	87	87	93	87	80
Action	Attained	Attained	Attained	Attained	Attained	Attained	Attained	Attained	Attained	Attained	Attained	Attained

Timestamp	Email Address	Name	Mobile Number	Designation	Organization	Giving suggestion for	Curriculum and syllabus of our department is	Are you	What skill set required for your entry level position at your organization	What skill set required for your present designation	Suggest us any tools and topics to be added as course and topics in syllabus
7-19-2024 10.52.18	vtu22745@veltech.edu.in	Kanaparthi Siva Vighnesh	9121206317	Govt. Job	Veltech	UG	Good	Parent	Nil	Nil	Nil

Name	Students able to apply engineering knowledge to solve problems	Students able to analyze and provide solutions	Students able to design by considering needs of health & safety, cultural, societal, and environmental considerations	Students able to conduct investigations on selected problem definition	Students able to use latest tools, techniques in projects	Students able to identify and follow ethics, rules and regulations related to project	Students able to understand impact of solutions on environmental and provide sustainable solutions	Students able to follow norms of engineering practice (ex: ASTM, ISO)	Students able to demonstrate leadership and team play	Students able to communicate professionally	Students able to bargain, budgeting and follow principles project management	Students demonstrating life long learning skills (ex: online courses, learning required skills by own)
Kanaparthi Siva Vighnesh	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Neutral	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree
Action	Attained	Attained	Attained	Attained	Attained	Awarness on curriculum to parents	Attained	Attained	Attained	Attained	Attained	Attained

Annexure II

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Department : AERONAUTICAL ENGINEERING **Regulation: VTR UGE 2021**

Name of the Degree Programme: B.Tech. in Aeronautical Engineering

Curriculum with L T P C and Minimum Periods to be Conducted

Lecture/Tutorial - 1 period/week = 1 credit Laboratory - 2 periods/week = 1 credit Project/Field work/Internship - 3 periods/week = 1 credit

Course Category : Foundation

S.No	Course Type	Course Code	Course Title	L	T	P	C	Minimum periods to be Conducted
1	Theory	10210PH102	Physics of Materials	3	0	0	**3**	45
2	Theory	10210CH105	Engineering Chemistry	3	0	0	**3**	45
3	Theory	10210CS101	Problem Solving using C	3	0	0	**3**	45
4	Theory	10210ME101	Design thinking	2	0	0	**2**	30
5	Theory	10210PH103	Applied Physics	2	0	0	**2**	30
6	Theory	10210BM101	Biology for Engineers	2	0	0	**2**	30
7	Theory	10210ME102	Universal Human Values	3	0	0	**3**	45
8	Laboratory	10210CH301	Engineering Chemistry Lab	0	0	2	**1**	30
9	Laboratory	10210CS301	Problem Solving using C Lab	0	0	2	**1**	30
10	Laboratory	10210EE301	Engineering Products Lab	0	0	2	**1**	30
11	Laboratory	10210PH302	Applied Physics Laboratory	0	0	2	**1**	30
12	Integrated	10210MA201	Matrices & Calculus	2	0	2	**3**	60
13	Integrated	10210EN201	Professional Communication - I	1	0	2	**2**	45
14	Integrated	10210ME201	Engineering Graphics	1	0	4	**3**	75

15	Integrated	10210MA203	Vector Calculus & Complex variable	2	0	2	**3**	60
16	Integrated	10210EE201	Basic Electrical, Electronics & Measurement Engineering	2	0	2	**3**	60
17	Integrated	10210EN202	Professional Communication - II	1	0	2	**2**	45
18	Integrated	10210CS201	Python Programming	1	0	2	**2**	45
19	Integrated	10210EE204	Introduction to Engineering	1	0	4	**3**	75
20	Mantatory	10217GE902	Constitution of India	1	0	0	**M**	15
21	Mantatory	10217GE901	Engineers and Society	1	0	0	**M**	15

Course Category : **Foundation (to be studied at Higher Semesters)**

22	Theory	10210MA105	Transforms & Fourier Series	3	0	0	3	45
23	Theory	10210MA109	Numerical Methods	3	0	0	3	45
24	Theory	10210CH104	Environmental Science a nd Sustainability	3	0	0	3	45
25	Theory	10210ME103	Innovation & Entrepreneurship	2	0	0	2	30
26	Theory	10210ME104	Project Management & Finance	2	0	0	2	30
						Credits to Completed	**56**	

Course Category : **Programme Core**

S.No	Course Type	Course Code	Course Title	L	T	P	C	Minimum periods to be Conducted
1	Theory	10211AE106	Thermodynamics & Heat Transfer	2	1	0	**3**	45
2	Theory	10211AE108	Aircraft Propulsion	2	1	0	**3**	45
3	Theory	10211AE109	Rocket & Space Propulsion	2	1	0	**3**	45
4	Theory	10211AE116	Engineering Mechanics	1	1	0	**2**	30
5	Theory	10211AE120	Airplane Performance	1	1	0	**2**	30

6	Theory	10211AE104	Aircraft Design Rules & Certification	1	0	0	**1**	15
7	Integrated Theory	10211AE201	Fluid Mechanics	1	1	2	**3**	60
8	Integrated Theory	10211AE202	Low Speed Aerodynamics	1	1	2	**3**	60
9	Integrated Theory	10211AE203	High Speed Aerodynamics	1	1	2	**3**	60
10	Integrated Theory	10211AE205	Computational Fluid Dynamics	1	1	2	**3**	60
11	Integrated Theory	10211AE210	Combustion & Gas Dynamics	1	1	2	**3**	60
12	Integrated Theory	10211AE211	Solid Mechanics	1	1	2	**3**	60
13	Integrated Theory	10211AE213	Aircraft Structural Mechanics	1	1	2	**3**	60
14	Integrated Theory	10211AE214	Aircraft Structural Dynamics	1	1	2	**3**	60
15	Integrated Theory	10211AE215	Finite Element Analysis	1	1	2	**3**	60
16	Integrated Lab	10211AE224	Robotics for Aeronautical Engineering	1	0	4	**3**	75
17	Integrated Theory	10211AE217	Linear system Analysis & Control	1	0	2	**2**	45
18	Integrated Lab	10211AE218	Aircraft Systems & Instruments	1	0	2	**2**	45
19	Integrated Lab	10211AE219	Avionics	1	0	2	**2**	45
20	Integrated Theory	10211AE221	Airplane Stability & Control	1	0	2	**2**	45
21	Integrated Theory	10211AE223	Introduction to Aerospace Engineering	1	0	2	**2**	45
22	Integrated Lab	10211AE225	Aircraft Design	1	0	2	**2**	45
23	Laboratory	10211AE307	Propulsion Lab	0	0	2	**1**	30
24	Laboratory	10211AE312	DIO Lab	0	0	2	**1**	30
25								

Credits to Completed	**58**

Course Category : **Programme Elective (Specialization in <u>Computational Engineering</u>)**

S.No	Course Type	Course Code	Course Title	L	T	P	C	Minimum periods to be Conducted
1	Theory	10212AE106	Software Engineering and Design	3	0	0	**3**	45
2	Integrated Theory	10212AE201	Electromechanical Systems	2	0	2	**3**	60
3	Integrated Theory	10212AE202	Introduction to Computer Programming	2	0	2	**3**	60
4	Integrated Theory	10212AE203	Engineering Computation	2	0	2	**3**	60
5	Integrated Theory	10212AE204	Computational Thinking and Data Science	2	0	2	**3**	60
6	Integrated Theory	10212AE205	Scientific Computation	2	0	2	**3**	60
7	MOOC Edx	10212AE401	Computational Thinking for Modeling and Simulation	3	0	0	**3**	N/A
		10212AE404	Software Engineering					
			Minimum no. of credits to be Completed				**18**	

Course Category : **Programme Elective (Specialization in <u>Autonomous Drone Technology</u>)**

S.No	Course Type	Course Code	Course Title	L	T	P	C	Minimum periods to be Conducted
1	Theory	10212AE107	Lighter Than Air System	3	0	0	**3**	45
2	Theory	10212AE108	Flapping Wing Dynamics	3	0	0	**3**	45
3	Theory	10212AE110	Unmanned Systems	3	0	0	**3**	45
4	Integrated Theory	10212AE209	Flight Testing	2	0	2	**3**	60
5	Integrated Theory	10212AE211	UAV Mapping & Monitoring	2	0	2	**3**	60
6	Integrated Theory	10212AE212	Data Analysis & System Identification	2	0	2	**3**	60
7	MOOC Edx	10212AE402	Autonomous Mobile Robots	3	0	0	**3**	45

MOOC NPTEL	10212AE405	UAV in Engineering Applications		
		Minimum no. of credits to be Completed		**18**

Course Category : **Programme Elective (Specialization in <u>Aerospace & Defence</u>)**

S.No	Course Type	Course Code	Course Title	L	T	P	C	Minimum periods to be Conducted
1	Integrated Theory	10212AE219	Aerospace Sensors and Systems	2	0	2	**3**	60
2	Integrated Theory	10212AE220	Aerospace Structures and Materials	2	0	2	**3**	60
3	Integrated Theory	10212AE221	Rocket Propulsion and Launch Systems	2	0	2	**3**	60
4	Integrated Theory	10212AE222	Spacecraft Dynamics and Control	2	0	2	**3**	60
5	Theory	10212AE223	Systems and warfare Platforms	3	0	0	**3**	45
6	Integrated Theory	10212AE224	Test and Evaluation of weapon system	2	0	2	**3**	60
7	MOOC Edx	10212AE403	Thermal-Fluids Engineering 1: Basics of Thermodynamics and Hydrostatics	3	0	0	**3**	45
8	MOOC NPTEL	10212AE406	Remote Sensing: Principles and Applications	3	0	0	**3**	45
9	MOOC Edx	10212AE407	Global Media, War, and Technology	3	0	0	**3**	45
			Minimum no. of credits to be Completed				**18**	

Course Category : **Open Electives**

S.No	Course Type	Course Code	Course Title	L	T	P	C	Minimum periods to be Conducted
1	Theory	10213AE101	Wind Engineering	3	0	0	**3**	45
2	Theory	10213AE102	Drones & its applications	3	0	0	**3**	45

3	Theory	10213AE105	Introduction to Drone Technology	3	0	0	**3**	45
4	Theory	10213AE103	Space Exploration	3	0	0	**3**	45
5	Theory	10213AE111	Satellite Launch Vehicle	3	0	0	3	45
6	Theory	10213AE104	Smart Structures	3	0	0	3	45
7	Theory	10213AE106	Introduction to Astrophysics	3	0	0	3	45
8	MOOC Edx	10213AE401	Sustainable Energy: Design a Renewable Future	3	0	0	3	45
9	MOOC NPTEL	10213AE402	System Design for Sustainability	3	0	0	3	45
10								
			Minimum no. of credits to be Completed				**12**	

Course Category : **Independent Learning (IL)**

S.No	Course Type	Course Code	Course Title	L	T	P	C	Minimum periods to be Conducted
1	Project	10214AE501	Community Service Project	0	0	3	**1**	NA
2	Project	10214AE601	Minor Project 1	0	0	6	**2**	NA
3	Project	10214AE602	Minor Project 2	0	0	6	**2**	NA
4	Project	10214AE701	Capstone Project	0	0	27	**9**	NA
			Minimum no. of credits to be Completed				**14**	

Course Category : **Industry/Higher Learning Institute Interaction (IHL)**

S.No	Course Type	Course Code	Course Title	L	T	P	C	Minimum periods to be Conducted
	IHL	10215AE801	Industry Internship 1			3	**1**	NA
	IHL	10215AE802	Industry Internship 2			3	**1**	NA
	IHL	10215AE803	Industry Internship 3			6	**2**	NA

Minimum no. of credits to be Completed	**2**

Course Category : **Professional Proficiency Courses (PPC)**

S.No	Course Type	Course Code	Course Title	L	T	P	C	Minimum periods to be Conducted
1								
			Minimum no. of credits to be Completed				**4**	

Course Category : **Minor in <u>UAV Remote Sensing & Mapping</u>**

S.No	Course Type	Course Code	Course Title	L	T	P	C	Minimum periods to be Conducted
1	Theory	10213AE105	Introduction to Drone Technology	3	0	0	**3**	45
2	Theory	10213AE206	UAV Systems	2	0	2	**3**	60
3	Theory	10213AE107	UAV & Satellite Remote Sensing	3	0	0	**3**	45
4	Integrated Lab	10213AE108	UAV Survey Techniques	3	0	0	**3**	45
5	Integrated Theory	10213AE209	Aerial Photography & Interpretation	2	0	2	**3**	60
6	Integrated Lab	10213AE110	UAV Mapping	1	0	4	**3**	75
			Minimum no. of credits to be Completed				**18**	

Course Category : **Honours in <u>Aerial Robotics</u>**

S.No	Course Type	Course Code	Course Title	L	T	P	C	Minimum periods to be Conducted
1	Theory	10212AE113	Introduction to Aerial Robotics	3	0	0	**3**	45
2	Theory	10212AE114	Robotic Perception	3	0	0	**3**	45
3	Theory	10212AE115	Navigation, Guidance & Control	3	0	0	**3**	45

4	Theory	10212AE116	Computational motion planning	3	0	0	**3**	45
5	Theory	10212AE117	State Estimation & learning	3	0	0	**3**	45
6	Integrated Lab	10212AE218	Experiential Learning on Aerial Robotics	1	0	4	**3**	75
			Minimum no. of credits to be Completed				**18**	

Link to access courses :
https://drive.google.com/file/d/1paa2WPSA1kgEbJEC4tf1u_HO7qLTQD1D/view?usp=sharing

6th MEETING of BOARD of STUDIES

Minutes

for

B.Tech Artificial Intelligence and Data Science

[CBCS]

On

27.07.2024

B.Tech Artificial Intelligence and Data Science

School of Computing

Index

6th MEETING of BOARD of STUDIES
For
B.Tech Artificial Intelligence and Data Science

Date: 27.7.2024– 09.30 AM

Venue: SOC Block

AGENDA

<table>
<tr><th>Item No</th><th>Agenda</th></tr>
<tr><td colspan="2">A. Opening</td></tr>
<tr><td>1.</td><td>Confirmation of 5th BoS meeting minutes held on 23.12.2023 (Annexure-I).</td></tr>
<tr><td>2.</td><td>To review the Action Taken Report on the minutes of the 5th meeting of the Board of Studies (Annexure-II).</td></tr>
<tr><td colspan="2">B. Items to be considered</td></tr>
<tr><td>3.</td><td>To discuss and approve the new courses and course contents to be offered under Program Elective category in the <u>existing B.Tech AI&DS curriculum VTR UGE 2021</u> keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills (Annexure – III).
<table>
<tr><th>S. No</th><th>Course Code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10212AD131</td><td>Cloud Driven Data Engineering with AI</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>2</td><td>10212AD132</td><td>Explainable AI</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>3</td><td>10212AD277</td><td>Machine Learning for Production</td><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>4</td><td>10212AD123</td><td>Data Security and Privacy</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>5</td><td>10212AD224</td><td>Artificial Intelligence for health care</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>6</td><td>10212AD243</td><td>Financial Analytics</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
</table></td></tr>
<tr><td>4.</td><td>To discuss and approve the new courses under Open Elective category, to be offered in the <u>existing B.Tech AI&DS curriculum VTR UGE 2021</u> keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills (Annexure – IV).
<table>
<tr><th>S.No</th><th>Course Code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10213GE103</td><td>Software Development and Maintenance</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
</table></td></tr>
<tr><td>5.</td><td>To discuss and approve the courses to be offered in Online MOOCs platforms under Program Elective and Open Elective Category during the academic year Summer, 2024-2025 for B.Tech Artificial Intelligence and Data Science (Annexure-V)
<u>Program Elective category</u>
<table>
<tr><th>S.No.</th><th>Course Code</th><th>Course Name</th><th>Course Provider</th><th>Duration in weeks</th><th>Credits</th></tr>
<tr><td>1.</td><td>10212AD401</td><td>Responsible and Safe AI systems</td><td>NPTEL</td><td>12 Weeks</td><td>3</td></tr>
<tr><td>2.</td><td>10212AD402</td><td>Reinforcement Learning</td><td>NPTEL</td><td>12 Weeks</td><td>3</td></tr>
</table></td></tr>
</table>

Open Elective category

S.No.	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1.	10213AD435	Computer Vision	NPTEL	12 Weeks	3
2.	10213AD436	Introduction to Industry 4.0 and Industrial Internet of Things	NPTEL	12 Weeks	3
3.	10213AD437	Introduction to Machine learning	NPTEL	12 Weeks	3

6. To discuss and approve the new **courses to be offered in Value added courses under Complementary skills Category** during the academic year, summer 2024-2025 for B.Tech Artificial Intelligence and Data Science (**Annexure-VI).**

S No	Course Code	Course title	L	T	P	C
1	10218AD924	Big Data Analytics	2	0	0	0
2	10218AD925	Power BI Data Analytics	2	0	0	0
3	10218AD928	Enrich Visualization using Tableau	2	0	0	0
4	10218AD938	Machine learning using Python	2	0	0	0

7. To discuss the Stakeholders feedback on curriculum of B.Tech Artificial Intelligence and Data Science taken for the academic year 2023-2024 (**Annexure-VII**).

Items to be Ratified

8. Ratification of Program Elective courses offered in the B.Tech Artificial Intelligence and Data Science program during winter 2023-2024 (**Annexure-VIII**).

S. No	Course Code	Course Name	L	T	P	C
1	10212AD276	Generative AI	1	0	2	2

9. Ratification of **courses offered under the category of Industry / Higher Institute Learning Interaction (IHL)** offered by Industry and Higher Institute Experts for B.Tech Artificial Intelligence and Data Science during winter Semester 2023-24. **(Annexure-IX).**

Sno	Course code	Course Name	L	T	P	C
1	10215AD925	Programming for Data Analytics	1	0	0	1
2	10215AD928	Fundamentals of MEMS	1	0	0	1
3	10215AD930	Cognitive Computing and Applications	1	0	0	1

10. **Ratification of Value added Courses** offered for B.Tech Artificial Intelligence and Data Science during Winter Semester 2023-24 (**Annexure-X**).

Sno	Course code	Course Name	L	T	P	C
1	10218AD935	Natural Language Processing with Projects	2	0	0	0
2	10218AD936	Linux Administration	2	0	0	0
3	10218AD937	Bash Shell Script administrator	2	0	0	0
4	10218AD939	AWS Solution Architect	2	0	0	0
5	10218AD941	Java Programming Fundamentals	2	0	0	0

		6	10218AD942	Essential Mongo DB Administration	2	0	0	0
		7	10218AD947	Data Structures and Algorithms using Python - Part 1	2	0	0	0
		8	10218AD948	Computer Vision - Theory and Projects in Python for Beginners	2	0	0	0
		9	10218AD949	Deep Learning and Neural Networks	2	0	0	0
		10	10218AD950	Exploratory Data Analysis Using R	2	0	0	0
11.	Any other cognate item							

6th MEETING of BOARD of STUDIES

For

B.Tech Artificial Intelligence and Data Science

Date: 27.07.2024– 09.30 AM

Venue: School of Computing

Members Present:

Sl.No	Name and Designation	Nominee	Signature
1	Prof.Dr.SP.Chokkalingam, Professor, Dean(SoC)	Chairperson	
2	Prof.P.Radha Krishna Professor, Dept of CSE National Institute of Technology, Warangal	Academic ExpertNominee	
3	Prof.Debdatta Kandar Professor, Dept of I.T. North-Eastern Hill University, Shillong	Academic Expert Nominee	
4	Mr. G. Roy Antony Arnold Senior Consultant, Infosys	Industry Expert Nominee	
5	Mr. Sandeep NVSR Senior Consultant, Accenture, INDIA	Alumni	
7	Dr.V.Dhilipkumar, Professor & HoD – AI&DS	Professor Nominee	
8	Dr. N. Malarvizhi, Professor	Professor Nominee	
9	Dr. M. Kavitha, Professor	Professor Nominee	
11	Dr.R.Srinivasan, Professor	Professor Nominee	
12	Dr.J.Visumathi, Professor & HoD – I.T.	Professor Nominee	
13	Dr.S.Sridevi, Professor	Professor Nominee	
14	Dr.A.Bhagyalakshmi, Professor	Professor Nominee	
15	Dr.S.Jagan, Professor	Professor Nominee	
15	Dr.N.Rajkumar, Professor	Professor Nominee	
16	Dr.N.R.Rajalakshmi, Professor & HoD- AIML	Professor Nominee	
17	Mrs.T.Kujani,Assistant Professor	Assistant Professor Nominee	
18	Mrs.C.Shyamala Kumari, Assistant Professor	Assistant Professor Nominee	

Invited Members

S.No	Name	Designation	Signature
1	Dr. M. S. Muralidhar	Associate Professor Head – CSE	
2	Dr.R.Parthasarathy	Associate Professor Head– CSD	
3	Dr. T. Rajendran	Associate Professor Head– CSE (CS)	
4	Dr. S. Lalitha	Associate Professor Head– CSE (AIML)	
5	Dr. P. Jose	Associate Professor Head– CSE (DS)	
6	Dr. R. Anandh	Assistant Professor – Senior Grade	
7	Dr. S. Maheswari	Assistant Professor	

The Chair expressed his happiness in welcoming all the members for the 6th meeting of BOS and thanked them for sparing their valuable time.

<table>
<tr><td>06-BoS-01</td><td>Confirmation of 6th BoS meeting minutes held on 27.07.2024</td></tr>
<tr><td>Action Taken:</td><td>The minutes of 6th BoS meeting minutes held on 27.05.2024 was circulated to members through e-mail, the members confirmed the minutes.
[Annexure - I]</td></tr>
<tr><td>06-BoS-02</td><td>To review the Action Taken Report on the minutes of the 5th meeting of the Board of Studies</td></tr>
<tr><td>Action Taken</td><td>The members reviewed the action taken report on the decisions of 5th BoS meeting minutes held on 27.05.2023
[Annexure - II]</td></tr>
<tr><td>06-BoS-03</td><td>To discuss and approve the new courses and course contents to be offered under Program Elective category in the <u>existing B.Tech AI&DS curriculum VTR UGE 2021</u> keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills (Annexure – III).</td></tr>
<tr><td>Discussion</td><td>Members suggested to include datasets in the Laboratory Tasks of Financial Analytics, Artificial Intelligence for Health Care and update the recent text book edition for Data Security and Privacy, Financial Analytics, Artificial Intelligence for Health Care. Members suggested to include online courses offered by NSE Academy and revise the course credit for Data Security and Privacy.</td></tr>
<tr><td>Resolution</td><td>The members suggestions is considered and the changes will be made in the Course contents. The course credits for Data Security and Privacy is revised as per the members suggestion. Course structure and content are available in [Annexure - III]</td></tr>
<tr><td>06-BoS-04</td><td>To discuss and approve the new courses under Open Elective category, to be offered in the <u>existing B.Tech AI&DS curriculum VTR UGE 2021</u> keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills
(Annexure – IV).
<table>
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<tr><td>1</td><td>10213GE103</td><td>Software Development and Maintenance</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
</table></td></tr>
<tr><td>Discussion</td><td>Members Suggested to change the title of the course and revise the syllabus according to credit hours.</td></tr>
<tr><td>Resolution</td><td>The members suggestions is considered and will be carried out in the forthcoming course revision.</td></tr>
<tr><td>06-BoS-05</td><td>To discuss and approve the courses to be offered in Online MOOCs platforms under Program Elective and Open Elective Category during the academic year Summer, 2024-2025 for B.Tech Artificial Intelligence and Data Science (Annexure-V)
<u>Program Elective category</u>
<table>
<tr><th>S.No.</th><th>Course Code</th><th>Course Name</th><th>Course Provider</th><th>Duration in weeks</th><th>Credits</th></tr>
<tr><td>3.</td><td>10212AD401</td><td>Responsible and Safe AI systems</td><td>NPTEL</td><td>12 Weeks</td><td>3</td></tr>
<tr><td>4.</td><td>10212AD402</td><td>Reinforcement Learning</td><td>NPTEL</td><td>12 Weeks</td><td>3</td></tr>
</table>
<u>Open Elective category</u>
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<tr><td>4.</td><td>10213AD435</td><td>Computer Vision</td><td>NPTEL</td><td>12 Weeks</td><td>3</td></tr>
<tr><td>5.</td><td>10213AD436</td><td>Introduction to Industry 4.0 and Industrial Internet of Things</td><td>NPTEL</td><td>12 Weeks</td><td>3</td></tr>
</table></td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><td>6.</td><td>10213AD437</td><td>Introduction to Machine learning</td><td>NPTEL</td><td>12 Weeks</td><td>3</td></tr>
</table>
</td></tr>
<tr><td>Discussion</td><td>The members reviewed the above list of courses and suggested to remove the instructor name from the course content.</td></tr>
<tr><td>Resolution</td><td>The members approved the courses to be offered under Open Elective and program elective Category during the academic year Summer, 2024-2025 for B.Tech-Artificial Intelligence and Data Science. [Annexure-V]</td></tr>
<tr><td>06-BoS-06</td><td>To discuss and approve the new courses to be offered in Value added courses under Complementary skills Category during the academic year, summer 2024-2025 for B.Tech Artificial Intelligence and Data Science (Annexure-VI).
<table>
<tr><th>S No</th><th>Course Code</th><th>Course title</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10218AD924</td><td>Big Data Analytics</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>2</td><td>10218AD925</td><td>Power BI Data Analytics</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>3</td><td>10218AD928</td><td>Enrich Visualization using Tableau</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>4</td><td>10218AD938</td><td>Machine learning using Python</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>Discussion</td><td>The members reviewed the above list of courses and the course contents to be offered as Value added courses under Complementary skills Category for B.Tech-Artificial Intelligence and Data Science.</td></tr>
<tr><td>Resolution</td><td>The members appreciated and approved the courses and course contents to be offered as Value added courses under Complementary skills Category during the academic year, Summer 2024-2025 for B.Tech-Artificial Intelligence and Data Science. [Annexure-VI]</td></tr>
<tr><td>06-BoS-07</td><td>To discuss the Stakeholders feedback on curriculum of B.Tech Artificial Intelligence and Data Science taken for the academic year 2023-2024 (Annexure-VII).</td></tr>
<tr><td>Discussion</td><td>The members reviewed the action taken based on Stakeholders feedback on curriculum of B.Tech Artificial Intelligence and Data Science for the academic year 2023-2024.</td></tr>
<tr><td>Resolution</td><td>The members approved the changes made in the curriculum structure under various category based on the feedback analysis carried out for the academic year 2023-2024 (Annexure-VII).</td></tr>
<tr><td>06-BoS-08</td><td>Ratification of Program Elective courses offered in the B.Tech Artificial Intelligence and Data Science program during winter 2023-2024 (Annexure-VIII).
<table>
<tr><th>S. No</th><th>Course Code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10212AD276</td><td>Generative AI</td><td>1</td><td>0</td><td>2</td><td>2</td></tr>
</table>
</td></tr>
<tr><td>Discussion</td><td>The members reviewed the above course and course contents offered under the category of Program Elective.</td></tr>
<tr><td>Resolution</td><td>The members approved the program elective course and course contents offered for B.Tech Artificial Intelligence and Data Science in Summer Semester 2024-25. (Annexure-VIII).</td></tr>
<tr><td>06-BoS-09</td><td>Ratification of courses offered under the category of Industry / Higher Institute Learning Interaction (IHL) offered by Industry and Higher Institute Experts for B.Tech Artificial Intelligence and Data Science during winter Semester 2023-24. (Annexure-IX).
<table>
<tr><th>Sno</th><th>Course code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10215AD925</td><td>Programming for Data Analytics</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>2</td><td>10215AD928</td><td>Fundamentals of MEMS</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>3</td><td>10215AD930</td><td>Cognitive Computing and Applications</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td>Discussion</td><td>The members reviewed the above list of courses and course contents offered under the category of Industry / Higher Institute Learning Interaction (IHL) by Industry and Higher Institute Experts.</td></tr>
<tr><td>Resolution</td><td>The members approved the courses and course contents offered by Industry and Higher Institute Experts for B.Tech Artificial Intelligence and Data Science in Winter Semester 2023-24. (Annexure-IX).</td></tr>
<tr><td>06-BoS-10</td><td>Ratification of Value added Courses offered for B.Tech Artificial Intelligence and Data Science during Winter Semester 2023-24 (Annexure-X).
<table>
<tr><th>Sno</th><th>Course code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10218AD935</td><td>Natural Language Processing with Projects</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>2</td><td>10218AD936</td><td>Linux Administration</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>3</td><td>10218AD937</td><td>Bash Shell Script administrator</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>4</td><td>10218AD939</td><td>AWS Solution Architect</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>5</td><td>10218AD941</td><td>Java Programming Fundamentals</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>6</td><td>10218AD942</td><td>Essential Mongo DB Administration</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>7</td><td>10218AD947</td><td>Data Structures and Algorithms using Python - Part 1</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>8</td><td>10218AD948</td><td>Computer Vision - Theory and Projects in Python for Beginners</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>9</td><td>10218AD949</td><td>Deep Learning and Neural Networks</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>10</td><td>10218AD950</td><td>Exploratory Data Analysis Using R</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
</table></td></tr>
<tr><td>Discussion</td><td>The members viewed the above list of course and course contents of Value added courses offered under Complementary skills Category for B.Tech Artificial Intelligence and Data Science in Winter Semester 2023-24.</td></tr>
<tr><td>Resolution</td><td>The members approved the courses and course contents of Value added courses offered under Complementary skills Category for B.Tech Artificial Intelligence and Data Science in Winter Semester 2023-24. (Annexure-X).</td></tr>
<tr><td>06-BoS-11</td><td>Any other Cognate Item</td></tr>
<tr><td>Resolution</td><td>The next BoS meeting will be conducted in the month of December 2024.</td></tr>
</table>

Annexure – I

1.	Confirmation of 5th BoS meeting minutes held on 23.12.2023

5th BoS Meeting Minutes - AI & DS External Inbox ×

Dean SoC Vel Tech,Chennai <deansoc@veltech.edu.in>
to Debdatta, Radha, Roy, me

Respected Sir

Herewith, I have attached the 5th BoS Meeting Minutes for your kind reference.

--
Thanks & Regards ,

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

One attachment • Scanned by Gmail


5th MEETING of BOARD of STUDIES
Minutes
for
B.Tech Artificial Intelligence and Data Science

PDF 5th-BoS-Minutes...

Annexure – II

2.	To review the Action Taken Report on the minutes of the 5th meeting of the Board of Studies

Item No	Item	Decision taken	Action Taken
ITEMS FOR DISCUSSION AND APPROVAL			
05-BoS-03	To discuss and approve Program Elective Course Structure and course contents to be offered in the programme B.Tech Artificial Intelligence and Data Science under the regulation VTR UGE 2021 with effect from Winter 2023-2024	Members suggested to include framework in the Laboratory Tasks of Time Series Analytics Course, ethical concern topics in social media analytics and to refine the text books for Cognitive Computing Course.	As per members suggestion changes were incorporated in the curriculum.
05-BoS-04	To discuss and approve the courses to be offered in Online MOOCs platforms under Open Elective Category during the academic year Winter, 2023-2024 for B.Tech Artificial Intelligence and Data Science.	The members reviewed the above list of courses and suggested to remove Emotional Intelligence course	Approved MOOC Course under Open Elective Category Course is offered with effect from Academic Year Winter 2023-2024.
05-BoS-05	To discuss and approve the courses to be offered as Value added courses under Complementary skills Category during the academic year ,winter 2023-2024 for B.Tech Artificial Intelligence and Data Science	The members reviewed the above list of courses and the course contents to be offered as Value added courses under Complementary skills Category for B.Tech-Artificial Intelligence and Data Science.	Approved Value added courses under Complementary skills Category Course is offered with effect from Academic Year Winter 2023-2024.

Annexure – III

3.	To discuss and approve the new courses and **course contents to be offered under Program Elective category** in the **existing B.Tech AI&DS curriculum VTR UGE 2021** keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills.

B.Tech - Artificial Intelligence and Data Science
(Specialization / Honors)
(With effect from 2021-2022)

Preamble:

Data Science is an interdisciplinary field with the ability to extract knowledge/insights from data-be it structure, unstructured, or semi-structured data. Twinned with Artificial Intelligence more efficient solutions to find meaningful information from huge pools of data are possible today, with data from multiple sources-sensors, images, streaming video, satellite, medical imagery and the cloud.

Program Structure

Course Category	Minimum Credits Required
Foundation Courses (FC)	56
Program Core (PC)	58
Program Elective (PE)	18
Open Elective (OE)	12
Independent Learning(IL)	14
Industry / Higher Institute Learning Interaction(IHL)	2
Professional Proficiency Courses (PPC)	4
TOTAL	**164**

Minimum credits required for regular students in various course categories for B.Tech Artificial Intelligence and Data Science with minor

The students shall earn 164 credits in various course categories and additional 18 to 20 credits in the specialized tracks / areas from other branches/Schools by satisfying the prerequisite courses for the award of degree of B.Tech Artificial Intelligence and Data Science with minor subject to the regulations.

Minimum credits required for regular students in various course categories for B.Tech Artificial Intelligence and Data Science with Honors

The students shall earn 164 credits in various course categories and additional 18 to 20 credits in the specialized tracks / areas courses by satisfying the prerequisite courses for the award of degree of B.Tech Artificial Intelligence and Data Science with Honors subject to the regulations.

Foundation Core (56 Credits)

Foundation courses enhance the knowledge, skills and attitude of UG engineering graduates of all programmes to the expected level. The foundation courses shall have the courses related to basic sciences and mathematics, basic engineering sciences and humanities and social sciences.

(L-Lecture, T-Tutorial , P-Practical,C-Credit)

S.No	Course Code	Subject Title	Category	L	T	P	C
Lecture Courses							
1	10210MA101	Linear Algebra for Computing	BSC	3	1	0	4
2	10210MA102	Calculus & Ordinary differential Equations	BSC	3	1	0	4
3	10210MA103	Probability, Statistics and Queuing theory	BSC	3	1	0	4
4	10210MA110	Discrete Mathematical Structures	BSC	3	1	0	4
5	10210PH101	Semiconductor Physics	BSC	3	0	0	3
6	10210CH103 (2021-2022) admitted batch only	Environmental Science	BSC	3	0	0	3
	10210CH104 (2022-2023) admitted batch onwards	Environmental Science and Sustainability	BSC	3	0	0	3
7	10210CS101	Problem Solving using C	ESC	3	0	0	3
8	10210CS103 (2021-2022) admitted batch only	Object Oriented Programming using C++	ESC	3	0	0	3
	10210CS104 (2022-2023) admitted batch onwards	Programming Using Python	ESC	3	0	0	3
9	10210ME101	Design thinking	ESC	2	0	0	2
10	10210BM101	Biology for Engineers	ESC	2	0	0	2
11	10210ME103	Innovation & Entrepreneurship	ESC	2	0	0	2
12	10210ME102	Universal Human Values	HSC	3	0	0	3
13	10210ME104	Project Management & Finance	HSC	2	0	0	2
14	10210ME105	Engineers and Society	HSC	1	0	0	M
15	10210BL101	Constitution of India	HSC	1	0	0	M
Integrated Courses							
16	10210EN201	Professional Communication - I	HSC	1	0	2	2
17	10210EN202	Professional Communication - II	HSC	1	0	2	2

18	10210EC201	Basic Electronics & Digital Logic Design	ESC	2	0	2	3
19	10210EE204	Introduction to Engineering	ESC	1	0	4	3
20	10210ME201	Engineering Graphics	ESC	1	0	4	3
Laboratory Courses							
21	10210PH301	Modern Physics Laboratory	BSC	0	0	2	1
22	10210EE301	Engineering Products Lab	ESC	0	0	2	1
23	10210CS301	Problem Solving using C Lab	ESC	0	0	2	1
24	10210CS303 (2021-2022) admitted batch only	IT workshop	ESC	0	0	2	1
25	10210CS304 (2021-2022) admitted batch only	Object Oriented Programming using C++ Lab	ESC	0	0	2	1
	10210CS305 (2022-2023) admitted batch onwards	Programming Using Python Lab	ESC	0	0	2	1
Total Credits							**56**

*BSC – Basic Science Courses, ESC – Engineering Science Courses, HSC – Humanities & Social Science Courses, M – Mandatory course

Program Core (58 Credits)

(L-Lecture, T-Tutorial, P-Practical, C-Credit)

S.No	Course Code	Course Name	L	T	P	C
		Theory Courses				
1	10211AD101	Data Structures	3	1	0	3
2	10211AD103	Operating Systems	3	0	0	3
3	10211AD104 (2021- 2022) admitted batch only	Computer Architecture and Organization	3	0	0	3
	10211AD129 (2022-2023) Admitted batch onwards	Modern Computer Architecture	3	0	0	3
4	10211AD110	Optimization Techniques	3	1	0	3
5	10211AD108 (2021-2022) admitted batch only	Image Processing	2	0	0	2
	10211AD118 (2022-2023) admitted batch onwards	Image Processing Techniques	3	0	0	3
		Integrated Courses				
6	10211AD202	Design and Analysis of Algorithms	3	1	2	4
7	10211AD204	Programming using Java	2	1	2	3

8	10211AD207	Database Management Systems	3	1	2	4
9	10211AD209 (2021-2022) admitted batch only	Artificial Intelligence	2	0	2	3
	10211AD211 (2022-2023) admitted batch only	Artificial Intelligence Techniques	3	0	2	4
10	10211AD210	Big Data Analytics	3	0	2	4
11	10211AD213 (2021-2022) admitted batch only	Python Programming	1	1	2	2
12	10211AD214	Data Visualization	3	0	2	4
13	10211AD223	Machine Learning Techniques	3	0	2	4
14	10211AD217	Data Science for Engineers	2	0	2	3
15	10211AD218	Modeling for Data Science	3	0	2	4
16	10211AD215	Deep Learning	3	1	2	4
		Laboratory Courses				
17	10211AD301	Data Structures Laboratory	0	0	2	1
18	10211AD304	Operating Systems Laboratory	0	0	2	1
19	10211AD306	Competitive Coding-I	0	0	2	1
20	10211AD307	Competitive Coding-II	0	0	2	1
21	10211AD309	Robotic Process Automation Laboratory	0	0	2	1
Total Credits						**58**

Program Elective (18 Credits)

Program electives are the courses offered in the programme which covers depth and breadth. The students may register for appropriate electives offered in the programme based on their area of interest. One course under this category shall be taken from the list of approved MOOCs.

(L-Lecture, T-Tutorial , P-Practical,C-Credit)

S.No	Course Code	Course Name	L	T	P	C
		General Elective				
1	10212AD106	Formal Languages and Automata Theory	3	1	0	3
2	10212AD107	Compiler Design	3	1	0	3
3	10212AD208	Software Engineering	3	1	2	4
4	10212AD105	Fundamentals of Computer Networks	3	0	0	3
5	10212AD212	Web and Mobile Application Development	3	0	2	4
6	10212AD228	Blockchain Technology*	2	0	2	3
7	10211AD229	IoT and Cloud Computing	3	0	2	4
		AI-Data Science-Core Courses				
8	10212AD216	Natural Language Processing	3	0	2	4
9	10212AD113	Reinforcement Learning	3	0	0	3
10	10212AD222	Cognitive Computing*	3	0	0	3
11	10212AD224	Computer Vision	3	0	2	4
12	10212AD234	Time Series and Forecasting	3	0	2	4
13	10212AD121	High Performance Computing	3	0	0	3
14	10212AD123	Data Security and Privacy	3	0	0	3
15	10212AD276	Generative AI	1	0	2	2
16	10212AD131	Cloud Driven Data Engineering with AI	1	0	0	0

17	10212AD132	Explainable AI	3	0	0	3
18	10212AD277	Machine Learning for Production	2	0	2	3
		Honors				
		Artificial Intelligence				
19		Expert Systems*	3	0	2	4
20	10212AD224	Artificial Intelligence for Health Care	3	0	2	4
21		Robotics & Automation*	3	0	2	4
22		Artificial Intelligence for Cyber Security*	3	0	0	3
		Data Science				
19		Social Media Analytics*	3	0	2	4
20	10212AD243	Financial Analytics	3	0	2	4
*The proposed course and the course content are subject to approval/ratification in the upcoming BOS meetings						

Open Electives (12 Credits)

Open electives are the courses offered across the schools to enhance the knowledge breadth and professional competency of the students. The students shall register for appropriate electives offered in other schools based on their area of interest. The courses offered under this category cover the interdisciplinary knowledge.

(L-Lecture, T-Tutorial , P-Practical,C-Credit)

S.No	Course Code	Course Name	L	T	P	C
1	XXX1	Course Name-1	3	0	0	3
2	XXX2	Course Name-2	3	0	0	3
3	XXX3	Course Name-3	3	0	0	3
4	XXX4	Course Name-3	3	0	0	3

*One of The Courses may be completed through MOOCs platform like NPTEL as described by the department.

These courses offered to the other departments/Schools by School of Computing under Open Elective category.

(L-Lecture, T-Tutorial , P-Practical,C-Credit)

S.No	Course Code	Course Name	L	T	P	C
1	10213AD101	Object Oriented Programming using Java	3	0	0	3
2	10213AD102	Data Structures	3	0	0	3
3	10213AD103	Operating Systems	3	0	0	3
4	10213AD104	Database Management Systems	3	0	0	3
5	10213AD105	Fundamentals of Computer Networks	3	0	0	3
6	10213AD106	Data warehousing and Data mining	3	0	0	3

Independent Learning (14 Credits)

The students are expected to learn the courses offered under this category on their own. The courses offered under this category include:

S.No	Course Code	Course Name	L	T	P	C
1	10214AD601	Community Service Project	-	-	-	1
2	10214AD701	Minor Project	0	0	4	2
3	10214AD702	Minor Project	0	0	4	2
4	10214AD801	Major Project	-	-	-	9
Total						**14**

Industry / Higher Institute Learning Interaction (2 Credits)

The students shall earn a minimum of two credits by undergoing internship and/or specialized courses.

1. **Internship:**

   The students shall undergo Internship in the industry/higher learning institute approved by Industry-Institute Interaction Cell (IIIC) during any time after the second academic year.

2. **Specialized Courses:**

   The students shall undergo the courses offered either by the industrial experts whose minimum academic qualification is Bachelor of Engineering or equivalent or faculty expert from higher learning institutions approved by IIIC. The students shall choose either one two credits course or one one credit course or two one credit courses.

S.No	Course Code	Course Name	L	T	P	C
1	10215AD901	Internship	-	-	-	2
2	10215AD902	Industry Expert Lecture-1	-	-	-	1
3	10215AD903	Industry Expert Lecture-2	-	-	-	1
4	10215AD951	Higher Institute Learning Interaction-1	-	-	-	1
5	10215AD952	Higher Institute Learning Interaction-2	-	-	-	1

Professional Proficiency Courses (4 Credits)

The Professional Proficiency Courses which carry four credits, to be offered in four different semesters, starting from third semester. These courses offered in this category are relevant to professional proficiency.

S.No	Course Code	Course Name	L	T	P	C
1	10216GE901	Soft Skill-I	2	-	-	1
2		Professional Proficiency Course-II	2	-	-	1
3		Professional Proficiency Course-III	2	-	-	1
4		Professional Proficiency Course-IV	2	-	-	1

PROGRAM ELECTIVES

S. No	Course Code	Course Name	L	T	P	C
1	10212AD131	Cloud Driven Data Engineering with AI	1	0	0	1
2	10212AD132	Explainable AI	3	0	0	3
3	10212AD277	Machine Learning for Production	2	0	2	3
4	10212AD123	Data Security and Privacy	3	0	0	3
5	10212AD224	Artificial Intelligence for health care	3	0	2	4
6	10212AD243	Financial Analytics	3	0	2	4
7	10212AD276	Generative AI	1	0	2	2

COURSE CODE	COURSE TITLE	L	T	P	C
10212AD123	DATA SECURITY AND PRIVACY	3	0	0	3

A. Preamble

The purpose of this course is to cover the broad range of data security controls to protect data against compromises of confidentiality, integrity and availability by dealing with various security concepts like cryptography and network security, safeguarding of sensitive personal and corporate data against inadvertent disclosure. This course also includes the security and privacy policies and legislations.

B. Prerequisite Courses

10211AD207 Database Management Systems

C. Course Objectives

Students are able to

- Learn the basics of data security, including threats and key concepts like confidentiality and integrity.
- Understand cryptography techniques, such as symmetric and asymmetric key algorithms, and how to manage keys and authentication.
- Explore methods to protect data, understand data breaches, and balance privacy with data use, with examples from healthcare and social networks.
- Learn about privacy-preserving techniques for generating test data and evaluate its quality and usefulness.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Understand the basics of Data Security	K2
CO2	Apply various Cryptographic Techniques for Data Protection	K3
CO3	Describe privacy protection mechanisms and its importance	K2
CO4	Implement the Anonymization technique to balance data and Privacy	K3
CO5	Explain the generation of Privacy Preserving Test Data	K2
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

D. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1		**2**						2						
CO2	**2**	**2**											2	
CO3	**2**	**2**											2	
CO4	**2**	**2**			3								2	
CO5	2	2			3			2					2	

3- High; 2-Medium; 1-Low

Course Contents

UNIT 1. DATA SECURITY FUNDAMENTALS L-9 Hours

Introduction **-** The Need for Security**-** Threat - Attacks & Services - Security policies – cookie policy- Confidentiality - Integrity – Availability – Layering – Abstraction - Data Hiding - Security Controls - Access control structures - Security governance – Risk Analysis – Assessment – Response - Security planning.

UNIT 2 CRYPTOGRAPHY MECHANISMS L-9 Hours

Introduction to Number Theory - Security Approaches - Principles of Security - Cryptography Techniques: Symmetric and Asymmetric Key Cryptography- Steganography Symmetric Key Algorithms -Data Encryption Standard(DES) - Advanced Encryption Standard(AES) - Key Management - RSA Algorithm - ElGamal Cryptography -Diffie-Hellman Key Exchange - Authentication requirement -Authentication and Hash Function.
Case Study: Data encryption at the Salvation Army.

UNIT 3 DATA PRIVACY AND ITS IMPORTANCE L-9 Hours

Data discovery and classification -need for sharing data - data subject access request - methods of protecting data - data breaches –policies, regulations, privacy models, importance of balancing data privacy and utility – disclosure methods: de-identification-suppression- statistical disclosure limitation(SDL)- coarsening- -swapping-sampling- noise infusion. - Emerging Applications: Social Network Privacy, Location Privacy, Query Log Privacy, Biomedical Privacy.CaseStudy : Privacy issues in Healthcare and Social Network

UNIT 4 DATA ANONYMIZATION L-9 Hours

Anonymization design principles, Multidimensional Data: Privacy Preservation methods -Group based anonymization: k-anonymity, i-diversity, t-closeness-Algorithm comparison - Complex Data: Privacy Preservation- Graph Data - Time Series Data - Longitudinal data - Synthetic Data Generation - Dynamic Data Protection – Tokenization- Threats to anonymity – case study : Theft of Unencrypted Laptop.

UNIT 5 PRIVACY PRESERVING AND TEST DATA GENERATION L-9 Hours

Privacy Preservation of Association Rule Mining – Privacy Preserving Clustering algorithms - Privacy-Preserving Synthetic Data Generation- Design for Privacy Preservation of Test Data Generation -Test Data Fundamentals - Utility of Test Data: Test Coverage - Privacy Preservation of Test Data - Quality of Test Data - Insufficiencies of Anonymized Test Data- Data Removal.

Total: 45 Hours

F. Learning Resources

i. Text Books:

1. William Stallings, "Cryptography and Network Security: Principles and Practice " Eighth Edition, Pearson Publishers, 2020- Unit I & II
2. NatarajVenkataramanan, AshwinShriram, "Data Privacy: Principles and Practice", Chapman and Hall/CRC, first edition, 2016. (ISBN No.: 978-1-49-872104-2). – (UNIT III, IV,V)

ii. Reference Books:

1. Stephen Massey, "The Ultimate GDPR Practitioner Guide (2nd Edition): Demystifying Privacy & Data Protection", Fox Red Risk; 2nd edition, 2020
2. Micki Krause, Harold F. Tipton, " Data Protection and Privacy:", Hart Publishing, (ISBN No. 978- 1509919345),2017
3. David Kim and Michael G.Solomon, " Fundamentals of Information Systems Security", Jones and Bartlett Publishers, Inc, 2018
4. VishwajitBarbudhe, Shraddha N Zanjat, Bhavana S Karmore, "Cryptography and Network Security Principles", Lambert Academic Publishing , 2020

iii. Online References:

1. William stallings,2021, williamstallings.com/Extras/Security-Notes/
2. Cryptography and Network Security, February 2, 2019. [Online].Available: [http://freevideolectures.com/Course/3027/Cryptography-and-Network- Security]
3. Introduction to Cryptography and Computer Security,2015, http://cs.brown.edu/courses/csci1510/
4. Woodrow Hartzog, Northeastern University, Data Privacy Fundamentals, 2020, https://www.coursera.org/learn/northeastern-data-privacy

COURSE CODE	COURSE TITLE	L	T	P	C
10212AD243	FINANCIAL ANALYTICS	3	0	2	4

A. Preamble

The advances in financial technology have brought about transformational changes in many branches of the finance industry. The course will provide students with analytics skills to develop business and financial insights to solve real-world problems, and access live market data using analytical tools.

B. Prerequisite Courses

NIL

C. Course Objectives

Students are able to

- Learn how analytics and technology are changing the financial industry.
- Grasp essential statistical concepts and how they apply to financial data.
- Learn how to clean, analyze, and create models with financial data.
- Become skilled at using tools like KNIME, RapidMiner, and Apache Spark for financial analysis.
- Use machine learning techniques for investment strategies, risk management, and stock price forecasting.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Demonstrate the key topics related to technological advancements for the provision of financial services.	K2
CO2	Design various schemas needed for the representation of financial data.	K3
CO3	Develop a financial model using various analytics techniques	K3
CO4	Perform Critical Analysis of Data analytics Applications using Special purpose tools and software	K3
CO5	Conduct data analytics using Machine learning techniques, make appropriate and powerful connections between quantitative analysis and real-world problems.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2												2	
CO2	2				2								3	
CO3	2	3	3	2							2			3
CO4	2	3	3		3						3			3
CO5	2	2	3	2							3			

3- High; 2-Medium; 1-Low

E. Course Contents

Unit 1 Need for Analytics **L-9 Hours**

Introduction, Key technological trends affecting financial services, Current trends in financial technology, Innovation in FinTech, Introduction to analytics, Types of analytics, areas of analytics, basics of financial statistics, statistical terms, hypothesis testing, an introduction to corporate finance, FinTech Typology, Digitization of Financial Services, -Structure of Indian banking system and types of banks, NBFC and its types-Financial Regulations

Unit 2 Applied Statistics with Applications **L-9 Hours**

Introduction to statistics and probability theory, General statistical methods, Sampling distributions, Categorical Data Analysis. Characteristics of discrete time financial data, Correlations, dependence, autocorrelation, Linear time series analysis for finance, Nonlinear models and applications in finance, A/B testing, quantitative techniques:financial, mathematical, and statistical basics. (monte carlo simulation tool) Case Study: Using Statistics to Identify Spam.

Unit 3 Financial Models using Analytics **L-9 Hours**

Understanding data in finance, sources of data, Cleaning and pre-processing financial data, Financial data structures, optimization techniques, cash flow and fund flow statements:prepare and analyse, capital budgeting, Types of models, Building Models using Accounting Data, Understanding stock price behaviour, time series analysis in finance, Valuation of Stocks, Credit risk modeling, CRISP Modeling,News analytics (accessing news using web scraping) and sentiment analysis in finance. Case Study: High Frequency Trading

Unit 4 Data Analytics Tools and its applications in Finance Industry **L-9 Hours**

KNIME, Rapidminer, QlikView, Apache Spark, Hadoop, Classification models for risk management: Identification and analysis of investment alternatives. Ensemble methods for algorithmic trading: bagging, boosting, and random forests, Technical analysis and algorithmic trading, Clustering analysis-risk diversification and factor models,Sentiment analysis for market, Financial Planing & financial reporting, Bayesian models Mean variance portfolio optimization and Black Litterman model,

Unit 5 Applied Machine Learning in Financial Analytics **L-9 Hours**

Machine learning techniques and application to finance- investment strategies across different markets (equities, rates, currencies), loans-evaluating risk levels, managing assets, calculating risk scores, machine learnings techniques for financial markets analysis, trend analysis, decision making, Forecasting stock prices using machine learning, Data Analysis and Quantitative Finance module-Evaluation of trend predictions for both the private and public sector using ML Techniques, portfolio management.

Total : 45 Hours

Laboratory Experiments **Total : 30 Hours**

Part - 1

TASK 1	To develop business models-investment, funding, competition, to understand business performance and to enable inter-company and intra-temporal comparisons for decision making valuation using CRISP/Hadoop **Tools: CRISP/HADOOP**
TASK 2	Develop a program to sort, group, join, project, and filter your data. **Tools: PYTHON/SPARK**
TASK 3	Demonstrate hypothesis testing using Apache Spark using any financial data set. **Tools: Apache Spark**
TASK4	Create a linear regression model to predict the profitability of an enterprise using Python/Hadoop. **Tools: Python/Hadoop**
TASK5	Demonstrate using KNIME how to visualise a dataset and extract important features from it. Use a linear regression predictor to estimate sales for each item accordingly. **Tools: KNIME**
TASK6	Apply and analyse ensampling methods and also develop a boosting model **Tools:** KNIME/Spark
TASK7	Demonstrate the following features using QlikView on any financial data a)Association, Aggregation, data compression, data visualization and searching **Tools: QlikView**
TASK8	Develop a program on how the interest rate charged on loans depends on various factors in financial sector using python **Tools: Python**
TASK9	Predicting Prices of Bitcoin with Machine Learning technique **Tools: Python**

DATASET

1. https://www.kaggle.com/datasets/shebrahimi/financial-distress
2. https://www.kaggle.com/code/bhavikbb/loan-prediction-dataset
3. https://www.kaggle.com/datasets/cnic92/200-financial-indicators-of-us-stocks-20142018

Part-2

Use Cases:

Use Case 1. Fraud Detection and Prevention

Use Case 2. Stock Market Prediction

Use Case 3. Algorithmic Trading

Use Case 4. Customer Service and Recommendation

Use Case 5. Risk Management in Banks and Financial Institutions

Use Case 5. NFT Marketplace

Total: 75 Hours

G. Learning Resources

i. Text Books:

1.George T. Friedlob, Lydia L. F. Schleifer , L.F. Schleifer , "Essentials of Financial Analysis", 1st Edition, Wily, 2002(Unit 1,2,3)

2.David Ruppert, David S. Matteson,"Statistics and Data Analysis for Financial Engineering with R examples", (Springer Texts in Statistics) 2nd Edition, Kindle Edition Second Edition, 2015 (2,3,4,5)

3. Marcos Lopez de Prado, "Advances in Financial Machine Learning", Wily publication, 2018 (3,4,5)

ii. Reference Books:

1. Michael Minelli, Michele Chambers, AmbigaDhiraj ,"Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends", John Wiley & Sons, 2013.
2. Prajapati, V, "Big Data Analytics with R and Hadoop", Packt Publishing Ltd, 2013.

iii. Online References:

1. https://www.nseindia.com/learn/advanced-program-in-finance-wealth-management
2. https://www.coursera.org/lecture/fintech/1-1-introduction-to-fintech-foundations overview-Jpaoj
3. https://www.edx.org/course/introduction-to-fintech
4. https://www.toppr.com/guides/general-awareness/banking/structure-of-banking-in-india/
5. https://nptel.ac.in/content/syllabus_pdf/110106064.pdf

COURSE CODE	COURSE TITLE	L	T	P	C
10212AD224	ARTIFICIAL INTELLIGENCE FOR HEALTH CARE	3	0	2	4

A. Preamble

This course will provide various components and design a machine learning production system end-to-end such as project scoping, data needs, modeling strategies, and deployment constraints and requirements.

B. Prerequisite Courses

10211AD223 - Machine Learning Techniques

C. Course Objectives

Students are able to

- Understand foundational aspects of healthcare delivery and analytics.
- Develop and evaluate models for medical image diagnosis.
- Explore prognostic models and evaluate risk scores.
- Estimate treatment effects and interpret AI models.
- Learn about US healthcare measures and value-based programs.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Identify the different health care systems and ICT applications	K3
CO2	Apply the artificial intelligence techniques for healthcare image diagnosis	K3
CO3	Build the health management system of patents using linear and tree-based prognostic models	K3
CO4	Solve question answering and treatment management problems using artificial intelligence techniques	K3
CO5	Develop medical applications using various medical standards and metrics	K3

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								2						
CO2	3	3	3		3								3	
CO3	3	2	2		3								3	
CO4	3	3	3		3								3	
CO5								3						

3- High; 2-Medium; 1-Low

F. Course Content

UNIT I Introduction to Artificial Intelligence for Healthcare **L-7 Hours**

Healthcare Foundations - Healthcare delivery in the US - Patient data – the journey from patient to computer - Standardized clinical code sets - Foundations of healthcare analytics - History of healthcare analytics - Examples of healthcare analytics

UNIT II Artificial Intelligence for Medical Image Diagnosis **L-9 Hours**

Building and Training a Model for Medical Diagnosis - Training, prediction, and loss - Image Classification and Class Imbalance - Binary Cross Entropy Loss Function - Impact of Class Imbalance on Loss Calculation - Resampling to Achieve Balanced Classes - Multi-Task - Multi-task Loss, Dataset size, and CNN Architectures - Working with a Small Training Set - Generating More Samples - Model Testing - Splitting data by patient – Sampling - Ground Truth and Consensus Voting - Additional Medical Testing – Case study: Eye Disease and Cancer Diagnosis

UNIT III Artificial Intelligence for Medical Prognosis **L-10 Hours**

Linear prognostic models: Medical Prognosis - Examples of Prognostic Tasks - Atrial fibrillation - Risk Score Computation - Evaluating Prognostic Models - Concordant Pairs, Risk Ties, Permissible Pairs - C-Index - Prognosis with Tree-based models: Decision trees for prognosis - Dividing the input space - Building a decision tree - Survival Data - Different distributions - Missing Data example - Missing completely at random - Missing at random - Missing not at random – Imputation - Mean Imputation - Regression Imputation - Calculate Imputed Values – Case studies: Liver Disease Mortality - Risk of heart disease

UNIT IV Artificial Intelligence for Medical Treatment **L-10 Hours**

Treatment Effect Estimation: Absolute risk reduction - Randomized control trials - Causal inference - Average treatment effect - Conditional average treatment effect - T-Learner - S-Learner - C-for-benefit – Medical Question Answering: Handling words with multiple meanings - Define the answer in a text - Automatic label extraction for medical imaging - Synonyms for labels - Presence or absence of a disease - Evaluating label extraction - Evaluating on multiple disease categories – Interpretation: Drop column method - Permutation method - Individual feature importance - Shapley values - Combining importance - Shapley values for all patients - Interpreting CNN models - Localization maps - Heat maps – case study: Evaluate individualized treatment effect

UNIT V Healthcare Measures **L-9 Hours**

Introduction to healthcare measures - US Medicare value-based programs - The Hospital Value-Based Purchasing (HVBP) program - The Hospital Readmission Reduction (HRR) program - The Hospital-Acquired Conditions (HAC) program - The End-Stage Renal Disease (ESRD) quality incentive program - The Skilled Nursing Facility Value-Based Program (SNFVBP) - The Home Health Value-Based Program (HHVBP) - The Merit-Based Incentive Payment System (MIPS) - Other value-based programs

Total: 45 Hours

Laboratory Experiments **Total: 30 Hours**

Part - 1

Task 1: Disease recognition using simple machine learning models (Tool: Scikit learn)

Task 2: Use machine learning algorithm to discover health disorders and compare their performance (Tool: Scikit learn)

Task 3: Multiclass classification using machine learning techniques (Tool: Scikit learn)

Task 4: Apply deep supervised learning techniques to diagnose disorders compare their performance (Tool: Scikit learn and keras)

Task 5: Implement a deep learning grid and deep neural networks for disease detection (Tool: Keras)

Task 6: Disease diagnosis from multiple data source using neural network (Tool: Keras)

Task 7: Image segmentation using deep learning model (Tool: Keras)

Task 8: Data augmentation on medical image data (Tool: Keras)
Task 9: Build a risk assessment model using linear and tree-based models (Tool: Keras)
Task 10: Develop chat bot using natural language techniques (Tool: Keras)

Part-2

Use Cases:

1. Detection of Breast cancer from 2D images using SVM and KNN model
2. Detection of autistic disease using SVM with optimized kernel and KNN model
3. Classify DNA sequences using Markov models, k-nearest neighbors algorithms, support vector machines, and other common classifiers
4. Develop generative adversarial networks for augmenting medical image data.
5. Use LSTM to develop hospital question answering system

Dataset

1. https://archive.ics.uci.edu/dataset/45/heart+disease
2. https://archive.ics.uci.edu/dataset/34/diabetes
3. https://www.kaggle.com/datasets/paultimothymooney/chest-xray-pneumonia
4. https://www.kaggle.com/datasets/uciml/breast-cancer-wisconsin-data

Total: 75 Hours

G. Learning Resources

i. **Textbook(s):**

1. R.D.Lele, "Computers in Medicine: Progress in Medical Informatics'', Tata McGraw Hill Publishing computers Ltd, 2017
2. Eric Topol, "Deep Medicine: How Artificial Intelligence Can Make Healthcare", Basic Books; 1st edition, 2019

ii. Reference Book(s):

1. Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing computers Ltd, New Delhi, 2013
2. N.Mathivanan, "PC-Based Instrumentation'', Prentice Hall of India Pvt Ltd – New Delhi, 2007
3. Vikas Kumar, Healthcare Analytics Made Simple, Packt Publisher, 2018
4. Wager, K. A., Lee, F. W., & Glaser, J. P, Health care information Systems: A practical approach for health care management -4th Edition, Jossey-Bass, 2017

iii. **Online Resource(s):**

1. "Coursera course on Fundamentals of Machine Learning for Healthcare", Accessed on Apr. 20, 2021 [Online], https://www.coursera.org/learn/ fundamental-machine-learning-healthcare
2. "Coursera course on Evaluations of AI Applications in Healthcare", Accessed on Apr. 20, 2021 [Online], https://www.coursera.org/learn/evaluations-ai-applications-healthcare

Annexure- IV

4.	To discuss and approve the new courses under Open Elective category, to be offered in the **existing B.Tech AI&DS curriculum VTR UGE 2021** keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills

COURSE CODE	COURSE TITLE	L	T	P	C
10213GE103	Software Development and Maintenance	3	0	0	3

(This course is offered under General Elective Category. All School students can opt the course.)

A. Preamble

This course provides basic concepts about SDLC, Unix commands and shell operations, Object Oriented Programming, JavaScript technologies to create the interactive client-side design of web applications. This course introduces DBMS concepts, to share a common set of models, design paradigms via a Structured Query Language (SQL). More specifically, this course also deals with UI/UX concepts to develop a pleasant user interface and deploy the application using Cloud AWS services.

B. Prerequisite Course

10210CS101 - Problem Solving using C.

C. Course Objectives

Learners are exposed to:

- Make use of basic SDLC, Unix Commands.
- Practice Java basic constructs for real world problems.
- Build efficient client-side validation using javascript.
- Acquire knowledge on basic SQL queries and designing database schema
- Learn and build the workflow of UI/UX
- Deploy the application on AWS cloud

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Interpret the Software Development Life Cycle (SDLC) stages, Unix basics commands and shell operations, and OOP.	**K2**
CO2	Articulate proficiency in exception handling, inheritance, and API fundamentals.	**K3**
CO3	Design the interactive and dynamic webpage using JavaScript.	**K3**
CO4	Model the Relation Database schema and perform CRUD operations.	**K3**
CO5	Chart UI/UX and deploy the applications using AWS cloud.	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

F. Course Contents

Unit 1 Introduction to SDLC, UNIX/OS and OOP Concepts L-9 Hours

SDLC: Requirements gathering - System design - Implementation - Testing - Various types of testing - Maintenance - Documentation - Project Management - Agile. UNIX/OS: Unix Basics - Unix shell - File Operations - Process Management - Networking and Communication - System Administration - Shell Customization. OOPs Concept: Benefits and Multiple Features of OOP - Object Oriented Programming Vs Procedural Programming - Class - Cohesion and Coupling in design process - Popular OOP Languages.

Unit 2 Exception Handling, Inheritance & APIs L-9 Hours

Exception Handling - Categories of Exceptions - Hierarchy of Exception Class - Exception Types - Checked and Unchecked Exceptions. Inheritance and its Types - Creating Subclass - Method Overriding - Super keyword - Polymorphism - instanceof operator - Abstract Vs Non-Abstract classes - Interface. **API:** Introduction - API Basics - Types of API Protocols - Styles and Benefits of API Development.

Unit 3 Scripting Language - Javascript L-9 Hours

Basic Web Development Concepts - **Javascript:** Introduction to Javascript - Syntax and Basic Concepts - Document Object Model (DOM) Manipulation - Arrays and Objects - Asynchronous JavaScript - Error Handling and Debugging - ECMAScript 6 (ES6)+ Features.

Unit 4 Database Fundamentals: RDBMS, SQL L-9 Hours

DBMS: History of Data and its definition - Various formats to recognize databases - DBMS through MySQL Workbench - DBMS Types and its features - Requirements of DBMS - Roles, job-related tasks. **RDBMS:** Introduction and its uses - popular RDBMS and their uses - Oracle RDBMS versions and features - SQL Server RDBMS, history and its features - MySQL RDBMS, history and its features - MySQL Workbench - Normalization - E.F. Codd.**SQL:** Introduction - Connectivity - Reserved words - Data Types - SQL Commands: DDL - Alter tables - drop and truncate - table constraints - constraint violation.

Unit 5 Fundamentals of UI/UX, Generative AI and AWS Cloud Practitioner L-9 Hours

UI/UX: Introduction - importance - UI Vs UX - Future of UI/UX - User prevention on errors - flowcharts of UI/UX - journey maps of UX design - micro interactions - age-responsive design - interstitial anxiety - VR interfaces Vs normal interfaces - Modern concepts of UI/UX.

Generative AI: Definition - Working principle - Model Types - Applications.

AWS Cloud Practitioner: Introduction - AWS services - SDKs Vs APIs - AWS Management Console - Infrastructure as Code (IaC) - Deployment and Management - Serverless Computing - Data Storage and Analytics.

Total: 45 Hours

G. Learning Resources

i.Text Books:

1. "Software Engineering: A Practitioner's Approach" by Roger S. Pressman is published by McGraw-Hill Education. September 2021 , 9th edition. [Unit - 1]
2. UNIX and Linux System Administration Handbook" is published by Pearson and the 5th edition was published in 2017. [Unit - 1]
3. "Introduction to Java Programming and Data Structures, Comprehensive Version" (12th Edition) By Y. Daniel Liang, Pearson in 2018. [Unit - 1 & 2]

5. APIs: A Strategy Guide" by Daniel Jacobson, Greg Brail, and Dan Woods, O'Reilly Media, Inc. December 2011. [Unit - 2]
6. JavaScript: The Definitive Guide, 7th Edition. by David Flanagan. Released May 2020. Publisher(s): O'Reilly Media, Inc. [Unit - 3]
7. Database System Concepts" by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan 7th edition McGraw-Hill Education. [Unit - 4]
8. "Don't Make Me Think: A Common Sense Approach to Web Usability" by Steve Krug 3rd edition by New Riders. [Unit - 5]
9. AWS Certified Cloud Practitioner Study Guide" 2nd Edition by Sybex. [Unit - 5]

ii.Reference Books:

1. H.M. Deitel and P.J. Deitel," Java How to Program", Pearson Prentice Hall Seventh edition, 2018.
2. E. Balaguruswamy, "Programming in java", Sixth Edition, Tata McGraw Hill, 2019.
3. Mary Delamater, "Murach's JavaScript and jQuery (4th Edition) Paperback – Illustrated", Mike Murach& Associates Inc, August 26, 2020.
4. Elmasri Ramez, Navathe S, "Fundamentals of Database System", Seventh Edition, Pearson, 2017.
5. The Design of Everyday Things: Revised and Expanded Edition by Don Norman.
6. Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud by Mark Wilkins.

iii. Online References:

1. "Java Tutorial", June 20, 2023 [Online], Available: https://www.javatpoint.com/java-tutorial
2. "Programming in Java", Accessed on: June 20, 2023 [Online], Available: https://nptel.ac.in/courses/106/105/106105191/
3. "UI / UX Design Tutorial – Wireframe, Mockup & Design in Figma " https://www.youtube.com/watch?v=c9Wg6Cb_YlU
4. Get started with Amazon EC2 Linux instances https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/EC2_GetStarted.html
5. " AWS EC2 Instances | How to Create AWS EC2 Instance | AWS EC2 Tutorial For Beginner" https://www.youtube.com/watch?v=LZXWlF5udYs

Annexure-V

5.	To discuss and approve the **courses to be offered in Online MOOCs platforms under Program Elective and Open Elective Category** during the academic year Summer, 2024-2025 for B.Tech Artificial Intelligence and Data Science

Program Elective category

COURSE CODE	COURSE TITLE	Course Provider	W	H	C
10212AD401	Responsible and Safe AI systems	NPTEL	12	-	3

Course Category:

Program Elective (Self - Learning Course)

Course Contents:

Week1&2:

AI Capabilities Improvement in last 5-10 years

- Imminent risks from AI Models: Toxicity, bias, goal misspecification, adversarial example set.
- Long-term risks from AI Models: Misuse, Misgeneralization, Rogue AGI
- Principles of RAI - Transparency; Accountability; Safety, Robustness and Reliability; Privacy and Security; Fairness and non-discrimination; Human-Centred Values;
- Inclusive and Sustainable development, Interpretability
- Recap of Deep Learning Techniques, Language/Vision Models
- AI Risks for Gen models, Adversarial Attacks – Vision, NLP, Superhuman Go agents

Week3&4:

ML Poisoning Attacks like Trojans

- Implications for current and future AI safety
- Explainability
- Imminent and Long-term potential for transparency techniques
- Mechanistic Interpretability
- Representation Engineering, model editing and probing
- Critiques of Transparency for AI Safety

Week5&6:

- Privacy & Fairness in AI

Week7&8:

- Metrics and Tools for RAI - measuring bias/fairness, adversarial testing, explanations (Lime/SHAP/GradCam), audit mechanisms
- Regulation landscape - DPDP act (India), GDPR (EU), EU AI act, US presidential declaration, Ethical approvals, informed consent, participatory design, future of work, Indian context
- What is AGI? When could it be achieved?
- Instrumental Convergence: Power Seeking, Deception etc.

Week9&10:

- RAI in Legal domain
- RAI in Health care domain
- RAI in Education domain
- A few other domains
- Policy issues in RAI

Week11&12:

- Couple of panel discussion with industry practitioners, academic, government (possibly), and others.
- Fireside chat with eminent personalities
- Recorded Paper reading discussion

COURSE CODE	COURSE TITLE	Course Provider	W	H	C
10212AD402	Reinforcement Learning	NPTEL	12	-	3

Course Category:

Program Elective (Self - Learning Course)

Course Contents:

Week 1 : Introduction
Week 2 : Bandit algorithms – UCB, PAC
Week 3 : Bandit algorithms –Median Elimination, Policy Gradient
Week 4 : Full RL & MDPs
Week 5 : Bellman Optimality
Week 6 : Dynamic Programming & TD Methods
Week 7 : Eligibility Traces
Week 8 : Function Approximation
Week 9 : Least Squares Methods
Week 10 : Fitted Q, DQN & Policy Gradient for Full RL
Week 11 : Hierarchical RL
Week 12 : POMDPs

NPTEL -Open Elective category

S.No.	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1.	10213AD435	Computer Vision	NPTEL	12 Weeks	3
2.	10213AD436	Introduction to Industry 4.0 and Industrial Internet of Things	NPTEL	12 Weeks	3
3.	10213AD437	Introduction to Machine learning	NPTEL	12 Weeks	3

COURSE CODE	COURSE TITLE	Course Provider	W	H	C
10213AD435	COMPUTER VISION	**NPTEL**	**12**	**-**	**3**

Course Category:

Open Elective (Self - Learning Course)

Course Contents:

Week 1 : Fundamentals of Image processing

Week 2 : 2-D Projective Geometry, homography, and Properties of homography

Week 3 : Camera geometry

Week 4 : Stereo geometry

Week 5 : Stereo geometry

Week 6 : Feature detection and description

Week 7 : Feature matching and model fitting

Week 8 : Color processing

Week 9 : Range image processing

Week 10 : Clustering and classification

Week 11 : Dimensionality reduction and sparse representation

Week 12 : Deep neural architecture and applications

COURSE CODE	COURSE TITLE	W	H	C
10213AD436	Introduction to Industry 4.0 and Industrial Internet of Things	12	-	3

Course Category:

Open Elective (Self - Learning Course)

Course Contents:

Week 1 : Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II

Week 2 : Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

Week 3 : Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis

Week 4 : Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

Week 5 : IIoT-Introduction, Industrial IoT: Business Model and Referece Architerture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.

Week 6 : Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

Week 7 : Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.

Week 8 : Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

Week 9 : Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II.

Week 10 : Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

Week 11 : Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Week 12 : Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies :

Case study - I : Milk Processing and Packaging Industries

Case study - II: Manufacturing Industries - Part I

Case study - III : Manufacturing Industries - Part II

Case study - IV : Student Projects - Part I

Case study - V : Student Projects - Part II

Case study - VI : Virtual Reality Lab

Case study - VII : Steel Technology Lab

COURSE CODE	COURSE TITLE	Course Provider	W	H	C
10213AD437	Introduction to Machine learning	NPTEL	12	-	3

Course Category:

Open Elective Elective (Self - Learning Course)

Course Contents:

Week 0: Probability Theory, Linear Algebra, Convex Optimization - (Recap)

Week 1: Introduction: Statistical Decision Theory - Regression, Classification, Bias Variance

Week 2: Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Partial Least squares

Week 3: Linear Classification, Logistic Regression, Linear Discriminant Analysis

Week 4: Perceptron, Support Vector Machines

Week 5: Neural Networks - Introduction, Early Models, Perceptron Learning, Backpropagation, Initialization, Training & Validation, Parameter Estimation - MLE, MAP, Bayesian Estimation

Week 6: Decision Trees, Regression Trees, Stopping Criterion & Pruning loss functions, Categorical Attributes, Multiway Splits, Missing Values, Decision Trees - Instability Evaluation Measures

Week 7: Bootstrapping & Cross Validation, Class Evaluation Measures, ROC curve, MDL, Ensemble Methods - Bagging, Committee Machines and Stacking, Boosting

Week 8: Gradient Boosting, Random Forests, Multi-class Classification, Naive Bayes, Bayesian Networks

Week 9: Undirected Graphical Models, HMM, Variable Elimination, Belief Propagation

Week 10: Partitional Clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density-based Clustering

Week 11: Gaussian Mixture Models, Expectation Maximization

Week 12: Learning Theory, Introduction to Reinforcement Learning, Optional videos (RL framework, TD learning, Solution Methods, Applications)

Annexure- VI

6.	To discuss and approve the new **courses to be offered in Value added courses under Complementary skills Category** during the academic year, summer 2024-2025 for B.Tech Artificial Intelligence and Data Science.

Complementary Skills – Value Added Course

S No	Course Code	Course title	L	T	P	C
1	10218AD438	Big Data Analytics	2	0	0	0
2	10218AD439	Power BI Data Analytics	2	0	0	0
3	10218AD440	Enrich Visualization using Tableau	2	0	0	0
4	10218AD441	Machine learning using Python	2	0	0	0

COURSE CODE	COURSE TITLE	L	T	P	C
10218AD438	**Big Data Analytics**	2	0	0	0

A. Preamble:

The key objective of this course is to make the students to be familiar with the concepts of Big Data. This course includes the most significant technologies used for storing, processing and analyzing big data.

B. Course Category: Value Added Course

C. Course Outcome:

The Students will be able to proficiently:

- Identify Big Data and its Business Implications.
- Access and Process Data on Distributed File System
- List the components of Hadoop and Hadoop Eco-System
- Develop Big Data Solutions using Hadoop Eco System
- Apply Machine Learning Techniques

D. Course Contents

Module–1: Understanding Big Data **6 Hours**

Concepts and Terminology: Data Analytics - Big Data Characteristics - Different Types of Data - Big Data Analytics Lifecycle - Big Data

Module–2: Big Data Storage Concepts **6 Hours**

Clusters - File Systems and Distributed File Systems – NoSQL Shading – Replication - CAP Theorem

Module–3: Big Data Processing Concepts **6 Hours**

Parallel Data Processing - Distributed Data Processing – Hadoop - Processing Workloads - Map and Reduce Tasks

Module–4: Big Data Storage Technology **6 Hours**

On-Disk Storage Devices: Distributed File Systems – RDBMS Databases - NoSQL Databases - In-Memory Storage Devices - In-Memory Databases

Module–5: Big Data Analysis Techniques **6 Hours**

Quantitative Analysis - Qualitative Analysis - Data Mining - Statistical Analysis - Machine Learning

Total 30 Hours

i. Text Books

1. Thomas Erl, Wajid Khattak, and Paul Buhler, “Big Data Fundamentals - Concepts, Drivers & Techniques", Prentice Hall, 1st Edition.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

ii. Reference Books

1. Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.
2. Arvind Sathi, “Big Data Analytics: Disruptive Technologies for Changing the Game”, MC Press, 2012

iii. Online Resources

1. https://www.udemy.com/course/big-data-and-hadoop-for-beginners/
2. https://www.coursera.org/specializations/big-data.

COURSE CODE	COURSE TITLE	L	T	P	C
10218AD439	Power BI Data Analytics	2	0	0	0

A. Preamble:

Power BI is a business analytics service provided by Microsoft. It provides interactive visualizations with self-service business intelligence capabilities, where end users can create reports and dashboards by themselves, without having to depend on any information technology staff or database administrator.

B. Course Category: Value Added Course

C. Course Outcome:

Students will be able to

- Identify Business Intelligence and Power BI.
- Process data Transformation in Power BI Desktop
- Analyze data with Microsoft Power BI
- Visualize data using Power BI
- Configure Power BI Service

D. Course Contents

Module–1: Introduction to Power BI **6 Hours**

Introduction to Business Intelligence - Self-Service Business Intelligence (SSBI) - Introduction to Power BI - Traditional BI vs. Power BI - Uses of Power BI

Module–2: Power BI Desktop and Data Transformation **6 Hours**

Data Sources in Power BI Desktop - Loading Data in Power BI Desktop - Views in Power BI Desktop - Query Editor In Power BI - Transform, Clean, Shape, and Model Data

Module–3: Data Analysis Expression (DAX) **6 Hours**

Introduction to DAX - Importance of DAX - Data Types in DAX - DAX Calculation Types - Steps to Create Calculated Columns - Measures in DAX

Module–4: Data Visualization **6 Hours**

Introduction to Visuals In Power BI - Visualization Charts in Power BI - Matrixes and Tables - Slicers and Map Visualizations - Gauges and Single Number Cards

Module–5: Power BI Service **6 Hours**

Introduction to Power BI - Creating a Dashboard - Quick Insights in Power BI - Configuring a Dashboard

Total 30 Hours

i. Text Books

1. Greg Deckler and Brett Powell, “Mastering Microsoft Power BI - Expert techniques to create interactive insights for effective data analytics and business intelligence”, Packt, Second Edition.

ii. Reference Books

1. Alan Murray, " Power BI for Jobseekers: Learn how to create interactive dashboards and reports, and gain insights from the data”, bpb, 2023.

iii. Online Resources

1. https://www.udemy.com/course/powerful-reports-and-dashboards-with-microsoft-powerbi/
2. https://www.coursera.org/professional-certificates/microsoft-power-bi-data-analyst

COURSE CODE	COURSE TITLE	L	T	P	C
10218AD440	Enrich Visualization using Tableau	2	0	0	0

A. Preamble:

This comprehensive course delves into unravel the potential of Tableau in seven easy steps. We will create and deploy meaningful and visually appealing dashboard in each steps. This course covers the latest features of data preparation in tableau and will create table calculations, stunning charts and informative storyboards for a better understanding of data.

B. Course Category: Value Added Course

C. Course Outcome:

The Students will be able to proficiently:

- Understand Data Exploration and Tableau with basic features.
- Ability to work with Data and perform various operation on it.
- Ability to draw geo plotting and create dashboard.
- Using Tableau statistics for clustering and forecasting.
- Use to develop dashboard for real time application.

F. Course Contents

Module–1: Introduction to Tableau **6 Hours**

Connecting to various file type, Organizing data pane, Cardinality set by Tableau, Building understanding of graphical user interface, Data source, Create Dash board and Story board, Data Analysis, Understanding Panes, Building Chart and Graphs.

Module–2: Getting Start with Tableau, Data exploration and calculation **6 Hours**

Understanding Tableau, connecting data source, Perform joining, blending and unions on data, Exploring data- hierarchy, sorting, grouping, set and filters. Data calculation- string, number and type calculation, logic and aggregation calculation, Table calculation, Introduction to LoD calculation.

Module–3: Geo Plotting Data and Dashboard **6 Hours**

Plotting geographical data, configuration and Trouble-shooting Maps, Adding custom location, Density chart, Building Dashboard, various object in dash board, Formatting in dashboard and adding Interactivity.

Module–4: Tableau for statistics **6 Hours**

Adding Trend Lines, Reference Lines, Forecasting in Tableau, Clustering in Tableau, Tableau workbook and public sharing

Module–5: Develop Real-World Business Application Dashboards **6 Hours**

Introduction to Projects
Project Phase I: Ticket Trend Analysis
Project Phase II: Employee Performance analysis.

Total 30 Hours

i. Text Book:

1. Matthew Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization Foundations, Techniques, and Applications”, 2nd Edition, A K Peters/CRC Press, 2021.

ii. Reference Book

1. Donabel Santos, “Tableau 10 Business Intelligence Cookbook”, Packt Publishing, 1786465639, 9781786465634, 2016.

iii. Online Resources

1. “Exploratory data analysis and Data visualization”, Accessed on April.11.2021 [Online]. Available: https://www.creative-wisdom.com/teaching/WBI/EDA.shtml.
2. “Visualization of Multivariate Data”, Accessed on April.11.2021 [Online].https://people.stat.sc.edu/hansont/stat730/MultivariateDataVisualization.pdf

COURSE CODE	COURSE TITLE	L	T	P	C
10218AD441	Machine Learning Using Python	2	0	0	0

A. Preamble

Machine learning offers invaluable tools for extracting insights and making predictions from vast data sets. Python, with its simplicity and powerful libraries, has become the go-to language for implementing these solutions. Starting with fundamental concepts, it progresses to advanced topics like classifier algorithms and error handling.

B. Course Category: Value Added Course

C. Course Outcome

Students should able to

- Learn machine learning packages in Python.
- Understand machine learning model performance.
- Implement predictive models using regression and classification techniques.
- Comprehend strategies to handle missing data.

D. Course Contents

Module I: Machine Learning using Python. **6 Hours**

Introduction: Introduction Machine Learning Using Python - Usage of Machine Learning Packages in Python - Example of Machine Learning Using Python - Example of Machine Learning Using Python Continues - Installation of Python

Module II: Linear Regression **6 Hours**

Linear Regression in ML - Linear Regression Example - Linear Regression Example Continues - Support Vector Algorithm in ML

Module III: Classifier and Python Package **6 Hours**

Decision Tree Classifier - Random Forest Classification - K Mean Clustering - Apriori Python Package - Apriori Python Package Continues

Module IV: Evaluation Metrics **6 Hours**

Evaluation Metrics - Example of Evaluation Metrics - Confusion Matrix in Evaluation Metrics - Classification Reports in Evaluation Metrics - Example of MAE, MSE and Variance using Evaluation Metrics - Sea Born Example using Evaluation Metrics - Scatter Matrix using Evaluation Metrics

Module V: Missing Value **6 Hours**

Handling Missing Values in Python - Handling Missing Values in Python Continues - Exception Handling in Python - More on Exception Handling in Python

Total 30 Hours

F.Learning Resources

1. https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_013843128689426432 31498_shared?collectionType=Course&collectionId=lex_auth_013843129228853248322O3_s hared&pathId=lex_auth_013843127683072000321 92_shared

Annexure-VII

7	To discuss the Stakeholders feedback on curriculum of B.Tech Artificial Intelligence and Data Science taken for the academic year 2023-2024

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

School of Computing

Department of Artificial Intelligence and Data Science

Faculty Feedback on Curriculum 2023-2024

PROGRAM CORE

1. Incorporate the latest industrial and practical-oriented technologies into the curriculum.
2. Suggest project-based learning for all applicable courses.
3. Increase the course outcome level to enhance knowledge of real-time problems.
4. Integrate real-world industry projects into the curriculum, allowing students to work on actual business problems.

PROGRAM ELECTIVE

1. Revise the Generative AI syllabus.
2. Include courses on Responsibility and Safe AI systems in the curriculum.
3. Recommend to add Explainable AI and Data Security and Privacy Courses.

OPEN ELECTIVE

1. Recommend practical hours for open elective courses.

INDEPENDENT LEARNING

1. Suggest including zero-credit courses under value education.

Action Taken: Academic Year 2023-2024 Curriculum Feedback

Based on the faculty feedback analysis few courses were introduced in the curriculum under various category:

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Data Security and Privacy	Program Elective	6th BOS-27.07.2024
2	Artificial Intelligence for health care	Program Elective	6th BOS-27.07.2024
3	Financial Analytics	Program Elective	6th BOS-27.07.2024
4	Cloud driven Data Engineering with AI	Program Elective	6th BOS-27.07.2024
5	Explainable AI	Program Elective	6th BOS-27.07.2024
6	Machine Learning for	Program Elective	6th BOS-27.07.2024

	Production		
7	Responsible and Safe AI systems	Program Elective	6th BOS-27.07.2024
8	Reinforcement Learning	Program Elective	6th BOS-27.07.2024

School of Computing

Department of Artificial Intelligence and Data Science

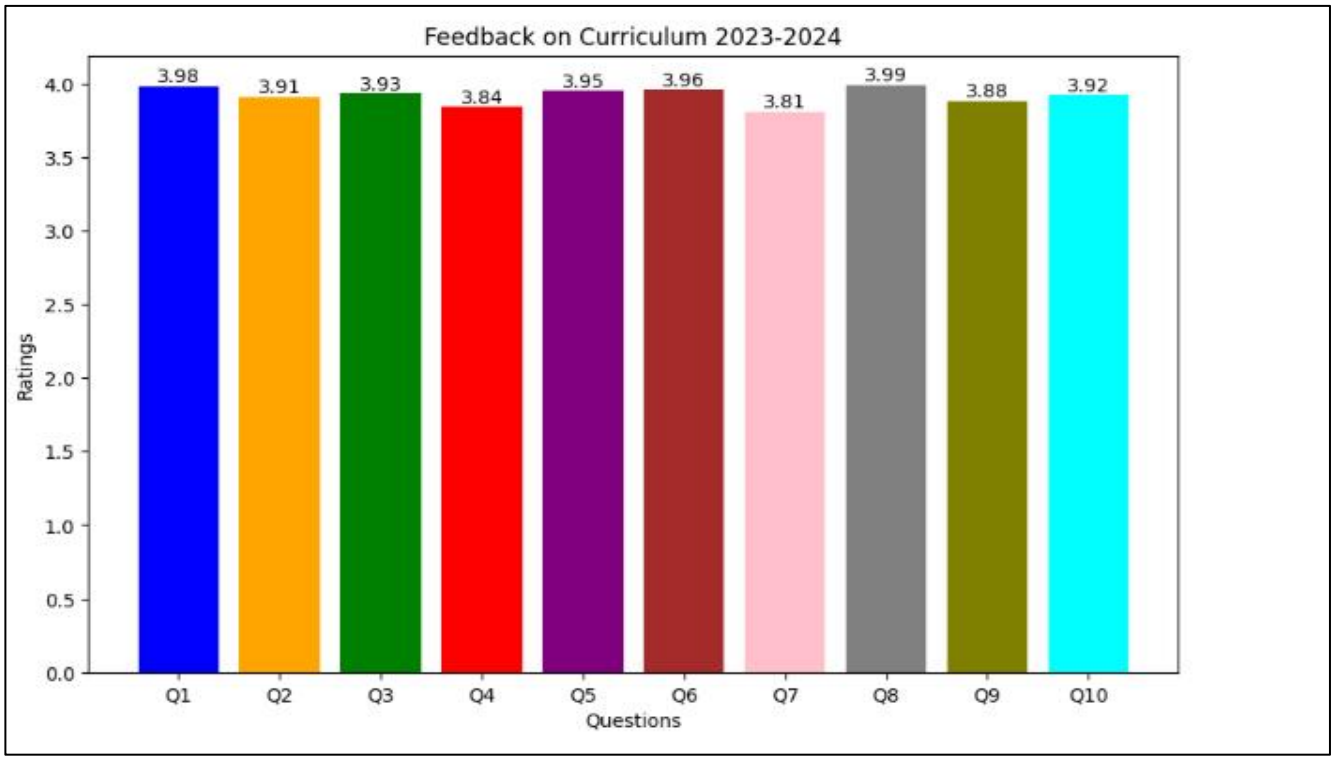
Students Feedback on Curriculum 2023-2024

The students are the most important stakeholders of B. Tech Artificial Intelligence and Data Science Programme. In the academic year 2023-2024, suggestions collected in the form of structured feedback from B. Tech AI&DS students. Received thirty-four student's feedback on curriculum and the major suggestions are listed below:

1. Integrate real-time projects into the curriculum for applicable courses to provide hands-on experience.
2. Offer targeted training sessions for specific programming languages relevant to the industry.
3. Recommend courses focused on developing job-related skills to enhance employability.
4. Revise the current Generative AI and Prompt Engineering course to ensure it covers the latest advancements and applications.
5. Introduce a course on responsible and safe AI practices to educate students on ethical considerations and safe usage of AI technologies.

The following questions are given to the students about feedback on curriculum and the response is mentioned in the below graph:

Q1	How do you rate the curriculum offered in relation to the Technological advancements?
Q2	How do you rate the syllabus in related to the needs of industry/society?
Q3	How do you rate the relevance of the courses for providing employability?
Q4	Did the course curriculum intellectually motivate you?
Q5	Was the course curriculum fulfilling your expectations?
Q6	How much has your experience at this curriculum contributed to your job-related knowledge and skills?
Q7	Does the syllabus create any interest to pursue post-graduation/research in the particular subject?
Q8	Were reading material and references regarding curriculum / subject easily found?
Q9	How do you rate the objectives stated for each of the courses
Q10	How do you rate the syllabus of the courses that you have studied in relation to the competencies expected out of the courses?



The above feedback analysis, students given 3.95/4 rating for Q5 i.e., was the course curriculum fulfilling your expectations. Students are highly satisfied with the curriculum offered in relation to the Technological advancements (3.98/4) and (3.91/4) for the syllabus in related to the needs of industry/society (Q2) and are (3.92/4) for the syllabus of the courses that you have studied in relation to the competencies expected out of the courses (Q10) , also rated the relevance of the courses for providing employability (3.93/4).

Action Taken: Academic Year 20223-2024 Curriculum Feedback

Based on the student feedback analysis few courses were introduced and some courses were revised in the curriculum under various category:

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Data Security and Privacy	Program Elective	6th BOS-27.07.2024
2	Artificial Intelligence for health care	Program Elective	6th BOS-27.07.2024
3	Financial Analytics	Program Elective	6th BOS-27.07.2024
4	Cloud driven Data Engineering with AI	Program Elective	6th BOS-27.07.2024
5	Explainable AI	Program Elective	6th BOS-27.07.2024
6	Machine Learning for Production	Program Elective	6th BOS-27.07.2024
7	Responsible and Safe AI systems	Program Elective	6th BOS-27.07.2024
8	Reinforcement Learning	Program Elective	6th BOS-27.07.2024

School of Computing

Department of Artificial Intelligence and Data Science

Industry Feedback on Curriculum 2023-2024

The industry are the most important stakeholders of B. Tech Artificial Intelligence and Data Science Programme. Suggestions collected in the form of structured feedback from the industries. Received industries feedback on curriculum and the major suggestions are listed below:

- Recommend to include Emerging courses like Responsible AI, Prompt Engineering, and Explainable AI to enhance students' proficiency in relevant area.
- Recommended to include Quantum Machine Learning Course.
- Propose to enhance the curriculum with practical, hands-on projects aligned with current industry trends.
- Focus on soft skills development, including communication, problem-solving, and teamwork, to prepare students for dynamic professional environments.

Action Taken: Academic Year 2023-2024 Curriculum Feedback

Based on the industry feedback analysis few courses were introduced and some courses were revised in the curriculum under various category:

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Data Security and Privacy	Program Elective	6th BOS-27.07.2024
2	Artificial Intelligence for health care	Program Elective	6th BOS-27.07.2024
3	Financial Analytics	Program Elective	6th BOS-27.07.2024
4	Cloud driven Data Engineering with AI	Program Elective	6th BOS-27.07.2024
5	Explainable AI	Program Elective	6th BOS-27.07.2024
6	Machine Learning for Production	Program Elective	6th BOS-27.07.2024
7	Responsible and Safe AI systems	Program Elective	6th BOS-27.07.2024
8	Reinforcement Learning	Program Elective	6th BOS-27.07.2024

Annexure-VIII

8.	Ratification of Program Elective courses offered in the B.Tech Artificial Intelligence and Data Science program during winter 2023-2024

COURSE CODE	COURSE TITLE	L	T	P	C
10212AD276	Generative AI	1	0	2	2

A. Preamble

The Generative AI course introduces students to the principles and applications of deep learning, focusing on generative models. The course covers the rise of deep learning, large language models (LLMs), prompt engineering, Lang chain, and diffusion models. It integrates theoretical knowledge with practical lab exercises to enhance learning and application.

B. Prerequisite Courses

10211AD223- Machine Learning Techniques

C. Course Objectives

Students will be able to:

- Understand the fundamentals of deep learning and its applications.
- Describe large language models and their architectures.
- Apply principles and techniques of prompt engineering.
- Explore Lang chain and its components.
- Explain diffusion models and their use in generative AI.

D. Course Outcomes

Upon successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Comprehend the fundamentals and rise of deep learning	K2
CO2	Apply knowledge of large language models in various NLP tasks	K3
CO3	Develop and utilize prompt engineering techniques	K3
CO4	Implement Langchain architecture for generative AI applications.	K3
CO5	Apply diffusion models to progressively refine noise into high-quality images and videos	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program Outcomes and Program Specific Outcome

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	3	3		2	1								2	2
CO2	3	3	3	2	2								2	2
CO3	1	2	3	2	3								2	2
CO4	1	2	2	2	3								2	2
CO5	3	3	2	2	3								2	2

3- High; 2-Medium; 1-Low

F. Course Contents

Unit I: Rise of Deep Learning — L - 3 Hours

AI vs ML vs DL, Need for DL, Power of Neural Networks, Tools for sequence models: RNNs, Transformers, attention, Deep vision by CNNs, Deep Generative Modeling, Responsible and ethical use of Deep Learning tools.

Unit II: Large Language Models (LLMs) — L - 3 Hours

History of NLP, Tokenization and embeddings, Positional encoding of Transformers, Text generation process, LLM model architecture: BERT, GPT, Training LLMs: Base, Instruction Tuned, Fine Tuning, Limitations of LLMs, API calling of OpenAI, Hugging Face, Google, Meta models.

Unit III: Prompt Engineering — L - 3 Hours

System-user-assistant format, Principles of prompting, chaining prompts, using delimiters to avoid prompt injections, Iterative prompt development, Zero and few shots prompting, Chain-of-thoughts prompting, Program-aided language prompting, ReAct prompting, Building a chatbot using prompt engineering (use cases: healthcare, education, e-commerce).

Unit IV: Langchain — L - 3 Hours

Langchain architecture, LangChain Expression Language (LCEL), Runnable interface, Chat models, Prompt templates, Example selectors, Output parsers, Chat history, Document loaders, Text splitters, embedding models, Vector stores, Retrievers, Agents, Callbacks, RAG using langchain and chromadb.

Unit V: Diffusion Models — L - 3 Hours

Variational Autoencoder, Generative Adversarial Networks, Diffusion Process: Forward Noising, Reverse Denoising, Stable Diffusion models, U-Net, Text encoder, Video generation, generating images from natural language using Hugging Face API, Beyond images: molecular design

Total -15 Hours

G. Laboratory Experiments (30 Hours)

Task 1	Introduction to Python & NLP, familiarizing with NLTK and Transformers. **Tools:** Python, NLTK, Transformers
Task 2	Create a text generator using any Hugging Face LLM that can generate realistic sentences or paragraphs. **Tools:** Python, Hugging Face Transformers
Task 3	Build a language translation tool using an LLM that can translate given text from one language to another with high accuracy. **Tools:** Python, Hugging Face Transformers
Task 4	Create a sentiment analysis tool that can analyze the sentiment of text data and classify it as positive, negative, or neutral. **Tools:** Python, Hugging Face Transformers
Task 5	Develop a text summarization tool that can generate concise summaries of long articles and documents. **Tools:** Python, Hugging Face Transformers
Task 6	Create a recipe generator that can generate new and unique recipes based on user preferences and dietary restrictions. **Tools:** Python, Hugging Face Transformers
Task 7	Develop a legal research tool that can search and retrieve relevant case details from the database based on user queries. **Tools:** Python, Hugging Face Transformers

Task 8	Develop a story generator using any Hugging Face LLM that can generate creative and engaging storylines and plot twists. **Tools:** Python, Hugging Face Transformers
Task 9	Build a painting generator using a model like Stable Diffusion that can create unique oil paintings. **Tools:** Python, Stable Diffusion, TensorFlow
Task 10	Develop a logo generator using a model like Stable Diffusion that can create unique and professional logos for businesses or organizations. **Tools:** Python, Stable Diffusion, TensorFlow
Task 11	Develop a program that generates random modern Disney-style avatars or character images with different facial features, hairstyles, and accessories. **Tools:** Python, Stable Diffusion, TensorFlow

Part – 2

Use Cases:

Use Case 1: Generate Cricket Match Summaries
Use Case 2: Automated Art Creation for E-commerce
Use Case 3: Interactive Storytelling for Children's Education
Use Case 4: Brand Identity Creation for Startups
Use Case 5: Personalized Recipe Suggestions for Health Apps

Total:45 hours

H. Learning Resources

i. Text Books:

1. Foster D, *et al*. “Generative deep learning ", O'Reilly Media, Inc, 2022.
2. Dhamani N, *et al.* “Introduction to Generative AI”, Simon and Schuster, 2024.
3. Phoenix J, Taylor M. “Prompt Engineering for Generative AI”, O'Reilly Media, Inc, 2024.
4. Omar Sanseviero, *et al*. “Hands-On Generative AI with Transformers and Diffusion Models”, O'Reilly Media, Inc, 2024.

ii. Reference Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville. "Deep Learning", 2021.
2. Delip Rao and Brian McMahan, "Natural Language Processing with Transformers", 2021.
3. David Foster. "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play", 2020.

iii. Online References:

1. “Generative AI with Large Language Models” (online): Coursera.
2. “Generative AI and Language Models” (online): NPTEL.

Annexure-IX

9.	Ratification of **courses offered under the category of Industry / Higher Institute Learning Interaction (IHL)** offered by Industry and Higher Institute Experts for B.Tech Artificial Intelligence and Data Science during winter Semester 2023-24.

Sno	Course code	Course Name	L	T	P	C
1	10215AD925	Programming for Data Analytics	1	0	0	1
2	10215AD928	Fundamentals of MEMS	1	0	0	1
3	10215AD930	Cognitive Computing and Applications	1	0	0	1

10215AD925 - Programming for Data Analytics

1. Introduction to Python
2. Programming for Data Analysis Introduction
3. Data cleaning and transformation
4. Data normalization and analysis
5. Classification
6. Correlation
7. Regression analysis
8. Cluster analysis
9. Deep Learning (Convolutional Neural Networks)

Total: 15 Hours

10215AD928 - Fundamentals of MEMS

1. Introduction to MEMS and transducers
2. Thermal sensors
3. Pressure sensors
4. Accelerometers
5. Biosensors
6. Thermal actuators
7. Electrostatic and magnetic actuators
8. Optical MEMS technology
9. Microfluidic valves and pumps

Total: 15 Hours

10215AD930 - Cognitive Computing and Applications

1. Fundamentals of Cognitive Computing
2. Design Principles of Cognitive Computing
3. NLP in Cognitive Computing Systems
4. Representing Knowledge in Taxonomies and Ontologies
5. Learning and Reasoning
6. Case-based Reasoning
7. Incremental Learning
8. Analogical Reasoning
9. Ethical Issues of Cognitive Systems
10. Business Implications of Cognitive Systems

Total: 15 Hours

Annexure- X

10.	**Ratification of Value added Courses** offered for B.Tech Artificial Intelligence and Data Science during Winter Semester 2023-24

Sno	Course code	Course Name	L	T	P	C
1	10218AD935	Natural Language Processing with Projects	2	0	0	0
2	10218AD936	Linux Administration	2	0	0	0
3	10218AD937	Bash Shell Script administrator	2	0	0	0
4	10218AD939	AWS Solution Architect	2	0	0	0
5	10218AD942	Essential Mongo DB Administration	2	0	0	0
6	10218AD941	Java Programming Fundamentals	2	0	0	0
7	10218AD947	Data Structures and Algorithms using Python - Part 1	2	0	0	0
8	10218AD948	Computer Vision - Theory and Projects in Python for Beginners	2	0	0	0
9	10218AD949	Deep Learning and Neural Networks	2	0	0	0
10	10218AD950	Exploratory Data Analysis Using R	2	0	0	0

COURSE CODE	COURSE TITLE	L	T	P	C
10218AD935	Natural Language Processing	2	0	0	0

A. Preamble:

Natural language processing deals with written text. Students will learn how to process written text from basic of fundamental knowledge starts with Finite automata, Regular expression and probabilistic model with n-grams. This course also covers basis of semantic analysis and discourse analysis and drives it to machine translation.

B. Course Category: Value Added Course

C. Course Outcome:

The Students will be able to proficiently:

- Perform various cleaning and pre-processing operations on textual data using NLTK
- Work with the various elements of text data such as Tokens, N-grams, Lemma and Frequency Distributions
- Annotate text with part of speech (POS) using in-built and custom POS taggers
- Work with various lexical resources provided with NLTK to pre-process the data
- Build applications such as Spam detector, Topic Modeler, Chatbot, Sentiment Analyzer using NLP and Machine Learning techniques
- Understand the concept of word embedding, Word2Vec model with a suitable example.
- Understand deep learning for NLP like RNN for NLP
- Build a language model with the help of recurrent neural network
- Build a LSTM network model for predicting a sequence data set
- Will understand different benchmarking solutions for various NLP solutions.

Course Contents

Module - 1: Basic NLP Concepts **L-6 Hours**

Why NLP - NLP Pipeline - Understanding Textual Data - Corpus - Wordnet, Wordlist - POS Tagging - Annotation - NER - Bag of Word and TF_IDF - Lookup tagger - Tagging pipeline and backoff

Module - 2: Embedding Words **L- 6 Hours**

Word2vec - How to train Word2Vec on Text data - Bag of words - skip-gram - Continuous Bag-Of-Words - Visualization of trained model - Word Sense Disambiguation

Module - 3: Language Modeling **L-6 Hours**

Unigram Language Model - Simple (Unsmoothed) N-grams - Smoothing - Back off - Deleted Interpolation, N-grams for Spelling and Pronunciation - Morphology - Overview of Hidden Markov Models

Module - 4: Sequential Modeling for NLP **L- 6 Hours**

Sequential Modeling for NLP using RNN - RNN - Language Modeling using RNN - Understanding RNN with Text Generation - Challenges / Limitation - Sequential Modeling for NLP using LSTM – Training using LSTM – Tuning the parameters – Bi-directional LSTM

Module - 5: Text Analysis **L-6 Hours**

Sentiment Mining, Entity Linking, Text Classification, LDA & Factorization - Text Summarization - Information Extraction - Named Entity Recognition - Relation Extraction, Question Answering in Multilingual Setting -NLP in Information Retrieval

Module - 6: Machine Translation **L-6 Hours**

Need of MT - MT Approaches - Issues - Statistical Machine Translation (SMT) - Parameter learning in SMT (IBM models) using EM - Encoder-decoder architecture - Neural Machine Translation Statistical Language Models, Kernel Methods, Word-Context Matrix Factorization Models

i. Text Book:

3. Daniel Jurafsky, James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech”,, Pearson Publication, 2014
4. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python‖, First Edition, O‘Reilly Media, 2009

ii. Reference Book

3. Breck Baldwin, “Language Processing with Java and LingPipe Cookbook”, Atlantic Publisher, 2015
4. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010

iii. Online Resources

3. “Natural Language Processing” Jul. 2, 2018. Accessed on: Apr. 16, 2021 [Online]. https://www.coursera.org/learn/language-processing
4. “Natural Language Processing” Jun 2016. Accessed on: Apr. 16, 2021 [Online]. https://www.udacity.com/course/natural-language-processingnanodegree.

COURSE CODE	COURSE TITLE	L	T	P	C
10218AD936	LINUX ADMINISTRATION	2	0	0	0

A. Preamble

Infosys launched InfyTQ- A Linux administrator must know how to manipulate and manage processes. Introduce yourself to processes, services, and daemons, and how to manage them in Linux.

B. Prerequisite course

Nil

C. Course Objectives:

Learners are exposed to:

- Understand the basics of Linux and system configuration.
- Make use of Command line proficiency to apply shell usage.
- Utilize the user and group management and software management.
- Organize various network configuration and management.
- Identify the system monitoring and performance tuning

.

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Illustrate manipulation and managing the process in Linux	K3
CO2	Apply System to start and stop the process in Linux	K3

Knowledge Level (Based on revised Bloom's Taxonomy)

K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	2	2											2	
CO 2	2	2		2	2									

High- 3; Medium-2; Low-1

D. Course contents

PROCESS AND MONITOR

List and identify running processes, recognize common running processes, moni processes and their resource utilization, start and stop processes, set or change the prior for a process.

TROUBLESHOOT AND SYSTEMD

Troubleshoot or identify problem processes, start and stop a network service, configure service to start or not start at boot, use SystemD to start services, work with SystemD manage running services, use SystemD to manage the system.

TOTAL 30 Hours

H. Learning Resources:

i. Online Resources:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01350155247123660872 98/overview

COURSE CODE	COURSE TITLE	L	T	P	C
10218AD937	Bash Shell Scripting Administration	2	0	0	0

A. Preamble:

This comprehensive course delves into Bash Shell scripting, providing participants with practical knowledge and skills to automate tasks, manipulate data, and optimize workflows. Starting from the basics of Bash Shell, participants progress through advanced topics, such as regular expressions and file processing commands. With real-world examples and hands-on exercises, participants gain proficiency in using Bash Shell scripting for various tasks.

B. Course Category: Value Added Course

C. Course Outcome:

The Students will be able to proficiently:

- Familiarity with command-line interface and basic commands
- Ability to work with files, test conditions, and patterns.
- Ability to configure access levels and system environment variables.
- Using regular expressions and substring operations effectively.
- Understanding input types and the pipe operator for command chaining.

F.Course Contents

Module–1: Introduction to Bash Shell **L- 5 Hours**

Definition and Importance of Data Structures-What is a data structure?- Types of Data Structures-Arrays: Definition and properties,-Advantages and disadvantages-Operations: insertion, deletion, traversal, searching, and sorting

Module–2: Getting Started **L - 5 Hours**

File Text Size, Test Numbers, Checking Conditions, Multiple Digit Pattern, Checking If File Exists, Test File Exists, Script Output

Module–3: Shell Environment **L- 5 Hours**

Introduction to Shell Environment, Command Program, Access Level Configuration, Booting Level Configuration, Booting Level Configuration Continue, System Admin Level Configuration, Networking Level Configuration, System Environment, User Configuration Files, Shell Special Variables. Array Declaration, Variable Declaration, Variable Declaration and Assignment

Module–4: Usage with String Manipulations **L- 5 Hours**

String Manipulation and Internal Commands, Topic Structure, Regular Expressions, Square Bracket Round Bracket, Dot Character, Substring Length, Substring Removal.

Module–5: Commands-External and Internal **L-5 Hours**

Quick Revision on String Manipulation, Types of shell commands-External and Internal, Types of User Input, Pipe Operator. Lecture Introduction, Awk Introduction, Syntax and Dataset Familiarity, AWK for Column, Columns Extraction, Skipping the Header Row, Awk for Pattern Matching, Awk for Pattern Matching Continue, Dynamic Redirection of File Output, AWK Keyword, Status Variable, AWK for Grouping, What is Array, Statement Output, Total Female Population, Total Male Population, Percentage of Population, Peplinski Population

Module–6: Reading **L- 5 Hours**

Internal Command, Reading from Single Variable, Reading from Array, Reading From File Introduction to Stacks Data Structure, Introduction to Stacks Data Structure Continue, Set Command Internal Command Set, Internal Command Unset, Intro to External Commands, External Command Cat External Command WC, Character Mode, Numerical Mode, Numerical Mode Continue, Searching Patterns in Multiple Files, Single File, Count Pattern Occurrence, Suppress Filename Headers Etc., Changing Ownership, Filter by Owner Before Change, External Command ENV, External Command CP, External Command MV, External Command Date, External Command ln, External Command ln Continue, Dataset Explanation for File Processing Commands, External Command-Essa-Jump to Line, Search for Pattern, External Command-Tail, External Command-Sort, External Command-Unit, External Command-PS, External Command Find, External Command Conclude

G. Learning Resources

i. Online Resources

1. https://infyspringboard.onwingspan.com/web/en/login?ref=%2Fapp%2Fsearch%2Flearning%3Flang%3Den%26q%3Dshell%2520scripts%2520administration%26f%3D%257B%257D

TOTAL 30 Hours

COURSE CODE	COURSE TITLE	L	T	P	C
10218AD939	AWS Solutions Architect Professional	2	0	0	0

AWS Solutions Architect Professional

Course Overview

1. Network Access Control Lists (ACLs)
2. Configuring Network ACLs Using the AWS Console
3. Configuring Network ACLs Using the AWS CLI
4. Configuring Network ACLs Using PowerShell
5. Security Groups
6. Configuring Security Groups Using the AWS Console
7. Configuring Security Groups Using the AWS CLI
8. Configuring Security Groups Using PowerShell
9. Deploying AWS Network Firewall
10. AWS Web Application Firewall (WAF)

TOTAL 30 Hours

COURSE CODE	COURSE TITLE	L	T	P	C
10218AD941	Java Programming Fundamentals	2	0	0	0

A. Preamble

Java Programming Fundamentals is designed to introduce the fundamentals of Java programming and its object-oriented features. It will help out the learners to understand various keywords available in Java and Java's architecture. Also, this course will help learners to know the working of Java APIs through hands on approach.

B. Course Outcomes

The Students will be able to proficiently:

- Create Java programs using the fundamental programming constructs
- Implement and design a class based on attributes and behaviors of objects
- Develop Java code that demonstrates the working of different keywords in Java
- Explain and implement different Object-Oriented concepts in Java
- Develop Java code that uses the appropriate access modifiers, package declarations, import statements
- Identify, apply and understand the working of the most common APIs used in Java
- Explains about Exception Handling, Collections Framework and, Generics
- Determine the best practices that are to be followed in Java

C. Course Contents

Module – 1: **L-6 Hours**

About Java Programming Fundamentals, Introduction and Features of Java, Java Architecture, Java Development Kit

Module – 2: **L- 6 Hours**

Data Types, Keywords and Identifiers, Operators, Type Casting, Widening and Narrowing, Conditional Statements, Control Flow and Looping, Arrays: Introduction to Arrays, Enhanced for loop

Module – 3: **L-6 Hours**

Object Oriented Concepts using Java, Class and Object, Constructors, this Keyword, Inheritance, Polymorphism, super keyword

Module – 4: **L-6 Hours**

Final Keyword, static Modifier, Variable Arguments, Enumerated Data Types, Abstract class Interface Package Access Modifiers Java Libraries

Module – 5: **L-6 Hours**

Exceptions, Generics, The Collections Framework, Date/Time APIs.

D. Learning Resources:

i. "Infosys Springboard", Accessed on December, 2023 [Online]. Available: https://infyspringboard.onwingspan.com/web/en/page/home

TOTAL 30 Hours

COURSE CODE	COURSE TITLE	Total Hours
10218AD942	Essential Mongo DB Administration	30

A. Preamble

The course places a strong emphasis on Mongo DB Essentials as a tool. It introduces essential techniques of performing CRUD operations on Modern Database. Additionally, it offers a brief overview of Sharding techniques, including replicas and cluster collections. These practices are essential for working with aggregation operators, exploring different aggregation stages, using MongoDB map reduce.

B. Course Category : Value Added Course

C. Course Outcomes

After successful completion of this course, the students are able to:

CO No's	Course Outcomes	K - Level
CO1	Illustrate the MongoDB queries to perform CRUD operations on document database.	K3
CO2	Apply Sharding Techniques to do backup and recovery	K3
CO3	Solve Aggregation problems using Map Reduce.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

D. Course Content:

Module I: MongoDB Overview L- 6 Hours

Install MongoDB, Access MongoDb Using Mongo 3T Studio, Introduction to MongoDB, MongoDB Document, Creating an AWS Server Instance, Establish Connection Using Putty. **MongoDb Replication:**Introduction to MongoDb Replication,Setting up Replica Set Servers, Configure Replica set, Connection Using Mongo Chef.

Module II: Working with Replica set Members L- 6 Hours

Election Process,Test Replica Set Election, Configure Priority, Configure Delayed, Hidden, and

Arbitter Members.

Module III: Sharding your MongoDb Cluster **L- 6 Hours**

Components of Sharded Cluster, Sharding Workflow**, Sharding Techniques:** Setting up replica sets, setting Up config servers and MongoS Server, Adding Shards, Sharding a Collection**.**

Module IV Administration and security **L- 6 Hours**

Practicing MongoDB backup and Restore Techniques, Exploring User Roles and authorization, Working with Journaling, Discovering importance of Profiler,

Module V Aggregation Techniques **L- 6 Hours**

Working with Aggregation operators, exploring different Aggregation Stages, Using MongoDB Map Reduce.

E. Learning Resources **Total 30 Hours**

i. Text Books:

1]MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow, O'Reilly.

ii. **Online Resources**

1]https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01317716929471283211 3_share d/overv iew (MongoDB)

COURSE CODE	COURSE TITLE	L	T	P	C
10218AD947	Data Structures and Algorithms using Python - Part 1	2	0	0	0

A. Preamble

Provides foundation of Data Structures using python programming. Discuss frequently used linear data structures like Stack, Queue, and List ADT. Discuss the commonly performed operations on linear data structures like insert, update, delete, search etc. Provide insights on non - linear data structures.

B. Course Outcomes

The Students will be able to proficiently:

- Create python program for all data structure ADT
- Implements list ADT using Array and Linked List
- Explain and implement Stack and Queue ADT
- Implements non-linear data structure such as Tree and Graph ADT using python programming.
- Visualizing linear data structures such as Linked List, Stack and Queue

C. Course Contents

Module – 1: **L- 6 Hours**

Introduction to Data Structure using Python, List ADT implementation using Array - CRUD Operation- Assessment on List using string, object and array.

Module – 2: **L- 6 Hours**

List ADT implementation using Linked List -CRUD Operation- Comparison between Array and Linked List Implementation. Exercise on Linked List basics, number and object. Assessment on Linked List using character, object and numbers

Module – 3: **L- 6 Hours**

Stack ADT implementation using Array and Linked List such as push and pop operation- Application of Stack- Exercise on stack of number and object

Module – 4: **L-6 Hours**

Queue ADT implementation using Array and Linked List such as enqueue and dequeue operation- types of queue- stack vs queue- Exercise on queue of number and object

Module – 5: **L-6 Hours**

Non Linear Data Structures – Tree ADT – Graph ADT- Visualizing Linear Data Structures-Linked List, Stack and Queue ADT.

D. Learning Resources: **Total 30 Hours**

1. “Infosys Springboard”, Accessed on December, 2023 [Online].
Available: https://infyspringboard.onwingspan.com/web/en/page/home

COURSE CODE	COURSE TITLE	L	T	P	C
10218AD948	Computer Vision- Theory and Projects in Python for Beginners	2	0	0	0

A.Preamble:

Computer vision is a rapidly advancing area of computer science and artificial intelligence that enables machines to interpret and make decisions based on visual data from the world around them. Learn about key computer vision techniques and algorithms such as edge detection, segmentation, object recognition, and motion analysis.

Course Category: Value Added Course

Course Outcome:

The Students will be able to proficiently:

- Discover the key concepts covered in this course
- Describe basic concepts in Computer Vision
- Compare image processing to Computer Vision
- Compare image processing to traditional methods of solving image problems
- Illustrate how AI can be part of a Computer Vision solution

F. Course Contents

Module–1: Introduction to Computer Vision **L- 6 Hours**

Overview of computer vision- Applications of computer vision- History and evolution of the field- Basic image formation and representation

Module–2: Computer Vision Vs Image Processing **L- 6 Hours**

Image acquisition and color spaces-Image enhancement techniques (histogram equalization, filtering)- Noise reduction and smoothing-Edge detection (Sobel, Canny)

Module–3: Traditional Solution to Vision Problems **L- 6 Hours**

Keypoint detection (Harris corner detector, SIFT, SURF)- Feature descriptors (BRIEF, ORB)- Feature matching and homography-Applications in panorama stitching

Module–4: AI Driven to CV Solution **L-6 Hours**

String Manipulation and Internal Commands, Topic Structure, Regular Expressions, Square Bracket Round Bracket, Dot Character, Substring Length, Substring Removal.

Module–5: Landscape of CV Tools and Models **L- 6 Hours**

Stereo vision and depth maps-Structure from motion-3D reconstruction techniques- Applications in augmented reality and robotics

Total 30 Hours

D. Learning Resources:

Text Books

1. Jian-Huang Lai, Cheng-Lin Liu, et al, "Pattern Recognition and Computer Vision: First Chinese Conference", PRCV 2018, Guangzhou, China, November 23-26, 2018, Proceedings, Part I: 11256 (Lecture Notes in Computer Science). | 2 November 2018
2. Numerical Algorithms: Methods for Computer Vision, Machine Learning, and Graphics (https://people.csail.mit.edu/jsolomon/share/book/numerical_book.pdf) - Justin Solomon 2015

ii. Reference Book

1. Computer Vision: A Modern Approach (2nd edition) -David Forsyth and Jean Ponce 2011

iii. Online Resources

1. https://infyspringboard.onwingspan.com/web/en/viewer/html/lex_auth_01350158250097049612176

COURSE CODE	COURSE TITLE	L	T	P	C
10218AD949	Deep Learning and Neural Networks	2	0	0	0

1. Course Overview
2. Understanding Deep Learning
3. Understanding Neurons
4. Training a Neural Network
5. Convolutional Neural Networks (CNNs)
6. Recurrent Neural Networks (RNNs)
7. Natural Language Processing (NLP)
8. Attention-based Models and Transformers
9. Generative Adversarial Networks (GANs)
10. Reinforcement Learning

Total 30 Hours

COURSE CODE	COURSE TITLE	L	T	P	C
10218AD950	Exploratory Data Analysis Using R	2	0	0	0

1. Prelude
2. Introduction
3. Exploratory Data Analysis Process
4. Information Measure
5. Kullback-Leibler Divergence
6. Capstone Project- Exploratory Data Analysis

Total 30 Hours

6th MEETING of BOARD of STUDIES

Minutes

for

B.Tech Artificial Intelligence and Machine Learning Programme

[CBCS]

On

18.07.2024

B.Tech Artificial Intelligence and Machine Learning

School of Computing

6th MEETING of BOARD of STUDIES
For
B.Tech Artificial Intelligence and Machine Learning
Index

6th MEETING of BOARD of STUDIES
For
B.Tech Artificial Intelligence and Machine Learning

Date: 18.7.2024

Venue: SOC Block

AGENDA

<table>
<tr><th>Item No</th><th>Agenda</th></tr>
<tr><td colspan="2">A. Opening</td></tr>
<tr><td>1.</td><td>Confirmation of 5th BoS meeting minutes held on 23.12.2023 (Annexure-I).</td></tr>
<tr><td>2.</td><td>To review the Action Taken Report on the minutes of the 5th meeting of the Board of Studies (Annexure-II).</td></tr>
<tr><td colspan="2">B. Items to be considered</td></tr>
<tr><td>3.</td><td>To discuss and approve any changes in the Program Core and Elective Course Structure and course contents of few Program Electives to be offered in the <u>existing B.Tech AIML curriculum VTR UGE 2021</u> keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills (Annexure – III).
<table>
<tr><th>S. No</th><th>Course Code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10212AM131</td><td>Cloud Driven Data Engineering with AI</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>2</td><td>10212AM132</td><td>Explainable AI</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>3</td><td>10212AM277</td><td>Machine Learning for Production</td><td>2</td><td>0</td><td>2</td><td>3</td></tr>
</table>
</td></tr>
<tr><td>4.</td><td>To discuss and approve the new courses under Open Elective category, to be offered in the <u>existing B.Tech AIML curriculum VTR UGE 2021</u> keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills (Annexure – IV).
<table>
<tr><th>S.No</th><th>Course Code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10213GE103</td><td>Software Development and Maintenance</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
</table>
</td></tr>
<tr><td>5.</td><td>To discuss and approve the Online MOOCs platforms courses under Program Elective and Open Elective Category to be offered in Summer, 2024-2025 for B.Tech Artificial Intelligence and Machine Learning (Annexure-V)
<u>Program Elective category</u>
<table>
<tr><th>S.No.</th><th>Course Code</th><th>Course Name</th><th>Course Provider</th><th>Duration in weeks</th><th>Credits</th></tr>
<tr><td>1.</td><td>10212AM401</td><td>Responsible and Safe AI systems</td><td>NPTEL</td><td>12 Weeks</td><td>3</td></tr>
<tr><td>2.</td><td>10212AM402</td><td>Introduction to Internet of Things</td><td>NPTEL</td><td>12 Weeks</td><td>3</td></tr>
</table>
</td></tr>
</table>

Open Elective category

S.No.	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1.	10213AM426	Applied Accelerated Artificial Intelligence	NPTEL	12 Weeks	3
2.	10213AM427	Introduction to Quantum Computing: Quantum Algorithms	NPTEL	4 Weeks	1
3.	10213AM428	Distributed Systems	NPTEL	8 Weeks	2

6. To discuss and approve the **courses to be offered in Value added courses under Complementary skills Category** during the academic year, summer 2024-2025 for B.Tech Artificial Intelligence and Machine Learning (**Annexure-VI).**

S No	**Course Code**	**Course title**	**L**	**T**	**P**	**C**
1	10218AM924	Big Data Analytics	2	0	0	0
2	10218AM925	Power BI Data Analytics	2	0	0	0
3	10218AM928	Enrich Visualization using Tableau	2	0	0	0
4	10218AM938	Machine learning using Python	2	0	0	0

7. To discuss the Stakeholders feedback on curriculum of B.Tech Artificial Intelligence and Machine Learning taken for the academic year 2023-2024 (Annexure-VII).

Items to be Ratified

8. Ratification of Program Elective courses offered in the B.Tech Artificial Intelligence and Machine Learning program during Winter 2023-2024 (Annexure-VIII).

S. No	Course Code	Course Name	L	T	P	C
1	10212AM276	Generative AI	1	0	2	2

9. Ratification of **courses offered under the category of Industry / Higher Institute Learning Interaction (IHL)** offered by Industry and Higher Institute Experts for B.Tech Artificial Intelligence and Machine Learning in Winter Semester 2023-24. **(Annexure-IX).**

Sno	Course code	Course Name	**L**	**T**	**P**	**C**
1	10215AM923	Programming for Data Analytics	1	0	0	1
2	10215AM928	Fundamentals of MEMS	1	0	0	1
3	10215AM930	Cognitive Computing and Applications	1	0	0	1

10. **Ratification of Value added Courses** offered for B.Tech Artificial Intelligence and Machine Learning in Winter Semester 2023-24 (**Annexure-X**).

Sno	Course code	Course Name	**L**	**T**	**P**	**C**
1	10218AM935	Natural Language Processing with Projects	2	0	0	0
2	10218AM936	Linux Administration	2	0	0	0
3	10218AM937	Bash Shell Script administrator	2	0	0	0
4	10218AM939	AWS Solution Architect	2	0	0	0
5	10218AM941	Java Programming Fundamentals	2	0	0	0

		6	10218AM942	Essential Mongo DB Administration	2	0	0	0
		7	10218AM947	Data Structures and Algorithms using Python - Part 1	2	0	0	0
		8	10218AM948	Computer Vision - Theory and Projects in Python for Beginners	2	0	0	0
		9	10218AM949	Deep Learning and Neural Networks	2	0	0	0
		10	10218AM950	Exploratory Data Analysis Using R	2	0	0	0
11.	Any other cognate item							

6thMEETING of BOARD of STUDIES
For
B.Tech Artificial Intelligence and Machine Learning

Date: 18.7.24– 10.00 AM
Venue: School of Computing

Members Present:

Sl.No	Name and Designation	Nominee	Signature
1	Dr. SP. Chokkalingam, Professor & Dean School of Computing	Chairperson	
2	Dr. S. Janakiraman, Professor, Department of Computer Science Engineering, Pondicherry University	Academic Expert Nominee	
3	Prof. P.K Das, Professor, Department of Computer Science Engineering, IIT Guwahatti, Assam	Academic Expert Nominee	
4	Mr. Savrah Mandal, Scientist E, Center of AI&ML DRDO, Bangalore	Industry Expert Nominee	
5	Mr. Poorinth Sundar Software Engineer, Opentext, Hyderabad	Industry Expert Nominee	
6	Dr. N. Malarvizhi,Professor	Professor Nominee	
7	Dr. M. Kavitha, Professor	Professor Nominee	
8	D r.N.R.Rajalakshmi, Professor Head – AI&ML	Professor Nominee	
9	Dr.R.Srinivasan, Professor	Professor Nominee	
10	Dr.J.Visumathi, Professor	Professor Nominee	
11	Dr.S.Sridevi, Professor	Professor Nominee	
12	Dr.A.Bhagyalakshmi, Professor	Professor Nominee	
13	Dr.S.Jagan, Professor	Professor Nominee	
14	Dr.N.Rajkumar, Professor	Professor Nominee	
15	Dr.V.Dhilipkumar,Professor Head – AI&DS	Professor Nominee	
16	Dr. R. Parthasarathy, Associate Professor Head – CSD	Associate Professor Nominee	
17	Dr.T.Kujani, Assistant Professor	Assistant Professor Nominee	
18	Mrs.C.Shyamala Kumari, Assistant Professor	Assistant Professor Nominee	

Invited Members

S.No	Name	Designation	
1	Dr.M.S.Muralidhar Head & Associate Professor – CSE	Associate Professor	
2	Dr.S.Lalitha Head & Associate Professor CSE(AIML)	Associate Professor	
3	Dr. T. Rajendran Head & Associate Professor CSE(CS)	Associate Professor	
4	Dr.P.Jose Head & Associate Professor CSE(DS)	Associate Professor	

The Chair expressed his happiness in welcoming all the members for the 6th meeting of BOS and thanked them for sparing their valuable time.

<table>
<tr><td>06-BoS-01</td><td>Confirmation of 5th BoS meeting minutes held on 23.12.2023</td></tr>
<tr><td>Action Taken:</td><td>The minutes of 5th BoS meeting minutes held on 23.12.2023 was circulated to members through e-mail, the members confirmed the minutes.(Annexure -I)</td></tr>
<tr><td>06-BoS-02</td><td>To review the Action Taken Report on the minutes of the 5th meeting of Board of Studies.</td></tr>
<tr><td>Action Taken</td><td>The members reviewed the action taken report on the decisions of 5th BoS meeting minutes held on 23.12.2023 (Annexure - II).</td></tr>
<tr><td>06-BoS-03</td><td>To discuss and approve any changes in the Program Core and Elective Course Structure and course contents of few Program Electives to be offered in the <u>existing B.Tech AIML curriculum VTR UGE 2021</u> keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills.
<table>
<tr><th>S.No</th><th>Course Code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10212AM131</td><td>Cloud Driven Data Engineering with AI</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>2</td><td>10212AM132</td><td>Explainable AI</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>3</td><td>10212AM277</td><td>Machine Learning for Production</td><td>2</td><td>0</td><td>2</td><td>3</td></tr>
</table></td></tr>
<tr><td>Discussion</td><td>Experts reviewed the new courses under the Artificial Intelligence bucket like Cloud Driven Data Engineering with AI and Explainable AI and also members reviewed new course under the Machine Learning buckets like Machine Learning for Production. Experts appreciated for offering Machine Learning for Production course as an Integrated course. Lab Examination questions may be framed as an scenario based question for Machine Learning for Production course. The Chairman informed that course outcomes of all the courses are mapped with Program Outcomes.</td></tr>
<tr><td>Resolution</td><td>Members approved the Program Core and Elective Course Structure and course contents of the new Program Elective courses which will be offered with effect from summer 2024-2025. Course structure and details are available in (Annexure - III).</td></tr>
<tr><td>06-BoS-04</td><td>To discuss and approve the new courses under Open Elective category, to be offered in the <u>existing B.Tech AIML curriculum VTR UGE 2021</u> keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills
<table>
<tr><th>S.No</th><th>Course Code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10213GE103</td><td>Software Development and Maintenance</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
</table></td></tr>
<tr><td>Discussion</td><td>The members reviewed the content of Software Development and Maintenance course to be offered under Open Elective Category and suggested to include the laboratory tasks.</td></tr>
<tr><td>Resolution</td><td>The members approved the course and course contents to be offered under Open Elective Category with effect from Summer 2024 – 2025. Experts suggestion will be incorporated during the revision of Curriculum. Course details are available in (Annexure-IV)</td></tr>
</table>

06-BoS-05

To discuss and approve the **Online MOOCs platforms courses under Program Elective and Open Elective Category to be offered in** Summer, 2024-2025 for B.Tech Artificial Intelligence and Machine Learning (**Annexure-V)**

Program Elective category

S.No.	Course Code	Course Name	Course Provider	Duration in weeks	Credits
3.	10212AM401	Responsible and Safe AI systems	NPTEL	12 Weeks	3
4.	10212AM402	Introduction to Internet of Things	NPTEL	12 Weeks	3

Open Elective category

S.No.	Course Code	Course Name	Course Provider	Duration in weeks	Credits
4.	10213AM426	Applied Accelerated Artificial Intelligence	NPTEL	12 Weeks	3
5.	10213AM427	Introduction to Quantum Computing: Quantum Algorithms	NPTEL	4 Weeks	1
6.	10213AM428	Distributed Systems	NPTEL	8 Weeks	2

Discussion

The members reviewed the above list of Online MOOCs platforms courses to be offered under Program Elective Category for B.Tech-Artificial Intelligence and Machine Learning and under Open Elective Category to other school students. Experts reviewed the credits for Online MOOCs platform courses as per the guidelines given by NPTEL/Swayam Platform.

Resolution

The members approved the above list of Online MOOCs platforms courses to be offered under Program Elective Category for B.Tech-Artificial Intelligence and Machine Learning and Open Elective Category to other school students (**Annexure-V).**

06-BoS-06

To discuss and approve the **courses to be offered in Value added courses under Complementary skills Category** during the academic year, summer 2024-2025 for B.Tech Artificial Intelligence and Machine Learning.

S No	Course Code	Course title	L	T	P	C
1	10218AM924	Big Data Analytics	2	0	0	0
2	10218AM925	Power BI Data Analytics	2	0	0	0
3	10218AM928	Enrich Visualization using Tableau	2	0	0	0
4	10218AM938	Machine learning using Python	2	0	0	0

Discussion

The members reviewed the above list of **Value added courses under Complementary skills Category** to be offered with effect from summer 2024-2025 for B.Tech-Artificial Intelligence and Machine Learning Program.

Resolution

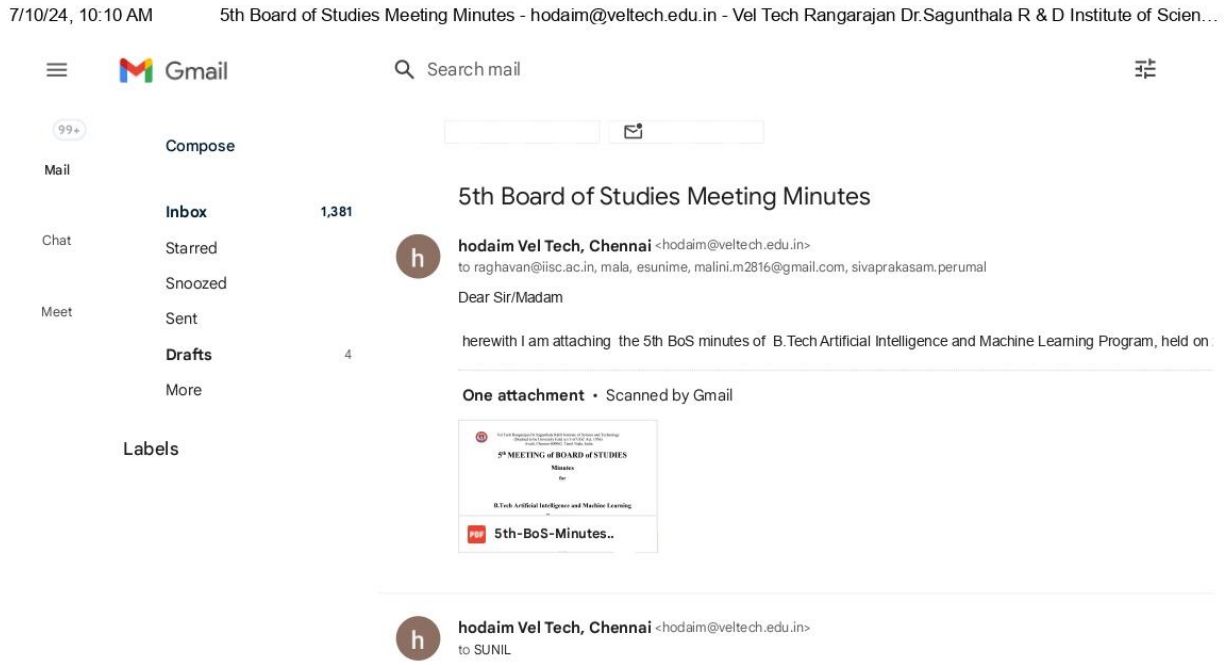
The members approved the above list of **Value added courses under Complementary skills Category** to be offered for B.Tech-Artificial Intelligence and Machine Learning Program. Course details are available in (**Annexure-VI)**

<table>
<tr><td>06-BoS-07</td><td>To discuss the Stakeholders feedback on curriculum of B.Tech Artificial Intelligence and Machine Learning taken for the academic year 2023-2024.</td></tr>
<tr><td>Discussion</td><td>The members reviewed the action taken based on Stakeholder`s feedback on curriculum of B.Tech Artificial Intelligence and Machine Learning for the academic year 2023-2024.</td></tr>
<tr><td>Resolution</td><td>The members approved the changes in course structure in the curriculum under various category based on the Stake holder feedback analysis for the academic year 2023-2024. (Annexure-VII).</td></tr>
<tr><td>06-BoS-08</td><td>Ratification of Program Elective courses offered in the B.Tech Artificial Intelligence and Machine Learning program during winter 2023-2024.
<table>
<tr><th>S. No</th><th>Course Code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10212AM276</td><td>Generative AI</td><td>1</td><td>0</td><td>2</td><td>2</td></tr>
</table></td></tr>
<tr><td>Discussion</td><td>The members reviewed the above list of courses and course contents offered under the Program Elective category in winter 2023-2024.</td></tr>
<tr><td>Resolution</td><td>The members ratified the courses and course contents offered under Program Elective category for B.Tech Artificial Intelligence and Machine Learning during winter Semester 2023-24 (Annexure-VIII).</td></tr>
<tr><td>06-BoS-09</td><td>Ratification of courses offered under the category of Industry / Higher Institute Learning Interaction (IHL) offered by Industry and Higher Institute Experts for B.Tech Artificial Intelligence and Machine Learning during winter Semester 2023-24.
<table>
<tr><th>S.no</th><th>Course code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10215AM923</td><td>Programming for Data Analytics</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>2</td><td>10215AM928</td><td>Fundamentals of MEMS</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>3</td><td>10215AM930</td><td>Cognitive Computing and Applications</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
</table></td></tr>
<tr><td>Discussion</td><td>The members reviewed the above list of courses and course contents offered under the category of Industry / Higher Institute Learning Interaction (IHL) by Industry and Higher Institute Experts.</td></tr>
<tr><td>Resolution</td><td>The members ratified the courses and course contents offered by Industry and Higher Institute Experts for B.Tech Artificial Intelligence and Machine Learning during Winter Semester 2023-24. (Annexure-IX).</td></tr>
<tr><td>06-BoS-10</td><td>Ratification of Value added Courses offered for B.Tech Artificial Intelligence and Machine Learning during Winter Semester 2023-24.
<table>
<tr><th>Sno</th><th>Course code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10218AM935</td><td>Natural Language Processing with Projects</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>2</td><td>10218AM936</td><td>Linux Administration</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>3</td><td>10218AM937</td><td>Bash Shell Script administrator</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>4</td><td>10218AM939</td><td>AWS Solution Architect</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>5</td><td>10218AM941</td><td>Java Programming Fundamentals</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>6</td><td>10218AM942</td><td>Essential Mongo DB Administration</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>7</td><td>10218AM947</td><td>Data Structures and Algorithms using Python - Part 1</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>8</td><td>10218AM948</td><td>Computer Vision - Theory and Projects in Python for Beginners</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>9</td><td>10218AM949</td><td>Deep Learning and Neural Networks</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>10</td><td>10218AM950</td><td>Exploratory Data Analysis Using R</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
</table></td></tr>
</table>

Discussion	The members reviewed the above list of course and course contents of Value added courses offered under Complementary skills Category for B.Tech Artificial Intelligence and Machine Learning during Winter Semester 2023-24 (**Annexure-X**).
Resolution	The members ratified the courses and course contents of Value added courses offered under Complementary skills Category for B.Tech Artificial Intelligence and Machine Learning during Winter Semester 2023-24. **(Annexure- X).**
06-BoS-11	Any other Cognate Item
Resolution	The next BoS meeting will be conducted in the month of December 2024.

Annexure – I

1.	Confirmation of 5thBoS meeting minutes held on 23.12.2023



Annexure – II

2.	To review the Action Taken Report on the minutes of the 5th meeting of the Board of Studies

Item No	Item	Decision taken	Action Taken
ITEMS FOR DISCUSSION AND APPROVAL			
05-BoS-03	To discuss and approve Program Core and Program Elective Course Structure and course contents to be offered in the programme B.Tech Artificial Intelligence and Machine Learning under the regulation VTR UGE 2021 with effect from Winter 2023-2024.	Experts reviewed the courses under the Artificial Intelligence bucket like Artificial Intelligence Techniques, Optimization Techniques, Natural Language Processing and Cognitive Computing. Experts suggested to include few contents in Cognitive Computing Course and also members reviewed courses under the Machine Learning buckets like Machine Learning Techniques, Deep Learning, Reinforcement Learning, Computer Vision, Time Series and Forecasting, Social Media Analytics. Experts suggested to include few contents in Time Series and Forecasting, Social Media Analytics courses. Experts appreciated for offering Majority of the courses as Integrated courses in this Program. The Chairman informed that course outcomes of all the courses are mapped with Program Outcomes..	By considering the suggestion of the members, changes made in the course contents of the Program Elective courses. Members approved the Program Core and Program Elective courses and course content to be offered with effect from Winter 2023-2024..
05-BoS-04	To discuss and approve the courses to be offered in Online MOOCs platforms under Open Elective Category during the academic year Winter, 2023-2024 for B.Tech Artificial Intelligence and Machine Learning	Online MOOCs platform courses under Open Elective Category during the Winter Semester 2023-2024 were presented and reviewed the same. Experts recommended to revise the credits for Online MOOCs platforms courses as per the guidelines given by NPTEL/Swayam Platform.	Course credits are revised as per the members suggestion and Approved MOOC Course under Open Elective Category Course to be offered with effect from Academic Year Winter 2023-2024.
05-BoS-05	To discuss and approve the courses to be offered as Value added courses under Complementary Skills Category during the academic year ,winter 2023-2024 for B.Tech Artificial Intelligence and Machine Learning	The members reviewed the above list of courses and the course contents to be offered as Value added courses under Complementary skills Category for B.Tech-Artificial Intelligence and Machine Learning. and members appreciated for taking initiatives to enhance the Employability skills.	Approved Value-added courses under Complementary skills Category to be offered with effect from Academic Year Winter 2023-2024.

Item No	Item	Decision taken	Action Taken
05-BoS-06	To discuss the Stakeholders feedback on curriculum of B.Tech Artificial Intelligence and Machine Learning taken for the academic year 2022-2023	The members reviewed the action taken based on Stakeholders feedback on curriculum of B.Tech Artificial Intelligence and Machine Learning for the academic year 2022-2023.	The members appreciated for incorporating changes in the programme structure based on Stakeholders feedback analysis taken for the academic year 2022-2023
05-BoS-07	Ratification of courses offered under the category of Industry / Higher Institute Learning Interaction (IHL) by Industry and Higher Institute Experts for B.Tech Artificial Intelligence and Machine Learning in Summer Semester 2023-24	The members reviewed the list of courses and course contents offered under the category of Industry / Higher Institute Learning Interaction (IHL) by Industry and Higher Institute Experts	Members ratified courses and course contents of Agile methodology and Applied Artificial Intelligence & Intelligence Systems offered during Summer Semester 2023-2024 by Industry and Higher Institute Experts to enrich the students knowledge and skill in emerging areas.
05-BoS-08	Ratification of Value added Courses offered in Summer Semester 2023-24.	The members reviewed the list of course and course contents of Value added courses offered for B.Tech Artificial Intelligence and Machine Learning in Summer Semester 2023-24.	The members finally ratified two Value added Courses offered during Summer Semester 2023-24.

Annexure – III

3.	To discuss and approve any **changes in the Program Core and Elective Course Structure** and **course contents of few Program Electives** are proposed in this BoS as per the list attached, to be offered in the programme B.Tech Artificial Intelligence and Machine Learning under the regulation VTR UGE 2021 with effect from Summer 2024-2025.

B.Tech - Artificial Intelligence and Machine Learning (Specialization / Honors)
(With effect from 2021-2022)

Preamble:

Artificial Intelligence refers to machines that replicate human abilities, whereas Machine Learning refers to machines that are trained to learn how to process and use data; which is termed 'Machine Intelligence'. Machine intelligence enables complex and larger data to be processed and analyzed along with the desired results.

Program Structure

Course Category	Minimum Credits Required
Foundation Courses (FC)	56
Program Core (PC)	58
Program Elective (PE)	18
Open Elective (OE)	12
Independent Learning(IL)	14
Industry / Higher Institute Learning Interaction(IHL)	2
Professional Proficiency Courses (PPC)	4
TOTAL	**164**

Minimum credits required for regular students in various course categories for B.Tech Artificial Intelligence and Machine Learning with minor

The students shall earn 164 credits in various course categories and additional 18 to 20 credits in the specialized tracks / areas from other branches/Schools by satisfying the prerequisite courses for the award of degree of B.Tech Artificial Intelligence and Machine Learning with minor subject to the regulations.

Minimum credits required for regular students in various course categories for B.Tech Artificial Intelligence and Machine Learning with Honors

The students shall earn 164 credits in various course categories and additional 18 to 20 credits in the specialized tracks / areas courses by satisfying the prerequisite courses for the award of degree of B.Tech Artificial Intelligence and Machine Learning with Honors subject to the regulations.

Program Core (58 Credits)
(L-Lecture, T-Tutorial, P-Practical, C-Credit)

S.No	Course Code	Course Name	L	T	P	C
		Theory Courses				
1	10211AM101	Data Structures	3	0	0	3
2	10211AM103	Operating Systems	3	0	0	3
3	10211AM104 (2021- 2022) admitted batch only	Computer Architecture and Organization	3	0	0	3
	10211AM129 (2022-2023) admitted batch onwards	Modern Computer Architecture	3	0	0	3
4	10211AM108 (2021-2022) admitted batch only	Image Processing	2	0	0	2
	10211AM118 (2022-2023) admitted batch onwards	Image Processing Techniques	3	0	0	3
5	10211AM110	Optimization Techniques	3	0	0	3
6	10211AM113	Reinforcement Learning	3	0	0	3
		Integrated Courses				
7	10211AM202	Design and Analysis of Algorithms	3	0	2	4
8	10211AM203	Programming using Java	2	0	2	3
9	10211AM205 (2021-2022) admitted batch only	Artificial Intelligence	2	0	2	3
	10211AM211 (2022-2023) admitted batch onwards	Artificial Intelligence Techniques	3	0	2	4
10	10211AM207	Database Management Systems	3	0	2	4
11	10211AM210	Big Data Analytics	3	0	2	4
12	10211AM213 (2021-2022) admitted batch only	Python Programming	1	1	2	2
13	10211AM223	Machine Learning Techniques	3	0	2	4
14	10211AM214	Data Visualization	3	0	2	4
15	10211AM215	Deep Learning	3	0	2	4
16	10211AM216	Natural Language Processing	3	0	2	4
		Laboratory Courses				
17	10211AM301	Data Structures Laboratory	0	0	2	1
18	10211AM304	Operating Systems Laboratory	0	0	2	1
19	10211AM306	Competitive Coding-I	0	0	2	1
20	10211AM307	Competitive Coding-II	0	0	2	1
21	10211AM309	Robotic Process Automation Laboratory	0	0	2	1
		Total Credits				**58**

B.Tech - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

CBCS CURRICULUM

Honors / Specialization

Lateral Entry 2022-2023 Admitted Batch (2021-2022)

Minimum credits required for Lateral Entry students in various course categories for B.Tech(Artificial intelligence and Machine Learning) - VTR UGE 2021

The students shall earn 120 credits in various course categories given below for the award of degree of B.Tech (Artificial intelligence and Machine Learning).

Course Category	Minimum Credits Required
Foundation Courses (FC)	22
Program Core (PC)	48
Program Elective (PE)	18
Open Elective (OE)	12
Independent Learning(IL)	14
Industry / Higher Institute Learning Interaction(IHL)	2
Professional Proficiency Courses (PPC)	4
TOTAL	**120**

B.Tech - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

CBCS CURRICULUM

Honors / Specialization

Lateral Entry 2022-2023 Admitted Batch (2021-2022)

VTR UGE 2021

Foundation Core Course: 22 Credits

S.No	Course Code	Subject Title	Category	L	T	P	C
Lecture Courses							
1	10210MA110	Discrete Mathematical Structures	BSC	3	1	0	4
2	10210CH103	Environmental Science	BSC	2	0	0	2
3	10210MA103	Probability, Statistics, and Queuing theory	ESC	3	1	0	4
4	10210ME101	Design thinking	ESC	2	0	0	2
5	10210ME103	Innovation & Entrepreneurship	ESC	2	0	0	2
6	10210BM101	Biology for Engineers	ESC	2	0	0	2
7	10210ME102	Universal Human Values	HSC	3	0	0	3
8	10210ME104	Project Management & Finance	HSC	2	0	0	2
9	10210ME105	Engineers and Society	HSC	1	0	0	M
10	10210BL101	Constitution of India	HSC	1	0	0	M
Laboratory Courses							
11	10210CS303 (2022-2023) Lateral Entry admitted batch only	IT Workshop	ESC	0	0	2	1
Total Credits							**22**

Program Core : 49 Credits

S.No	Course Code	Course Name	L	T	P	C
		Theory Courses				
1	10211AM101	Data Structures	3	0	0	3
2	10211AM104	Computer Architecture and Organization	3	0	0	3
3	10211AM110	Optimization Techniques	3	0	0	3
4	10211AM113	Reinforcement Learning	3	0	0	3
		Integrated Courses				
5	10211AM202	Design and Analysis of Algorithms	3	0	2	4
6	10211AM203	Programming using Java	2	0	2	3
7	10211AM205	Artificial Intelligence	2	0	2	3
8	10211AM207	Database Management Systems	3	0	2	4
9	10211AM210	Big Data Analytics	3	0	2	4
10	10211AM213	Python Programming	1	1	2	2
11	10211AM223	Machine Learning Techniques	3	0	2	4
12	10211AM214	Data Visualization	3	0	2	4
13	10211AM215	Deep Learning	3	0	2	4
14	10211AM216	Natural Language Processing	3	0	2	4
		Laboratory Courses				
15	10211AM301	Data Structures Laboratory	0	0	2	1
		Total Credits				**49**

B.Tech - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

CBCS CURRICULUM

Honors / Specialization

Lateral Entry

(With effect from 2023-2024 admitted batch onwards)

VTR UGE 2021

Foundation Core Course: 22 Credits

L-Lecture T-Tutorial P-Practical C-Credits

S.No	Course Code	Subject Title	Category	L	T	P	C
Lecture Courses							
1	10210MA110	Discrete Mathematical Structures	BSC	3	1	0	4
2	10210CH104	Environmental Science and Sustainability	BSC	3	0	0	3
3	10210CS104	Programming Using Python	ESC	3	0	0	3
4	10210ME101	Design thinking	ESC	2	0	0	2
5	10210BM101	Biology for Engineers	ESC	2	0	0	2
6	10210ME103	Innovation & Entrepreneurship	ESC	2	0	0	2
7	10210ME102	Universal Human Values	HSC	3	0	0	3
8	10210ME104	Project Management & Finance	HSC	2	0	0	2
9	10210ME105	Engineers and Society	HSC	1	0	0	M
10	10210BL101	Constitution of India	HSC	1	0	0	M
Laboratory Courses							
11	10210CS305	Programming Using Python Lab	ESC	0	0	2	1
Total Credits							**22**

Program Core – 48 Credits

S.No	Course Code	Course Name	L	T	P	C
		Theory Courses				
1	10211AM101	Data Structures	3	0	0	3
2	10211AM129	Modern Computer Architecture	3	0	0	3
3	10211AM110	Optimization Techniques	3	0	0	3
4	10211AM113	Reinforcement Learning	3	0	0	3
		Integrated Courses				
5	10211AM202	Design and Analysis of Algorithms	3	0	2	4
6	10211AM203	Programming using Java	2	0	2	3
7	10211AM211	Artificial Intelligence Techniques	3	0	2	4
8	10211AM207	Database Management Systems	3	0	2	4
9	10211AM210	Big Data Analytics	3	0	2	4
10	10211AM223	Machine Learning Techniques	3	0	2	4
11	10211AM214	Data Visualization	3	0	2	4
12	10211AM215	Deep Learning	3	0	2	4
13	10211AM216	Natural Language Processing	3	0	2	4
		Laboratory Courses				
14	10211AM301	Data Structures Laboratory	0	0	2	1
		Total Credits				**48**

Program Elective (18 Credits)

Program electives are the courses offered in the programme which covers depth and breadth. The students may register for appropriate electives offered in the programme based on their area of interest. One course under this category shall be taken from the list of approved MOOCs.

(L-Lecture, T-Tutorial , P-Practical, C-Credit)

S. No	Course Code	Course Name	L	T	P	C
		General Electives				
1	10212AM106	Formal Languages and Automata Theory	3	0	0	3
2	10212AM107	Compiler Design	3	0	0	3
3	10212AM208	Software Engineering	2	0	2	3
4	10212AM130	Fundamentals of Computer Networks	3	0	0	3
5	10212AM212	Web and Mobile Application Development	3	0	2	4
6	10212AM228	Block chain Technology	2	0	2	3
7	10212AM229	IoT and Cloud Computing	3	0	2	4
8	10211AM312	Fundamentals of Computer Networks Laboratory	0	0	2	1
		Core Electives				
9	10212AM121	High Performance Computing	3	0	0	3
10	10212AM224	Computer vision	3	0	2	4
11	10212AM234	Time series and Forecasting	3	0	2	4
12	10212AM122	Cognitive Computing	3	0	0	3
13	10212AM124	Artificial Intelligence for Cyber Security*	3	0	0	3
14	10212AM233	Social Media Analytics	3	0	2	4
15	10212AM276	Generative AI	1	0	2	2
16	10212AM131	Cloud Driven Data Engineering with AI	1	0	0	0
17	10212AM132	Explainable AI	3	0	0	3
18	10212AM277	Machine Learning for Production	2	0	2	3
		Honors				
		Artificial Intelligence				
14		Speech Recognition*	3	0	0	3
15		Robotics & Automation*	3	0	2	4
16		Intelligent Agents*	3	0	2	4
17		Human Computer Interaction*	2	0	2	3
18		Artificial Intelligence for Health Care*	3	0	2	4
		Machine Learning				
19		Financial Analytics*	3	0	2	4
20		Frameworks for Deep Learning*	3	0	2	4
*The proposed Course and the Course content are subject to approval/ratification in the upcoming BoS meetings						

Open Electives (12 Credits)

Open electives are the courses offered across the schools to enhance the knowledge breadth and professional competency of the students. The students shall register for appropriate electives offered in

other schools based on their area of interest. The courses offered under this category cover the interdisciplinary knowledge.

(L-Lecture, T-Tutorial, P-Practical, C-Credit)

S.No	Course Code	Course Name	L	T	P	C
1	XXX1	Course Name-1	-	-	-	3
2	XXX2	Course Name-2	-	-	-	3
3	XXX3	Course Name-3	-	-	-	3
4	XXX4	Course Name-4	-	-	-	3

S.No	Course Code	Course Name	L	T	P	C	Offered By
1	10213GE301	Programming Challenges	0	1	4	2	Leet Code
2	10213GE103	Software Development and Maintenance	3	0	0	3	

*One of the courses may be completed through MOOCs platform like NPTEL as described by other School department.

Independent Learning (14 Credits)

The students are expected to learn the courses offered under this category on their own. The courses offered under this category include:

(L-Lecture, T-Tutorial, P-Practical, C-Credit)

S.No	Course Code	Course Name	L	T	P	C
1	10214AM501	Community Service Project	-	-	-	1
2	10214AM601	Minor Project-1	0	0	4	2
3	10214AM602	Minor Project-2	0	0	4	2
4	10214AM701	Major Project	-	-	-	9
Total					**14**	

Industry / Higher Institute Learning Interaction (2 Credits)

The students shall earn a minimum of two credits by undergoing internship and/or specialized courses.

1. **Internship:**
   The students shall undergo Internship in the industry/higher learning institute approved by Industry-Institute Interaction Cell (IIIC) during any time after the second academic year.
2. **Industry / Higher Institute Learning Interaction (IHL) Courses:**

The students shall undergo the courses offered either by the industrial experts whose minimum academic qualification is Bachelor of Engineering or equivalent or faculty expert from higher learning institutions approved by IIIC. The students shall choose either one two credits course or two one credit courses.

S.No	Course Code	Course Name	L	T	P	C
1	10215AM801	Internship	-	-	-	2
2	10215AMXXX	Industry Expert Lecture-1	-	-	-	1
3	10215AMXXX	Industry Expert Lecture-2	-	-	-	1
4	10215AMXXX	Higher Institute Learning Interaction-1	-	-	-	1
5	10215AMXXX	Higher Institute Learning Interaction-2	-	-	-	1

Professional Proficiency Courses (4 Credits)

The Professional Proficiency Courses which carry four credits, to be offered in four different semesters, starting from third semester. These courses offered in this category are relevant to professional proficiency.

S.No	Course Code	Course Name	L	T	P	C
1	10216GE901	Professional Proficiency Course-I	2	0	0	1
2	10216GE902	Professional Proficiency Course-II	2	0	0	1
3	10216GE903	Professional Proficiency Course-III	2	0	0	1
4	10216GE904	Professional Proficiency Course-IV	2	0	0	1

Program Elective

10212AM131	Cloud Driven Data Engineering with AI	1	0	0	1

A. Preamble

This Course covers Data Warehouse Architecture, Data Base Languages, Python, Cloud Fundamentals. It also covers the Artificial Intelligence, Machine Learning Techniques, Gen AI, and Prompt Engineering Concepts.

B. Prerequisite Courses

Nil

C. Course Objectives

Students are able to

- Understand the data warehouse, Data Lakehouse and business intelligence fundamentals.
- Explain the SQL and NOSQL queries to perform complex operations.
- Learn the Amazon Web services, Azure, Google cloud Platform services.
- Explain Python Programming Concepts to implement real time examples.
- Discuss Artificial Intelligence, Machine Learning, and Prompt Engineering Concepts.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Understand the Data warehouse, Data Lakehouse and business intelligence fundamentals.	K2
CO2	Explain the SQL and NOSQL queries to perform complex operations and Python Programming Concepts to implement real time examples.	K2
CO3	Know the Amazon Web services, Azure, Google cloud Platform services.	K2
CO4	Understand the Artificial Intelligence and Machine Learning Techniques to solve a given problem.	K2
CO5	Illustrate Prompt Engineering Concepts to implement real time examples.	K2
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

D. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2	2		1								2	2
CO2		2	2		1								2	2
CO3		2	2		1								2	2
CO4		2	2		1								2	2
CO5		2	2		1								2	2

H- High; M-Medium; L-Low

Course Contents

UNIT – I Data Warehouse Concepts 3 Hours

Data Warehouse concepts - Data Lakehouse – ETL - Variety of ETL Tools- Informatica

UNIT – II Data Base and Python Programming Fundamentals 3 Hours

Data Base language, Optimizing SQL queries, NoSQL Fundamentals and Comparison with SQL, Connecting Data Sources and Data Bases, Data Modelling, Creating Calculated Fields in Power BI.

Python Programming – Basics of Python Programming, Iterators, Modules, Packages, Generators, List, Comprehensions, Regular expressions, Serialization, Partial functions, closures, Decorators, Python Data Science Libraries

UNIT – III AWS, Azure, and Google Cloud Platform Services 3 Hours

AWS- Benefits of AWS, AWS Services- Computer, Storage, Database Service, Networking Service, Security Service, Management tool Service, Developer tool Service. Azure- Cloud Computing, Services in Azure - Compute, Containers, Databases, Identity, Security, Networking, Storage. Google Cloud Platform - Cloud Computing, Benefits of GCP, GCP services, AWS vs Azure vs GCP.

UNIT – IV Artificial Intelligence and Machine Learning Techniques 3 Hours

Introduction, Demand of AI, Types of AI, Python Packages for AI, Machine Learning -Types of Machine learning , AI vs ML, Data Pre-processing , Classification , Regression and Clustering Techniques, Neural Network Concepts.

UNIT – V Prompt Engineering and Generative AI 3 Hours

Introduction to Linguistics, Language Models, Prompt Engineering Mindset, Zero shot and few shot prompts, AI hallucinations, Vectors/text embedding. Generative AI and its use cases, Large Language Models (LLMs) - LLMs generates output for NLP task, LLM model decision criteria, Proprietary models, Fine-tuned models, Mixing LLM flavours in workflow, Data privacy, Data security.

F. Learning Resources **Total 15 hours**

i. Text Books:

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, “Database System Concepts”, Seventh Edition, Tata McGraw Hill, 2019.[Unit:1}
2. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012. [Unit 1]
3. EthemAlpaydin,, “Introduction to Machine Learning”, 4th edition, MIT Press, 2020.

ii. Reference Books:

1. Tom Mitchell, “Machine Learning: A Guide to Current Research”, Kluwer academic publisher, 2019.

iii. Online References:

1. https://www.youtube.com/watch?v=Q2tX2v7KXhk
2. https://www.youtube.com/watch?v=xQnIN9bW0og
3. https://www.youtube.com/watch?v=Yrtm7d3TJbs
4. https://www.youtube.com/watch?v=qu9rTSl_ZUU
5. https://www.youtube.com/watch?v=vACTtmLWiQY
6. https://www.youtube.com/watch?v=_ZvnD73m40o
7. https://www.youtube.com/watch?v=1fQ1DDMmiqo

COURSE CODE	COURSE TITLE	L	T	P	C
10212AM132	Explainable AI	3	0	0	3

A. Preamble

This course's main goal is to present the fundamental principles, techniques, and applications of Explainable AI (XAI). Explainable AI expounds the facts, variables, and decision points that went into making a recommendation. Students will learn about the many strategies utilized in XAI, which will play an important part in healthcare, manufacturing, insurance, and Autonomous Vehicles.

B. Prerequisite Courses

10211AM211- Artificial Intelligence Techniques/ 10211AM205 - Artificial Intelligence

C. Course Objectives

Students are able to

- Understand and apply the fundamental principles of Explainable Artificial Intelligence (XAI) concepts in Model Prediction, Automation, and Decision Making to solve problems.
- Understand how to recognize, handle, and avoid common concerns with AI ethics and bias
- Integrate fair AI into popular apps and reporting tools to achieve business results
- Learn explainable AI tools and approaches to process trustworthy AI results

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Explain the concept for XAI through the different stages of the machine learning life cycle	K2
CO2	Discuss the strengths and weaknesses of popular open-source XAI applications	K2
CO3	Understand the XAI concepts to examine how to detect and handle bias issues in machine learning data	K2
CO4	Make use of XAI toolkits in explainable machine learning life cycles to solve business problems	K3
CO5	Comprehend the XAI ethics considerations and tools to address common problems in Explainable machine learning data	K2
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2									2	2
CO2	2	3	2	2				2					2	2
CO3	2	3	2	2									2	2
CO4	2	2	2	2	2								2	2

CO5	**2**	**2**	**2**	**2**	**2**							**2**	**2**

H- High; M-Medium; L-Low

E. Course Contents

UNIT – I Introduction to XAI **8 Hours**

Explainable- Artificial Intelligence (XAI)– Introduction – Explaining and Interpreting- Black Box model and White Box model- Designing and Extracting – XAI Executive function – Case studies – Medical Diagnosis.

UNIT – II White Box XAI for AI Bias and Ethics **10 Hours**

Moral AI Bias Self-Driving Cars – Life and death of Auto Pilot decision making – The trolley problem – Explaining the moral limits of ethical AI- Standard explanation of Autopilot decision trees- using XAI and ethics to control a decision tree. – Case studies -Overriding Traffic regulations – Emotional Intelligence in Autopilot

UNIT – III Explainable Machine Learning with Facets **9 Hours**

Facets Overview- Retrieving Datasets – Reading the data files – Creating feature Statistics with datasets- Sorting the Facets statistics- Sorting data by feature order-non-uniformity- distribution distance – Facets Dive – Building the Facets Dive – case studies – Visualizing Census Data

UNIT – IV Explainable ML Interpretability with SHAP **8 Hours**

SHAP Principles-Microsoft Azure introduction – Symmetry – Null Player – Additivity – Overview of Shapley Value – Intercepting and Vectorizing the dataset – Agnostic model with SHAP – Case Studies – IMDb reviews with SHAP

UNIT – V Ethical XAI Perspective **10 Hours**

WIT Overview- pre-processing data using WIT – DNN – Train Model – Shapley Values – WIT Datapoint explorer and Editor – Features – Performance and Fairness – LIME -Experimenting AutoML Module – Counterfactual Explanation Methods- Choice of Distance Function – Contrastive XAI – Anchors XAI – Cognitive XAI – Case studies – Explainable AI Chatbots

Total: 45 Hours

G. Learning Resources

i. Text Books:

1. Denis Rothman. “Hands-On Explainable AI (XAI) with Python: Interpret, visualize, explain, and integrate reliable AI for fair, secure, and trustworthy AI apps” Packt Publishing, Year: 2020 (Unit 1 – 5)

ii. Reference Books:

1. Leonida Gianfagn, Antonio Di Cecco “Explainable AI with Python” Springer 2021.

iii. Online References:

1. “Explainable ML, model transparency, and the right to explanation”, [Online]. Available:https://www.coursera.org/lecture/machine-learning-under-the-hood/explainable-ml-model-transparency-and-the-right-to-explanation-NuXd7
2. “Learning-xai-explainable-artificial-intelligence” Feb. 22, 2019 [online] Available : https://www.linkedin.com/learning/learning-xai-explainable-artificial-intelligence

COURSE CODE	COURSE TITLE	L	T	P	C
10212AM277	Machine Learning for Production	2	0	2	3

A. Preamble

This course will provide various components and design a machine learning production system end-to-end such as project scoping, data needs, modeling strategies, and deployment constraints and requirements.

B. Prerequisite Courses

10211AM223 - Machine Learning Techniques

C. Course Objectives

Students are able to

- Design simple machine learning application using MLOPs techniques.
- Implement machine learning pipelines using MLOps.
- Apply the MLOps techniques to develop various machine learning applications.
- Demonstrate machine learning model for production using MLOps.
- Deploy the machine learning model using MLOps pipeline

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Design simple machine learning application using MLOPs techniques	K3
CO2	Implement machine learning pipelines using MLOps	K3
CO3	Apply the MLOps techniques to develop various machine learning applications	K3
CO4	Demonstrate machine learning model for production using MLOps	K3
CO5	Deploy the machine learning model using MLOps pipeline	K3

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1					2								2	2
CO2	2	3	3		3								2	2
CO3	2	3	3		3								2	2
CO4	3	3	3		3								2	2
CO5		2	2		2								2	2

F. Course Content

UNIT I INTRODUCTION TO MLOPS **L-6 hours**

Defining MLOps and Its Challenges: MLOps to Mitigate Risk, Risk Assessment, Risk Mitigation, MLOps for Responsible AI - MLOps for Scale - Closing Thoughts - People of MLOps - Subject Matter Experts - Data Scientists - Data Engineers - Software Engineers – DevOps - Model Risk Manager/Auditor - Machine Learning Architect

UNIT II MLOPS FEATURES IN MACHINE LEARNING **L-6 hours**

A Primer on Machine Learning, Model Development: Establishing Business Objectives, Data Sources and Exploratory Data Analysis, Feature Engineering and Selection, Training and Evaluation, Reproducibility, Responsible AI - Productionalization and Deployment: Model Deployment Types and Contents, Model Deployment Requirements – Monitoring, DevOps Concerns, Data Scientist Concerns, Business Concerns - Iteration and Life Cycle, Iteration, The Feedback Loop – Governance, Data Governance, Process Governance

UNIT III MLOPS FOR MODEL DEVELOPMENT **L-6 hours**

Machine Learning Model: Required Components, Different ML Algorithms, Different MLOps Challenges - Data Exploration - Feature Engineering and Selection: Feature Engineering Techniques, Feature Selection Impacts MLOps Strategy – Experimentation - Evaluating and Comparing Models: Choosing Evaluation Metrics, Cross-Checking Model Behaviour, Impact of Responsible AI on Modeling - Version Management and Reproducibility

UNIT IV MLOPS FOR PRODUCTION PROCESS **L-6 hours**

Runtime Environments: Adaptation from Development to Production Environments, Data Access Before Validation and Launch to Production, Final Thoughts on Runtime Environments - Model Risk Evaluation, The Purpose of Model Validation, The Origins of ML Model Risk - Quality Assurance for Machine Learning - Key Testing Considerations - Reproducibility and Auditability - Machine Learning Security: Adversarial Attacks, Other Vulnerabilities - Model Risk Mitigation: Changing Environments, Interactions Between Models, Model Misbehaviour

UNIT V MLOPS FOR DEPLOYMENT **L-6 hours**

Deploying to Production: CI/CD Pipelines - Building ML Artifacts: The Testing Pipeline- Deployment Strategies: Categories of Model Deployment - Considerations When Sending Models to Production - Maintenance in Production – Containerization - Scaling Deployments - Requirements and Challenges - Monitoring and Feedback Loop - Understanding Model Degradation: Ground Truth Evaluation, Input Drift Detection- Drift Detection in Practice: Example Causes of Data Drift, Input Drift Detection Techniques - The Feedback Loop: Logging, Model Evaluation, Online Evaluation

Total: 30 Hours

G. Laboratory Experiments **Total: 30 Hours**

Part - 1

TASK 1	Build an MLOps Pipeline **Tools:** ONNX and Tensorflow
TASK 2	Selecting and Training a Model using MLOps Pipeline **Tools:** ONNX and Tensorflow
TASK 3	Feature Engineering and Preprocessing using MLOps Pipeline **Tools:** ONNX and Tensorflow
TASK 4	Hyperparameter Tuning and Neural Architecture Search using MLOps Pipeline **Tools:** ONNX and Tensorflow
TASK 5	MLOps for Containers and Edge Devices **Tools:** ONNX and Tensorflow
TASK 6	Continuous Delivery for Machine Learning Models **Tools:** ONNX and Tensorflow
TASK 7	Monitoring and Logging of ML applications **Tools:** ONNX and Tensorflow
TASK 8	MLOps for Azure developments **Tools:** ONNX and Tensorflow
TASK 9	Machine Learning Interoperability **Tools:** ONNX and Tensorflow
TASK 10	Model Analysis and Debugging using MLOps Pipeline **Tools:** ONNX and Tensorflow

Part-2
Use Cases:

Use case 1: Consumer Credit Risk Management development using MLOps Pipeline
Tools: ONNX and Tensorflow

Use case 2: Stock market price prediction using MLOps Pipeline
Tools: ONNX and Tensorflow

Use case 3: Marketing Recommendation Engines using MLOps Pipeline
Tools: ONNX and Tensorflow

Use case 4: Consumption Forecast using MLOps Pipeline
Tools: ONNX and Tensorflow

H. Learning Resources

i. Textbook(s):

1. Mark Treveil, Nicolas Omont, Clément Stenac, Kenji Lefevre, Du Phan, Joachim Zentici, Adrien Lavoillotte, Makoto Miyazaki, Lynn Heidmann, "Introducing MLOps", First edition, O'Reilly Media, Inc., 2020, ISBN: 9781492083290.

ii. Reference Book(s):

1. Noah Gift, Alfredo Deza, "Practical MLOps", First edition, O'Reilly Media, Inc., 2021
2. Emmanuel Raj, Engineering MLOps: Rapidly Build, Test, and Manage Production-ready Machine Learning Life Cycles at Scale, First edition, Packt Publishers, 2021.

iii. Online Resource(s):

1. "Coursera course on Introduction to Machine Learning in Production", Accessed on Apr. 20, 2021 [Online], https://www.coursera.org/learn/introduction-to-machine-learning-in-production?specialization=machine-learning-engineering-for-production-mlops
2. "Coursera course on Machine Learning Data Lifecycle in Production", Accessed on Apr. 20, 2021 [Online], https://www.coursera.org/learn/machine-learning-data-lifecycle-in-production?specialization=machine-learning-engineering-for-production-mlops
3. "Coursera course on Machine Learning Modeling Pipelines in Production", Accessed on Apr. 20, 2021 [Online], https://www.coursera.org/learn/machine-learning-modeling-pipelines-in-production?specialization=machine-learning-engineering-for-production-mlops

Annexure- IV

To discuss and approve the **new courses under Open Elective category**, to be offered in the **existing B.Tech AIML curriculum VTR UGE 2021** keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills.

COURSE CODE	COURSE TITLE	L	T	P	C
10213GE103	**Software Development and Maintenance**	**3**	**0**	**0**	**3**

(This course is offered under General Elective Category. All School students can opt the course.)

A. Preamble

This course provides basic concepts about SDLC, Unix commands and shell operations, Object Oriented Programming, JavaScript technologies to create the interactive client-side design of web applications. This course introduces DBMS concepts, to share a common set of models, design paradigms via a Structured Query Language (SQL). More specifically, this course also deals with UI/UX concepts to develop a pleasant user interface and deploy the application using Cloud AWS services.

B. Prerequisite Course

10210CS101 - Problem Solving using C.

C. Course Objectives

Learners are exposed to:

- Make use of basic SDLC, Unix Commands.
- Practice Java basic constructs for real world problems.
- Build efficient client-side validation using javascript.
- Acquire knowledge on basic SQL queries and designing database schema
- Learn and build the workflow of UI/UX
- Deploy the application on AWS cloud

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Interpret the Software Development Life Cycle (SDLC) stages, Unix basics commands and shell operations, and OOP.	**K2**
CO2	Articulate proficiency in exception handling, inheritance, and API fundamentals.	**K3**
CO3	Design the interactive and dynamic webpage using JavaScript.	**K3**
CO4	Model the Relation Database schema and perform CRUD operations.	**K3**
CO5	Chart UI/UX and deploy the applications using AWS cloud.	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

F. Course Contents

Unit 1 Introduction to SDLC, UNIX/OS and OOP Concepts L-9 Hours

SDLC: Requirements gathering - System design - Implementation - Testing - Various types of testing - Maintenance - Documentation - Project Management - Agile. UNIX/OS: Unix Basics - Unix shell - File Operations - Process Management - Networking and Communication - System Administration - Shell Customization. OOPs Concept: Benefits and Multiple Features of OOP - Object Oriented Programming Vs Procedural Programming - Class - Cohesion and Coupling in design process - Popular OOP Languages.

Unit 2 Exception Handling, Inheritance & APIs L-9 Hours

Exception Handling - Categories of Exceptions - Hierarchy of Exception Class - Exception Types - Checked and Unchecked Exceptions. Inheritance and its Types - Creating Subclass - Method Overriding - Super keyword - Polymorphism - instanceof operator - Abstract Vs Non-Abstract classes - Interface. **API:** Introduction - API Basics - Types of API Protocols - Styles and Benefits of API Development.

Unit 3 Scripting Language - Javascript L-9 Hours

Basic Web Development Concepts - **Javascript:** Introduction to Javascript - Syntax and Basic Concepts - Document Object Model (DOM) Manipulation - Arrays and Objects - Asynchronous JavaScript - Error Handling and Debugging - ECMAScript 6 (ES6)+ Features.

Unit 4 Database Fundamentals: RDBMS, SQL L-9 Hours

DBMS: History of Data and its definition - Various formats to recognize databases - DBMS through MySQL Workbench - DBMS Types and its features - Requirements of DBMS - Roles, job-related tasks.
RDBMS: Introduction and its uses - popular RDBMS and their uses - Oracle RDBMS versions and features - SQL Server RDBMS, history and its features - MySQL RDBMS, history and its features - MySQL Workbench - Normalization - E.F. Codd.
SQL: Introduction - Connectivity - Reserved words - Data Types - SQL Commands: DDL - Alter tables - drop and truncate - table constraints - constraint violation.

Unit 5 Fundamentals of UI/UX, Generative AI and AWS Cloud Practitioner L-9 Hours

UI/UX: Introduction - importance - UI Vs UX - Future of UI/UX - User prevention on errors - flowcharts of UI/UX - journey maps of UX design - micro interactions - age-responsive design - interstitial anxiety - VR interfaces Vs normal interfaces - Modern concepts of UI/UX.

Generative AI: Definition - Working principle - Model Types - Applications.

AWS Cloud Practitioner: Introduction - AWS services - SDKs Vs APIs - AWS Management Console - Infrastructure as Code (IaC) - Deployment and Management - Serverless Computing - Data Storage and Analytics.

Total: 45 Hours

G. Learning Resources

i.Text Books:

1. "Software Engineering: A Practitioner's Approach" by Roger S. Pressman is published by McGraw-Hill Education. September 2021 , 9th edition. [Unit - 1]
2. UNIX and Linux System Administration Handbook" is published by Pearson and the 5th edition was published in 2017. [Unit - 1]

3. "Introduction to Java Programming and Data Structures, Comprehensive Version" (12th Edition) By Y. Daniel Liang, Pearson in 20
18. [Unit - 1 & 2]
5. APIs: A Strategy Guide" by Daniel Jacobson, Greg Brail, and Dan Woods, O'Reilly Media, Inc. December 2011. [Unit - 2]
6. JavaScript: The Definitive Guide, 7th Edition. by David Flanagan. Released May 2020. Publisher(s): O'Reilly Media, Inc. [Unit - 3]
7. Database System Concepts" by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan 7th edition McGraw-Hill Education. [Unit - 4]
8. "Don't Make Me Think: A Common Sense Approach to Web Usability" by Steve Krug 3rd edition by New Riders. [Unit - 5]
9. AWS Certified Cloud Practitioner Study Guide" 2nd Edition by Sybex. [Unit - 5]

ii.Reference Books:

1. H.M. Deitel and P.J. Deitel," Java How to Program", Pearson Prentice Hall Seventh edition, 2018.
2. E. Balaguruswamy, "Programming in java", Sixth Edition, Tata McGraw Hill, 2019.
3. Mary Delamater, "Murach's JavaScript and jQuery (4th Edition) Paperback – Illustrated", Mike Murach& Associates Inc, August 26, 2020.
4. Elmasri Ramez, Navathe S, "Fundamentals of Database System", Seventh Edition, Pearson, 2017.
5. The Design of Everyday Things: Revised and Expanded Edition by Don Norman.
6. Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud by Mark Wilkins.

iii. Online References:

1. "Java Tutorial", June 20, 2023 [Online], Available: https://www.javatpoint.com/java-tutorial
2. "Programming in Java", Accessed on: June 20, 2023 [Online], Available: https://nptel.ac.in/courses/106/105/106105191/
3. "UI / UX Design Tutorial – Wireframe, Mockup & Design in Figma " https://www.youtube.com/watch?v=c9Wg6Cb_YlU
4. Get started with Amazon EC2 Linux instances https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/EC2_GetStarted.html
5. " AWS EC2 Instances | How to Create AWS EC2 Instance | AWS EC2 Tutorial For Beginner" https://www.youtube.com/watch?v=LZXWlF5udYs

Annexure-V

5.	To discuss and approve the **courses to be offered in Online MOOCs platforms under Program Elective and Open Elective Category** during the academic year Summer, 2024-2025 for B.Tech Artificial Intelligence and Machine Learning

Program Elective category

COURSE CODE	COURSE TITLE	Course Provider	W	H	C
10212AM401	Responsible and Safe AI systems	NPTEL	12	-	3

Course Category:

Program Elective (Self - Learning Course)

Course Contents:

Week1&2:

AI Capabilities Improvement in last 5-10 years

- Imminent risks from AI Models: Toxicity, bias, goal misspecification, adversarial example set.
- Long-term risks from AI Models: Misuse, Misgeneralization, Rogue AGI
- Principles of RAI - Transparency; Accountability; Safety, Robustness and Reliability; Privacy and Security; Fairness and non-discrimination; Human-Centred Values;
- Inclusive and Sustainable development, Interpretability
- Recap of Deep Learning Techniques, Language/Vision Models
- AI Risks for Gen models, Adversarial Attacks – Vision, NLP, Superhuman Go agents

Week3&4:

ML Poisoning Attacks like Trojans

- Implications for current and future AI safety
- Explainability
- Imminent and Long-term potential for transparency techniques
- Mechanistic Interpretability
- Representation Engineering, model editing and probing
- Critiques of Transparency for AI Safety

Week5&6:

Privacy & Fairness in AI

Week7&8:

Metrics and Tools for RAI - measuring bias/fairness, adversarial testing, explanations (Lime/SHAP/GradCam), audit mechanisms

- Regulation landscape - DPDP act (India), GDPR (EU), EU AI act, US presidential declaration, Ethical approvals, informed consent, participatory design, future of work, Indian context
- What is AGI? When could it be achieved?
- Instrumental Convergence: Power Seeking, Deception etc.

Week9&10:

- RAI in Legal domain
- RAI in Health care domain
- RAI in Education domain
- A few other domains
- Policy issues in RAI

Week11&12:

- Couple of panel discussion with industry practitioners, academic, government (possibly), and others.
- Fireside chat with eminent personalities
- Recorded Paper reading discussion

Course Provider : NPTEL
Professor : 1. Prof. Ponnurangam Kumaraguru, 2.Prof. Balaraman Ravindran, 3.Prof. Arun Rajkumar
University : IIT Hyderabad, IIT Madras

COURSE CODE	COURSE TITLE	W	H	C
10212AM402	Introduction to Internet of Things	12	-	3

Course Category:

Program Elective (Self - Learning Course)

Course Contents:

Week 1: Introduction to IoT: Part I, Part II, Sensing, Actuation, Basics of Networking: Part-I

Week 2: Basics of Networking: Part-II, Part III, Part IV, Communication Protocols: Part I, Part II

Week 3: Communication Protocols: Part III, Part IV, Part V, Sensor Networks: Part I, Part II

Week 4: Sensor Networks: Part III, Part IV, Part V, Part VI, Machine-to-Machine Communications

Week 5: Interoperability in IoT, Introduction to Arduino Programming: Part I, Part II, Integration of Sensors and Actuators with Arduino: Part I, Part II

Week 6: Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi

Week 7: Implementation of IoT with Raspberry Pi (contd), Introduction to SDN, SDN for IoT

Week 8: SDN for IoT (contd), Data Handling and Analytics, Cloud Computing

Week 9: Cloud computing (contd), Sensor-Cloud

Week 10: Fog Computing, Smart Cities and Smart Homes

Week 11: Connected Vehicles, Smart Grid, Industrial IoT

Week 12: Industrial IoT (contd), Case Study: Agriculture, Healthcare, Activity Monitoring

Professor : Prof. Sudip Misra
University : IIT Kharagpur

NPTEL -Open Elective category

S.No.	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1.	10213AM426	Applied Accelerated Artificial Intelligence	NPTEL	12 Weeks	3
2.	10213AM427	Introduction to Quantum Computing: Quantum Algorithms and Qiskit	NPTEL	4 Weeks	1
3.	10213AM428	Distributed Systems	NPTEL	8 Weeks	2

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	Course Provider	W	H	C
10213AM426	**Applied Accelerated Artificial Intelligence**	NPTEL	**12**	**-**	**3**

Course Category:

Open Elective (Self - Learning Course)

Course Contents

Week 1: Introduction to AI System Hardware CPU, RAM, GPU, Interconnects, Storage, Network Controller; Introduction to AI Accelerators GPUs; Introduction to System Software Operating System, Virtualization, and Cloud.

Week 2: Introduction to Containers and IDE, Scheduling and Resource Management Introduction to schedulers and orchestration tools; DeepOps: Deep-dive into Kubernetes with deployment of various AI-based services.

Week 3: DeepOps; Design principles for building High Performance compute clusters for AI; Implementation details for building High Performance compute clusters for AI.

Week 4: Frameworks for Accelerated Deep Learning Workloads – PyTorch,

Week 5: Frameworks for Accelerated Deep Learning Workloads - TensorFlow; Accelerated TensorFlow

Week 6: Optimizing Deep Learning Training: Automated Mixed Precision; Optimizing Deep Learning Training: Transfer Learning.

Week 7: Fundamentals of Distributed AI Computing: Multi-GPU and multi-node implementation (MPI, NCCL, RDMA; Distributed AI Computing: Horovod

Week 8: Challenges with Distributed Deep Learning Training Convergence; Fundamentals of Accelerating Deployment

Week 9: Accelerating neural network inference in PyTorch and Tensor Flow; Accelerated Data Analytics; Accelerated Machine Learning

Week 10: Scale Out with DASK; Web visualizations to GPU accelerated cross filtering; Accelerated ETL Pipeline with SPARK

Week 11: Applied AI: Smart City (Intelligent Video Analytics);

Week 12: Applied AI: Healthcare (Federated Learning, AI Assisted Annotation);

Professor : Prof. Satyajit Das

University : IIT Palakkad

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	Course Provider	W	H	C
10213AM427	**Introduction to Quantum Computing: Quantum Algorithms and Qiskit**	**NPTEL**	**4**	**-**	**1**

Course Category:

Open Elective (Self - Learning Course)

Course Contents:

Week 1:Introduction and IBM Quantum Perspective, Q Mission in India – Invited talk, Quantum Computing Applications, Quantum Computing Basics
Week 2:IBM Quantum Composer and Quantum Lab using Qiskit
Week 3: Quantum Algorithms-I (Oracles, Deustch Jozsa), Quantum Algorithms-II (Grover's Algorithm with Hands-on)
Week 4:Quantum Error Correction, NISQ era Quantum Algorithms (VQE/QAOA and industrial applications)

Professor : Prof. Prabha Mandayam,
Prof. Anupama Ray
University : IIT Madras, IBM Research

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	Course Provider	W	H	C
10213AM428	**Distributed Systems**	**NPTEL**	**8**	**-**	**2**

Course Category:

Open Elective (Self - Learning Course)

Course Contents

Week 1: Introduction to DS, Message Passing, Leader Election, Distributed Models, Causality and Logical Time
Week 2: Logical Time, Global State & Snapshot and Distributed Mutual Exclusion-Non-Token and Quorum based approaches
Week 3: Distributed Mutual Exclusion-Token based approaches, Consensus & Agreement, Check pointing & Rollback Recovery
Week 4: Deadlock Detection, DSM and Distributed MST
Week 5: Termination Detection, Message Ordering & Group Communication, Fault Tolerance and Self-Stabilization
Week 6: Distributed Randomized Algorithms, DHT and P2P Computing
Week 7: Case Studies: GFS, HDFS, Map Reduce and Spark
Week 8: Case Studies: Sensor Networks, Authentication & Security in DS

Professor : Prof. Rajiv Misra

University : IIT Patna

Annexure- VI

6.	To discuss and approve the courses to be offered in Value added course under Complementary skills Category during the academic year Summer, 2024-2025 for B.Tech Artificial Intelligence and Machine Learning.

Complementary Skills – Value Added Course

S No	Course Code	Course title	L	T	P	C
1	10218AM924	Big Data Analytics	2	0	0	0
2	10218AM925	Power BI Data Analytics	2	0	0	0
3	10218AM928	Enrich Visualization using Tableau	2	0	0	0
4	10218AM938	Machine learning using Python	2	0	0	0

COURSE CODE	COURSE TITLE	L	T	P	C
10218AM924	**Big Data Analytics**	2	0	0	0

A. Preamble:

The key objective of this course is to make the students to be familiar with the concepts of Big Data. This course includes the most significant technologies used for storing, processing and analyzing big data.

B. Course Category: Value Added Course

C. Course Outcome:

The Students will be able to proficiently:

- Identify Big Data and its Business Implications.
- Access and Process Data on Distributed File System
- List the components of Hadoop and Hadoop Eco-System
- Develop Big Data Solutions using Hadoop Eco System
- Apply Machine Learning Techniques

D. Course Contents

Module–1: Understanding Big Data **6 Hours**

Concepts and Terminology: Data Analytics - Big Data Characteristics - Different Types of Data - Big Data Analytics Lifecycle - Big Data

Module–2: Big Data Storage Concepts **6 Hours**

Clusters - File Systems and Distributed File Systems – NoSQL Shading – Replication - CAP Theorem

Module–3: Big Data Processing Concepts **6 Hours**

Parallel Data Processing - Distributed Data Processing – Hadoop - Processing Workloads - Map and Reduce Tasks

Module–4: Big Data Storage Technology **6 Hours**

On-Disk Storage Devices: Distributed File Systems – RDBMS Databases - NoSQL Databases - In-Memory Storage Devices - In-Memory Databases

Module–5: Big Data Analysis Techniques **6 Hours**

Quantitative Analysis - Qualitative Analysis - Data Mining - Statistical Analysis - Machine Learning

E. Learning Resources

Total 30 Hours

i. Text Books

1. Thomas Erl, Wajid Khattak, and Paul Buhler, “Big Data Fundamentals - Concepts, Drivers & Techniques", Prentice Hall, 1st Edition.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

ii. Reference Books

1. Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.
2. Arvind Sathi, “Big Data Analytics: Disruptive Technologies for Changing the Game”, MC Press, 2012

iii. Online Resources

1. https://www.udemy.com/course/big-data-and-hadoop-for-beginners/
2. https://www.coursera.org/specializations/big-data.

COURSE CODE	COURSE TITLE	L	T	P	C
10218AM925	Power BI Data Analytics	2	0	0	0

A.Preamble:

Power BI is a business analytics service provided by Microsoft. It provides interactive visualizations with self-service business intelligence capabilities, where end users can create reports and dashboards by themselves, without having to depend on any information technology staff or database administrator.

B. Course Category: Value Added Course

C. Course Outcome:

Students will be able to

- Identify Business Intelligence and Power BI.
- Process data Transformation in Power BI Desktop
- Analyze data with Microsoft Power BI
- Visualize data using Power BI
- Configure Power BI Service

D. Course Contents

Module–1: Introduction to Power BI **6 Hours**

Introduction to Business Intelligence - Self-Service Business Intelligence (SSBI) - Introduction to Power BI - Traditional BI vs. Power BI - Uses of Power BI

Module–2: Power BI Desktop and Data Transformation **6 Hours**

Data Sources in Power BI Desktop - Loading Data in Power BI Desktop - Views in Power BI Desktop - Query Editor In Power BI - Transform, Clean, Shape, and Model Data

Module–3: Data Analysis Expression (DAX) **6 Hours**

Introduction to DAX - Importance of DAX - Data Types in DAX - DAX Calculation Types - Steps to Create Calculated Columns - Measures in DAX

Module–4: Data Visualization **6 Hours**

Introduction to Visuals In Power BI - Visualization Charts in Power BI - Matrixes and Tables - Slicers and Map Visualizations - Gauges and Single Number Cards

Module–5: Power BI Service **6 Hours**

Introduction to Power BI - Creating a Dashboard - Quick Insights in Power BI - Configuring a Dashboard

Total 30 Hours

E. Learning Resources

i.Text Books

1. Greg Deckler and Brett Powell, “Mastering Microsoft Power BI - Expert techniques to create interactive insights for effective data analytics and business intelligence”, Packt, Second Edition.

ii. Reference Books

2. Alan Murray, " Power BI for Jobseekers: Learn how to create interactive dashboards and reports, and gain insights from the data”, bpb, 2023.

iii. Online Resources

1. https://www.udemy.com/course/powerful-reports-and-dashboards-with-microsoft-powerbi/
2. https://www.coursera.org/professional-certificates/microsoft-power-bi-data-analyst

COURSE CODE	COURSE TITLE	L	T	P	C
10218AM928	Enrich Visualization using Tableau	2	0	0	0

A. Preamble:

This comprehensive course delves into unravel the potential of Tableau in seven easy steps. We will create and deploy meaningful and visually appealing dashboard in each steps. This course covers the latest features of data preparation in tableau and will create table calculations, stunning charts and informative storyboards for a better understanding of data.

B. Course Category: Value Added Course

C. Course Outcome:

The Students will be able to proficiently:

- Understand Data Exploration and Tableau with basic features.
- Ability to work with Data and perform various operation on it.
- Ability to draw geo plotting and create dashboard.
- Using Tableau statistics for clustering and forecasting.
- Use to develop dashboard for real time application.

D. Course Contents

Module–1: Introduction to Tableau **6 Hours**

Connecting to various file type, Organizing data pane, Cardinality set by Tableau, Building understanding of graphical user interface, Data source, Create Dash board and Story board, Data Analysis, Understanding Panes, Building Chart and Graphs.

Module–2: Getting Start with Tableau, Data exploration and calculation **6 Hours**

Understanding Tableau, connecting data source, Perform joining, blending and unions on data, Exploring data- hierarchy, sorting, grouping, set and filters. Data calculation- string, number and type calculation, logic and aggregation calculation, Table calculation, Introduction to LoD calculation.

Module–3: Geo Plotting Data and Dashboard **6 Hours**

Plotting geographical data, configuration and Trouble-shooting Maps, Adding custom location, Density chart, Building Dashboard, various object in dash board, Formatting in dashboard and adding Interactivity.

Module–4: Tableau for statistics **6 Hours**

Adding Trend Lines, Reference Lines, Forecasting in Tableau, Clustering in Tableau, Tableau workbook and public sharing

Module–5: Develop Real-World Business Application Dashboards **6 Hours**

Introduction to Projects
Project Phase I: Ticket Trend Analysis
Project Phase II: Employee Performance analysis.

Total 30 Hours

E. Learning Resources

i. Text Book:

1. Matthew Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization Foundations, Techniques, and Applications”, 2nd Edition, A K Peters/CRC Press, 2021.

ii. Reference Book

1. Donabel Santos, “Tableau 10 Business Intelligence Cookbook”, Packt Publishing, 1786465639, 9781786465634, 2016.

iii. Online Resources

1. “Exploratory data analysis and Data visualization”, Accessed on April.11.2021 [Online]. Available: https://www.creative-wisdom.com/teaching/WBI/EDA.shtml.
2. “Visualization of Multivariate Data”, Accessed on April.11.2021 [Online].https://people.stat.sc.edu/hansont/stat730/MultivariateDataVisualization.pdf

COURSE CODE	COURSE TITLE	L	T	P	C
10218AM938	Machine Learning Using Python	2	0	0	0

A. Preamble

Machine learning offers invaluable tools for extracting insights and making predictions from vast data sets. Python, with its simplicity and powerful libraries, has become the go-to language for implementing these solutions. Starting with fundamental concepts, it progresses to advanced topics like classifier algorithms and error handling.

B. Course Category: Value Added Course

C. Course Outcome

Students should able to

- Learn machine learning packages in Python.
- Understand machine learning model performance.
- Implement predictive models using regression and classification techniques.
- Comprehend strategies to handle missing data.

D. Course Contents

Module I: Machine Learning using Python. **6 Hours**

Introduction: Introduction Machine Learning Using Python - Usage of Machine Learning Packages in Python - Example of Machine Learning Using Python - Example of Machine Learning Using Python Continues - Installation of Python

Module II: Linear Regression **6 Hours**

Linear Regression in ML - Linear Regression Example - Linear Regression Example Continues - Support Vector Algorithm in ML

Module III: Classifier and Python Package **6 Hours**

Decision Tree Classifier - Random Forest Classification - K Mean Clustering - Apriori Python Package - Apriori Python Package Continues

Module IV: Evaluation Metrics **6 Hours**

Evaluation Metrics - Example of Evaluation Metrics - Confusion Matrix in Evaluation Metrics - Classification Reports in Evaluation Metrics - Example of MAE, MSE and Variance using Evaluation Metrics - Sea Born Example using Evaluation Metrics - Scatter Matrix using Evaluation Metrics

Module V: Missing Value **6 Hours**

Handling Missing Values in Python - Handling Missing Values in Python Continues - Exception Handling in Python - More on Exception Handling in Python

Total 30 Hours

E. Learning Resources

1. https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_013843128689426432 31498_shared?collectionType=Course&collectionId=lex_auth_013843129228853248322203_s hared&pathId=lex_auth_013843127683072000321 92_shared

Annexure-VII

7	To discuss the Stakeholders feedback on curriculum of B.Tech Artificial Intelligence and Machine Learning taken for the academic year 2023-2024.

Faculty Feedback on Curriculum 2023-2024

PROGRAM CORE

1. Suggested to include Ethics and Safe AI System Course into the Curriculum.
2. The books prescribed/listed as reference materials are relevant and updated.
3. Curriculum has more Integrated Courses. It covers breadth and depth of the course.
4. The curriculum is highly effective in enabling students.
5. Quality and relevance of the courses included into the curriculum.
6. Courses in the Curriculum as per Current trends and Future Predictions.
7. Suggested to incorporate Robotic Process Automation (RPA), Edge AI Courses into the curriculum.

PROGRAM ELECTIVE

1. Recommend to add Cloud Computing , Explainable AI, Data Engineering Courses.
2. Project based Learning may be added in the Program Elective Courses. The outcome of each course should end with a project.
3. Recommended to include Responsible AI course.

Action Taken: Academic Year 2023-2024 Curriculum Feedback

Based on the faculty feedback analysis few courses were introduced in the curriculum under various category:

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Cloud Driven Data Engineering with AI	Program Elective	6th BOS-18.07.2024
2	Responsible and Safe AI systems	Program Elective	6th BOS-18.07.2024
3	Explainable AI	Program Elective	6th BOS-18.07.2024

School of Computing

Department of Artificial Intelligence and Machine Learning

Students Feedback on Curriculum 2023-2024

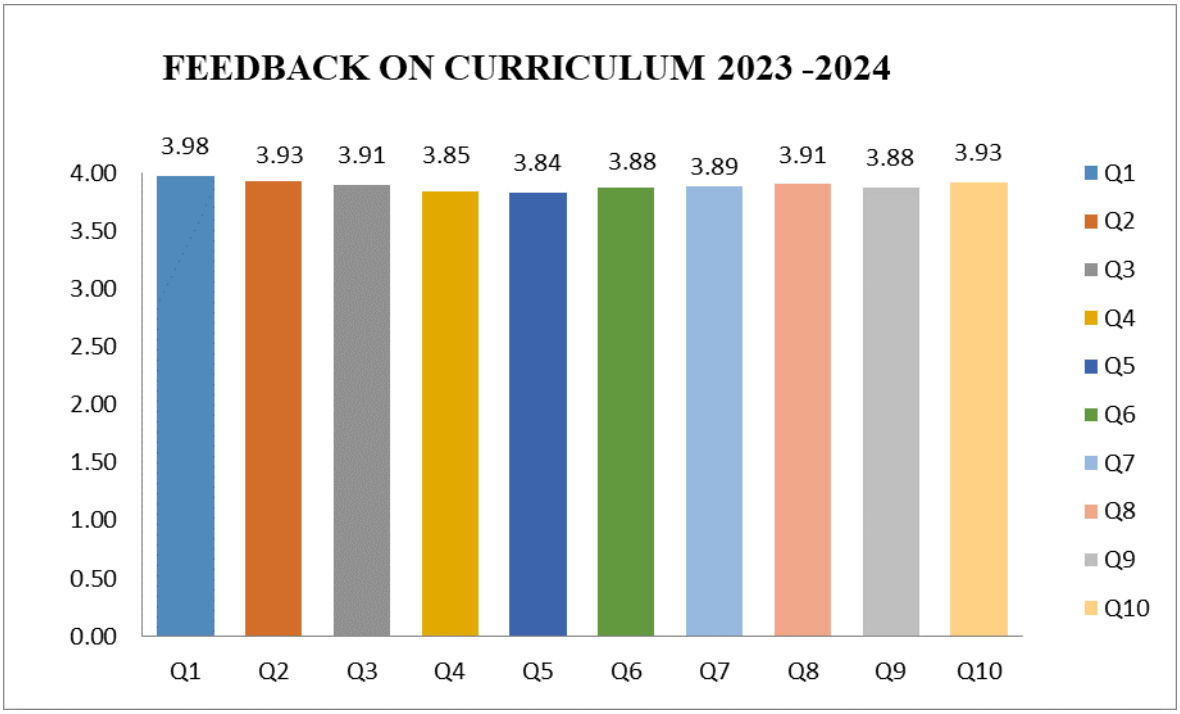
The students are the most important stakeholders of B. Tech Artificial Intelligence and Machine Learning Programme. In the academic year 2023-2024, suggestions collected in the form of structured feedback from B. Tech AIML students. Received student's feedback on curriculum and the major suggestions are listed below:

- Suggested to make more exposure on Real Time Data Collection.
- Advanced Technological courses like MLOPS, Responsible AI, and Safe AI to be added.
- Suggested to use innovative Pedagogy methods and ICT tools.
- Suggested to make more industrial visits to get a real time implementation exposure.
- Recommended to add courses related to software development and programming fundamentals, as well as design patterns and best practices.
- Students require Slip test for all the subject every week.
- Students become expertise in Developing and Deploying Models.
- Students able to develop their communication and interpersonal skills through implementation of active learning Strategy

The following questions are given to the students about feedback on curriculum and the response is mentioned in the below graph:

Q1	How do you rate the curriculum offered in relation to the Technological advancements?
Q2	How do you rate the syllabus in related to the needs of industry/society?
Q3	How do you rate the relevance of the courses for providing employability?
Q4	Did the course curriculum intellectually motivate you?
Q5	Was the course curriculum fulfilling your expectations?
Q6	How much has your experience at this curriculum contributed to your job-related knowledge and skills?
Q7	Does the syllabus create any interest to pursue post-graduation/research in the particular subject?
Q8	Were reading material and references regarding curriculum / subject easily found?
Q9	How do you rate the objectives stated for each of the courses

Q10 How do you rate the syllabus of the courses that you have studied in relation to the competencies expected out of the courses?



The above feedback analysis, students given 3.84/4 rating for Q5 i.e., was the course curriculum fulfilling your expectations. Students are highly satisfied with the curriculum offered in relation to the Technological advancements (3.98/4) and the ratings for the syllabus in related to the needs of industry/society (Q2) and the syllabus of the courses that you have studied in relation to the competencies expected out of the courses (Q10) are (3.93/4), also rated the relevance of the courses for providing employability (3.91/4).

Action Taken: Academic Year 20223-2024 Curriculum Feedback

Based on the student feedback analysis few courses were introduced in the curriculum under various category:

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Cloud Driven Data Engineering with AI	Program Elective	6th BOS-18.07.2024
2	Responsible and Safe AI systems	Program Elective	6th BOS-18.07.2024
3	Machine Learning for Production	Program Elective	6th BOS-18.07.2024
4	Software Development and Maintenance	Open Elective	6th BOS-18.07.2024

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

School of Computing

Department of Artificial Intelligence and Machine Learning

Industry Feedback on Curriculum 2023-2024

The industry are the most important stakeholders of B. Tech Artificial Intelligence and Machine Learning Programme. Suggestions collected in the form of structured feedback from the industries. Received industries feedback on curriculum and the major suggestions are listed below:

- Recommend to include Emerging courses like Edge AI, LLM, and Explainable AI to enhance students' proficiency in relevant area.
- Recommended to include Quantum Computing Course.
- Propose to enhance the curriculum with practical, hands-on projects aligned with current industry trends.
- Focus on soft skills development, including communication, problem-solving, and teamwork, to prepare students for dynamic professional environments.

Action Taken: Academic Year 2023-2024 Curriculum Feedback

Based on the industry feedback analysis few courses were introduced in the curriculum under various category:

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Responsible and Safe AI systems	Program Elective	6th BOS-18.07.2024
2	Machine Learning for Production	Program Elective	6th BOS-18.07.2024
3	Explainable AI	Program Elective	6th BOS-18.07.2024
4	Generative AI	Program Elective	6th BOS-18.07.2024
5	DevOPS	Industry / Higher Institute Learning Interaction (IHL)	6th BOS-18.07.2024

Annexure-VIII

8.	Ratification of Program Elective courses offered in the B.Tech Artificial Intelligence and Machine Learning program during winter 2023-2024.

COURSE CODE	COURSE TITLE	L	T	P	C
10212AM276	Generative AI	1	0	2	2

A. Preamble

The Generative AI course introduces students to the principles and applications of deep learning, focusing on generative models. The course covers the rise of deep learning, large language models (LLMs), prompt engineering, Lang chain, and diffusion models. It integrates theoretical knowledge with practical lab exercises to enhance learning and application.

B. Prerequisite Courses

10211AM223- Machine Learning Techniques

C. Course Objectives

Students will be able to:

- Understand the fundamentals of deep learning and its applications.
- Describe large language models and their architectures.
- Apply principles and techniques of prompt engineering.
- Explore Lang chain and its components.
- Explain diffusion models and their use in generative AI.

D. Course Outcomes

Upon successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Comprehend the fundamentals and rise of deep learning	K2
CO2	Apply knowledge of large language models in various NLP tasks	K3
CO3	Develop and utilize prompt engineering techniques	K3
CO4	Implement Langchain architecture for generative AI applications.	K3
CO5	Apply diffusion models to progressively refine noise into high-quality images and videos	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

F. Correlation of COs with Program Outcomes and Program Specific Outcome

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	3	3		2	1								2	2
CO2	3	3	3	2	2								2	2
CO3	1	2	3	2	3								2	2
CO4	1	2	2	2	3								2	2
CO5	3	3	2	2	3								2	2

3- High; 2-Medium; 1-Low

F. Course Contents

Unit I: Rise of Deep Learning — L - 3 Hours

AI vs ML vs DL, Need for DL, Power of Neural Networks, Tools for sequence models: RNNs, Transformers, attention, Deep vision by CNNs, Deep Generative Modeling, Responsible and ethical use of Deep Learning tools.

Unit II: Large Language Models (LLMs) — L - 3 Hours

History of NLP, Tokenization and embeddings, Positional encoding of Transformers, Text generation process, LLM model architecture: BERT, GPT, Training LLMs: Base, Instruction Tuned, Fine Tuning, Limitations of LLMs, API calling of OpenAI, Hugging Face, Google, Meta models.

Unit III: Prompt Engineering — L - 3 Hours

System-user-assistant format, Principles of prompting, chaining prompts, using delimiters to avoid prompt injections, Iterative prompt development, Zero and few shots prompting, Chain-of-thoughts prompting, Program-aided language prompting, ReAct prompting, Building a chatbot using prompt engineering (use cases: healthcare, education, e-commerce).

Unit IV: Langchain — L - 3 Hours

Langchain architecture, LangChain Expression Language (LCEL), Runnable interface, Chat models, Prompt templates, Example selectors, Output parsers, Chat history, Document loaders, Text splitters, embedding models, Vector stores, Retrievers, Agents, Callbacks, RAG using langchain and chromadb.

Unit V: Diffusion Models — L - 3 Hours

Variational Autoencoder, Generative Adversarial Networks, Diffusion Process: Forward Noising, Reverse Denoising, Stable Diffusion models, U-Net, Text encoder, Video generation, generating images from natural language using Hugging Face API, Beyond images: molecular design

Total -15 Hours

G. Laboratory Experiments (30 Hours)

Task 1	Introduction to Python & NLP, familiarizing with NLTK and Transformers. **Tools:** Python, NLTK, Transformers
Task 2	Create a text generator using any Hugging Face LLM that can generate realistic sentences or paragraphs. **Tools:** Python, Hugging Face Transformers
Task 3	Build a language translation tool using an LLM that can translate given text from one language to another with high accuracy. **Tools:** Python, Hugging Face Transformers
Task 4	Create a sentiment analysis tool that can analyze the sentiment of text data and classify it as positive, negative, or neutral. **Tools:** Python, Hugging Face Transformers
Task 5	Develop a text summarization tool that can generate concise summaries of long articles and documents. **Tools:** Python, Hugging Face Transformers
Task 6	Create a recipe generator that can generate new and unique recipes based on user preferences and dietary restrictions. **Tools:** Python, Hugging Face Transformers

Task 7	Develop a legal research tool that can search and retrieve relevant case details from the database based on user queries. **Tools:** Python, Hugging Face Transformers
Task 8	Develop a story generator using any Hugging Face LLM that can generate creative and engaging storylines and plot twists. **Tools:** Python, Hugging Face Transformers
Task 9	Build a painting generator using a model like Stable Diffusion that can create unique oil paintings. **Tools:** Python, Stable Diffusion, TensorFlow
Task 10	Develop a logo generator using a model like Stable Diffusion that can create unique and professional logos for businesses or organizations. **Tools:** Python, Stable Diffusion, TensorFlow
Task 11	Develop a program that generates random modern Disney-style avatars or character images with different facial features, hairstyles, and accessories. **Tools:** Python, Stable Diffusion, TensorFlow

Part – 2

Use Cases:

Use Case 1: Generate Cricket Match Summaries
Use Case 2: Automated Art Creation for E-commerce
Use Case 3: Interactive Storytelling for Children's Education
Use Case 4: Brand Identity Creation for Startups
Use Case 5: Personalized Recipe Suggestions for Health Apps

Total:45 hours

H. Learning Resources

i. Text Books:

1. Foster D, *et al*. “Generative deep learning ", O'Reilly Media, Inc, 2022.
2. Dhamani N, *et al.* “Introduction to Generative AI”, Simon and Schuster, 2024.
3. Phoenix J, Taylor M. “Prompt Engineering for Generative AI”, O'Reilly Media, Inc, 2024.
4. Omar Sanseviero, *et al*. “Hands-On Generative AI with Transformers and Diffusion Models”, O'Reilly Media, Inc, 2024.

ii. Reference Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville. "Deep Learning", 2021.
2. Delip Rao and Brian McMahan, "Natural Language Processing with Transformers", 2021.
3. David Foster. "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play", 2020.

iii. Online References:

“Generative AI with Large Language Models” (online): Coursera.
“Generative AI and Language Models” (online): NPTEL.

Annexure- IX

9.	Ratification of courses offered under the category of Industry / Higher Institute Learning Interaction (IHL) by Industry and Higher Institute Experts for B.Tech Artificial Intelligence and Machine Learning during Winter Semester 2023-24.

Sno	Course code	Course Name	L	T	P	C
1	10215AM923	Programming for Data Analytics	1	0	0	1
2	10215AM928	Fundamentals of MEMS	1	0	0	1
3	10215AM930	Cognitive Computing and Applications	1	0	0	1

10215AM923 - Programming for Data Analytics

1. Introduction to Python
2. Programming for Data Analysis Introduction
3. Data cleaning and transformation
4. Data normalization and analysis
5. Classification
6. Correlation
7. Regression analysis
8. Cluster analysis
9. Deep Learning (Convolutional Neural Networks)

Total: 15 Hours

10215AM928 - Fundamentals of MEMS

1. Introduction to MEMS and transducers
2. Thermal sensors
3. Pressure sensors
4. Accelerometers
5. Biosensors
6. Thermal actuators

7. Electrostatic and magnetic actuators
8. Optical MEMS technology
9. Microfluidic valves and pumps **Total: 15 Hours**

10215AM930 - Cognitive Computing and Applications

1. Fundamentals of Cognitive Computing
2. Design Principles of Cognitive Computing
3. NLP in Cognitive Computing Systems
4. Representing Knowledge in Taxonomies and Ontologies
5. Learning and Reasoning
6. Case-based Reasoning
7. Incremental Learning
8. Analogical Reasoning
9. Ethical Issues of Cognitive Systems
10. Business Implications of Cognitive Systems

Total: 15 Hours

Annexure- X

10.	Ratification of Value added Courses Which are being offered for B.Tech **Artificial** Intelligence and Machine Learning during Winter Semester 2023-24.

Sno	Course code	Course Name	**L**	**T**	**P**	**C**
1	10218AM935	Natural Language Processing with Projects	2	0	0	0
2	10218AM936	Linux Administration	2	0	0	0
3	10218AM937	Bash Shell Script administrator	2	0	0	0
4	10218AM939	AWS Solution Architect	2	0	0	0
5	10218AM942	Essential Mongo DB Administration	2	0	0	0
6	10218AM941	Java Programming Fundamentals	2	0	0	0
7	10218AM947	Data Structures and Algorithms using Python - Part 1	2	0	0	0
8	10218AM948	Computer Vision - Theory and Projects in Python for Beginners	2	0	0	0
9	10218AM949	Deep Learning and Neural Networks	2	0	0	0
10	10218AM950	Exploratory Data Analysis Using R	2	0	0	0

COURSE CODE	COURSE TITLE	L	T	P	C
10218AM935	Natural Language Processing	2	0	0	0

A, Preamble:

Natural language processing deals with written text. Students will learn how to process written text from basic of fundamental knowledge starts with Finite automata, Regular expression and probabilistic model with n-grams. This course also covers basis of semantic analysis and discourse analysis and drives it to machine translation.

B. Course Category: Value Added Course

C. Course Outcome:

The Students will be able to proficiently:

- Perform various cleaning and pre-processing operations on textual data using NLTK
- Work with the various elements of text data such as Tokens, N-grams, Lemma and Frequency Distributions
- Annotate text with part of speech(POS) using in-built and custom POS taggers
- Work with various lexical resources provided with NLTK to pre-process the data
- Build applications such as Spam detector, Topic Modeler, Chatbot, Sentiment Analyzer using NLP and Machine Learning techniques
- Understand the concept of word embedding, Word2Vec model with a suitable example.
- Understand deep learning for NLP like RNN for NLP
- Build a language model with the help of recurrent neural network
- Build a LSTM network model for predicting a sequence data set
- Will understand different benchmarking solutions for various NLP solutions.

D. Course Contents

Module - 1: Basic NLP Concepts **6 Hours**

Why NLP - NLP Pipeline - Understanding Textual Data - Corpus - Wordnet, Wordlist - POS Tagging - Annotation - NER - Bag of Word and TF_IDF - Lookup tagger - Tagging pipeline and backoff

Module - 2: Embedding Words **6 Hours**

Word2vec - How to train Word2Vec on Text data - Bag of words - skip-gram - Continuous Bag-Of-Words - Visualization of trained model - Word Sense Disambiguation

Module - 3: Language Modeling **6 Hours**

Unigram Language Model - Simple (Unsmoothed) N-grams - Smoothing - Back off - Deleted Interpolation, N-grams for Spelling and Pronunciation - Morphology - Overview of Hidden Markov Models

Module - 4: Sequential Modeling for NLP **6 Hours**

Sequential Modeling for NLP using RNN - RNN - Language Modeling using RNN - Understanding RNN with Text Generation - Challenges / Limitation - Sequential Modeling for NLP using LSTM – Training using LSTM – Tuning the parameters – Bi-directional LSTM.

Module - 5: Text Analysis **6 Hours**

Sentiment Mining, Entity Linking, Text Classification, LDA & Factorization - Text Summarization - Information Extraction - Named Entity Recognition - Relation Extraction, Question Answering in Multilingual Setting -NLP in Information Retrieval

Module - 6: Machine Translation **6 Hours**

Need of MT - MT Approaches - Issues - Statistical Machine Translation (SMT) - Parameter learning in SMT (IBM models) using EM - Encoder-decoder architecture - Neural Machine Translation Statistical Language Models, Kernel Methods, Word-Context Matrix Factorization Models

E. Learning Resources

i. Text Book:

1. Daniel Jurafsky, James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech”,, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python‖, First Edition, O‘Reilly Media, 2009

ii. Reference Book

1. Breck Baldwin, “Language Processing with Java and LingPipe Cookbook”, Atlantic Publisher, 2015
2. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010

iii. Online Resources

1. “Natural Language Processing” Jul. 2, 2018. Accessed on: Apr. 16, 2021 [Online]. https://www.coursera.org/learn/language-processing
2. “Natural Language Processing” Jun 2016. Accessed on: Apr. 16, 2021 [Online]. https://www.udacity.com/course/natural-language-processingnanodegree.

COURSE CODE	COURSE TITLE	L	T	P	C
10218AM936	LINUX ADMINISTRATION	2	0	0	0

A. Preamble

Infosys launched InfyTQ- A Linux administrator must know how to manipulate and manage processes. Introduce yourself to processes, services, and daemons, and how to manage them in Linux.

B. Prerequisite course

Nil

C. Course Objectives:

Learners are exposed to:

- Understand the basics of Linux and system configuration.
- Make use of Command line proficiency to apply shell usage.
- Utilize the user and group management and software management.
- Organize various network configuration and management.
- Identify the system monitoring and performance tuning.

.

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Illustrate manipulation and managing the process in Linux	K3
CO2	Apply System to start and stop the process in Linux	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2											2	
CO2	2	2		2	2									

High- 3; Medium-2; Low-1

F. Course contents

PROCESS AND MONITOR

List and identify running processes, recognize common running processes, monitor processes a their resource utilization, start and stop processes, set or change the priority for a process.

TROUBLESHOOT AND SYSTEM

Troubleshoot or identify problem processes, start and stop a network service, configure a service start or not start at boot, use SystemD to start services, work with SystemD to manage runn services, use SystemD to manage the system.

TOTAL 30 Hours

H. Learning Resources:

Online Resources:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0135015524712366087298/overview

COURSE CODE	COURSE TITLE	L	T	P	C
10218AM937	Bash Shell Scripting Administration	2	0	0	0

A. Preamble:

This comprehensive course delves into Bash Shell scripting, providing participants with practical knowledge and skills to automate tasks, manipulate data, and optimize workflows. Starting from the basics of Bash Shell, participants progress through advanced topics, such as regular expressions and file processing commands. With real-world examples and hands-on exercises, participants gain proficiency in using Bash Shell scripting for various tasks.

B. Course Category: Value Added Course

C. Course Outcome:

The Students will be able to proficiently:

- Familiarity with command-line interface and basic commands
- Ability to work with files, test conditions, and patterns.
- Ability to configure access levels and system environment variables.
- Using regular expressions and substring operations effectively.
- Understanding input types and the pipe operator for command chaining.

F.Course Contents

Module–1: Introduction to Bash Shell **5 Hours**

Definition and Importance of Data Structures-What is a data structure?- Types of Data

Structures- Arrays: Definition and properties,-Advantages and disadvantages-Operations: insertion, deletion, traversal, searching, and sorting

Module–2: Getting Started **5 Hours**

File Text Size, Test Numbers, Checking Conditions, Multiple Digit Pattern, Checking If File Exists, Test File Exists, Script Output

Module–3: Shell Environment **5 Hours**

Introduction to Shell Environment, Command Program, Access Level Configuration, Booting Level Configuration, Booting Level Configuration Continue, System Admin Level Configuration, Networking Level Configuration, System Environment, User Configuration Files, Shell Special Variables. Array Declaration, Variable Declaration, Variable Declaration and Assignment

Module–4: Usage with String Manipulations **5 Hours**

String Manipulation and Internal Commands, Topic Structure, Regular Expressions, Square Bracket Round Bracket, Dot Character, Substring Length, Substring Removal.

Module–5: Commands-External and Internal **5 Hours**

Quick Revision on String Manipulation, Types of shell commands-External and Internal, Types of User Input, Pipe Operator. Lecture Introduction, Awk Introduction, Syntax and Dataset Familiarity, AWK for Column, Columns Extraction, Skipping the Header Row, Awk for Pattern Matching, Awk for Pattern Matching Continue, Dynamic Redirection of File Output, AWK Keyword, Status Variable, AWK for Grouping, What is Array, Statement Output, Total Female Population, Total Male Population, Percentage of Population, Peplinski Population

Module–6: Reading **5 Hours**

Internal Command, Reading from Single Variable, Reading from Array, Reading From File Introduction to Stacks Data Structure, Introduction to Stacks Data Structure Continue, Set Command Internal Command Set, Internal Command Unset, Intro to External Commands, External Command Cat External Command WC, Character Mode, Numerical Mode, Numerical Mode Continue, Searching Patterns in Multiple Files, Single File, Count Pattern Occurrence, Suppress Filename Headers Etc., Changing Ownership, Filter by Owner Before Change, External Command ENV, External Command CP, External Command MV, External Command Date, External Command ln, External Command ln Continue, Dataset Explanation for File Processing Commands, External Command-Essa-Jump to Line, Search for Pattern, External Command-Tail, External Command-Sort, External Command-Unit, External Command-PS, External Command Find, External Command Conclude

TOTAL 30 Hours

G. Learning Resources

i. Online Resources

1. https://infyspringboard.onwingspan.com/web/en/login?ref=%2Fapp%2Fsearch%2Flearning%3Flang%3Den%26q%3Dshell%2520scripts%2520administration%26f%3D%257B%257

COURSE CODE	COURSE TITLE	L	T	P	C
10218AM939	AWS Solutions Architect Professional	2	0	0	0

AWS Solutions Architect Professional

A. Course Overview

1. Network Access Control Lists (ACLs)
2. Configuring Network ACLs Using the AWS Console
3. Configuring Network ACLs Using the AWS CLI
4. Configuring Network ACLs Using PowerShell
5. Security Groups
6. Configuring Security Groups Using the AWS Console
7. Configuring Security Groups Using the AWS CLI
8. Configuring Security Groups Using PowerShell
9. Deploying AWS Network Firewall
10. AWS Web Application Firewall (WAF)

TOTAL 30 Hours

COURSE CODE	COURSE TITLE	L	T	P	C
10218AM941	Java Programming Fundamentals	2	0	0	0

A. Preamble

Java Programming Fundamentals is designed to introduce the fundamentals of Java programming and its object-oriented features. It will help out the learners to understand various keywords available in Java and Java's architecture. Also, this course will help learners to know the working of Java APIs through hands on approach.

B. Course Outcomes

The Students will be able to proficiently:

- Create Java programs using the fundamental programming constructs
- Implement and design a class based on attributes and behaviors of objects
- Develop Java code that demonstrates the working of different keywords in Java
- Explain and implement different Object-Oriented concepts in Java
- Develop Java code that uses the appropriate access modifiers, package declarations, import statements
- Identify, apply and understand the working of the most common APIs used in Java
- Explains about Exception Handling, Collections Framework and, Generics

- Determine the best practices that are to be followed in Java

C. Course Contents

Module – 1: **6 Hours**

About Java Programming Fundamentals, Introduction and Features of Java, Java Architecture, Java Development Kit

Module – 2: **6 Hours**

Data Types, Keywords and Identifiers, Operators, Type Casting, Widening and Narrowing, Conditional Statements, Control Flow and Looping, Arrays: Introduction to Arrays, Enhanced for loop

Module – 3: **6 Hours**

Object Oriented Concepts using Java, Class and Object, Constructors, this Keyword, Inheritance, Polymorphism, super keyword

Module – 4: **6 Hours**

Final Keyword, static Modifier, Variable Arguments, Enumerated Data Types, Abstract class Interface Package Access Modifiers Java Libraries

Module – 5: **6 Hours**

Exceptions, Generics, The Collections Framework, Date/Time APIs.

D. Learning Resources:

i. "Infosys Springboard", Accessed on December, 2023 [Online]. Available: https://infyspringboard.onwingspan.com/web/en/page/home

TOTAL 30 Hours

COURSE CODE	COURSE TITLE	Total Hours
10218AM942	Essential Mongo DB Administration	30

A. Preamble

The course places a strong emphasis on Mongo DB Essentials as a tool. It introduces essential techniques of performing CRUD operations on Modern Database. Additionally, it offers a brief overview of Sharding techniques, including replicas and cluster collections. These practices are essential for working with aggregation operators, exploring different aggregation stages, using MongoDB map reduce.

B. Course Category : Value Added Course

C. Course Outcomes

After successful completion of this course, the students are able to:

CO No's	Course Outcomes	K - Level
CO1	Illustrate the MongoDB queries to perform CRUD operations on document database.	K3
CO2	Apply Sharding Techniques to do backup and recovery	K3
CO3	Solve Aggregation problems using Map Reduce.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

D. Course Content:

Module I: MongoDB Overview 6 Hours

Install MongoDB, Access MongoDb Using Mongo 3T Studio, Introduction to MongoDB, MongoDB Document, Creating an AWS Server Instance, Establish Connection Using Putty. **MongoDb Replication:**Introduction to MongoDb Replication,Setting up Replica Set Servers, Configure Replica set, Connection Using Mongo Chef.

Module II: Working with Replica set Members 6 Hours

Election Process,Test Replica Set Election, Configure Priority, Configure Delayed, Hidden, and Arbitter Members.

Module III: Sharding your MongoDb Cluster 6 Hours

Components of Sharded Cluster, Sharding Workflow**, Sharding Techniques:** Setting up replica sets, setting Up config servers and MongoS Server, Adding Shards, Sharding a Collection**.**

Module IV Administration and security **6 Hours**

Practicing MongoDB backup and Restore Techniques, Exploring User Roles and authorization, Working with Journaling, Discovering importance of Profiler,

Module V Aggregation Techniques **6 Hours**

Working with Aggregation operators, exploring different Aggregation Stages, Using MongoDB Map Reduce.

E. Learning Resources **Total 30 Hours**

i. Text Books:

1]MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow, O'Reilly.

ii. **Online Resources**

1]https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_013177169294712832113_shared/overv iew (MongoDB)

COURSE CODE	COURSE TITLE	L	T	P	C
10218AM947	Data Structures and Algorithms using Python - Part 1	2	0	0	0

A. Preamble

Provides foundation of Data Structures using python programming. Discuss frequently used linear data structures like Stack, Queue, and List ADT. This course includes the commonly performed operations on linear data structures like insert, update, delete, search etc. and also provide insights on non - linear data structures.

B. Course Outcomes

The Students will be able to

- Create python program for all data structure ADT
- Implements list ADT using Array and Linked List
- Explain and implement Stack and Queue ADT
- Implements non-linear data structure such as Tree and Graph ADT using python programming.
- Visualizing linear data structures such as Linked List, Stack and Queue

C. Course Contents

Module – 1: **6 Hours**

Introduction to Data Structure using Python, List ADT implementation using Array - CRUD Operation- Assessment on List using string, object and array.

Module – 2: **6 Hours**

List ADT implementation using Linked List -CRUD Operation- Comparison between Array and Linked List Implementation. Exercise on Linked List basics, number and object. Assessment on Linked List using character, object and numbers.

Module – 3: **6 Hours**

Stack ADT implementation using Array and Linked List such as push and pop operation- Application of Stack- Exercise on stack of number and object.

Module-4: **6 Hours**

Queue ADT implementation using Array and Linked List such as enqueue and dequeue operation- types of queue- stack vs queue- Exercise on queue of number and object.

Module-5: **6 Hours**

Non Linear Data Structures – Tree ADT – Graph ADT- Visualizing Linear Data Structures-Linked List, Stack and Queue ADT.

D. Learning Resources: **Total 30 Hours**

1. "Infosys Springboard", Accessed on December, 2023 [Online].
Available: https://infyspringboard.onwingspan.com/web/en/page/home

COURSE CODE	COURSE TITLE	L	T	P	C
10218AM948	Computer Vision- Theory and Projects in Python for Beginners	2	0	0	0

A.Preamble:

Computer vision is a rapidly advancing area of computer science and artificial intelligence that enables machines to interpret and make decisions based on visual data from the world around them. Learn about key computer vision techniques and algorithms such as edge detection, segmentation, object recognition, and motion analysis.

Course Category: Value Added Course

Course Outcome:

The Students will be able to proficiently:

- Discover the key concepts covered in this course
- Describe basic concepts in Computer Vision
- Compare image processing to Computer Vision
- Compare image processing to traditional methods of solving image problems
- Illustrate how AI can be part of a Computer Vision solution

F.CourseContents

Module–1: Introduction to Computer Vision **6 Hours**

Overview of computer vision- Applications of computer vision- History and evolution of the field- Basic image formation and representation

Module–2: Computer Vision Vs Image Processing **6 Hours**

Image acquisition and color spaces-Image enhancement techniques (histogram equalization, filtering)- Noise reduction and smoothing-Edge detection (Sobel, Canny)

Module–3: Traditional Solution to Vision Problems **6 Hours**

Keypoint detection (Harris corner detector, SIFT, SURF)- Feature descriptors (BRIEF, ORB)- Feature matching and homography-Applications in panorama stitching

Module–4: AI Driven to CV Solution **6 Hours**

String Manipulation and Internal Commands, Topic Structure, Regular Expressions, Square Bracket Round Bracket, Dot Character, Substring Length, Substring Removal.

Module–5: Landscape of CV Tools and Models **6 Hours**

Stereo vision and depth maps-Structure from motion-3D reconstruction techniques- Applications in augmented reality and robotics

Total 30 Hours

D. Learning Resources:

i.Text Books

1. Jian-Huang Lai, Cheng-Lin Liu, et al, "Pattern Recognition and Computer Vision: First Chinese Conference", PRCV 2018, Guangzhou, China, November 23-26, 2018, Proceedings, Part I: 11256 (Lecture Notes in Computer Science). | 2 November 2018
2. Numerical Algorithms: Methods for Computer Vision, Machine Learning, and Graphics (https://people.csail.mit.edu/jsolomon/share/book/numerical_book.pdf) - Justin Solomon 2015

ii. Reference Book

1. Computer Vision: A Modern Approach (2nd edition) -David Forsyth and Jean Ponce 2011

iii. Online Resources

1. https://infyspringboard.onwingspan.com/web/en/viewer/html/lex_auth_01350158250097049612176

COURSE CODE	COURSE TITLE	L	T	P	C
10218AM949	Deep Learning and Neural Networks	2	0	0	0

1. Course Overview
2. Understanding Deep Learning
3. Understanding Neurons
4. Training a Neural Network
5. Convolutional Neural Networks (CNNs)
6. Recurrent Neural Networks (RNNs)
7. Natural Language Processing (NLP)
8. Attention-based Models and Transformers
9. Generative Adversarial Networks (GANs)
10. Reinforcement Learning

A. Learning Resources: **Total 30 Hours**

1. "Infosys Springboard", Accessed on December, 2023 [Online]. Available: https://infyspringboard.onwingspan.com/web/en/page/home

COURSE CODE	COURSE TITLE	L	T	P	C
10218AM950	Exploratory Data Analysis Using R	2	0	0	0

1. Prelude
2. Introduction
3. Exploratory Data Analysis Process
4. Information Measure
5. Kullback-Leibler Divergence
6. Capstone Project- Exploratory Data Analysis

A. Learning Resources: **Total 30 Hours**

1. "Infosys Springboard", Accessed on December, 2023 [Online]. Available: https://infyspringboard.onwingspan.com/web/en/page/home.

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Minutes of 12th meeting

Of

Board of Studies

DEPARTMENT OF BIOMEDICAL ENGINEERING

Date: 29/06/2024

Time: 10:00 AM

Venue: B-2406

12th Board of Studies Minutes Department of Biomedical Engineering, School of Electrical and Communication 29th June 2024

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

School of Electrical and Communication

DEPARTMENT OF BIOMEDICAL ENGINEERING

Minutes of Meeting for 12th BoS

Date: 29/06/2024

Time: 10 am

Venue: Room no. 2406

The 12th BoS meeting for B-Tech for the Department of Bio-Medical Engineering was held on 29th June 2024 with the presence of external and internal BoS members. The meeting started with greetings and approval of the 11th MoM held on 28/01/24 by the Head of the Department Dr. D. Balasubramaniam. The agenda items of the meeting are:

12.1 Approval of MoM for 11th BoS held on 08/01/2024
12.2 Changes in Course Content
12.3 Changes in COs and K level
12.4 NPTEL Courses
12.5 Others

Dr. Deepa presented the agendas, followed by the respective faculties' presentation of the respective agendas.

Discussion:

Agenda 12.1: Approval of MoM for 11th BoS held on 08/01/2024

Members approved the Minutes of 11th BoS held on 28/01/2024

Agenda 12.2: Changes in the content

The following changes in the course have been presented and discussed

S. No.	OLD COURSE CODE & NAME	NEW COURSE CODE & NAME	DISCUSSION & ACTION TAKEN
1	10211BM102- Analog and Digital Integrated Circuits	There are no changes in the code and name as the changes are less than 20%	The changes have been recommended
2	10210BM101- Biology for Engineers	10210BM101- Biology for Engineers	It can be simplified and remove the subtopic

3	10211BM104 - Engineering Mechanics	10211BM114 - Engineering Mechanics and its Applications	The changes have been recommended
4	10212BM113- Predictive Analysis of Medical Data	10212BM115-Medical data analysis	The changes have been recommended
5	10212BM124 - High-Performance Computing	10212BM209- GPU Architecture and Programming	The changes have been recommended
6	10212BM123- Computer Vision	It is offered for the first time, no need to change the code and name	The changes have been recommended
7	10212BM208- Introduction to Computer Vision	Same as 10212BM123- Computer Vision with the inclusion of Lab	The changes have been recommended
8	10212BM304 - Essential Python Modules for Machine Learning Laboratory	10212BM207- Programming Essentials in Python	The changes have been recommended
9	10212BM110 - Natural Language Processing	-	It has been removed from the specialization elective course list. If students are interested they can take it as an open elective

Agenda 12.3: Changes in COs and K level

S. No.	Course Code	Course Name	Suggestion
1	10213BM117	Drone Technology in Healthcare	Change of K4 to K2 level for CO2 has been recommended. All the COs have been reframed

Agenda 12.4 NPTEL Courses

The following course has been discussed to offer as an open elective for another department student

S. No.	Course Code	Course Name	Suggestion & Action taken
1	10213BM401	Design & Implementation of Human-Computer Interfaces	The course has been recommended
2	10213BM402	Nanomaterials and their Properties	The course has been recommended
3	10213BM403	Introduction to Biomedical Imaging Systems	The course has been recommended

12th Board of Studies Minutes Department of Biomedical Engineering, School of Electrical and Communication 29th June 2024

Agenda 12.:5 Others

Discussion

The student's representative presented the difficulty of writing observations and records and the insufficiency of exam timing. In addition, the student representative stated the inclusion of core companies and the introduction of a specialization course based on hardware. She also state the vast syllabus of Diagnostic and therapeutic Equipments and the content of Natural language processing course.

Action:

The member recommended giving the manual to the student and asking only to write the observation and results. The maintenance of the record can be kept as it is. The list of core companies has already been submitted to the placement department. Regarding Diagnostic and therapeutic Equipments member recommended to reduce and Natural language processing course taken as open elective with students interest from other department.

Annexure 1- Agenda no. 12.2- Rearrangement and changes in course content

10211BM102 - Analog and Digital Intergraded Circuits

Unit	Existed Syllabus	Proposed syllabus	Remarks
Unit I	**BJT, FET, and OP-AMP 12** Transistor as an amplifier, Methods of Transistor biasing- fixed bias, voltage divider, Emitter feedback bias and Bias stability. Biasing the FET, Biasing MOSFET. Characteristics and applications of operational amplifiers - difference amplifier, adder, subtractor, integrator, differentiator, instrumentation amplifier.	**Introduction to OP-AMP 9** VI Characteristics of BJT, FET and MOSFET; Transistor as an amplifier, Transistor as an amplifier, Methods of Transistor biasing- fixed bias, voltage divider, Emitter feedback bias and Bias stability. Characteristics and applications of operational amplifiers - difference amplifier, adder, subtractor, integrator, differentiator, instrumentation amplifier.	Biasing the FET, Biasing MOSFET. -vast topic next time will try to give separate unit or course. VI Characteristics of BJT, FET and MOSFET; -Warm-up for before electronics basics
Unit II	**Oscillators and 555 Timer 12** Oscillators- Classification of Oscillators, Barkhausen Criterion, General form of an LC Oscillator, Hartley oscillator, Colpitts oscillator, Tuned Collector Oscillator, RC oscillator, Wein-Bridge Oscillator, waveform generator, Multivibrators. Introduction to 555 timer; Astable and monostable operation of 555 timer, Schmitt Trigger using 555 timer, Applications of 555 in Astable and Monostable operation	**Oscillators and 555 Timer 9** Oscillators- Classification of Oscillators, Barkhausen Criterion, General form of an LC Oscillator, Hartley oscillator, Colpitts oscillator, RC oscillator, Wein-Bridge Oscillator, Introduction to 555 timer; Astable and monostable operation of 555 timer, Schmitt Trigger using 555 timer, Applications of 555 in Astable and Monostable operation	Tuned Collector Oscillator, waveform generator, Multivibrators. -vast topic next time will try to give separate unit or course.
Unit III	**Number system & Boolean algebra 12** Number system; Base conversion methods; compliments- 1's and 2's compliment, Codes- BCD- 2421- Excess 3- Gray and ASCII, [Error detection and Error Correction using Hamming Code] Boolean Algebra: Basic theorems and	**Number system & Boolean algebra 10** Number system; Base conversion methods; compliments- 1's and 2's compliment, Codes- BCD- 2421- Excess 3- Gray and ASCII, Boolean Algebra: Basic theorems and properties- Boolean laws and De-Morgan's theorem, Canonical	[Error detection and Error Correction using Hamming Code] -vast topic next time will try to give separate

	properties- Boolean laws and De-Morgan's theorem, Canonical & Standard form, Boolean algebraic simplification and realizing using logic gates, K-Map.	& Standard form, Boolean algebraic simplification and realizing using logic gates, K-Map.	unit
Unit IV	**Combinational Logic, Sequential Machine and Circuit Analysis 15** Combinational Logic: Introduction- Arithmetic circuits, Comparators, Decoders and encoders, Multiplexers and De-multiplexers. Fundamentals of sequential machine operation, Storage elements- Latches & Flip-flops (D-Flip-flop, T-Flip-flop, J-K flip-flop and Clocked flip-flops), Counters-Design of single mod counter- ripple counter- ring counters, Registers- Shift register sequences. State Diagram, Approaches to the design of synchronous sequential finite state machines (ASM); State reduction steps.	**Combinational and Sequential Logic Circuit 10** Combinational Logic: Introduction- Arithmetic circuits, Comparators, Decoders and encoders, Multiplexers and De-multiplexers. Fundamentals of sequential machine operation, Storage elements- Latches & Flip-flops (D-Flip-flop, T-Flip-flop, J-K flip-flop and Clocked flip-flops), Counters- ripple counter, ring counters, Registers- Shift register sequences. State Diagram.	Design of single mod counter- Approaches to the design of synchronous sequential finite state machines (ASM); State reduction steps. -vast topic next time will try to give separate unit
Unit V	**UNIT V Signal Conversion 9** A/D and D/A converters: Weighted-resistor D/A converter; R-2R Ladder D/A converter; Parallel comparator A/D converter; Successive-approximation A/D converter.	**UNIT V A-D and D-A Conversion 7** A/D and D/A converters: Weighted-resistor D/A converter; R-2R Ladder D/A converter; Parallel comparator A/D converter; Successive-approximation A/D converter.	NO CHANGES

10210BM101 - Biology for Engineers

Unit	Existed Syllabus	Proposed syllabus	Remarks
Unit I	**EVOLUTION AND CELL BIOLOGY 6** Relevance of Biology in Engineering ; Origin of Life , Cell biology -Cell theory, Types of cell, structure and function of Cell Organelles; Introduction to Nucleic acids (DNA, RNA)	**EVOLUTION AND CELL BIOLOGY 6** Relevance of Biology in Engineering ; Origin of Life , Cell biology -Cell theory, Types of cell, structure and function of Cell Organelles; Introduction to Nucleic acids (DNA, RNA)	NO CHANGES
Unit II	**HUMAN PHYSIOLOGY 6** Circulatory system- conduction system of the Heart -ECG; Respiratory system-Mechanism of Respiration- Lung volume & pressure; Nervous system (CNS&PNS)-Function of Neurons-Action Potential- Synaptic Transmission ; Skeletal system- properties of bones, joints and	**HUMAN PHYSIOLOGY 6** Circulatory system- conduction system of the Heart -ECG; Respiratory system-Mechanism of Respiration- Lung volume & pressure; Nervous system (CNS&PNS)-Function of Neurons-Action Potential-Synaptic Transmission ;	Skeletal system- properties of bones, joints and movement of joints. -vast topic next time will try to give separate unit
Unit III	**IMMUNOLOGICAL SCIENCE & APPLICATIONS OF MICROBES 6** Introduction to the Immune systems - Antibody function; Introduction to Cancer Biology; Introduction to Microorganisms- Applications in Industry & Medicine.	**IMMUNOLOGICAL SCIENCE & APPLICATIONS OF MICROBES 6** Introduction to the Immune systems - Antibody function; Introduction to Cancer Biology; Introduction to Microorganisms- Applications in Industry & Medicine.	NO CHANGES
Unit IV	**ENGINEERING CONCEPTS IN BIOLOGY 6** Biomolecules – Carbohydrates, Lipids, Proteins (qualitative aspect); Micro and Nano Sensors for detection of Biomolecules, Bioinformatics & Bioenergy; Biosafety.	**ENGINEERING CONCEPTS IN BIOLOGY 6** Biomolecules – Carbohydrates, Lipids, Proteins (qualitative aspect); Micro and Nano Sensors for detection of Biomolecules, Bioinformatics & Bioenergy; Biosafety.	NO CHANGES

10211BM114-Engineering Mechanics and its Applications

Unit V	**ADVANCES IN BIOLOGICAL SCIENCES 6** Introduction to Biomaterials; Bio Mechanics - Gait Analysis, Brain Computer Interface; Stem Cell Technology; Basic principles of Tissue Engineering;	**ADVANCES IN BIOLOGICAL SCIENCES 6** Introduction to Biomaterials; Bio Mechanics - Gait Analysis, Brain Computer Interface; Stem Cell Technology; Basic principles of Tissue Engineering;	NO CHANGES

12th Board of Studies Minutes Department of Biomedical Engineering, School of Electrical and Communication 29th June 2024

Unit	Existed Syllabus	Proposed syllabus	Remarks
Unit - 1	**UNIT I BASICS & STATICS OF PARTICLES** Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem – Vectors – Vectorial representation of forces and couples – Vector operations: additions, subtraction, dot product, cross product – ~~Coplanar Forces~~ – Resolution and Composition of forces – Equilibrium of a particle – Equivalent systems of forces – Principle of transmissibility – ~~Single equivalent force.~~	**UNIT I BASICS & STATICS OF PARTICLES** Introduction – Units and Dimensions – Laws of Mechanics – Vectors – Vectorial representation of forces and couples – Vector operations: additions, subtraction, dot product, cross product– Resolution and Composition of forces – Equilibrium of a particle – **Lami's theorem**–– Principle of transmissibility – **Equivalent systems of forces and simple problems.**	• Coplanar forces, triangular law of forces and single equivalent force are a vast topic. So, next time will try to give separate unit. • Parallelogram and triangular Law of forces comes under laws of mechanics, so it is removed. • Lami's theorem and Equivalent systems of forces have to be placed after understanding the basic concepts of mechanics. • Simple problems to be dealt to meet the available contact hours with respect to Equivalent systems of forces (& simple problems)
Unit - 2	**UNIT II EQUILIBRIUM OF RIGID BODIES** Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force ~~about a point and about an axis~~ – Scalar components of a moment – Varignon's theorem – ~~Equilibrium of Rigid bodies in two dimensions~~	**UNIT II EQUILIBRIUM OF RIGID BODIES** Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force and simple problems– Scalar components of a moment – Varignon's theorem.	• Students feel difficulty to understand this topic 'Moment of a force about a point and about an axis', So this has been changed to Moment of a force and simple problems. • Students feel difficulty to understand this topic 'Equilibrium of Rigid bodies in two dimensions'.
Unit - 3	**UNIT III PROPERTIES OF SURFACES AND SOLIDS** ~~Determination of Areas and Volumes – First moment of area and the~~ Centroid of sections – ~~Second and product moments of plane area~~ – Parallel axis theorem and perpendicular axis theorem	**UNIT III CENTRE OF GRAVITY AND MOMENT OF INERTIA** **Centriod- Methods of determining the centroid- Centroid of symmetrical sections- Centroid of unsymmetrical sections – Moment of Inertia- Moment of inertia of plane area**– Parallel axis theorem- Perpendicular axis theorem.	• Students feel difficulty to understand this topic, 'Determination of Areas and Volumes – First moment of area-Second and product moments of plane area. • To enhance clarity for the students the removed contents has been elaborated (with suitable title) as Centriod- Methods of determining the centroid- Centroid of symmetrical sections- Centroid of unsymmetrical

			sections – Moment of Inertia- Moment of inertia of plane area.
Unit - 4	**UNIT IV BASICS OF MECHANICS OF FLUIDS** Fluids – density – pressure – blood pressure and gravity – buoyancy – ~~moments of force and stability - movement in water~~ – Newton's laws of viscosity – Definitions and simple problems on Newtonian fluid, Non-Newtonian fluid.	Fluids – density – pressure – blood pressure and gravity – buoyancy – Newton's laws of viscosity – Definitions and simple problems on Newtonian fluid, Non-Newtonian fluid.	•Students feel difficulty to understand this topic,'moments of force and stability –movement in water.
Unit - 5	**UNIT V DYNAMICS OF PRACTICLES & FRICTION** Frictional force – Laws of Coulomb friction – simple contact friction – Belt friction – Roller friction. ~~Translation and Rotation of Rigid Bodies - General Plane motion.~~	Frictional force – Laws of Coulomb friction– simple contact friction – Belt friction – Roller friction.	Students feel difficulty to understand this topic so the topic 'Translation and Rotation of Rigid Bodies – General Plane motion' is removed.

10212BM113 - Predictive Analysis of Medical Data (Honors) ---> 10212BM115- Medical Data Analytics			
Units	**Original**	**Modified**	**Reason**
4	Biomedical Image Analysis - Mining of sensor data in healthcare - Biomedical Signal Analysis- Data analytics for Pervasive Health-Fraud detection in healthcare-Data analytics for pharmaceutical discoveries.	Biomedical Image Analysis - Biomedical Imaging Modalities, Object Detection, Image Segmentation and Registration, and Feature extraction. Biomedical Signal Analysis - Types of Biomedical Signals, ECG signal Analysis, Denoising of Signals, Multivariate Biomedical Signal Analysis and Recent Trends.	Each topic is very vast and covers many topics. So, they are trimmed to be specific applications by including micro-topics in each of them
5	Genomic Data Analysis for Personalized Medicine, Clinical Prediction model, Predicting models for Integrating clinical and genomic data. Clinical decision support systems -Computer-assisted medical image analysis system - Mobile imaging and analytics of Biomedical Data.	Mining of sensor data in healthcare - Scope, Challenges in Healthcare Data Analysis, Sensor Data Mining Applications and Nonclinical Healthcare Applications. Fraud Detection in Healthcare - Definition, Types, Identifying Healthcare Fraud from Data, Knowledge Discovery-Based Solutions for Identifying Fraud. Social Media Analytics for Healthcare - Social Media Analysis for Detection and Tracking of Infectious Disease, Social Media Analysis for Public Health Research and Analysis of Social Media Use in Healthcare	

10212BM113 - Predictive Analysis of Medical Data (Honors) ---> 10212BM115 - Medical Data Analytics			
COs	**CO Changes**		**K Levels**
CO4	Outline the usage of data in personalized medicine	Predict diseases using biomedical image and signal analysis	K2
CO5	Acquire knowledge on the latest available technology for data analysis in healthcare.	Mine data and utilize data analysis to prevent fraud and to detect infectious diseases	K2

10212BM113 - Predictive Analysis of Medical Data (Honors) ---> 10212BM115 - Medical Data Analytics			
COs	**CO Changes**		**K Levels**
CO3 - same as CO2 and changed here	Get knowledge on and will be able to use Decision trees algorithm Describe about the decision tree algorithm and will be able to use them for various applications.	Understand and apply dimensionality reduction technique for data analysis	K2

12th Board of Studies Minutes Department of Biomedical Engineering, School of Electrical and Communication 29th June 2024

Course Code	Course Title	L	T	P	C
10212BM122	**GPU Architecture and Programming**	**3**	**0**	**1**	**4**

Unit No	Content to be removed	Content Added/modified to	Reason
2	Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.	Cuda programing template for Hello world, CUDA code for printing global thread ID, CUDA code for vector addition, CUDA code for matrix addition and Multiplication	Single GPU is not included, the syllabus jumped into multi GPU directly
4	OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples	Origin of OpenCL, CUDA and OpenCL correspondence, OpenCL-Platform model, execution model, memory model and programing model. OpenCL Host code and kernel code. Simple examples	Elaborated the syllabus / micro syllabus contents
5	Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster	Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster (only theoretical explanation)	Considering the students background knowledge in programing, it is limited to theoretical explanation)

12th Board of Studies Minutes Department of Biomedical Engineering, School of Electrical and Communication 29th June 2024

CO Changes

CO	Old	New	Level
CO1	Describe GPU Architecture	Describe GPU hardware architecture Solve problems on thread, block , gird associated with software abstraction	K3
CO2	Write programs using CUDA, considering memory, thread usage & resource contentions	Write simple CUDA programs for mathematical operations like addition and multiplication	K3
CO3	Explain data movement issues in shared program architecture in HPC	Describe different performance improving techniques for deep learning models	K2
CO4	Work with OpenCL environment	Compare the software model with OpenCL and GPU	K2
CO5	Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication	Explain how different algorithms written for CPU processing can be parallelised for GPU	K2

12th Board of Studies Minutes Department of Biomedical Engineering, School of Electrical and Communication 29th June 2024

Course Code	Course Title	L	T	P	C
10212BM207	Programming essentials in Python	**1**	**0**	**2**	**2**

a) Course Category

Specialization/Integrated

b) Preamble

This course gives an introduction on classification using neural networks which is used in most biomedical applications.

c) Prerequisite

10210CS201-Python Programming

d) Related Courses

Image Processing, Machine Learning.

e) Course Outcomes

Upon the successful completion of the course, students will be able to:

CO Nos.	Course outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Write, test python programs and import basic packages.	K3
CO2	Write programs in python to process data by utilizing the modules Numpy, Pandas etc.	K3
CO3	Write programs in python to process data using program flow controls.	K3
CO4	Write programs in python to create functions and modules.	K3
CO5	Write programs in python to use packages.	K3

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	2	2			3								2		3
CO 2	2	2			3								2		3
CO 3	1	2	3	1	3				2	2			3		3
CO 4	2	2			3								2		3
CO 5	2	2			3								2		3

f) Course content

UNIT - 1: BASICS OF PYTHON - 03

Overview and fundamentals of python, executing simple programs, exploring python variables, operators and comprehend python blocks.

UNIT - 2: DATA TYPE CONVERSIONS - 03

Type conversions – Implicit type and Explicit type, list to tuple, tuple to list.

UNIT - 3: PROGRAM FLOW CONTROLS - 03

Indentation, conditional blocks, control statements, looping statements, break statements, for loop, while loop – Examples.

UNIT - 4: FUNCTIONS AND MODULES - 03

Create your own functions, Functions parameters, Variable Arguments, Scope of a Function, Function Documentations, Lambda Functions & map – Examples, Create a Module, Standard Modules.

UNIT - 5: PACKAGES & DATA ANALYSIS - 03

Creating packages, NumPy, SciPy, Pandas, Matplotlib

15 Hrs.

LIST OF EXPERIMENTS

1. Implementation of simple python program by installing and exploring python IDE.
2. Import basic packages, libraries and execute programs in python IDE.
3. Write a python program to implement basic data types – Strings, Numeric, List data types and Tuples.
4. Write a python program to create and manipulate one-dimensional and two-dimensional Numpy arrays.
5. Write a pandas program to create and display a DataFrame from a specified dictionary data which has the index labels.
6. Write a pandas program to join and merge data frames.
7. Write a python program to define constants, variables and placeholders using Tensorflow.
8. Write a python program to define functions in Tensorflow.
9. Write a python program to do mathematical operations on Tensor/Matrix.
10. (a) Write a python program to convert image array to a new color space using skimage.

10. (b) Write a python program for conversions between one color space to another color space using skimage.

30 Hrs.

Total: 45 Hrs.

Learning Resources

Text Books

1. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.
2. Charles Dierbach, “Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

Reference Books

1. John V Guttag, “Introduction to Computation and Programming Using Python’’, Revised and expanded Edition, MIT Press, 2013.
2. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd., 2015.

Web sources/videos:

1. https://www.geeksforgeeks.org/python-programming-language

Course Code	Course Title	L	T	P	C
10211BM102	**Analog and Digital Integrated Circuits**	**2**	**1**	**0**	**3**

a) Course Category

Program core

b) Preamble

Every medical instrument whether it is diagnostic or therapeutic does not come without basic electronics circuits like an Instrumentation amplifier. This course gives an insight into the design of such equipment

c) Prerequisite

NIL

d) Related Courses

Microprocessor and Microcontroller, Sensors and Transducers, Circuit Theory.

e) Course Outcomes

Upon the successful completion of the course, students will be able to:

CO Nos.	Course outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Design Biasing circuits for Transistor Design simple mathematical circuits using opamp	K3
CO2	Design various wave shaping circuits with op amp and 555 timers	K3
CO3	Solve problems on number system Use Boolean algebra to simplify digital circuits	K3
CO4	Apply the concept of counters, flip flops, registers and combinational logic in digital circuits	K3
CO5	Solve problems on A/D and D/A converters	K3

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2
CO 1	3	2	1									1	2	
CO 2	3	2	1									1	2	
CO 3	3	1	1									1	1	
CO 4	3	2	1		1					1		1	1	
CO 5	3	1	1		1				1			1	1	

UNIT I BJT, FET, and OP-AMP 9

Transistor as an amplifier, Methods of Transistor biasing- fixed bias, voltage divider, Emitter feedback bias and Bias stability. Biasing the FET, Biasing MOSFET. Characteristics and applications of operational amplifiers - difference amplifier, adder, subtractor, integrator, differentiator, instrumentation amplifier.

UNIT II Oscillators and 555 Timer 9

Oscillators- Classification of Oscillators, Barkhausen Criterion, General form of an LC Oscillator, Hartley oscillator, Colpitts oscillator, Tuned Collector Oscillator, RC oscillator, Wein-Bridge Oscillator, waveform generator, Multivibrators. Introduction to 555 timer; Astable and monostable operation of 555 timer, Schmitt Trigger using 555 timer, Applications of 555 in Astable and Monostable operation

UNIT III Number system & Boolean algebra 9

Number system; Base conversion methods; compliments- 1's and 2's compliment, Codes- BCD-2421- Excess 3- Gray and ASCII, [Error detection and Error Correction using Hamming Code] Boolean Algebra: Basic theorems and properties- Boolean laws and De-Morgan’s theorem, Canonical & Standard form, Boolean algebraic simplification and realizing using logic gates, K-Map.

UNIT IV Combinational Logic, Sequential Machine and Circuit Analysis 9

Combinational Logic: Introduction- Arithmetic circuits, Comparators, Decoders and encoders, Multiplexers and De-multiplexers. Fundamentals of sequential machine operation, Storage elements- Latches & Flip-flops (D-Flip-flop, T-Flip-flop, J-K flip-flop and Clocked flip-flops),

Counters-Design of single mod counter- ripple counter- ring counters, Registers- Shift register sequences. State Diagram, Approaches to the design of synchronous sequential finite state machines (ASM); State reduction steps.

UNIT V Signal Conversion **9**

A/D and D/A converters: Weighted-resistor D/A converter; R-2R Ladder D/A converter; Parallel comparator A/D converter; Successive-approximation A/D converter.

Total: 45 Hrs

g) Learning Resources

Text Books

1. Electronic Devices and Circuits – S Salivahanan, N Suresh Kumar. Mc Graw Hill Education 4th 2016 edition.
2. D. Roy Chowdary, Sheil B Jani- Linear Integrated circuits- new age publication, 2003 edition.
3. M. Morris Mano- Digital Design- pearson- fourth edition

Reference Books

1. Jacob Milliam Halkias- Electronic devices and circuits- printis hall of india 2010 edition.
2. Allan Mottershed- Electronic devices and circuits an introduction- printis hall of India 2011 edition.
3. Donald P Leach- Digital principles and applications-pearson- seventh edition

Course Code	Course Title	L	T	P	C
10211BM114	**Engineering Mechanics and its Applications**	**2**	**1**	**0**	**3**

a) Course Category

Program core

b) Preamble

This course provides an introduction to the basic concepts of forces, inertias, centroids, and moments of area and techniques of finding their effects on motion. It introduces the phenomenon of friction and its effects. It introduces students to cognitive learning in applied mechanics and develops problem-solving skills in both theoretical and engineering oriented problems.

c) Pre-Requisite

10210MA203-Vector Calculus & Complex variable

d) Related Courses

None

e) Course Outcomes

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Solve engineering problems using the principles of statics of particles	K2
CO2	Establish the magnitude of forces and moments acting on rigid bodies	K2
CO3	Define properties and theories related to surfaces and solids	K3
CO4	Solve engineering problems on basics of fluid mechanics and relate it to bio-fluids.	K3
CO5	Describe the principles of dynamics of particles and various types of friction.	K2

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO	3	1	3											1	

1															
CO 2	3	1	3										1	1	
CO 3	3	1	3										1	1	
CO 4	3	1	3										1	1	
CO 5	3	1	3										1	1	

f) Course Content

UNIT I BASICS AND STATICS OF PARTICLES

Introduction – Units and Dimensions – Laws of Mechanics – Vectors – Vectorial representation of forces and couples – Vector operations: additions, subtraction, dot product, cross product– Resolution and Composition of forces – Equilibrium of a particle – Lami's theorem – Principle of transmissibility – Equivalent systems of forces and simple problems.

UNIT II EQUILIBRIUM OF RIGID BODIES

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force and simple problems– Scalar components of a moment – Varignon's theorem.

UNIT III CENTRE OF GRAVITY AND MOMENT OF INERTIA

Centroid- Methods of determining the centroid- Centroid of symmetrical sections- Centroid of unsymmetrical sections – Moment of Inertia- Moment of inertia of plane area– Parallel axis theorem- Perpendicular axis theorem.

UNIT IV BASICS OF MECHANICS OF FLUIDS

Fluids – density – pressure – blood pressure and gravity – buoyancy –Newton's laws of viscosity – Definitions and simple problems on Newtonian fluid, Non-Newtonian fluid.

UNIT V DYNAMICS OF PRACTICLES & FRICTION

Frictional force – Laws of Coulomb friction – simple contact friction – Belt friction – Roller friction.

Total: 45 Hrs

g) Learning Resources

Text Books

1. R.S.Khurmi, A Text Book of Engineering Mechanics, S Chand and Company (P) Ltd., New Delhi. Revised Edition, 2019.
2. S.Timoshenko, D.H.Young, J.V.Rao, Sukumar Pati, Engineering Mechanics, McGraw Hill Education (India) Private Limited., 2018.
3. Dr. R. K. Bansal, A Text Book of Fluid Mechanics, Laxmi Publications (P) Ltd., New Delhi. 2018.
4. Kumar, K. L., Engineering Mechanics, Tata McGraw- Hill, New Delhi, 2019.

References

1. Palanichamy, M. S., and Nagan, S., Engineering Mechanics (Statics and Dynamics), Tata McGraw Hill, New Delhi 2012.
2. Shames, I. H., and Krishna Mohana Rao, G., Engineering Mechanics (Statics and Dynamics), Dorling Kindersley India) Pvt. Ltd. (Pearson Education), 2019.
3. Beer, F. P., and Johnston, E. R., Vector Mechanics for Engineers – Dynamics and Statics, Tata McGraw-Hill, New Delhi, 2011.
4. Natarajan, K.V., Engineering Mechanics, Dhanalakshmi Publishers, 2011.
5. Lee Waite, ―Bio fluid Mechanics in Cardiovascular Systems‖, The McGraw-Hill Companies, 2016.

Course Code	Course Title	L	T	P	C
10212BM123	**Computer Vision**	**3**	**0**	**0**	**3**

a) Course Category:
Specialization

b) Preamble
Computer Vision is a field of AI which deals with understanding and extracting information from digital images and videos. This course provides an outline of important notions in the field of computer vision

c) Prerequisite:
10211BM204 - Image Processing

d) Related Courses
Image analysis and machine vision

e) Course Outcomes:
Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Do analysis and synthesis of texture of images	K2
CO2	Explain the need for segmentation in computer vision and compare the different segmentation algorithms applied to computer vision Solve problems on clustering algorithms	K3
CO3	Compare the various ways by which image stitching and image aligning algorithm is working	K2
CO4	Explain how deep learning is applied in computer vision	K3
CO5	Explain the steps in creating a computer aided diagnostic tool	K2

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	1	1	2	3										3
CO 2	3	2	1	2	3										3
CO 3	3	2	1	2	3										3
CO 4	3	2	2	2	3	3									3
CO 5	3	2	3	2	3	3									3

UNIT-1 TEXTURE REPRESENTATION 08 Hrs

Computer vision an Introduction, Local texture representation using filters- Spots and bars, Filter output to texture representation, Shape from texture-Shape from texture for planes, shape from texture for curved surfaces, Analysis and synthesis of texture

UNIT-II SEGMENTATION BY CLUSTERING 10 Hrs

Image segmentation by clustering pixels-Basic clustering methods, the watershed algorithm, Segmentation using K means, Clustering and segmentation with mean shift, Segmentation, clustering and graphs-Terminology and facts for graphs, Agglomerative Clustering with a graph, Divisive clustering with the graph

UNIT-III IMAGE ALIGNMENT AND STITCHING 09 Hrs

Pairwise alignment- 2D alignment using least squares, Iterative algorithms, Robust least squares and RANSAC. Image stitching- parametric motion models, Rotational panoramas, Gap closing, cylindrical and spherical coordinates. Global Alignment- bundle adjustment and parallax removal.

UNIT-IV INTRODUCTION TO DEEP LEARNING 10 Hrs

Introduction to Deep Neural Networks- Weights and layers, Activation functions, Regularization and normalization, Loss function, Back propagation. Convolutional Neural Networks- Pooling and Unpooling, Network Architectures, Application of CNN (Digit Classification). Introduction to 3D CNNs.

UNIT-V STEPS IN CREATING A CAD DIAGNOSTIC TOOL 08 Hrs

What is computer vision in healthcare, Key applications in healthcare, issues with medical image database, Data de-identification, Data annotation. Finding a AI Dataset, Computer vision algorithms-DeepNets

.

Total: 45 Hrs.

TEXT BOOK

1. Szeliski, R. (2022). *Computer vision: algorithms and applications*. Springer Nature.

REFERENCE BOOKS

1. Steger, C., Ulrich, M., & Wiedemann, C. (2018). *Machine vision algorithms and applications*. John Wiley & Sons.
2. Raja, R., Kumar, S., Rani, S., & Laxmi, K. R. (Eds.). (2020). *Artificial intelligence and machine learning in 2D/3D medical image processing*. CRC Press.
3. Gonzalez, R. C. (2009). *Digital image processing*. Pearson education India.

Course Code	Course Title	L	T	P	C
10212BM208	**Introduction to Computer Vision**	**3**	**0**	**2**	**4**

a) Course Category:
Specialization

b) Preamble
Computer Vision is a field of AI which deals with understanding and extracting information from digital images and videos. This course provides an outline of important notions in the field of computer vision

c) Prerequisite:
Digital Image Processing

d) Related Courses:
Image processing, Image analysis and machine vision

e) Course Outcomes:
Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Do analysis and synthesis of texture of images	K2
CO2	Explain the need for segmentation in computer vision and compare the different segmentation algorithms applied to computer vision Solve problems on clustering algorithms	K3
CO3	Compare the various ways by which image stitching and image aligning algorithm is working	K2
CO4	Explain how deep learning is applied in computer vision	K3
CO5	Explain the steps in creating a computer aided diagnostic tool	K2

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	1	1	2	3										3
CO 2	3	2	1	2	3										3
CO 3	3	2	1	2	3										3
CO 4	3	2	2	2	3	3									3
CO 5	3	2	3	2	3	3									3

UNIT-1 TEXTURE REPRESENTATION 08 Hrs

Computer vision an Introduction, Local texture representation using filters- Spots and bars, Filter output to texture representation, Shape from texture-Shape from texture for planes, shape from texture for curved surfaces, Analysis and synthesis of texture

UNIT-II SEGMENTATION BY CLUSTERING 10 Hrs

Image segmentation by clustering pixels-Basic clustering methods, the watershed algorithm, Segmentation using K means, Clustering and segmentation with mean shift, Segmentation, clustering and graphs-Terminology and facts for graphs, Agglomerative Clustering with a graph, Divisive clustering with the graph

UNIT-III IMAGE ALIGNMENT AND STITCHING 09 Hrs

Pairwise alignment- 2D alignment using least squares, Iterative algorithms, Robust least squares and RANSAC. Image stitching- parametric motion models, Rotational panoramas, Gap closing, cylindrical and spherical coordinates. Global Alignment- bundle adjustment and parallax removal.

UNIT-IV INTRODUCTION TO DEEP LEARNING 10 Hrs

Introduction to Deep Neural Networks- Weights and layers, Activation functions, Regularization and normalization, Loss function, Back propagation. Convolutional Neural Networks- Pooling and Unpooling, Network Architectures, Application of CNN (Digit Classification). Introduction to 3D CNNs.

UNIT-V STEPS IN CREATING A CAD DIAGNOSTIC TOOL 08 Hrs

What is computer vision in healthcare, Key applications in healthcare, issues with medical image database, Data de-identification, Data annotation. Finding a AI Dataset, Computer vision algorithms-DeepNets

.

Total: 45 Hrs.

TEXT BOOK

1. Szeliski, R. (2022). *Computer vision: algorithms and applications*. Springer Nature.

REFERENCE BOOKS

1. Steger, C., Ulrich, M., & Wiedemann, C. (2018). *Machine vision algorithms and applications*. John Wiley & Sons.
2. Raja, R., Kumar, S., Rani, S., & Laxmi, K. R. (Eds.). (2020). *Artificial intelligence and machine learning in 2D/3D medical image processing*. CRC Press.
3. Gonzalez, R. C. (2009). *Digital image processing*. Pearson education India.

Laboratory Experiments

1. Bar and spot filters
2. Texture analysis with gray level co-occurrence matrix
3. Segmentation using K means
4. Agglomerative Clustering
5. Image stitching
6. Image alignement
7. U-Net for medical image segmentation
8. Cancer image annotation by software

Course Code	Course Title	L	T	P	C
10212BM209	**GPU Architecture and Programming**	**3**	**0**	**2**	**4**

a) Course Category

Specialization

b) Preamble

This course explores the basics of programming for heterogeneous architectures. Also, the course introduces different GPU programming models and the issues in mapping algorithms for GPUs.

c) Prerequisite

10210CS301 – Problem solving using C lab

d) Related Courses

10211BM107 - Microcontroller and Digital Signal Processor

e) Course Outcomes

Upon the successful completion of the course, students will be able to:

CO Nos.	Course outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Describe GPU hardware and software architecture Solve problems on thread, block , gird associated with software abstraction/model/architecture	K3
CO2	Write simple CUDA programs for mathematical operations like addition and multiplication	K3
CO3	Describe different performance improving techniques for deep learning models	K2
CO4	Compare the software model with OpenCL and GPU	K2
CO5	Explain how different algorithms written for CPU processing can be parallelized for GPU	K2

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO 1	3	1	3	2										1	2
CO 2	3	1	3	2	3					3				1	2
CO 3	3	1	3	1										1	2
CO 4	3	2	3	1	3					3				1	2
CO 5	3	1	3	1	1									1	2

f) Course content

UNIT I GPU ARCHITECTURE 10

Evolution of GPU architectures – Understanding Parallelism with GPU –Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

UNIT II CUDA PROGRAMMING 9

Cuda programing template for Hello world, CUDA code for printing global thread ID, CUDA code for vector addition, CUDA code for matrix addition and Multiplication

UNIT III PROGRAMMING ISSUES 8

Common Problems: CUDA Error Handling-527, Parallel Programming Issues-536, Synchronization-537, Algorithmic Issues-544, Finding and Avoiding Errors-547.

UNIT IV OPENCL BASICS 9

Origin of OpenCL, CUDA and OpenCL correspondence, OpenCL-Platform model, execution model, memory model and programing model. OpenCL Host code and kernel code. Simple examples.

UNIT V ALGORITHMS ON GPU 9

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster (theoretical treatment).

Total 45 Hrs.

Laboratory Experiments **15 hrs**

The following experiments to be done with both CUDA and OpenCL

1. CUDA Hello world program
2. Global thread ID computation for multi thread and block application
3. Vector addition
4. Vector multiplication
5. Matrix addition
6. Matrix multiplication

h) Learning Resources

Text Books

1. Shane Cook, CUDA Programming: ―A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.

2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, ―Heterogeneous computing with OpenCL, 3rd Edition, Morgan Kauffman, 2015.

Reference Books

1. Nicholas Wilt, ―CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison – Wesley, 2013.
2. Jason Sanders, Edward Kandrot, ―CUDA by Example: An Introduction to General Purpose GPU Programming, Addison – Wesley, 2010.
3. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors – A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.
4. http://www.nvidia.com/object/cuda_home_new.html
5. http://www.openCL.org

Course Code	Course Title	L	T	P	C
10212BM115	**Medical Data Analytics**	**3**	**0**	**0**	**3**

a. Course Category
Honors Specialization

b. **Preamble**
This course deals with the fundamentals of predictive analysis and its application in healthcare.

c. **Prerequisite**
10212BM111 - Inferential Analysis and Machine Learning

d. **Related Courses**
None

e. Course Outcomes
Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Explain the concept of supervised learning and kernel classifiers.	K3
CO2	Get knowledge on and will be able to use decision trees algorithm	K3
CO3	Understand and apply dimensionality reduction technique for data analysis	K2
CO4	Mine data and utilize data analysis to prevent fraud and to detect infectious diseases	K2
CO5	Acquire knowledge on the latest available technology for data analysis in healthcare.	K2

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	2								1	3	3	
CO2	3	3	3	2								1	3	3	
CO3	3	3	3	2								1	3	3	
CO4	3	3	3	2								1	3	3	
CO5	3	3	3	2	3							1	3	3	

f. Course content

UNIT I Introduction to Supervised Learning and Classifiers 9

Supervised learning - types - Vapnik-Chervonenkis Dimension – Learning multiple classes –Model selection and Generalization – Dimensions of a Supervised machine learning algorithm. SVM - Binary Classification-Classification with Hyperplanes - Multi-class classification- Algorithm implementation to SVM. Case study-prediction of metastasis of colorectal cancer.

UNIT II Decision Trees 9

Decision tree- Divide and conquer-Entropy-Misclassification error and Gini index-C5.0 Decision tree algorithm-Pruning the decision tree-Comparing different impurity indices-Classification rules, case study- Predicting disease and outcome using decision trees-Random Forest classifier, case study- Personalized risk prediction in clinical oncology.

UNIT III Dimensionality Reduction Technique 9

Dimensionality reduction- definition and application- Reducing dimension- Matrix rotation-Notation; Principal Component Analysis (PCA)- Principal Components - using PCA; case study - estimating outcome of biomechanical factors in cutting, automatic recognition of arrhythmia.

UNIT IV Biomedical Data Analysis 9

Biomedical Image Analysis - Biomedical Imaging Modalities, Object Detection, Image Segmentation and Registration, and Feature extraction. Biomedical Signal Analysis - Types of Biomedical Signals, ECG signal Analysis, Denoising of Signals, Multivariate Biomedical Signal Analysis and Recent Trends.

UNIT V Healthcare Data Analysis 9

Mining of sensor data in healthcare - Scope, Challenges in Healthcare Data Analysis, Sensor Data Mining Applications and Nonclinical Healthcare Applications. Fraud Detection in Healthcare - Definition, Types, Identifying Healthcare Fraud from Data, Knowledge Discovery-Based Solutions for Identifying Fraud. Social Media Analytics for Healthcare - Social Media Analysis for Detection and Tracking of Infectious Disease, Social Media Analysis for Public Health Research and Analysis of Social Media Use in Healthcare

Total: 45 Hrs

g. Learning Resources

Textbooks

1. Data Science and Predictive Analytics - Biomedical and Health Applications using R, Ivo D. Dinov, Springer, 2018
2. Machine Learning for Predictive Data Analytics, John D. Kelleher, Brian Mac Namee and Aoife D'Arcy, MIT Press, 2015
3. Introduction to Machine Learning, Ethem Alpaydin, Third Edition, 2014

Reference Books

1. Learning with Support Vector Machines, Colin Campbell, Yiming Ying, 2011
2. Pattern Recognition and Machine Learning, Christopher M Bishop, Springer, 2006
3. Healthcare Data Analytics, Chandan K. Reddy and Charu C Aggarwal, Taylor & Francis, 2015

SCHOOL OF ELECTRICAL AND COMMUNICATION

DEPARTMENT OF BIOTECHNOLOGY

Minutes of

12th Meeting

of

Board of Studies

DEPARTMENT OF BIOTECHNOLOGY

SCHOOL OF ELECTRICAL & COMMUNICATION

Date : 26/06/2024

Time : 10.00 AM

Venue : 3212 – Biotechnology Department seminar hall.

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

SCHOOL OF ELECTRICAL AND COMMUNICATION
DEPARTMENT OF BIOTECHNOLOGY
12th Board of Studies Meeting
26th June 2024 @10.00 a.m.

AGENDA

12 BoS 01 To confirm the Minutes of Meeting of the 11th Board of Studies.

12 BoS 02 To discuss the minutes of the meeting of the 12th Board of Studies.

12 BoS 03 To record the leave of absence of members

ITEMS FOR CONSIDERATION AND APPROVAL

12 BoS 04 Approval for proposed NPTEL courses

12 BoS 05 Curriculum Revision - Syllabus discussion

ITEMS FOR DISCUSSION AND RATIFICATION

12 BoS 06 Course offering for the summer semester

12 BoS 07 One credit courses offered under VTUR21 for UG students were discussed.

ITEMS FOR REPORTING

12 BoS 08 Students and Faculty achievements

12 BoS 09 Results of Previous semesters

12 BoS 10 Introduction of New Courses

OPENING

CALL TO ORDER

Welcome Address: Chairman – BOS, welcomed the Special invitees and other members for the 12th BOS meeting.

The Chairman called the meeting to order and welcomed the members and invitees.

12 BoS 01 To confirm the Minutes of Meeting of the 11th Board of Studies.

Discussion **:** Chairman – BOS, presented the minutes of the 11th Board of Studies held on 03/01/2024.

Action **:** The members confirmed the minutes of the 11th BOS meeting.

Minutes of Meeting of the 11th Board of Studies held on 03/01/2024 was confirmed as received and ratified by the members present

1. Request to transfer Biochemistry course from Foundation Course to Basic Sciences. Instead of Biochemistry, the students will be studying Engineering Chemistry in their first semester.
2. Instead of Advanced Biochemistry, students will study **Biochemistry**.
3. Transfer of Advanced Biochemistry course from Program core to Program elective.
4. Transfer of Unit operations in Biotechnology course from industrial domain to Chemical Engineering Domain.
5. Instead of Marine biotechnology, the committee has suggested to offer **Plant and Animal Biotechnology**.
6. Instead of Computational Biology course, the committee has advised to offer **Bioinformatics** course and also the committee has agreed to transfer the computational biology from program core to program elective category.
7. Request to change the credits of Engineering Advances in Food Preservation from 2 credits to 3 credits.
8. NPTEL courses are proposed for approval.

12 BoS 02 To discuss the minutes of the meeting of the 12th Board of Studies.

Discussion : Chairman – BoS, highlighted the follow-up action taken on the suggestions given by the expert members. These are:

12 BoS 03 To record the leave of absence of members.

Minutes of Meeting of the 12th Board of Studies meeting being held was confirmed to all members present.

Discussion : One of the External BoS Member Dr. Abhishek Mathur, DGM – Technical and R&D, Prathista Industries Limited (Prathista Group), Telengana State absent was attended meeting in Online.

Action : The BoS members accepted and the same was recorded.

S.No	Name	Designation
1	Dr. P. Azhagu Saravana Babu Head of the Department, and Professor Department of Biotechnology Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology	Chairman
2	Dr. Vignesh Muthuvijayan Professor, Department of Biotechnology Bhupat and Jyoti Mehta School of Biosciences Indian Institute of Technology Madras Chennai	Academic Expert
3	Dr. Abhishek Mathur DGM – Technical and R&D Prathista Industries Limited (Prathista Group) Telengana State	Industry Expert
4	Dr. R. Ravikumar Professor, Department of Biotechnology Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology	Member
5	Dr. K. Jagajjanani Rao Associate Professor, Department of Biotechnology Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology	Member
6	Dr. S. Mugesh Associate Professor, Department of Biotechnology Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology	Member
7	Dr. R. Sai Nandhini Assistant Professor, Department of Biotechnology Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology	Member
8	Ms. Nithya sree Dxc Technology Guindy Industrial Estate, SIDCO Industrial Estate, Guindy, Chennai, Tamil Nadu 600032	Alumni

ITEMS FOR CONSIDERATION AND APPROVAL

12 BoS 04 Approval for proposed NPTEL courses

Discussion : The Chairman – BoS listed the Independent-Learning courses to be offered through NPTEL Platform, under MOOC option, for completing the Independent Learning category, during the Academic Year: 2024-2025 (List is give below)

Action : Members accepted and recommended the different courses and their corresponding credits for the forth coming semester.

Sl. No	Course Code	Course Name	No. of Weeks	Credits	Online Portal Swayam/NPTEL
1	10213BT404	Design for Biosecurity	12	3	NPTEL
2	10213BT405	Introduction to Mechanobiology	8	2	NPTEL
3	10213BT406	Biomedical Instrumentation and sensors	12	4	SWAYAM
4	10213BT407	Electronic Systems for Cancer Diagnosis	12	3	NPTEL
5	10213BT408	Understanding Incubation and Entrepreneurship	12	3	NPTEL

12 BoS 05 Curriculum Revision - Syllabus discussion

1. Requested to modify the syllabus of AGRICULTURAL BIOTECHNOLOGY, FOOD PRESERVATION AND PACKAGING TECHNOLOGIES (PE), and PRINCIPLES OF CHEMICAL ENGINEERING.

Modified Syllabus

10211BT108 - PRINCIPLES OF CHEMICAL ENGINEERING

UNIT I BASIC CHEMICAL CALCULATIONS 12 hours

SI units, stoichiometry, basic chemical calculations: mole, atomic mass and molar mass, equivalent mass, conversion of mass function to mole fraction, molarity, normality, density, specific gravity. Ideal gas law- Ideal mixtures and solutions – Dalton's law of additive volumes, Henry's law, Raoult's law, Concepts of Simpson's rule and their applications to different systems.

UNIT II MATERIAL AND ENERGY BALANCE 12 hours

Overall and component balances, material balances without and with chemical reactions, degrees of freedom, Basics of steady and unsteady state, unit operations. Energy balance with and without chemical reactions.

UNIT III THERMODYNAMIC LAWS AND PROPERTIES 12 hours

Review of laws of thermodynamics and their applications; thermodynamic analysis of processes. Thermodynamic properties of fluids and their interrelationship: PVT behavior of pure substances; Equation of state; generalized correlations and acentric factor; Basics of thermodynamic properties.- Maxwell relations, Universal gas constant relations

UNIT IV SOLUTION THERMODYNAMICS 12 hours

Partial molar properties; Chemical potential; Gibbs-Duhem equation; Ideal and non-ideal solutions; Fugacity and fugacity coefficient; Activity and activity coefficient.

UNIT V PAHSE AND CHEMICAL REACTION EQUILIBRIA 12 hours

Gibbs phase rule and its derivation for reacting and non-reacting systems; Phase equilibria-criteria-VLE Calculations – Liquid-liquid Equilibria; Chemical equilibrium constants; Homogeneous and heterogeneous reactions; Effect of Temperature- Effect of pressure-Equilibrium conversion in single and multiple reactions.

10212BT104- AGRICULTURAL BIOTECHNOLOGY

UNIT I INTRODUCTION 9 hours

Basic concepts of Agriculture, Role of Genetic engineering for increasing crop productivity, Agricultural Applications of Genetic Engineering, : shoot - tip - cultures, shoot - tip - grafting, viricidal compound, Protoplast isolation: culture and fusion, selection of hybrid cells and regeneration of hybrid plants, somatic hybridization. DNA mediated and Agrobacterium mediated transfers, microinjection, electroporation, somatic cell hybridization.

UNIT II GENETIC ENGINEERING TECHNOLOGIES IN AGRICULTURE 9 hours

Molecular Farming: Plants As factories for biopharmaceuticals, Transgenic value added specialty crops, Use of antisense RNA and other technologies, Developing stress tolerant varieties, vaccine and antibody producing plants. Terminator technology, Introduction of male sterility through genetic engineering. Genetic engineering in improving nitrogen fixation in plants.

UNIT III BIOFERTILIZERS AND ORGANIC FARMING 9 hours

Biofertilizer: Mass cultivation of microbial inoculants, green manuring, algalization, Azolla. Plant growth promoting factors Microbial products and plant health: PGPR (plant growth promoting Rhizobacteria), significance of mycorrhizae, toxin producing microbes (antibiotics, aflatoxin, and others), Organic Farming: Introduction and sustainable use of natural and bioresources, Organic standards and certification of organic produce and products, Biological control.

UNIT IV BIODIVERSITY AND ENVIRONMENTAL PRESERVATION 9 hours

Preservation of rare plant species germplasm collection and conservation, Soil Reclamation: Phytoremediation

UNIT V ISSUES IN AGRICULTURE AND FOOD SECURITY 9 hours

Global initiatives and future prospects of Organic Farming. World Food Security: Causes of food insecurity, social economic issues, ensuring food security, BIS regulations, GM food, GM Crops – Ethical challenges.

10212BT133 - FOOD PRESERVATION AND PACKAGING TECHNOLOGIES

UNIT I Different modes of Food Preservation 9 hours

Introduction of preservation, Preservation methods: thermal and other non-thermal methods, microbiological additives, and pulsed electric or magnetic fields. High temperature, low temperature, drying, radiation, chemical preservatives, bio-preservatives, hurdle technology, active packaging. Preservation by fermentation – Curing, Pickling and Smoking, Chilling and Freezing, Properties of frozen foods. Food preservation and handling of food.

UNIT II FOOD PRESERVATION THROUGH DEHYDRATION 9 hours

Water activity and moisture absorption isotherms, Psychometric chart, Dehydration and drying of foods, drying curve and drying time calculation, Enthalpy change during freezing, Plank's equation for freezing time, Cold storage and Refrigeration load, Refrigeration cycle, Cryogenic freezing and IQF Different types of dryers: Conductive, convective and combined, IMF foods, Osmotic dehydration. food preservatives of microbial origin.

UNIT III ADVANCED TECHNIQUES OF PACKAGING 9 hours

Packaging of foods, requirement, importance and scope. Factors affecting shelf life of food material during storage, spoilage agents with environmental factors. Control of the spoilage agents. Functions of packaging. Aseptic packaging. Retort processing. Packaging machines, technical packaging systems and data management packaging systems. Nutritional labeling on packages, CAS and MAP, shrink and cling packaging, vacuum and gas packaging;

UNIT IV MATERIALS FOR FOOD PACKAGING 9 hours

Different types of packaging materials, their key properties and applications.. Canning of food products, Classifications and structure of cans, corrosion, Lacquering.. Glass containers, types of glass used in food packaging. Paper and paper board packaging, paper and paper board manufacture process Nutritional labeling on packages, CAS and MAP, shrink and cling packaging, vacuum and gas packaging; Factors affecting the choice of packaging materials, Disposal and recycle of packaging waste. Printing and labeling, Lamination.

UNIT V TESTING METHODS FOR PACKAGING MATERIALS 9 hours

Testing methods for flexible materials, rigid materials and semi rigid materials; Tests for paper (thickness, bursting strength, breaking length, stiffness, tear resistance, folding endurance, ply bond test, surface oil absorption test, etc.), plastic film and laminates (thickness, tensile strength, gloss, haze, burning test to identify polymer, etc.), aluminium foil (thickness, pin holes, etc.), glass containers (visual defects, colour, dimensions, impact strength, etc.), metal containers (pressure test, product compatibility, etc.)

ITEMS FOR DISCUSSION AND RATIFICATION

12 BoS 06 Course offering for the summer semester

Graduation	YEAR	COURSE CODE	COURSE NAME	Credits
UG	II	10211BT303	CELL BIOLOGY LAB	2
UG	II	10211BT104	MOLECULAR BIOLOGY : CONCEPTS AND TECHNIQUES	3
UG	II	10211BT114	GREEN BIOTECHNOLOGY & POLLUTION ABETMENT	2
UG	II	10211BT302	BIOCHEMISTRY LAB	2
UG	II	10211BT102	CELL BIOLOGY	3
UG	II	10211BT301	MICROBIOLOGY LAB	2
UG	II	10211BT108	PRINCIPLES OF CHEMICAL ENGINEERING	4
UG	II	10211BT101	MICROBIOLOGY	3
UG	III	10212BT133	FOOD PRESERVATION AND PACKAGING TECHNOLOGIES (PE)	3
UG	III	10211BT105	GENETIC ENGINEERING	3
UG	III	10212BT142	OMICS TECHNOLOGIES (H)	3
UG	III	10212BT125	HERBAL AND PHYTOCHEMICAL ENGINEERING (PE)	3
UG	III	10211BT109	ADVANCED BIOCHEMISTRY	3
UG	III	10212BT131	PRINCIPLES OF FUNCTIONAL FOOD AND APPLICATIONS (PE)	3
UG	III	10211BT305	BIOPROCESS ENGINEERING LAB	2
UG	III	10212BT137	INSTRUMENTATION AND CONTROL (H)	3
UG	III	10211BT115	ANALYTICAL AND INSTRUMENTATION ENGINEERING	3
UG	III	10211BT107	MASS TRANSFER OPERATIONS IN BIOTECHNOLOGY	3
UG	III	10212BT118	STEM CELL TECHNOLOGY (PE)	3
UG	IV	10211BT117	PLANT AND ANIMAL BIOTECHNOLOGY	3
UG	IV	10212BT115	CANCER BIOLOGY (PE)	3
UG	IV	10212BT135	FOOD SAFETY, QUALITY AND REGULATION (PE)	3
UG	IV	10212BT132	NUTRACEUTICALS (PE)	3
UG	IV	10211BT111	DOWNSTREAM PROCESSING (RE-REG)	3
UG	IV	10211BT113	METABOLIC ENGINEERNG (RE-REG)	3
UG	IV	10211BT106	CHEMICAL REACTION ENGINEERING (RE-REG)	3
UG	OE	10213BT111	BIOMATERIALS	3

Graduation	YEAR	COURSE CODE	COURSE NAME	Credits
PG	I	20231BT101	BIOCHEMISTRY	3
PG	I	20231BT102	CELL AND MOLECULAR BIOLOGY	3
PG	I	20231BT104	MICROBIOLOGY	3
PG	I	20231BT105	PLANT AND ANIMAL CELL CULTURE TECHNOLOGY	3
PG	I	20231BT301	BIOCHEMISTRY & ANALYTICAL TECHNIQUES LABORATORY	3
PG	I	20231BT103	INTRODUCTION TO ENGINEERING PRINCIPLES	3
PG	I	20231BT302	MICROBIOLOGY LABORATORY	3
PG	II	20231BT112	BIOPROCESS EQUIPMENT AND ECONOMICS	3
PG	II	20231BT115	RESEARCH METHODOLOGY AND SCIENTIFIC COMMUNICATION SKILLS	2
PG	II	20232BT104	ENZYME ENGINEERING AND TECHNOLOGY	2
PG	II	20231BT116	INTELLECTUAL PROPERTY RIGHTS, BIOSAFETY AND BIOETHICS	2
PG	II	20232BT108	NANO BIOTECHNOLOGY	2
PG	II	20231BT114	INSTRUMENTATION AND CONTROL	3
PG	II	20231BT113	BIOENTREPRENEURSHIP	3
PG	II	20231BT305	DOWNSTREAM PROCESSING IN BIOTECHNOLOGY LABORATORY	3

12 BoS 07 One credit course offered under VTUR21 for UG students were discussed.

Discussion : The Chairman – BoS presented the One credit course offered under VTUR21 for UG students of AY 2022-2023.

One Credit course

Club Activity

NCC/ NSS certification

Value added courses offered

Offered by International Professors

Industrial Internship

Action : Members have noted and ratified.

ITEMS FOR REPORTING

12 BoS 08 Students and Faculty achievements

Discussion : The Chairman – BOS presented the list of Students achievements in Winter Semester of AY 2023–24

Action : Members approved and recorded.

12 BoS 09 Results of Previous semesters

Discussion : The end-semester examination results for December 2023 were discussed during the meeting.

Action : Members approved and recorded.

12 BoS 10 Introduction of New Courses

Discussion : Chairman – BOS, Discussed about new courses introduction under the category of Open Elective for "VTR UGE 2021".

- Biotechnological products validation and Entrepreneurship
- Intellectual property rights and patent design in Biotechnology
- Clinical Trials and Health care policies in Biotechnology
- Bio-fertilizer production & mushroom cultivation

Action : BoS Members approved the courses. The BOS Members have suggested including the significant points in the content of the specialized courses. Given suggestion for credits and benchmarking.

ANNEXURES

ANNEXURE 1: Curriculum of VT UGE21 and PG M. Tech Biotechnology

ANNEXURE 1: Curriculum of VT UGE21

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R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

SCHOOL OF ELECTRICAL AND COMMUNICATION

DEPARTMENT OF BIOTECHNOLOGY

CURRICULUM AND SYLLABI

VT UG Regulation 2021

Department of Biotechnology

List of Courses – UG
B. Tech - Biotechnology

PROGRAM CORE COURSES VTR UGE 2021						
		Course Name	L	T	P	C
	Course Code	BASIC SCIENCES				
1	10211BT101	Microbiology	3	0	0	3
2	10211BT102	Cell Biology	3	0	0	3
3	10211BT115	Analytical and Instrumentation Engineering	3	0	0	3
4	10211BT301	Microbiology Lab	0	0	2	1
5	10211BT302	Biochemistry Lab	0	0	2	1
6	10211BT303	Cell Biology Lab	0	0	2	1
7	10211BT109	Biochemistry	3	0	0	3
GENETIC ENGINEERING / MOLECULAR BIOLOGY						
7	10211BT104	Molecular Biology: Concepts and Techniques	3	0	0	3
8	10211BT105	Genetic Engineering	3	0	0	3
9	10211BT304	Molecular Biology & Genetic Engineering Lab	0	0	2	1
CHEMICAL ENGINEERING						
10	10211BT106	Chemical Reaction Engineering	3	0	0	3
11	10211BT107	Mass Transfer Operations in Biotechnology	3	0	0	3
12	10211BT108	Principles of Chemical Engineering	3	1	0	4
13	10211BT112	Unit Operations in Biotech Industry	3	0	0	3
INDUSTRIAL BIOTECHNOLOGY						
14	10211BT110	Bioprocess Engineering	3	0	0	3
15	10211BT111	Downstream Processing	3	0	0	3
17	10211BT113	Metabolic Engineering	3	0	0	3
18	10211BT114	Green Biotechnology & Pollution Abetment	2	0	0	2
19	10211BT117	Animal Biotechnology	3	0	0	3
20	10211BT305	Bioprocess Engineering Lab	0	0	2	1
21	10211BT306	Downstream Processing Lab	0	0	2	1
PHARMACEUTICAL & MEDICAL BIOTECHNOLOGY						
22	10211BT201	Bioinformatics	2	0	2	3
23	10211BT116	Immunology and Immunotechnology	3	0	0	3
24	10211BT307	Immunology Lab	0	0	2	1
		TOTAL				58

PROGRAM ELECTIVE COURSES VTR UGE 2021						
Course Name			L	T	P	C
INDUSTRIAL DOMAIN						
1	10212BT101	Fluid Mechanics and Transport phenomena	3	0	0	3
2	10212BT102	Bioenergy	3	0	0	3
3	10212BT103	Food Processing Technology	3	0	0	3
4	10212BT104	Agricultural Biotechnology	3	0	0	3
5	10212BT105	Algal Biotechnology	3	0	0	3
6	10212BT106	Nanobiotechnology and application	3	0	0	3
7	10212BT107	Fermentation Technology	3	0	0	3
8	10212BT108	Protein Engineering	3	0	0	3

9	10212BT109	Process Instrumentation and dynamic control	3	0	0	3
10	10212BT110	Bioreactor design and Instrumentation control	3	0	0	3
11	10212BT111	Valorisation	3	0	0	3
12	10212BT112	Environmental Biotechnology	3	0	0	3
13	10212BT113	Enzyme technology and Biotransformation	3	0	0	3
14	10212BT114	Synthetic Biology	3	0	0	3
MEDICAL DOMAIN						
15	10212BT115	Cancer Biology	3	0	0	3
16	10212BT116	Molecular Pathogenesis	3	0	0	3
17	10212BT117	Biopharmaceutical Technology	3	0	0	3
18	10212BT118	Stem cell Technology	3	0	0	3
19	10212BT119	Biosensor and Instrumentation	3	0	0	3
20	10212BT120	Biomaterials	3	0	0	3
21	10212BT121	Biochips and Microarray technologies	3	0	0	3
22	10212BT122	Plant Biotechnology	3	0	0	3
23	10212BT123	Animal Biotechnology	3	0	0	3
24	10212BT124	Tissue Engineering	3	0	0	3
25	10212BT125	Herbal and Phytochemical Engineering	3	0	0	3
26	10212BT126	Medical Genomics and Proteomics	3	0	0	3
27	10212BT127	Cellular Engineering	3	0	0	3
28	10212BT128	Bioprinting	3	0	0	3
29	10212BT129	Augmented Reality & Virtual Reality	3	0	0	3
30	10212BT130	Precision Agricultural Biotechnology	3	0	0	3
31	10212BT131	Computational Biology:Techniques and Applications(Integrated)	3	0	0	3
32	10212BT132	Advanced Biochemistry	3	0	0	3

		FOOD BIOTECHNOLOGY				
33	10212BT131	Principles of Functional Food and Applications	3	0	0	3
34	10212BT132	Nutraceuticals	3	0	0	3
35	10212BT133	Food Preservation and Packaging Technologies	3	0	0	3
36	10212BT134	Marine Biotechnology and Aquaculture	3	0	0	3
37	10212BT135	Food Safety, Quality and Regulation	3	0	0	3
38	10212BT136	Storage Engineering	3	0	0	3

OPEN ELECTIVE COURSES

S. No.	Course Code	Course Name	L	T	P	C
1	10213BT101	Biochips	3	0	0	3
2	10213BT102	Biosensors	3	0	0	3
3	10213BT103	Biomaterials engineering	3	0	0	3
4	10213BT104	Bio-inspired design: principles and practice	3	0	0	3
5	10213BT105	Engineering advances in food preservation	3	0	0	3

Minor Course

S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	10213BT107	Bioprocess Control components	3	0	0	3
2	10213BT108	Advanced Analytical and Instrumentation bioprocess	3	0	0	3

		applications				
3	10213BT109	Biosensors	3	0	0	3
4	10213BT110	Biochips	3	0	0	3
5	10213BT111	Biomaterials	3	0	0	3
6	10213BT112	Computational applications in Bioprocess	3	0	0	3

Honors courses

S.No	Course Code	Course Name	L	T	P	C
1	10212BT137	Instrumentation and Process Control	3	0	0	3
2	10212BT138	Biomolecular Modelling	2	0	2	3
3	10212BT139	Biomechanics	2	0	2	3
4	10212BT140	Bio-nanotechnology	2	0	2	3
5	10212BT141	Biochemical Engineering	3	0	0	3
6	10212BT142	OMICS Technologies	3	0	0	3

Specialization Courses

S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	10212BT131	Principles of Functional Food and Applications	3	0	0	3
2	10212BT132	Nutraceuticals	3	0	0	3
3	10212BT133	Food preservation, packaging technologies	3	0	0	3
4	10212BT135	Food Safety, Quality and Regulation	3	0	0	3
5	10212BT130	Precision Agricultural Biotechnology	3	0	0	3
6	10212BT122	Agricultural Biotechnology	3	0	0	3

List of Courses – PG
B. Tech – Biotechnology

FOUNDATION COURSES						
S.No	Course Code	Course Name	L	T	P	C
1	20230BT101	Basics of Mathematics and Statistics	2	0	0	2
2	20230BT102	Basics of Chemistry and Physics	2	0	0	2
PROGRAM CORE THEORY COURSES						
S.No	Course Code	Course Name	L	T	P	C
1	20231BT101	Biochemistry	3	0	0	3
2	20231BT102	Cell and Molecular Biology	3	0	0	3
3	20231BT103	Introduction to Engineering Principles	3	0	0	3
4	20231BT104	Microbiology	3	0	0	3
5	20231BT105	Plant and Animal Cell Culture Technology	3	0	0	3
6	20231BT106	Genetic Engineering	3	0	0	3
7	20231BT107	Immunology	3	0	0	3
8	20231BT108	Bioprocess Engineering and Technology	3	0	0	3
9	20231BT109	Downstream Processing in Biotechnology	3	0	0	3
10	20231BT110	Bioreactor Operations	3	0	0	3
11	20231BT111	Computational Biology	3	0	0	3
12	20231BT112	Bioprocess Equipment Design and Economics	3	0	0	3
13	20231BT113	Bioenterpreneurship	2	0	0	2
14	20231BT114	Instrumentation and Control	3	0	0	3
15	20231BT115	Research Methodology and Scientific Communication skills	2	0	0	2
16	20231BT116	Intellectual Property Rights, Biosafety and Bioethics	2	0	0	2
PROGRAM CORE LABORATORY COURSES						
1	20231BT301	Biochemistry & Analytical Techniques Laboratory	0	0	6	3
2	20231BT302	Microbiology Laboratory	0	0	6	3
3	20231BT303	Molecular Biology and Genetic Engineering Laboratory	0	0	6	3
4	20231BT304	Immunology Laboratory	0	0	6	3
5	20231BT305	Downstream Processing in Biotechnology Laboratory	0	0	6	3
PROGRAM ELECTIVE COURSES						
S.No	Course Code	Course Name	L	T	P	C
1	20232BT101	Bioreaction Engineering	2	0	0	2
2	20232BT102	Computational Programming	2	0	0	2

3	20232BT103	Environmental Biotechnology	2	0	0	2
4	20232BT104	Enzyme Engineering and Technology	2	0	0	2
5	20232BT105	Metabolic and Systems Biology	2	0	0	2
6	20232BT106	Medical Devices	2	0	0	2
7	20232BT107	Molecular Diagnostics	2	0	0	2
8	20232BT108	Nano biotechnology	2	0	0	2
9	20232BT109	Production of Bio Therapeutics	2	0	0	2
10	20232BT110	OMICS Technologies	2	0	0	2
INDEPENDENT LEARNING						
1	20234BT401	Project Proposal Preparation and Presentation	0	2	0	2
2	20234BT701	Project Work Phase - I	0	0	12	6
3	20234BT702	Project Work Phase - II	0	0	40	20

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R&D Institute of Science and Technology
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MINUTES OF

27th BOARD OF STUDIES MEETING

on

22-06-2024

at

10.30AM

held in

Department Meeting Room

DEPARTMENT OF CIVIL ENGINEERING

SCHOOL OF MECHANICAL AND CONSTRUCTION

VISION AND MISSION OF THE INSTITUTE

Vision:

To create, translate and share frontiers of knowledge embedded with wisdom and innovation for a positive transformation of emerging society.

Mission:

To nurture excellence in teaching, learning, creativity and research; translate knowledge into practice; foster multidisciplinary research across science, medicine, engineering, technology and humanities; incubate entrepreneurship; instill integrity and honour; inculcate scholarly leadership towards global competence and growth beyond self in a serene, inclusive and free academic environment.

VISION AND MISSION OF THE DEPARTMENT

Vision:

To impart knowledge and excellence in Civil Engineering with global perspectives to the student community and to make them ethically strong engineers to build the nation.

Mission:

M1: To produce Civil Engineers of high calibre with advanced technical skills and ethical values to serve the society and the nation.

M2: To make the department as a centre of excellence in the field of Civil Engineering and allied research activities.

M3: To provide knowledge base and consultancy services to the community in all areas of Civil Engineering

M4: To promote innovative ideas which original thinking in the minds of budding Engineers to face the future challenges.

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School of Mechanical and Construction
Department of Civil Engineering
27th Board of Studies Meeting of Civil Engineering
22nd June 2024 @10.30 a.m.

Ref: -Civil/BoS -27/Agenda/2024

Agenda No.	**Agenda**
OPENING	
27BoS01	To confirm the minutes of meeting of the 26th BoS, held on 30.12.2023
27BoS02	Action taken report on Minutes of 26th BoS meeting
27BoS03	To record leave of Absence of members
ITEMS FOR CONSIDERATION AND APPROVAL	
27BoS04	Syllabi for new courses Geopolymer Concrete and Special Concrete for M.Tech Structural Engineering course under VTR PGE 2023.
27BoS05	Syllabus for Mathematics for M.Tech courses under "VTR PGE 2023".
27BoS06	Open Elective courses under section 7.2.4 of VTR UGE 2021 for the Winter Semester of AY 2023-2024.
ITEMS FOR DISCUSSION AND RATIFICATION	
27BoS07	Value added Courses under section 7.2.9 of VTR UGE 2021 and MOOC courses recommended under Program Elective Category of section 7.2.3.
27BoS08	Industrial /Higher Learning courses offered under section 7.2.6 of VTR UGE 2021 for the Winter Semester of AY 2023-2024.
ITEMS FOR REPORTING AND RECORDING	
27BoS09	Any other points

Attendance

Sl.No	Name	Designation	Remarks
1.	Dr. GEETHA SELVARANI. A.	Chairman –BoS, Professor &HOD/Civil	Attended
External Members			
2.	Dr. SENTHIL SELVAN. S.	Professor, Department of Civil Engineering, Faculty of Engineering and Technology, Kattankulathur Campus, SRM Institute of Science and Technology.	Attended
3.	Er. SURESH KUMAR. L.	Assistant Engineer, Central Public Works Department.	Attended
Internal Members			
4.	Dr. SAMSON. S.	Professor	Attended
5.	Dr. ASWIN SIDHAARTH. K.R.	Professor	Attended
6.	Dr. VINODKUMAR. M.	Professor	Attended
7.	Dr. KANDASAMY. S.	Professor	Attended
8.	Dr. KUMAR. G.	Assoc. Professor	Attended
9.	Dr. LOGESHWARI. J.	Assoc. Professor	Attended
10.	Dr. TAMILARASAN. K.	Asst. Professor	Attended
11.	Dr. SELVAKUMAR. S.	Asst. Professor	Attended
Alumni and Student Representative			
12.	Mr. KUSHAL KUMAR	Alumni	Attended
13.	Mr. DINESH SHARMA GURUMAYUM – VTU16911	Student Representative	Not Attended

Welcome Address: Chairman –BoS, welcomed the Special invitees and other members for the 27th BOS meeting.

Agenda 27.01 : **Confirmation of the Minutes of Meeting of 26th BoS held on 30.12.2023.**

Discussion : Chairman – BoS, presented the minutes of the 26th BoS held on 30.12.2023.

Action : BoS members have approved the action taken report on the minutes of 26th BoS Meeting, held on 30.12.2023.

Agenda 27 .02 : **To review the Action Taken report on the Minutes of 26th BoS Meeting.**

Discussion : Chairman – BoS, highlighted the follow-up action taken on the suggestions given by the expert members. These are:

S.No	Points Discussed	Action Taken
1	To remove a few references and add a new reference from 20231CE106 SEISMIC DESIGN OF STRUCTURES	Suggested Modifications incorporated.
2	To change the title of Unit V from Bearings and Substructures to "Bearings and Substructures of Bridges" of 20231CE107 DESIGN OF BRIDGES	Suggested Modifications incorporated.
3	To include design of Spandrel Beams in Unit II of 20231CE104 DESIGN OF ADVANCED CONCRETE STRUCTURES	Suggested Modifications incorporated.
4	To add J funnel Flow tests in 20231CE301 ADVANCED STRUCTURAL ENGINEERING LABORATORY	Suggested Modifications incorporated.
5	To move 20232CE103 PREFABRICATEDSTRUCTURES from Program Elective to Program Core.	Suggested Modifications incorporated.

Action : BoS Members gone through the action taken report and approved the same.

Agenda 27.03 : **To record leave of absence of members.**

Discussion : Our student representative Mr. Dinesh Sharma Gurumayum was absent in view of academic and personal constraint.

Action : The BoS members accepted and the same was recorded.

ITEMS FOR CONSIDERATION AND APPROVAL

Agenda 27.04 : **Syllabi for new courses Geopolymer Concrete and Special Concrete for M.Tech Structural Engineering course under VTR PGE 2023.**

Discussion : PG Coordinator presented the syllabi for new courses Geopolymer Concrete and Special Concrete for M.Tech Structural Engineering course under VTR PGE 2023 and the experts recommended a few suggestions and modifications.

20232CE107 – GEOPOLYMER CONCRETE

Academic Expert: Dr. S. Senthil Selvan

i. Problems with conventional Concrete is to be moved after history of geopolymer concrete in Unit-1
ii. Model is to be added in Unit -4
iii. Limitations of Geopolymer Concrete has to be moved last in Unit- 5

Industrial Expert: Er. L. Suresh Kumar

i. Case studies to be added in Unit-4

20232CE108- SPECIAL CONCRETE

Academic Expert: Dr. S. Senthil Selvan

i. Suggested to use word special concrete in Unit-1
ii. Case Studies on HPC to be added in Unit-2
iii. EFNARC Guidelines to be included in Unit-4
iv. Bendable concrete is to be added in Unit-5.
v. The following references are to be added
   - EFNARC, Specifications and Guidelines for Self-Compacting Concrete, European Federation, 2005.
   - IS 10262:2019-Concrete Mix Proportioning – Guidelines- 2019, Bureau of Indian Standards, New Delhi

Industrial Expert: Er. L. Suresh Kumar

i. Unit-3 has to be based on Ultra high-performance concrete
ii. Mix Design of UHPC to be added in Unit-4
iii. The term "High performance" is to be removed for all the mentioned concretes.
iv. Bendable concrete is to be added in Unit-5.

Refer Annexure: 1

Agenda 27.05 : **Syllabus for Mathematics for M.Tech courses under "VTR PGE 2023".**

Discussion : Mathematics Faculty presented the syllabus for Advanced Mathematics course under VTR PGE 2023 and the experts suggested a few modifications.

20231CE118 – ADVANCED MATHEMATICS

Academic Expert: Dr. S. Senthil Selvan

i. The topics "Error Analysis" and "Boundary value Problems" can be removed from Unit I.
ii. The topics "Solutions to Poisson's and Elliptic equations, Paraolic equations" from Unit II can be removed.
iii. The topics "Parametric equations of variational problems" from Unit V can be removed.

Industrial Expert: Er. L. Suresh Kumar

i. The topics "Error Analysis" and "Boundary values" are suggested to be removed from Unit I.
ii. The topic "Convergence problems" from Unit IV can be removed.

Refer Annexure: 2

Agenda 27.06 : **Open Elective courses under section 7.2.4 of VTR UGE 2021 for the Winter Semester of AY 2023-2024.**

S. No	Name of the Course	Course Offering Institution	Number of Weeks	Course Code	Recommended Credits
1	MUNICIPAL SOLID WASTE MANAGEMENT	IIT GUWAHATI	12	10213CE401	3
2	REMOTE SENSING PRINCIPLES AND APPLICATIONS	IIT BOMBAY	12	10213CE402	3

3	INTRODUCTION TO MULTIMODAL URBAN TRANSPORTATION SYSTEMS	IIT KHARAGPUR	12	10213CE403	3

Discussion : Members have considered and approved.

ITEMS FOR DISCUSSION AND RATIFICATION

Agenda 27.07 : **Value added Courses under section 7.2.9 of VTR UGE 2021 and MOOC courses recommended under Program Elective Category of section 7.2.3.**

Discussion : The Chairman – BOS presented the Courses offered Value added Courses under section 7.2.9 of VTR UGE 2021 and MOOC courses recommended under Program Elective Category of section 7.2.3.

List of Value-Added Courses

S.No.	No. OF DAYS	COURSE NAME	No. OF STUDENTS BENEFITTED
1	4	Remote sensing/DIP software training	22(II Year) + 35(III Year)
2	4	Drone Surveying	22(II Year) + 35(III Year)

Refer: Annexure 3

List of MOOC Courses

S. No	Name of the Course	Course Offering Institution	No. of Weeks	Course Code	Recommended Credits	Enrolment End date
1	Advanced Foundation Engineering	IIT KHARAGPUR	12	10212CE401	3	Jan29th, 2024
2	Applied Seismology for Engineers	IIT GUWAHATI	12	10212CE402	3	Jan29th, 2024
3	Environmental Remediation of Contaminated Sites	IIT ROORKEE	12	10212CE403	3	Jan29th, 2024
4	Geosynthetics and Reinforced Soil Structures	IIT MADRAS	12	10212CE404	3	Jan29th, 2024
5	Soil Structure Interaction	IIT KHARAGPUR	12	10212CE405	3	Jan29th, 2024
6	Energy Efficiency, acoustics and Day lighting in building	IIT KHARAGPUR	12	10212CE406	3	Jan29th, 2024

7	Industrial waste water treatment	IIT DELHI	12	10212CE407	3	Jan29th, 2024

Action: : Members have noted and ratified.

Agenda 27.08 : **Industrial /Higher Learning courses offered under section 7.2.6 of VTR UGE 2021 for the Winter Semester of AY 2023-2024.**

S.No	Course Code	Title of Course	Regulation	Credits
1	10215CE902	IoT for Civil Engineers	VTR UGE 21	3
2	10215CE901	IoT for Civil Engineers-A Hands on Training	VTR UGE 21	2

Discussion : Members have noted and ratified.
Refer Annexure 4

ITEMS FOR REPORTING AND RECORDING

Agenda 27.09 : **Any other Points (Discussion on Proposed Skill Development Course "E-TABS" Syllabus associate with CREDAI)**

Discussion : Course Coordinator presented the Proposed Skill development Course on "E-Tabs" syllabus associate with CREDAI and the experts suggested few suggestions:

Industrial Expert: Er. L. Suresh Kumar

- Scale factor to be added in the content.
- Static method and lateral forces to be added.
- T-Beam and L-Beam classification has to be included.
- Modelling can be divided into vertical and horizontal elements.

Action : NIL

Meeting ended with a Vote of thanks proposed by Dr. S. Samson, Professor, Department of Civil Engineering.

Submitted to Vice-Chancellor for approval

Dr. A. Geetha Selvarani – Chairman, BoS.

ANNEXURE 1

			L	T	P	C
20232CE115	**PE**	**GEOPOLYMER CONCRETE**	**3**	**0**	**0**	**3**

Preamble:

To study the properties, materials, making of Geopolymer concrete and advancements in Geopolymer concrete.

Course Content:

UNIT 1 INTRODUCTION **9**

History of geopolymer concrete, Problems with conventional concrete, Need for sustainable concrete, Geopolymer concrete, Ingredients of geopolymer concrete, Chemistry, Curing conditions.

UNIT 2 BINDERS **9**

Binders, Types of binders, Agricultural waste based binders, Industrial waste based binders, Physical and chemical properties of different types of binders, Properties of geopolymer concrete – mechanical, short term, long term and thermal properties.

UNIT 3 ALKALINE ACTIVATORS **9**

Alkaline activator, Types of alkaline activators, Commercially available Activators- Preparation of alkaline activators, Agro-based residues, Sustainability Aspects

UNIT 4 MICRO STRUCTURAL INVESTIGATION ON GEOPOLYMER CONCRETE **9**

TGA, SEM, and XRD Analysis over geopolymer matrix (Model), SEM, EDX and XRD over binders (Model), Laboratory testing of geopolymer concrete, Case studies in geopolymer concrete

UNIT 5 APPLICATIONS AND ADVANCEMENTS IN GEOPOLYMER CONCRETE **9**

Green buildings, Use of geopolymer concrete in India, Life cycle assessment, Research works on geopolymer concrete, Limitations of geopolymer concrete.

TOTAL: 45 HOURS

REFERENCES:

1. Joseph Davidovits, "Geopolymer Chemistry and Applications", Institute of Geopolymer, 5th Edition, 2020.
2. Dechang Jia, Peigang He, Meirong Wang, Shu Yan, “Geopolymer and Geopolymer Matrix Composites” Springer Series in Materials Science, Volume 331, 2020.
3. Fernando Pacheco- Torgal, Prinya Chindaprasirt, Togay Ozbakkaloglu, "Handbook of Advances in Alkali-Activated Concrete", Elsevier, 2022.
4. John L. Provis and Jannie S.J. van Deventer, “Geopolymers Structures, Processing, Properties and Industrial Applications”, Woodhead Publishing, 2009.

20232CE116	PE	SPECIAL CONCRETE	L	T	P	C
			3	0	0	3

Preamble:
To study various special concretes and their properties
Course Content

UNIT I INTRODUCTION 9
Sustainability of concrete industry- Enhancement in strength, durability and ductility of special concrete- Use of hybrid systems in special concrete- Smart Concrete

UNIT II HIGH PERFORMANCE CONCRETE 9
Introduction – Principles of HPC – Ingredients used for HPC – Production of HPC – Curing of HPC – Mechanism of HPC – Properties of HPC during the fresh and hardened state. Acid Attack – Permeability – Scaling resistance – Chloride penetration – Resistance to sea water – sulfate attack – Alkali-aggregate reaction – Fire resistance. Case Studies on HPC

UNIT III ULTRA HIGH PERFORMANCE CONCRETE 9
Introduction – Principles of UHPC – Ingredients used for UHPC – Production of UHPC - Mechanism of UHPC, Properties of HPC during the fresh and hardened state. Durability of UHPC, Case Studies on UHPC

UNIT IV MIX DESIGN METHODS 9
Mix Design Methods of HPC, Mix Design Methods of UHPC, Mix design methods of SCC– EFNATC Guidelines - Designs examples

UNIT V OTHER CONCRETE 9
Air-entrained Concrete – Light weight Concrete – Heavy weight Concrete – Fiber reinforced Concrete – Confined Concrete – Roller Compacted Concrete – Self Compacting Concrete – Reactive powder Concrete-Bio concrete-Bendable Concrete- Geopolymer concrete

TOTAL: 45 HOURS

REFERENCES:
1. P.-C.Aïtcin, High Performance Concrete, E &FN SPON, 1998
2. E.G.Nawy, Fundamentals of High Performance Concrete, John Wiley &Sons., 2nd edition, 2000
3. High Performance Concrete Structural Designers Guide published by FHWA, USA, 2005.
4. Geert De Schutter, Peter J.M. Bartos, Peter Domone, John Gibbs, Self Compacting Concrete, Whittles Publishing, 2008.
5.A R Santhakumar, Concrete Technology, Oxford University Press, New Delhi,2010.

6. EFNARC, Specifications and Guidelines for Self Compacting Concrete, European Federation, 2002.
7. IS 10262:2019-Concrete Mix Proportioning – Guidelines- 2019, Bureau of Indian Standards, New Delhi.

ANNEXURE 2

			L	T	P	C
20231CE118	**PC**	**ADVANCED MATHEMATICS**	**3**	**1**	**0**	**4**

Preamble

To familiarize the students in solving differential equations using numerical methods, to enable the students to perform statistical analysis and to enable them to solve boundary value problems associated with engineering applications

Course Content

UNIT I - NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Introduction -Picard's Method - Taylor's Series Method -Euler's Method - Modified Euler's Method -Runge's Method-Runge-Kutta Method -Predictor-Corrector Methods - Milne's Method-Adams-Bashforth Method - Simultaneous First Order Differential Equations -Second Order Differential Equations -Error Analysis -Convergence of a Method - Stability Analysis - Boundary Value Problems -Finite-Difference Method - Shooting Method

UNIT II - NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 12

Introduction - Classification of Second Order Equations - Finite Difference Approximations to Partial Derivatives - Elliptic Equations - Solution of Laplace's Equation - Solution of Poisson's Equation - Solution of Elliptic Equations by Relaxation Method - Parabolic Equations -Solution of One Dimensional Heat Equation -Solution of Two Dimensional Heat Equation - Hyperbolic Equations - Solution of Wave Equation

UNIT III - REGRESSION ANALYSIS 12

The Method of Least Squares-Inferences Based on the Least-Squares Estimators -Curvilinear Regression -Multiple Regression- Checking the Adequacy of the Model-Correlation- Multiple Linear Regression (Matrix Notation)

UNIT IV - ANALYSIS OF VARIANCE 12

Some General Principles-Completely Randomized Designs -Randomized-Block Designs- Multiple Comparisons- Analysis of Covariance.

UNIT V- METHOD OF VARIATION IN PROBLEMS WITH FIXED BOUNDARIES 12

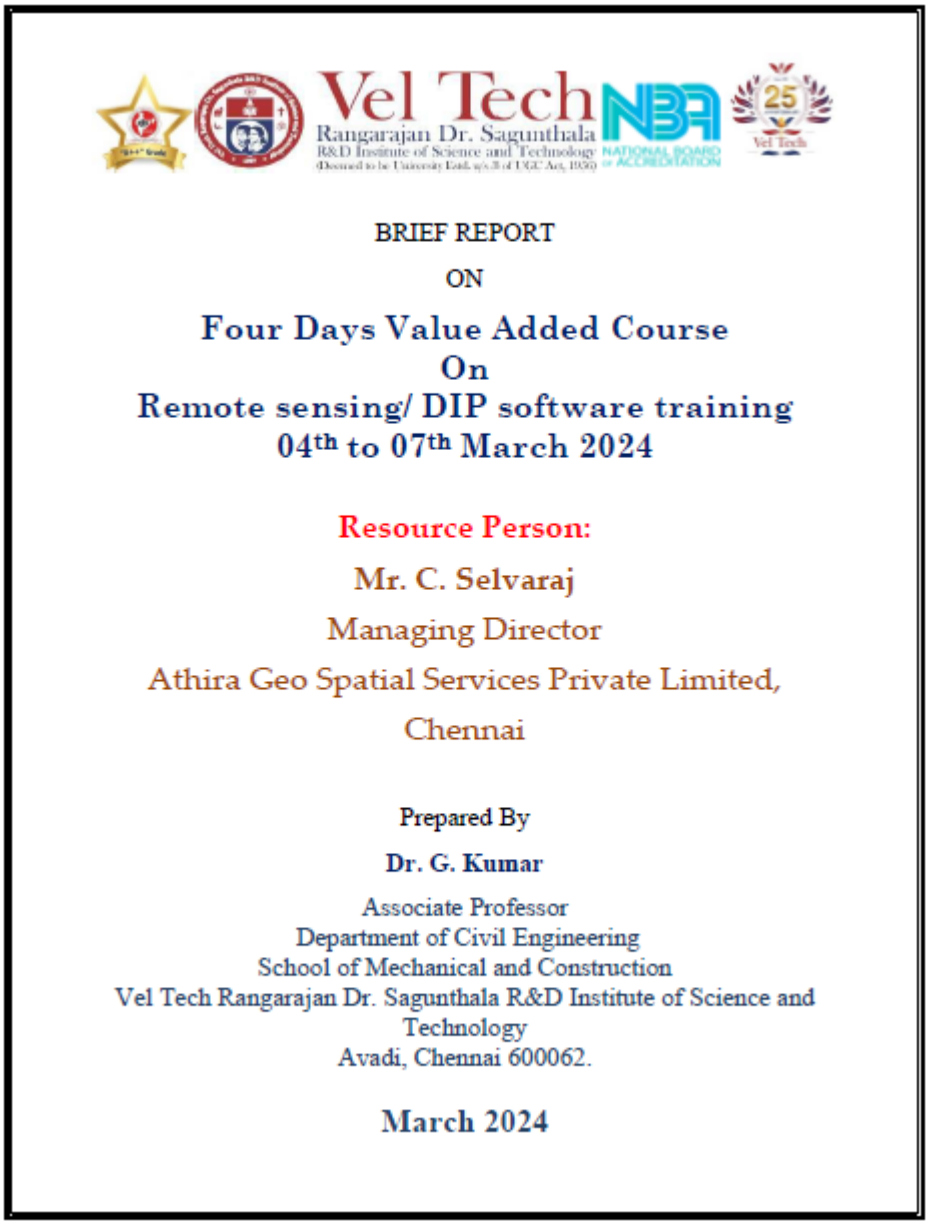
The variation and its properties-Euler equation- Functionals involving first order derivatives - Functionals involving derivatives of higher order-Functionals depending on functions of several independent variables-parametric representation of variational problems-some applications.

TOTAL: 60 HOURS

REFERENCES:

1. B. S. Grewal, "Numerical Methods In engineering and science C, C++, and Matlab", Mercury learning and information, New Delhi, 2019
2. Richard A. Johnson, "Miller & Freund's Probability and statistics For engineers" Ninth edition, Pearson Education, Boston, 2017.
3. Lev D. Elsgolc, "Calculus of variations", Dover Publications, Inc.Mineola, New York, 2007
4. Narayanan S. , Manigavachagom Pillay T. K., Ramanaiah G., "Advanced Mathematics For Engineering Students Volume 3" S Viswanathan Pvt Ltd, 2000
5. Montgomery D.C., Runger G.C., Hubele N. F. "Engineering Statistics", John Wiley and Sons, Inc.USA, 2011

ANNEXURE 3



Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology

BRIEF REPORT

ON

Four Days Value Added Course
On
Remote sensing/ DIP software training
04th to 07th March 2024

Resource Person:

Mr. C. Selvaraj

Managing Director

Athira Geo Spatial Services Private Limited,

Chennai

Prepared By

Dr. G. Kumar

Associate Professor
Department of Civil Engineering
School of Mechanical and Construction
Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology
Avadi, Chennai 600062.

March 2024

Vel Tech
Rangarajan Dr. Sagunthala

SCHOOL OF MECHANICAL AND CONSTRUCTION
DEPARTMENT OF CIVIL ENGINEERING
Remote Sensing and DIP - 04/03/2024 to 07/03/2024
Attendance II Year

S.NO	ID NO	STUDENT NAME	Attendance %
1	23435	ANUPOJU KEERTHI	100
2	26986	MEDAM SAI VYSHNAVI	100
3	24254	DEEPAK KUMAR	100
4	27323	ISTARLA RAM CHARAN TEJA	100
5	27010	MALLE VISHAL VYAS	67
6	27364	BAKKAMANTULA VARUN KUMAR	33
7	27368	AYUSH KUMAR	100
8	27158	SREERAM CVN MANIKANTA RAO	100
9	23866	YASHNIT ISAAC	67
10	23287	AKSHAYA KUMAR Y	33
11	24232	PEYYALA SRILAKSHMI YASWANTH	33
12	24297	SURYA PRAKASH R	100
13	26709	FIRDOASH HUSSAIN	0
14	23415	SULAIMAN K	100
15	27272	VEMULA VENKATA TEJA	100
16	23778	JOGU SREEKAR REDDY	67
17	23326	JITSIASIE NYUTHE	67
18	23320	B SHWETA	100
19	22162	M THAVASELVAM	67
20	24300	H MOHAMED SHAHID	0
21	24289	VETOKA V ZHIMOMI	33
22	23771	KALLURI INDRASENA REDDY	100

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology

SCHOOL OF MECHANICAL AND CONSTRUCTION
DEPARTMENT OF CIVIL ENGINEERING
Remote Sensing and DIP - 04/03/2024 to 07/03/2024
Attendance - III Year

S.NO	ID NO	STUDENT NAME	Attendance %
1	19546	BOKKA VENKATA TARUN	100
2	19616	MOHAMMAD ABDUL LATIF	AB
3	19901	POREDDY SURESH REDDY	100
4	20342	ANGATH K RAVI	100
5	20404	ADHIKARIMAYUM DANIEL SHARMA	67
6	20564	S LOGESH	AB
7	20573	YERRAMSETTI JETENDRA	100
8	20779	BAGDE AMAN ASHOK	100
9	20805	ANANJIT KHANGEMBAM	33
10	20834	NILOKA H ZHIMOMI	67
11	20925	TEKI SRINIVAS	AB
12	20936	ABHISHEK KUMAR	100
13	20959	RAJIB GHOSH	33
14	20967	INOKA H ZHIMOMI	67
15	20980	CHINGMAK T CHANG	33
16	21034	L JYOTHI VARDHAN	AB
17	21131	SHRUTI LAL	100
18	21169	BHUKYA SRUTHI	AB
19	21200	CARWYN VYVIAN RYMBAI	67
20	21204	DIPSHIKA HOWLADER	100
21	21277	ALAMURU AJAY BABU	100
22	21317	R SATISH	100
23	21320	MONISH SOUGAIJAM	AB
24	21456	AJAY KUMAR MANDAL	100
25	21478	NOOR MD RAIN	100
26	21489	SAMRAJ ALAM MANSURI	100
27	21490	KRISHNA PATEL	67
28	21492	SANJAY KUMAR SHRESTHA	67
29	21494	BHARAT KUMAR SHARMA	67
30	21495	MEDHAVI NIROULA	100
31	23943	CHAPATI ADI MADHAVA REDDY (LE)	67
32	23988	KUNDETI DEVI SARASWATHI (LE)	100
33	24038	AMAL KRISHNA A R (LE)	AB
34	24031	RAMALINGAM V (LE)	67
35	24035	INTINONGBOU T CHANG (LE)	100
36	24051	GUTHIREDDY JAYANTH REDDY(LE)	33

SAMPLE CERTIFICATE

ATHIRA GEO SPATIAL SERVICES PRIVATE LIMITED

No: 1, Manimegalai Street, Pallikaranai, Chennai - 600 100
Contact Number: 9941834119/8667418508
Email:selvaathira.gis@gmail.com/athirageospatialservices@gmail.com
www.athirageospatial.com

Ref No: AGSS/Training/50/2024

CERTIFICATE

This is to certify that Mr/Miss.Malle Vishal Vyas, II Year, Department of Civil Engineering has successfully completed "Four Days Value Added Course on Remote Sensing/Digital Image Processing" during March 04 - 6, 2024 at Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology, Chennai.

For Athira Geo Spatial Services Private Limited

C.Selvaraj
Managing Director

BRIEF REPORT

ON

Four Days Value Added Course On Drone surveying 26th to 29th February 2024

Resource Person:

Mr. C. Selvaraj

Managing Director

Athira Geo Spatial Services Private Limited,

Chennai

Prepared By

Dr. G. Kumar

Associate Professor
Department of Civil Engineering
School of Mechanical and Construction
Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology
Avadi, Chennai 600062.

February 2024

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology

SCHOOL OF MECHANICAL AND CONSTRUCTION
DEPARTMENT OF CIVIL ENGINEERING
Drone surveying - 26/02/2024 to 29/02/2024
Attendance - II Year

S.NO	ID NO	STUDENT NAME	Attendance %
1	23435	ANUPOJU KEERTHI	100
2	26986	MEDAM SAI VYSHNAVI	100
3	24254	DEEPAK KUMAR	100
4	27323	ISTARLA RAM CHARAN TEJA	100
5	27010	MALLE VISHAL VYAS	100
6	27364	BAKKAMANTULA VARUN KUMAR	100
7	27368	AYUSH KUMAR	100
8	27158	SREERAM CVN MANIKANTA RAO	100
9	23866	YASHNIT ISAAC	100
10	23287	AKSHAYA KUMAR Y	100
11	24232	PEYYALA SRILAKSHMI YASWANTI	67
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13	26709	FIRDOASH HUSSAIN	100
14	23415	SULAIMAN K	AB
15	27272	VEMULA VENKATA TEJA	AB
16	23778	JOGU SREEKAR REDDY	100
17	23326	JITSIASIE NYUTHE	33
18	23320	B SHWETA	100
19	22162	M THAVASELVAM	67
20	24300	H MOHAMED SHAHID	33
21	24289	VETOKA V ZHIMOMI	33
22	23771	KALLURI INDRASENA REDDY	100

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology

SCHOOL OF MECHANICAL AND CONSTRUCTION
DEPARTMENT OF CIVIL ENGINEERING
Drone surveying - 26/02/2024 to 28/02/2024
Attendance - III Year

S.NO	ID NO	STUDENT NAME	Attendance %
1	19546	BOKKA VENKATA TARUN	100
2	19616	MOHAMMAD ABDUL LATIF	AB
3	19901	POREDDY SURESH REDDY	100
4	20342	ANGATH K RAVI	100
5	20404	ADHIKARIMAYUM DANIEL SHARMA	100
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7	20573	YERRAMSETTI JETENDRA	100
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9	20805	ANANJIT KHANGEMBAM	100
10	20834	NILOKA H ZHIMOMI	AB
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17	21131	SHRUTI LAL	100
18	21169	BHUKYA SRUTHI	AB
19	21200	CARWYN VYVIAN RYMBAI	100
20	21204	DIPSHIKA HOWLADER	100
21	21277	ALAMURU AJAY BABU	100
22	21317	R SATISH	100
23	21320	MONISH SOUGAIJAM	AB
24	21456	AJAY KUMAR MANDAL	67
25	21478	NOOR MD RAIN	67
26	21489	SAMRAJ ALAM MANSURI	100
27	21490	KRISHNA PATEL	100
28	21492	SANJAY KUMAR SHRESTHA	100
29	21494	BHARAT KUMAR SHARMA	100
30	21495	MEDHAVI NIROULA	100
31	23943	CHAPATI ADI MADHAVA REDDY (LE)	AB
32	23988	KUNDETI DEVI SARASWATHI (LE)	67
33	24038	AMAL KRISHNA A R (LE)	AB
34	24031	RAMALINGAM V (LE)	100
35	24035	INTINONGBOU T CHANG (LE)	67
36	24051	GUTHIREDDY JAYANTH REDDY(LE)	100

SAMPLE CERTIFICATE

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Contact Number: 9941834119/8667418508
Email:selvaathira.gis@gmail.com/athirageospatialservices@gmail.com
www.athirageospatial.com

Ref No: AGSS/Training/39/2024

CERTIFICATE

This is to certify that Mr/Miss.Ramalingam V (LE), III Year, Department of Civil Engineering has successfully completed "Four Days Value Added Course on Drone Survey and Process " during February 26 - 28, 2024 at Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology, Chennai.

For Athira Geo Spatial Services Private Limited

C.Selvaraj
Managing Director

ANNEXURE 4

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

SCHOOL OF MECHANICAL AND CONSTRUCTION

DEPARTMENT OF CIVIL ENGINEERING

ParaV ENGINEERING
UNITED KINGDOM

Short – term course on

"IoT for civil Engineering"

By

Dr. Bharani Iyengar

Chief Executive Officer,

ParaV Electronics, UK.

05 February 2024 – 08 February 2024

Report

VEL TECH RANGARAJAN Dr. SAGUNTHALA R&D INSTITUTE OF SCIENCE AND TECHNOLOGY
SCHOOL OF MECHANICAL AND CONSTRUCTION
DEPARTMENT OF CIVIL ENGINEERING
BATCH 2022-2026
ACADEMIC YEAR 2023-24
WINTER SEMESTER
ATTENDANCE SHEET

S.NO	ID NO	STUDENT NAME	05-Feb							06-Feb							07-Feb								08-Feb								ATT %	ELIGIBILITY
			1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8		
1	22162	THAVASELVAM. M	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	63.33	NE
2	23287	Y. AKSHAYA KUMAR	P	P	P	P	P	P	P	P	P	P	P	A	A	A	P	P	P	P	A	A	A	A	A	A	A	A	A	A	A	A	50	NE
3	23326	JITSIASH NYUTHE	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	100	E
4	23415	SULAIMAN.K	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	86.66	E
5	23435	KEERTHI ANUPOJU	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	100	E
6	23771	KALLURI INDRA SENAREDDY	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	100	E
7	23866	YASHNET ISAAC	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	80	E
8	24232	PEYYALA SRILAKSHMI YASWANTH	P	P	P	P	P	P	P	A	A	A	A	P	P	P	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	33.33	NE
9	24254	DEEPAK KUMAR	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	100	E
10	24289	VETOKA V ZHIMOMI	P	P	P	P	P	P	P	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	86.66	E
11	24297	SURYA PRAKASH R	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	100	E
12	23778	JOGU SREEKAR REDDY	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	86.66	E
13	24300	H MOHAMED SHAHID	A	A	A	A	A	A	A	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A	P	P	P	P	P	P	P	P	50	NE
14	23320	B SWETA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	100	E
15	26709	FIRDOASH HUSSAIN	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A	60	NE
16	26986	MEDAM SAI VYSHNAVI	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	100	E
17	27010	M VISHAL VYAS	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	100	E
18	27158	SREERAM CVN MANIKANTA RAO	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	100	E
19	27272	VEMULA VENKATA TEJA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	100	E
20	27323	ESTARLA RAM CHARAN TEJA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	100	E
21	27368	AYUSH KUMAR	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	100	E
22	27364	B. VARUN KUMAR	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	100	E

Photos


GPS Map Camera
Morai, Tamil Nadu, India
53GX+M6V, Morai, Tamil Nadu 600055, India
Lat 13.176835°
Long 80.09812°
10/02/24 12:00 PM GMT +05:30
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Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

SCHOOL OF MECHANICAL AND CONSTRUCTION

DEPARTMENT OF CIVIL ENGINEERING

ParaV
ENGINEERING
UNITED KINGDOM

Special Program Elective on

"10212CE901- IoT for Civil Engineering"

By

Dr. Bharani Iyengar

Chief Executive Officer, ParaV Electronics, UK.

05 – 10 February 2024

Report

VEL TECH RANGARAJAN Dr.SAGUNTHALA R&D INSTITUTE OF SCIENCE AND TECHNOLOGY
SCHOOL OF MECHANICAL AND CONSTRUCTION
DEPARTMENT OF CIVIL ENGINEERING
BATCH 2021-2026
ACADEMIC YEAR 2026-24
WINTER SEMESTER

ATTENDANCE SHEET
10212CE901- IoT FOR CIVIL ENGINEERING

S.NO	ID NO	STUDENT NAME	06-Feb							08-Feb							07-Feb							08-Feb							09-Feb							10-Feb				RI	RII	RIII	ATT	ATT %	ELIGIBILITY
			1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	2	2	2			
1	###	BOKKA VENKATA TARUN	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
2	###	POREDDY SURESH REDDY	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	41	91	Eligible
3	###	ANGATH K RAVI	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
4	###	ADHIKARIMAYUM DANIEL	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
5	###	VERRAMBETTI JETENDRA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
6	###	BAGDE AMAN ASHOK	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	43	96	Eligible
7	###	ANANJIT KHANGEMBAM	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	42	93	Eligible
8	###	NILOKA H ZHIMOMI	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	41	91	Eligible
9	###	TEKI SRINIVAS	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	43	96	Eligible
10	###	ABHISHEK KUMAR	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
11	###	RAJIB GHOSH	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
12	###	INOKA H ZHIMOMI	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	41	91	Eligible
13	###	CHINGMAK T CHANG	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	41	91	Eligible
14	###	L JYOTHI VARDHAN	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	39	87	Eligible
15	###	SHRUTI LAL	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	41	91	Eligible
16	###	CARWYN VYVIAN RYMBAI	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
17	###	DIPSHIKA HOWLADER	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	41	91	Eligible
18	###	ALAMURU AJAY BABU	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
19	###	MONISH SOUGAIJAM	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	P	P	37	82	Eligible
20	###	AJAY KUMAR MANDAL	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
21	###	NOOR MD RAIN	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
22	###	SAMRAJ ALAM MANSURI	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
23	###	KRISHNA PATEL	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	41	91	Eligible
24	###	SANJAY KUMAR SHRESTHA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
25	###	BHARAT KUMAR SHARMA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
26	###	MEDHAVI NIROULA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
27	###	CHAPATI ADI MADHAVA R	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	P	P	P	A	A	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	35	78	Eligible
28	###	KUNDETI DEVI SARASWAT	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	43	96	Eligible
29	###	RAMALINGAM V **(LE)**	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	45	100	Eligible
30	###	INTINONGBOU T CHANG (L	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	41	91	Eligible
31	###	GUTHIREDDY JAYANTH RE	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	43	96	Eligible


GPS Map Camera
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53GX+M6V, Morai, Tamil Nadu 600055, India
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Google

Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)
Avadi, Chennai-600062, Tamil Nadu, India

6th MEETING of BOARD of STUDIES

Minutes

for

B.Tech Computer Science and Design Programme

[CBCS]

On

12.07.2024

B.Tech Computer Science and Design

School of Computing

Department of Computer Science and Design
School of Computing
6th MEETING of BOARD of STUDIES
For
B.Tech Computer Science and Design

Index

Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)
Avadi, Chennai-600062, Tamil Nadu, India

6th MEETING of BOARD of STUDIES
For
B.Tech Computer Science and Design

Date: 12.07.2024
Venue: SoC Block

AGENDA

<table>
<tr><th>Item No</th><th>Agenda</th></tr>
<tr><td colspan="2">A. Opening</td></tr>
<tr><td>1.</td><td>Confirmation of 5th BoS meeting minutes held on 23.12.2023</td></tr>
<tr><td>2.</td><td>To review the Action Taken Report on the minutes of the 5th meeting of the Board of Studies</td></tr>
<tr><td colspan="2">B. Items to be considered</td></tr>
<tr><td>3.</td><td>To discuss and approve the new courses and course contents under Program Elective category for B. Tech Computer Science and Design offered under regulation VTRUGE 21, with effect from Summer 2024-2025
<table>
<tr><th>S. No</th><th>Course Code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1.</td><td>10212CD239</td><td>3D Character Modeling</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>2.</td><td>10212CD243</td><td>Mobile Game Development Tools</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>3.</td><td>10212CD216</td><td>Natural Language Processing</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>4.</td><td>10212CD223</td><td>Machine Learning Techniques</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
</table></td></tr>
<tr><td>4.</td><td>To discuss and approve the courses to be offered in Online MOOCs platforms under Open Elective Category during the academic year Summer, 2024-2025
<table>
<tr><th>S. No</th><th>Course Code</th><th>Course Name</th><th>Course Provider</th><th>Duration in Weeks</th><th>Credits</th></tr>
<tr><td>1.</td><td>10213CD424</td><td>Design, Technology and Innovation</td><td>NPTEL</td><td>8</td><td>2</td></tr>
<tr><td>2.</td><td>10213CD425</td><td>Innovation by Design</td><td>NPTEL</td><td>4</td><td>1</td></tr>
</table></td></tr>
</table>

C. Items to be ratified

5. To Ratify new Program Elective courses offered during Winter 2023-2024 in the existing B.Tech Computer Science and Design curriculum under the regulation VTRUGE 2021

S. No	Course Code	Course Name	L	T	P	C
1.	10212CD252	Windows Client Administration Operating Systems	2	0	2	3
2.	10212CD253	Windows Server Administration Operating Systems	2	0	2	3

6. To ratify the courses offered by Industry Experts for B.Tech Computer Science and Design for Skill enhancement and Employment opportunities under Industry/Higher Institute Interaction Learning Category during the Winter Semester of academic year 2023-2024 for B.Tech Computer Science and Design

S. No	Course Code	Course Name	L	T	P	C
1.	10215CD924	IoS Application Creation	1	0	0	1

7. To Ratify the Value-added Courses offered in Winter Semester 2023-24 for B.Tech Computer Science and Design

S. No	Course code	Course Name	L	T	P	C
1	10218CD941	Java Programming Fundamentals	2	0	0	0
2	10218CD942	Data Structures and Algorithms using Python - Part 1	2	0	0	0

8. Any other cognate item

School of Computing
6th MEETING of BOARD of STUDIES
For
B.Tech Computer Science and Design

Date: 12.07.2024
Venue: SoC Block

Members Present:

S. No	Name and Designation	Nominee	Signature
1	Dr. SP. Chokkalingam, Professor, Dean (SoC)	Chairperson	
2	Dr. C. Mala Professor Department of Computer Science Engineering NIT, Tiruchirapalli, Tamil Nadu	Academic Expert Nominee	
3	Dr. Komondoor V.Raghavan Associate Professor Department of Computer Science and Automation Indian Institute of Science, Bangalore, Karnataka	Academic Expert Nominee	
4	Mr. Sivaprakasam Perumal Software Engineer, Hewlett-Packard Enterprise, Chennai, Tamil Nadu	Industry Expert Nominee	
5	Mr. E. Sunil, Assistant General Manager, ATRIA Convergence Technologies Ltd, T.Nagar, Chennai, Tamil Nadu	Industry Expert Nominee	
6	Ms. Malini Consultant- Data Analytics Det Norske Veritas (DNV)	Alumni	
7	Dr. N. Malarvizhi, Professor	Professor Nominee	
8	Dr. M. Kavitha, Professor	Professor Nominee	
9	Dr. N.R. Rajalakshmi, Professor	Professor Nominee	
10	Dr. R. Srinivasan, Professor	Professor Nominee	
11	Dr. J. Visumathi, Professor and Head – IT	Professor Nominee	
12	Dr. S. Sridevi, Professor	Professor Nominee	

13	Dr. A. Bhagyalakshmi, Professor	Professor Nominee	
14	Dr. S. Jagan, Professor	Professor Nominee	
15	Dr. N. Rajkumar, Professor	Professor Nominee	
16	Dr. V. Dhilipkumar, Professor and Head – AI & DS	Professor Nominee	
17	Dr. R. Parthasarathy, Associate Professor and Head – CSD	Associate Professor Nominee	
18	Dr. T. Kujani, Assistant Professor (Sr. Grade)	Assistant Professor (Sr. Grade) Nominee	
19	Mrs. C. Shyamala Kumari, Assistant Professor	Assistant Professor Nominee	

Invited Members

S. No	Name	Designation	
1	Dr. M. S. Muralidhar	Associate Professor – Head – CSE	
2	Dr. T. Rajendran	Associate Professor – Head – CSE (CS)	
3	Dr. S. Lalitha	Associate Professor – Head – CSE (AIML)	
4	Dr. P. Jose	Associate Professor – Head – CSE (DS)	

The Chair expressed his happiness in welcoming all the members for the 6th meeting of BOS and thanked them for sparing their valuable time.

06-BoS-01	Confirmation of 5th BoS meeting minutes held on 23.12.2023
Action Taken:	The minutes of 5th BoS meeting minutes held on 23.12.2023 was circulated to members through e-mail, the members confirmed the minutes. [Annexure - I]
06-BoS-02	To review the Action Taken Report on the minutes of the 5th meeting of the Board of Studies
Resolution	The members reviewed the action taken report on the decisions of 5th BoS meeting minutes held on 23.12.2023 [Annexure - II]
06-BoS-03	To discuss and approve the new courses and course contents under Program Elective category for B. Tech Computer Science and Design offered under regulation VTRUGE 21, with effect from Summer 2024-2025 in view of breadth, depth and employability Skills.
Discussion	Experts reviewed the content of Courses under Program Elective category for B. Tech Computer Science and Design to be offered under regulation VTRUGE 21, with effect from Summer 2024-2025
Resolution	The members approved the content of Courses under Program Elective category for B. Tech Computer Science and Design to be offered under regulation VTRUGE 21, with effect from Summer 2024-2025 [Annexure - III]
06-BoS-04	To discuss and approve the courses to be offered in Online MOOCs platforms under Open Elective Category during the academic year Summer, 2024-2025
Discussion	Experts reviewed the listed courses to be offered during the academic year Summer, 2024-2025
Resolution	The members approved the MOOC courses and course content to be offered under Open Elective Category during the academic year Summer, 2024-2025 for B.Tech Computer Science and Design [Annexure-IV]
06-BoS-05	To Ratify new Program Elective courses offered during Winter 2023-2024 in the existing B.Tech Computer Science and Design curriculum under the regulation VTR UGE 2021
Discussion	Experts reviewed the Industry collaborated the Program Elective courses and suggested to combine the courses and offer as a single course in the new regulation

Resolution	The courses were ratified by the members and by considering the suggestion of the members, the contents of the 10212CD252 - Windows Client Administration Operating Systems and 10212CD253 - Windows Server Administration Operating Systems Program Elective courses will be combined as a single course in the new regulation [Annexure - V]
06-BoS-06	To ratify the courses offered by Industry Experts for B.Tech Computer Science and Design for Skill enhancement and Employment opportunities under Industry/Higher Institute Interaction Learning Category during the Winter Semester of academic year 2023-2024 for B.Tech Computer Science and Design
Resolution	The members ratified the offered by Industry Experts for B.Tech Computer Science and Design for Skill enhancement and Employment opportunities under Industry/Higher Institute Interaction Learning Category during the Winter Semester of academic year 2023-2024 for B.Tech Computer Science and Design [Annexure-VI]
06-BoS-07	To Ratify the Value-added Courses offered in Winter Semester 2023-24 for B.Tech Computer Science and Design
Resolution	The members ratified the Value-added Courses offered in Winter Semester 2023-24 for B.Tech Computer Science and Design [Annexure-VII]
06-BoS-08	Any other Cognate Item
Discussion	The members recommended to offer Operating Systems and Software Engineering Courses to the students admitted through the Lateral Entry Category from the next academic year, and to avoid using the words like Modern, Fundamentals in the Course name
Resolution	As per the suggestions from the members, the recommendations will be incorporated in the new Regulation. The next BoS meeting will be conducted in December 2024

Annexure – I

[Confirmation of 5th BoS meeting minutes held on 23.12.2023]

1,149

Department of Computer Science and Design (CSD) - 5th Board of St

hodcsd Vel Tech, Chennai <hodcsd@veltech.edu.in>
to mala, raghavan@iisc.ac.in, malini.m2816@gmail.com, SUNIL, sivaprakasam.perumal, deansoc

Dear Sir / Madam,

Herewith I am attaching the 5th Board of Studies Meeting Minutes of B.Tech - Computer Science and Design (CSD) for

With regards
Dr. R. Parthasarathy
Associate Professor & Head - CSD,
School of Computing,
Vel Tech Rangarjan Dr. Sagunthala R&D Institute of Science and Technology.

One attachment • Scanned by Gmail

5th-BoS-Minutes..

Reply Reply all Forward

Annexure – II

[Action Taken Report]

Item No	Item	Decision taken	Action Taken
ITEMS FOR DISCUSSION AND APPROVAL			
05-BoS-03	To discuss the stakeholders feedback on curriculum of B.Tech Computer Science and Design taken for the academic year 2022-2023	The members reviewed the stakeholders feedback on curriculum of B.Tech Computer Science and Design	Members reviewed and approved
05-BoS-04	To discuss and approve the Program Core and Program Electives to be offered in the existing B.Tech CSD curriculum VTR UGE 2021 keeping in view of NEP 2020 to be implemented with effect from the academic year Winter 2023 - 2024 in view of breadth, depth and employability Skills.	Experts reviewed the content of 10212CD238 – Design, Drawing and Visualization Course and suggested to fine tune the theory course content based on the allotted hours	By considering the suggestion of the members, changes were made and the updated Course structure and details are available
05-BoS-05	To discuss and approve the courses to be offered in Online MOOCs platforms under Open Elective Category during the academic year Winter, 2023-2024 for B.Tech Computer Science and Design	Experts reviewed the listed courses to be offered during the academic year Winter, 2023-2024 and suggested to increase the MooC Courses credits	The members approved the MOOC courses and course content to be offered under Open Elective Category during the academic year Winter, 2023-2024 for B.Tech Computer Science and Design and as per the suggestion the Credit for 12 Weeks has been increased from 2 to 3 and 1 to 2 for 8 Weeks Course

05-BoS-06	To discuss and approve the introduction of new Program Elective courses in various domains under Industry Institute Interaction (III) Initiatives collaboration of ATOS in the existing B.Tech Computer Science and Design curriculum under the regulation VTR UGE 2021 to be implemented with effect from the academic year Winter 2023-2024 in view of employability skills	Experts reviewed the new Program Elective courses in various domains under Industry Institute Interaction (III) Initiatives collaboration of ATOS and suggested to include the courses under General Program Elective	By considering the suggestion of the members, the new Program Elective courses under Industry Institute Interaction (III) Initiatives collaboration of ATOS were included under General Program Elective
05-BoS-07	To approve the Value added Courses to be offered during the Winter 2023-2024 for B.Tech CSD programme	The members approved the Value added courses and course content to be offered under during the academic year Winter, 2023-2024 for B.Tech Computer Science and Design	The proposed courses are offered with effect from the Academic Year Winter 2023-2024
05-BoS-08	To Ratify new Program Elective courses offered during Summer 2023-2024 in various domains under Industry Institute Interaction (III) Initiatives collaboration of ATOS in the existing B.Tech Computer Science and Design curriculum under the regulation VTR UGE 2021	Experts reviewed the new Program Elective courses in various domains under Industry Institute Interaction (III) Initiatives collaboration of ATOS and suggested to include the courses under General Program Elective Category	The courses were included under the General Program Elective Category

05-BoS-09	To ratify the courses offered by Industry Experts for B.Tech Computer Science and Design for Skill enhancement and Employment opportunities under Industry/Higher Institute Interaction Learning Category during the Summer Semester of academic year 2023-2024 for B.Tech Computer Science and Design	The members ratified the course offered by Industry Experts for B.Tech Computer Science and Design for Skill enhancement and Employment opportunities under Industry/Higher Institute Interaction Learning Category during the Summer Semester of academic year 2023-2024 for B.Tech Computer Science and Design	The offered courses were ratified
05-BoS-10	To Ratify the Value-added Courses offered in Summer Semester 2023-24 for B.Tech Computer Science and Design	The members ratified the Value-added Courses offered in Summer Semester 2023-24 for B.Tech Computer Science and Design	The offered courses were ratified

Annexure – III

[Approval of Program Electives Courses]

B.Tech - COMPUTER SCIENCE AND DESIGN
(Specialization / Honors)
(With effect from 2021-2022)

Preamble:

Computer Science and Design (CSD) aim to develop graduates that are not only well versed with computing approaches, tools, and technologies, but are also experienced with Design approaches. The program will prepare students to work in the software industry as well as gaming, animation and user experience design industry. The program will prepare students to take up higher studies in CS or in Design.

Program Structure

Course Category	Minimum Credits Required
Foundation Courses (FC)	56
Program Core (PC)	58
Program Elective (PE)	18
Open Elective (OE)	12
Independent Learning (IL)	14
Industry / Higher Institute Learning Interaction (IHL)	2
Professional Proficiency Courses (PPC)	4
TOTAL	**164**

Minimum credits required for regular students in various course categories for B.Tech Computer Science and Design with minor

The students shall earn 164 credits in various course categories and additional 18 to 20 credits in the specialized tracks / areas from other branches/Schools by satisfying the prerequisite courses for the award of degree of B.Tech Computer Science and Design with minor subject to the regulations.

Minimum credits required for regular students in various course categories for B.Tech Computer Science and Design with Honors

The students shall earn 164 credits in various course categories and additional 18 to 20 credits in the specialized tracks / areas courses by satisfying the prerequisite courses for the award of degree of B.Tech Computer Science and Design with Honors subject to the regulations.

Foundation Core (56 Credits)

Foundation courses enhance the knowledge, skills and attitude of UG engineering graduates of all programmes to the expected level. The foundation courses shall have the courses related to basic sciences and mathematics, basic engineering sciences and humanities and social sciences.

S. No	Course Code	Subject Title	Category	L	T	P	C
Lecture Courses							
1	10210MA101	Linear Algebra for Computing	BSC	3	1	0	4
2	10210MA102	Calculus & Ordinary Differential Equations	BSC	3	1	0	4
3	10210MA103	Probability, Statistics and Queuing theory	BSC	3	1	0	4
4	10210MA110	Discrete Mathematical Structures	BSC	3	1	0	4
5	10210PH101	Semiconductor Physics	BSC	3	0	0	3
6	10210CH103 (2021-2022) admitted batch only	Environmental Science	BSC	3	0	0	3
	10210CH104 (2022-2023) admitted batch onwards	Environmental Science and Sustainability	BSC	3	0	0	3
7	10210CS101	Problem Solving using C	ESC	3	0	0	3
8	10210CS103 (2021-2022) admitted batch only	Object Oriented Programming using C++	ESC	3	0	0	3
	10210CS104 (2022-2023) admitted batch onwards	Python Programming	ESC	3	0	0	3
9	10210ME101	Design thinking	ESC	2	0	0	2
10	10210BM101	Biology for Engineers	ESC	2	0	0	2
11	10210ME103	Innovation & Entrepreneurship	ESC	2	0	0	2

12	10210ME102	Universal Human Values	HSC	3	0	0	3
13	10210ME104	Project Management & Finance	HSC	2	0	0	2
14	10210ME105	Engineers and Society	HSC	1	0	0	M
15	10210BL101	Constitution of India	HSC	1	0	0	M
Integrated Courses							
16	10210EN201	Professional Communication – I	HSC	1	0	2	2
17	10210EN202	Professional Communication – II	HSC	1	0	2	2
18	10210EC201	Basic Electronics & Digital Logic Design	ESC	2	0	2	3
19	10210EE204	Introduction to Engineering	ESC	1	0	4	3
20	10210ME201	Engineering Graphics	ESC	1	0	4	3
Laboratory Courses							
21	10210PH301	Modern Physics Laboratory	BSC	0	0	2	1
22	10210EE301	Engineering Products Lab	ESC	0	0	2	1
23	10210CS301	Problem Solving using C Lab	ESC	0	0	2	1
24	10210CS303 (2021-2022) admitted batch only	IT workshop	ESC	0	0	2	1
25	10210CS304 (2021-2022) admitted batch only	Object Oriented Programming using C++ Lab	ESC	0	0	2	1
	10210CS305 (2022-2023) admitted batch onwards	Python Programming Lab	ESC	0	0	2	1
Total Credits							**56**

*****BSC – Basic Science Courses, ESC – Engineering Science Courses, HSC – Humanities & Social Science Courses, M – Mandatory course

Program Core (58 Credits)

L - Lecture, T - Tutorial, P - Practical, C - Credit

S. No	Course Code	Course Name	L	T	P	C

		Theory Courses				
1	10211CD101	Data Structures	3	1	0	3
2	10211CD103	Operating Systems	3	0	0	3
3	10211CD104 (2021- 2022) admitted batch only	Computer Architecture and Organization	3	0	0	3
	10211CD129 (2022-2023) admitted batch onwards	Modern Computer Architecture	3	0	0	3
4	10211CD105	Computer Networks	3	0	0	3
	10211CD130 (2022-2023) admitted batch onwards	Fundamentals of Computer Networks	3	0	0	3
5	10211CD106	Formal Languages and Automata Theory	3	1	0	3
6	10211CD107	Compiler Design	3	1	0	3
		Integrated Courses				
7	10211CD202	Design and Analysis of Algorithms	3	1	2	4
8	10211CD203	Programming using Java	2	1	2	3
9	10211CD205	Computer Graphics and Image Processing	2	1	2	3
10	10211CD206	Human Computer Interaction	2	0	2	3
11	10211CD207	Database Management Systems	3	1	2	4
12	10211CD208	Software Engineering	2	1	2	3
13	10211CD210	Big Data Analytics	3	0	2	4
14	10211CD220	Animation Engineering	3	0	2	4
15	10211CD221	Game Design	3	0	2	4
16	10211CD222	Virtual and Augmented Reality	2	0	2	3
		Laboratory Courses				
17	10211CD301	Data Structures Laboratory	0	0	2	1
18	10211CD303	Computer Networks Laboratory	0	0	2	1
19	10211CD312 (2022-2023) admitted batch onwards	Fundamentals of Computer Networks Laboratory	0	0	2	1
	10211CD304	Operating Systems Laboratory	0	0	2	1
20	10211CD306	Competitive Coding- I	0	0	2	1
21	10211CD307	Competitive Coding –II	0	0	2	1
Total Credits						**58**

B.Tech - COMPUTER SCIENCE AND DESIGN

CBCS CURRICULUM

Honors / Specialization

2022-2023 Admitted Batch

Minimum credits required for Lateral Entry students in various course categories for B.Tech (Computer Science and Design) - VTR UGE 2021

The students shall earn 120 credits in various course categories given below for the award of degree of B.Tech (Computer Science and Design).

Course Category	Minimum Credits Required
Foundation Courses (FC)	22
Program Core (PC)	48
Program Elective (PE)	18
Open Elective (OE)	12
Independent Learning (IL)	14
Industry / Higher Institute Learning Interaction (IHL)	2
Professional Proficiency Courses (PPC)	4
TOTAL	**120**

B.Tech - COMPUTER SCIENCE AND DESIGN

CBCS CURRICULUM

Honors / Specialization

2022-2023 Admitted Batch

VTR UGE 2021

Foundation Core Course: 22 Credits

S.No	Course Code	Subject Title	Category	L	T	P	C
Lecture Courses							
1	10210MA110	Discrete Mathematical Structures	BSC	3	1	0	4
2	10210CH103	Environmental Science	BSC	2	0	0	2
3	10210MA103	Probability, Statistics and Queuing theory	ESC	3	1	0	4
4	10210ME101	Design thinking	ESC	2	0	0	2
5	10210ME103	Innovation & Entrepreneurship	ESC	2	0	0	2
6	10210BM101	Biology for Engineers	ESC	2	0	0	2
7	10210ME102	Universal Human Values	HSC	3	0	0	3
8	10210ME104	Project Management & Finance	HSC	2	0	0	2
9	10210ME105	Engineers and Society	HSC	1	0	0	M
10	10210BL101	Constitution of India	HSC	1	0	0	M
Laboratory Courses							
11	10210CS303	IT Workshop	ESC	0	0	2	1
			Total Credits				**22**

Program Core (48 Credits)

S. No	Course Code	Course Name	L	T	P	C
		Theory Courses				
1	10211CD101	Data Structures	3	1	0	3
2	10211CD104	Computer Architecture and Organization	3	0	0	3
3	10211CD105	Computer Networks	3	0	0	3
4	10211CD130 (2022-2023) admitted batch onwards	Fundamentals of Computer Networks	3	0	0	3
5	10211CD106	Formal Languages and Automata Theory	3	1	0	3
6	10211CD107	Compiler Design	3	1	0	3
		Integrated Courses				
7	10211CD202	Design and Analysis of Algorithms	3	1	2	4
8	10211CD203	Programming using Java	2	1	2	3
9	10211CD205	Computer Graphics and Image Processing	2	1	2	3
10	10211CD206	Human Computer Interaction	2	0	2	3
11	10211CD207	Database Management Systems	3	1	2	4
12	10211CD210	Big Data Analytics	3	0	2	4
13	10211CD220	Animation Engineering	3	0	2	4
14	10211CD221	Game Design	3	0	2	4
15	10211CD222	Virtual and Augmented Reality	2	0	2	3
		Laboratory Courses				
16	10211CD301	Data Structures Laboratory	0	0	2	1
17	10211CD312	Fundamentals of Computer Networks Laboratory	0	0	2	1
Total Credits						**49**

B.Tech - COMPUTER SCIENCE AND DESIGN

CBCS CURRICULUM

Honors / Specialization

2023-2024 Admitted Batch

Minimum credits required for Lateral Entry students in various course categories for B.Tech (Computer Science and Design) - VTR UGE 2021

The students shall earn 120 credits in various course categories given below for the award of degree of B.Tech (Computer Science and Design).

Course Category	Minimum Credits Required
Foundation Courses (FC)	22
Program Core (PC)	48
Program Elective (PE)	18
Open Elective (OE)	12
Independent Learning (IL)	14
Industry / Higher Institute Learning Interaction (IHL)	2
Professional Proficiency Courses (PPC)	4
TOTAL	**120**

B.Tech - COMPUTER SCIENCE AND DESIGN

CBCS CURRICULUM

Honors / Specialization

2023-2024 Admitted Batch

VTR UGE 2021

Foundation Core Course: 22 Credits

L-Lecture T-Tutorial P-Practical C-Credits

S.No	Course Code	Subject Title	Category	L	T	P	C
Lecture Courses							
1	10210MA110	Discrete Mathematical Structures	BSC	3	1	0	4
2	10210CH104	Environmental Science and Sustainability	BSC	3	0	0	3
3	10210CS104	Programming Using Python	ESC	3	0	0	3
4	10210ME101	Design thinking	ESC	2	0	0	2
5	10210BM101	Biology for Engineers	ESC	2	0	0	2
6	10210ME103	Innovation & Entrepreneurship	ESC	2	0	0	2
7	10210ME102	Universal Human Values	HSC	3	0	0	3
8	10210ME104	Project Management & Finance	HSC	2	0	0	2
9	10210ME105	Engineers and Society	HSC	1	0	0	M
10	10210BL101	Constitution of India	HSC	1	0	0	M
Laboratory Courses							
11	10210CS305	Programming Using Python Lab	ESC	0	0	2	1
			Total Credits				**22**

Program Core (48 Credits)

S. No	Course Code	Course Name	L	T	P	C
		Theory Courses				
1	10211CD101	Data Structures	3	1	0	3
2	10211CD129	Modern Computer Architecture	3	0	0	3
3	10211CD130	Fundamentals of Computer Networks	3	0	0	3
4	10211CD106	Formal Languages and Automata Theory	3	1	0	3
5	10211CD107	Compiler Design	3	1	0	3
		Integrated Courses				
6	10211CD202	Design and Analysis of Algorithms	3	1	2	4
7	10211CD203	Programming using Java	2	1	2	3
8	10211CD205	Computer Graphics and Image Processing	2	1	2	3
9	10211CD206	Human Computer Interaction	2	0	2	3
10	10211CD207	Database Management Systems	3	1	2	4
11	10211CD210	Big Data Analytics	3	0	2	4
12	10211CD220	Animation Engineering	3	0	2	4
13	10211CD221	Game Design	3	0	2	4
14	10211CD222	Virtual and Augmented Reality	2	0	2	3
		Laboratory Courses				
15	10211CD301	Data Structures Laboratory	0	0	2	1
16	10211CD312	Fundamentals of Computer Networks Laboratory	0	0	2	1
Total Credits						**49**

Program Elective (18 Credits)

Program electives are the courses offered in the programme which covers depth and breadth. The students may register for appropriate electives offered in the programme based on their area of interest. One course under this category shall be taken from the list of approved MOOCs.

L - Lecture, T - Tutorial, P - Practical, C - Credit

S. No	Course Code	Course Name	L	T	P	C
		General Electives				
1	10211CS212	Web and Mobile Application Development	3	0	2	4
2	10212CD228	*Block Chain Technology	2	0	2	3
3	10212CD229	IoT and Cloud Computing	3	0	2	4
4	10212CD251	Virtualization Techniques	2	0	2	3
5	10212CD262	Storage Management	2	0	2	3
6	10212CD260	Advanced Routing Techniques and Security	2	0	2	3
7	10212CD264	Application Server Technologies	2	0	2	3
8	10212CD268	Database Administration Using MSSQL Server	2	0	0	3
9	10212CD252	Windows Client Administration Operating Systems	2	0	2	3
10	10212CD253	Windows Server Administration Operating Systems	2	0	2	3
		Track: Design and Animation				
11	10212CD237	*Design Processes and Perspectives	2	0	2	3
12	10212CD238	Design Drawing and Visualization	2	0	2	3
13	10212CD239	3D Character Modeling	3	0	2	4
14	10212CD240	Design and Prototyping of Interactive Systems	3	0	2	4
15	10212CD241	*User Interface Software and Technology	3	0	2	4
16	10212CD125	*Sound Design for Animation	3	0	0	3
17	10212CD243	Mobile Game Development Tools	3	0	2	4
		Track: Artificial Intelligence and Machine Learning				
18	10212CD211	Artificial Intelligence Techniques	3	0	2	4

19	10212CD214	Data Visualization	3	0	2	4
20	10212CD215	Deep Learning	3	1	2	4
21	10212CD216	Natural Language Processing	3	0	2	4
22	10212CD113	Reinforcement Learning	3	1	0	3
23	10212CD122	*Cognitive Computing	3	0	0	3
24	10212CD223	Machine Learning Techniques	3	0	2	4
25	10212CD234	*Time series and Forecasting	3	0	2	4
* The proposed course and the course content are subject to approval / ratification in the upcoming BoS meetings						

Open Electives (12 Credits)

Open electives are the courses offered across the schools to enhance the knowledge breadth and professional competency of the students. The students shall register for appropriate electives offered in other schools based on their area of interest. The courses offered under this category cover the interdisciplinary knowledge.

L - Lecture, T - Tutorial, P - Practical, C – Credit

S. No	Course Code	Course Name	L	T	P	C
1	XXX1	Course Name-1	3	0	0	3
2	XXX2	Course Name-2	3	0	0	3
3	XXX3	Course Name-3	3	0	0	3
4	XXX4	Course Name-4	3	0	0	3

*One of the courses may be completed through MOOCs platform like NPTEL as described by the department.

Independent Learning (14 Credits)

The students are expected to learn the courses offered under this category on their own. The courses offered under this category include:

L - Lecture, T - Tutorial, P - Practical, C – Credit

S. No	Course Code	Course Name	L	T	P	C
1	10214CD601	Community Service Project	-	-	-	1
2	10214CD701	Minor Project 1	0	0	4	2
3	10214CD702	Minor Project 2	0	0	4	2
4	10214CD801	Major Project	-	-	-	9
Total					**14**	

Industry / Higher Institute Learning Interaction (2 Credits)

The students shall earn a minimum of two credits by undergoing internship and/or specialized courses.

1. **Internship:**
   The students shall undergo Internship in the industry/higher learning institute approved by Industry-Institute Interaction Cell (IIIC) during any time after the second academic year.
2. **Specialized Courses:**
   The students shall undergo the courses offered either by the industrial experts whose minimum academic qualification is Bachelor of Engineering or equivalent or faculty expert from higher learning institutions approved by IIIC. The students shall choose either one two credits course or one credit course or two one credit courses.

S. No	Course Code	Course Name	L	T	P	C
1	10215CD801	Internship	-	-	-	2
2	10215CD9xx	Industry Expert Lecture-1	-	-	-	1
3	10215CD9xx	Industry Expert Lecture-2	-	-	-	1
4	10215CD9xx	Higher Institute Learning Interaction-1	-	-	-	1
5	10215CD9xx	Higher Institute Learning Interaction-2	-	-	-	1

Professional Proficiency Courses (4 Credits)

The Professional Proficiency Courses which carry four credits, to be offered in four different semesters, starting from third semester. These courses offered in this category are relevant to professional proficiency.

S. No	Course Code	Course Name	L	T	P	C
1	10216GE901	Soft Skill-I	2	-	-	1
2	10216GE902	Soft Skill-II	2	-	-	1
3	10216GE903	Aptitude-I	2	-	-	1
4	10216GE904	Aptitude-II	2	-	-	1

PROGRAM ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
10212CD243	Mobile Game Development Tools	3	0	2	4

A. Preamble

This course provides students with an in-depth introduction to technologies and techniques used to create successful cross-platform mobile games. This course will give a knowledge on game design engines like unity and unreal. Familiarized themselves with mobile game modeling tools such as blender and design the graphics using design tools such as photoshop, painter and will have the exposure to the programing concepts related to mobile game development.

B. Prerequisite Courses

10211CD221 – Game Design

C. Course Objectives

Learners are exposed to

- To develop competence necessary for graduate students to be employed in the areas of computer science and design and the industry of game development
- Enable students to develop games individually and in teams
- To develop creativity and individuality in problem solving and in performing tasks
- Enable students to continue their studies and to introduce them to scientific work in the areas of extended reality, computer graphics, and artificial intelligence

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Explain the basic concepts of Unreal Game Engine	K2
CO2	Know the structure of Unity Game Engine	K2
CO3	Apply the modeling tools for game design	K3
CO4	Construct the graphics for game environment using design tools	K3
CO5	Use the suitable programming language for game development	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO 1	**2**		**2**		**2**				1	1			2	2
CO 2	**2**		**2**		**2**				1	1			2	2
CO 3	**2**		**2**		**2**				1	1			2	2
CO 4	**2**		**2**		**2**				1	1			2	2
CO 5	2		2		2				1	1			2	2

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Unreal Game Engine L-9 Hours

Project Preview - Project Primer - Project Creation - Project Organization - Game Design Overview - Geometry Overview - Building to the Grid - Level Layout - Import Marketplace Assets - Blueprint Overview - Layout - Framework Blueprints - Game Instance Blueprint

Unit 2 Unity Game Engine L-9 Hours

Unity's interface - Unity scenes - Creating Gameplay - Asset Workflow - Editor Features – Analysis

Unit 3 Modeling Tools L-9 Hours

Blender: User Interface – Editors - Scenes & Objects – Document Settings - Move through space -Rendering - Creating basic primitive figures.

Unit 4 Design Tools ` L-9 Hours

Photoshop: Workspace and Interface – Layers - Photoshop Tools
Substance Painter: Navigation & UI - Texture Sets - Brush Tool - Layers – Masking - The Shelf - Projection Tool - Polygon Fill - Generators & Mask Editor - Smart Materials.

Unit 5 Programming Language L-9 Hours

C++: Required Setup - Create a New C++ Class - Edit Your C++ Class - Compile and Test Your C++ Code - End Result – user defined class.
C#: Variables – Functions – Classes

Total: 45 Hours

G. Laboratory Experiments

Part – 1

TASK 1	Creating a project for game using Unreal **Tool: Unreal Game Engine**
TASK 2	Create a game environment for the given requirement using Unreal. **Tool: Unreal Game Engine**
TASK 3	Creating a project for game using Unity **Tool: Unity Game Engine**
TASK4	Create a game environment for the given requirement using Unity. **Tool: Unity Game Engine**
TASK5	Develop a 3D model for the given game environment **Tool: Blender**
TASK6	Render the environment using Blender **Tool: Blender**
TASK7	Create a User Interface Element using Photoshop for the given game. **Tool: Photoshop**
TASK8	Create a texture using Substance Painter for the given 3D game Environment object. **Tool: Substance Painter**
TASK9	Write a script to implement the object move. **Tool: Unreal / Unity Game Engine**
TASK10	Write a script for event handling for the User Interface Elements. **Tool: Unreal / Unity Game Engine**

Part – 2

Use Cases

Use Case 1: Crossy road

Add various characters and exciting features to entice audiences. In such an app, a user has to select a character and then make it cross a busy road with many hurdles.

Use Case 2: Car/Motorcycle racing

Games such as car or motorcycle racing not only entice children but also the adults. To make your app different from the ones that are already there on the App Stores and Google PlayStores, you can add challenging circuits or provide various vehicles that users can choose to race and compete with other players.

Use Case 3: Counting game

A counting game application can help children to count things in an interactive and entertaining way. Such an app can become immensely popular.

Use Case 4: Cribbage

Cribbage is one of the most-liked card games that are played among four or more players. Add separate hand counting for the dealer, an exceptional scoring system, and other features to make your app different.

Use Case 5: Word search

Add different languages a user can select and then start making the words by selecting the alphabets vertically, horizontally, and diagonally.

Total: 30 Hours

Total: 75 Hours

H. Learning Resources

i. Text Books:

1. Jeremy Gibson Bond - Introduction to Game Design, Prototyping, and Development From Concept to Playable Game with Unity and C#, Pearson Education, Second Edition, 2018
2. Justin Plowman - 3D Game Design with Unreal Engine 4 and Blender, Packt Publishing, First Edition, 2016

ii. References Books:

1. John P. Doran - Unity 2020 Mobile Game Development, Packt Publishing, Second Edition, 2020
2. Robert Zubek - Elements of Game Design, MIT Press, 2020

iii. Online References Books:

1. https://unity.com/mobile-solution-guide [Online].
2. https://docs.unrealengine.com/4.27/en-US/SharingAndReleasing/Mobile/ [Online].
3. https://www.udemy.com/course/mobile-game-programming-using-unreal-engine/ [Online].
4. https://www.tutorialspoint.com/mobile_game_programming_using_unreal_engine/index.asp [Online].

COURSE CODE	COURSE TITLE	L	T	P	C
10212CD239	3D Character Modeling	3	0	2	4

A. Preamble

3D Character Modeling will be able to transform a concept/idea into a three-dimensional model, with a desire to learn modern character modeling and sculpture workflows. It helps the students to blend the organic and hard surface modeling concepts into a cohesive design with a basic understanding of prop modeling.

B. Prerequisite Course

10211CD220 - Animation Engineering

C. Course Objectives

- Aims to equip students with the fundamental knowledge required for the development of 3D character models for interactive digital environments
- The course also aims to provide practical sessions, to enable students explore the theoretical knowledge and express their ideas as animated 3D Character Models

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Develop a 3D Character model using modeling techniques	K3
CO2	Identify the use of surface modeling concepts in 3D Character modeling	K3
CO3	Use Materials to Improve the Visuals of 3D character	K3
CO4	Build textures for 3D characters	K3
CO5	Apply Rigging and Animation techniques on 3D Character model	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO 3
CO1	2		2		2				1	1					2
CO2	2		2		2				1	1					2
CO3	2		3		2				2	1					2
CO4	2		3		2				2	1					2
CO5	2		3		2				2	1					2

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Modeling **L-9 Hours**

Introduction to Modeling - 3ds Max/Blender Modeling interface - Poly Modeling – Low poly Vs High Poly– Using Primitives – Modelling with Modifiers – Subdivision Surfaces

Unit 2 Surface Modeling **L-9 Hours**

Patch Grid – Patch modelling, Compound Objects Modelling – 2D to 3D - 3D to 2D - Introduction to NURBS - NURBS Splines and Surfaces - Working with NURBS Curves and Surfaces - NURBS Curves Modelling - NURBS Surface Modelling

Unit 3 Material Creation **L-9 Hours**

External References – Objects and Scenes - File Formats - Materials – 2D Maps - 3D Maps - Compositors and Compound Materials – Blend - Composite - Double Sided Materials - Smoothing Polygons - Subdivide Polygons

Unit 4 Texture Mapping **L-9 Hours**

Working with poly sub-object - modeling a Low poly Character model for Game Design - Creating Texture for object model - UVs and Mapping - Material using UVW Mapping - Unwrap Mapping - UVW Mapping - Edit UVW modifier

Unit 5 Rigging and Animation **L-9 Hours**

Rigging techniques - Setting Biped Animation for character model - Rendering Techniques – Arnold - Art - Scan line – Ray tracer, Radiosity

Total: 45 Hours

G. Laboratory Experiments **Total:30 Hours**

Part – 1

TASK 1	**Conceptualizing and creating the storyboard:** a) Prepare a storyboard for a given concept. b) Identify the 3D Character's Properties
TASK 2	For the given 3D animation/Game concept perform the following operation, Use various transformations and modifiers to bring realistic 3D Character. a) Model the Head b) Model the Arms/Legs c) Model the Eyes d) Model the Body **Tool: Blender**
TASK 3	For the developed 3D model perform the following operation, a) Create an image texture to apply on the 3D Character b) Import the texture to the 3D animation tool c) Apply texture on the 3D Character **Tool: Blender**
TASK 4	For the developed 3D character perform the following operation, a) Create Joints - Leg Joints, Arm Joints, Backbone Joints, Head and Neck Joints. b) Setting Up Controls - Leg Controls, Arm Controls, Root and Hip Controls, Shoulder Controls and Neck Control c) Finishing up the Controls d) Finishing up the rig **Tool: Blender**
TASK 5	Animate the 3D character in following way: Moving as a whole object a) Changing their position, b) Orientation or size in time **Tool: Blender**
TASK 6	Animate the 3D character in following way: By Deforming them a) Animating their vertices or control points **Tool: Blender**
TASK 7	Inherited animation • Causing the object to move based on the movement of another object **Tool: Blender**
TASK 8	Render the Animated 3D Model/Character Using following render methods. • Extra Easy Virtual Environment Engine (Eevee) • Blender's physically-based path tracer for production rendering (Cycles) • The Workbench Engine **Tool: Blender**

TASK 9	For the rendered 3D Character perform the following operations. a) Compositing - Assemble video clips together and enhance them b) Motion Tracking & Masking - perform masking and tracking with the Movie Clip Editor **Tool: Blender**
TASK 10	To bring the final output perform the following operations **a)** Add audio and Lip sync to the Developed 3D character **b)** Display result of rendering Sequencer timeline - Sequencer preview **Tool: Blender**

Part - 2

Use Cases:

Use Case 1: A Game Development company requested to model a 3D female character for their 3D car game. As a 3d modeler design and model the 3D character using any 3D modeling tool.

Use Case 2: A film production company needs a 10 years old boy character for a 3D animation movie. As a 3D modeler design and model the 3D character using any 3D modeling tool.

H. Learning Resources

i. Text Books:

1. Bill Culbertson. "3Ds Max Basics; for Modeling Video Game Assets Model, Rig and Animate Characters for Export to Unity or Other Game Engines". CRC Press; 2021

ii. Reference Books:

1. Oliver Villar "Learning Blender: A Hands-On Guide to Creating 3D Animated Characters" Addison-Wesley, 2017

iii. Online References:

1. "Blender: Character Modelling – Easy Beginner's Guide", [Online]. Available: https://all3dp.com/2/blender-2-8-character-modeling-simply-explained
2. "Blender 3D Modeling Tutorials for Beginners: The Ultimate Collection", [Online]. Available: https://conceptartempire.com/blender-modeling-tutorials

Track: Artificial Intelligence and Machine Learning

Course Code	Course Title	L	T	P	C
10212CD223	Machine Learning Techniques	3	0	2	4

A.Preamble

This course introduces students to new and actively evolving interdisciplinary field of modern data analysis. The interplay between known data and unknown ones give rise to complex pattern structures and machine learning methods that are the focus of the study. In the course we will consider methods of Machine Learning and Data Mining Learning. It also includes dimensionality reduction techniques which help to deal with huge datasets.

B.Prerequisite Course

10210MA103- Probability, Statistics and Queuing theory

C.Course Objectives

Students are exposed to

- Apply the concepts of supervised and unsupervised learning algorithms for real time applications
- Executing classification and association models to overcome the problem of over fitting
- Analyse and suggest appropriate machine learning approaches for various types of problems
- Demonstrate the aspects of simple perceptron and multi-layer perceptron

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Examine the basic concepts of machine learning techniques concepts	**K2**
CO2	Design and evaluate the dimensionality reduction algorithms using real world datasets.	**K3**
CO3	Apply various algorithms of Classification and Association.	**K3**
CO4	Demonstrate experiments to evaluate and compare different unsupervised learning algorithms	**K3**
CO5	Use the concept of neural networks for learning linear and non-linear activation functions	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2							1	1				
CO2	3	3	3	2	2				1	1			2	2
CO3	3	3	3	2	2				1	1			2	2
CO4	3	3	3	2	2				1	1			2	2
CO5	3	2	2	2	2	1	1		1	1			2	2

High-3; Medium-2; Low-1

F.Course Contents

Unit 1 Introduction to Data Mining and Machine Learning L-9 Hours

Introduction to Data mining and Knowledge Discovery – Data – Data Mining Functionalities – Steps in Data Mining Process, Architecture of Typical Data Mining systems - Interesting Pattern - Classification of Data Mining Systems – Machine Learning -Types of machine learning– Model selection and generalization-Evaluation Metric-Perspectives and Issues in Machine Learning – Concept Learning Task – Applications of Data Mining and Machine Learning.

Unit 2 Dimensionality reduction L-9 Hours

Data Pre-processing- Needs Pre-processing the Data- Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation- Dimensionality Reduction – Feature Extraction- Variable Selection- Variable ranking- Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis –Cross Validation – Resampling methods

Unit 3 Association and Classification L-9 Hours

Association Rule Mining- Mining Multilevel Association Rules- Mining Multidimensional Association Rule-Constraint Based Association Mining –Decision Tree Induction - Bayesian Classification –Support Vector Machines – Linear Regression - Logistic Regression- Decision Trees – Univariate Tree – Multivariate Tree –Regression Trees –ID3- Random forest- Probability and Learning – Gaussian Mixture Models – Nearest Neighbor Methods

Unit 4 Clustering Techniques L-9 Hours

Cluster Analysis - Types of Clustering methods – Partitioning Clustering- K-means, K- Medoid, K Mode- Density-Based Clustering-DBSCAN Algorithm - Distribution Model Based Clustering -Maximum likelihood Estimation- Expectation-Maximization Algorithm- Hierarchical Clustering- Agglomerative Hierarchical algorithm- Fuzzy Clustering- Fuzzy C-means algorithm Agglomerative and Divisive Clustering –BRICH - ROCK- Chameleon

Unit 5 Neural Networks **L-9 Hours**

ANN- Simple Perceptron- Gate implementation- Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation- Optimization- Hyper parameter tuning

Total: 45 Hours

G.Laboratory Experiments

Part – 1

Task 1 Apply and demonstrate the FIND-S algorithm for finding the most specific Hypothesis based on a given set of training data samples.

Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 2 Implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 3 Apply LDA algorithm to select the appropriate data from the given data set. Use XG boost algorithm for classification.

Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 4 Build a classification model that can effectively analyze and extract features from an image. Apply PCA algorithm to find the appropriate feature.

Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 5 Write a program to demonstrate the working of the decision tree based on ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

Tools: Weka, Python, Scikitlearn, Anaconda navigator

Task 6 Write a program to implement the Gaussian mixture model. Compute the accuracy of the classifier, considering few test data sets.

Tools: Rapid Miner, Python, Scikitlearn, Anaconda navigator

Task 7 Apply unsupervised learning to implement K – means clustering to perform cluster analysis, find the optimal number of clusters, identify appropriate features and interpret results.

Tools: Weka, Python, Scikitlearn, Anaconda navigator

Task 8 Apply unsupervised learning to implement Hierarchical clustering to perform cluster analysis, find the optimal number of clusters, identify appropriate features and interpret results.

Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 9 Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm.Compare the results of these two algorithms and comment on the quality of clustering.

Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 10 Apply back propagation neural network on image data. The idea is to build a Artificial Neural Network model that can effectively analyze and extract features from an image.

Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 11 Assuming a set of documents that need to be classified, use the Radial basis function Classifier model to perform this task. Calculate the classification rate, accuracy, precision, and recall for your data set.

Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 12 Write a program to implement artificial neural network with back propagation.

Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 13 Create a perceptron with appropriate number of inputs and outputs. Train it using fixed incrementlearning algorithm until no change in weights is required. Output the final weights.

Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Part-2

Use Cases:

1. Medical Data Diagnosis
2. Text Classification
3. Biometrics pattern analysis
4. Climatic prediction
5. Credit Card Fraud Detection

Total: 30 Hours

H.Learning Resources

i.Text Books:

1. EthemAlpaydin,, "Introduction to Machine Learning", 4th edition, MIT Press, 2020 (Unit 1 to 4)
2. Christopher M Bishob, "Pattern Recognition and Machine Learning", Springer-Verlag New York Inc, 2018
3. Tom Mitchell, "Machine Learning: A Guide to Current Research", Kluwer academic publisher, 2019.

ii.Reference books:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An Introduction", Second Edition, MIT Press, 2019.(Unit 5)
2. Oliver Theobald," Machine Learning for Absolute Beginners", Scatterplot Press,thirdedtition, 2020
3. Beattie, Guy, "Machine Learning: Start with Machine Learning with all new tips tricks2020.Understand how machine learning can help", 2020

iii.Online References:

1.Machine Learning, accessed online April 20, 2021 [online].Available: https://www.coursera.org/learn/machine-learning
2.Machine Learning by Georgia Tech, accessed online April 20, 2021[online], Available: https://www.udacity.com/course/machine-learning--ud2

Course Code	Course Title	L	T	P	C
10212CD216	Natural Language Processing	3	0	2	4

A.Preamble

Natural language processing deals with written text. Students will learn how to process written text from basic of fundamental knowledge starts with Finite automata, Regular expression and probabilistic model with n-grams. This course also covers basis of semantic analysis and discourse analysis and drives it to machine translation.This course is intended as a theoretical and methodological introduction to the most widely used and effective current techniques, strategies and toolkits for natural language processing.

B.Prerequisite Course

10211CD101-Data Structures

C.Course Objectives

Student will be able to

- Provide the student with knowledge of various levels of analysis involved in NLP
- Understand the applications of NLP
- Gain knowledge in automated Natural Language Generation and Machine Translation
- Understand Deep learning concepts for NLP.

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Comprehend the fundamental concepts of Natural Language Processing.	**K3**
CO2	Use the concept of Probabilistic model of defining language and POS tagging for NLP applications	**K3**
CO3	Develop the Syntactic parser and Semantic Parser for Translation for word forms	**K3**
CO4	Interpret the concept of text analysis, summarization and extractions for Information Extraction.	**K3**
CO5	Apply the concepts of machine translation and deep learning for NLTK Modelling.	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	3								2	
CO2	3	3	3	2	3								1	
CO3	3	3	2	3	3	3							2	
CO4	3	3	2	3	3	3	3						2	
CO5	3	3	3	3	3	3	3						3	

High- 3; Medium-2; Low-1

F.Course Contents

Unit 1 Introduction to Natural Language Processing L-9 Hours

History of NLP, Components of NLP, Applications of NLP, Phases of NLP, NLP APIs, NLP Libraries, Knowledge in Speech and Language processing, Ambiguity and models and algorithm, language and understanding, brief history. Regular Expressions, Extracting Terms from Tokens, Vector Space Representation and Normalization, Similarity Computation in Text

Unit 2 Language Modelling and Part-of-Speech (POS) Tagging L-9 Hours

Unigram Language Model, , Counting Words in Corpora, Simple (Unsmoothed) N-grams, Smoothing, Back off, Deleted Interpolation, N-grams for Spelling and Pronunciation, Entropy Natural Language Generation, Parts of Speech Tagging, Morphology, Named Entity Recognition, Overview of Hidden Markov Models.

Unit 3 Words and Word Forms L-9 Hours

Context-Free Grammars for English, Lexicalized and Probabilistic Parsing, Semantic Analysis, Lexical Semantics, WordNet: A Database of Lexical Relations, Bag of words, skip-gram, Continuous Bag-Of-Words, Embedding representations for words Lexical Semantics, Word Sense Disambiguation, Knowledge Based and Supervised Word Sense Disambiguation

Unit 4 Text Analysis, Summarization and Extractions L-9 Hours

Sentiment Mining, Entity Linking, Text Classification, LDA & Factorization - Text Summarization, Information Extraction, Named Entity Recognition, Relation Extraction, Question Answering in Multilingual Setting; NLP in Information Retrieval, Vector space model, Cross-Lingual IR

Unit 5 Machine Translation and Deep Learning L-9 Hours

Need of MT, Problems of Machine Translation, MT Approaches, Statistical Machine Translation (SMT), Parameter learning in SMT (IBM models) using EM, Encoder-decoder architecture, Neural Machine Translation Statistical Language Models, Kernel Methods, Word-Context Matrix

Factorization Models, Neural Language Models, Recurrent Neural Networks, Sentiment Analysis, Opinion Mining.

Total: 45 Hours

G.Laboratory Experiments

Part - 1

Task 1 Introduction to Python & NLP

- Get familiar with Python programming
- Practice NLTK and libraries

Tools: Python, NLTK, spaCy, Libraries

Task 2 To perform Word Analysis

- To tokenize a text using the `transformers` package
- To tokenize text with stopwords as delimiters

Tools: Python, NLTK & spaCy

Task 3 To analyze algorithms for Word Generation

- Single Layer LSTM Model

Tools: Python, NLTK &spaCy

Task4 Morphology is important factor for word Embedding. Develop algorithms for finding morphology of Word Documents.

Tools: Python, NLTK &spaCy

Task5 Develop N-Grams for Word Document

- Text generation using N-gram model

Tools: Python, NLTK &spaCy

Task6 To perform N-Grams Smoothing in Word Documents

Tools: Python

Task7 To perform the POS Tagging using Hidden Markov Model

Tools: Pandas, Python NLTK &spaCy, Gensim

Task8 Use POS Tagging using Viterbi Decoding
To perform t log-linear model for PoS tagging problem
Compare the performance of log-linear model with HMM's performance

Tools: Python NLTK &spaCy, Gensim

Task9 To Building POS Tagger for unstructured Web Documents
Extracting some particular information form an unstructured text

Tools: PyTorch, Keras

Task10 To perform Chunking for Web Documents

- Content Chunking
- Designing Precise
- Engaging Web Pages

Tools: PyTorch, Keras

Task11 To build Build Chunker for Web Documents

- Content processing
- Extracting information from text
- Mining web pages

Tools: PyTorch, Keras

Task12 Python Data Visualizations Libraries

Tools: matplotlib, seaborne

Part-2
Use Cases:

Use Case 1: Game Winning Prediction (Cricket)

Use Case 2: Machine Translation from English-Hindi.

Use Case 3: Query Expansion for Information Retrieval.

Use Case 4: Emotion detection for texts.

Use Case 5: Semantic Search Engine for Indian Languages.

Use Case 6: Large Hindi Corpora

Use Case 7: Crisp Query relevant Summary of each retrieved webpage

Use Case 8: Semantic Query-Webpage Relevance

Total: 30 Hours

H.Learning Resources

i.Text Books:

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech",, Pearson Publication, 2014.(All 5 Units)
2. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python‖, First Edition, O'Reilly Media, 2009.

ii.Reference Books:

1. Breck Baldwin, "Language Processing with Java and LingPipe Cookbook", Atlantic Publisher, 2015
2. Charu C.Aggarwal, "Machine Learning for Text"- by Springer,2018 edition
3. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.

iii.Online References:

1. "Natural Language Processing", Mar. 2015. Accessed on: Apr. 16, 2021 [Online]: https://onlinecourses.nptel.ac.in/noc19_cs56
2. "Natural Language Processing" Jun 2016. Accessed on: Apr. 16, 2021 [Online]. https://www.udacity.com/course/natural-language-processingnanodegree
3. "Natural Language Processing" Jul. 2, 2018. Accessed on: Apr. 16, 2021 [Online]. https://www.coursera.org/learn/language-processing

Annexure – IV

[Approval of Online MOOCs platforms]

Open Elective - MOOC Course

S. No	Course Code	Course Name	Course Provider	Duration in Weeks	Credits
1.	10213CD424	Design, Technology and Innovation	NPTEL	8	2
2.	10213CD425	Innovation by Design	NPTEL	4	1

COURSE CODE	COURSE TITLE	W	H	C
10213CD424	Design, Technology and Innovation	8	-	2

Course Contents

Week 1 : i. Jaipur Foot - A classic innovation
ii.User Centred Helmet Design
Week 2 : Challenges of Reaching a Million Users
Week 3 : i. Technology to Solution
ii. Collaborative Excellence
Week 4 : Collaborative Innovation Methods
Week 5 : Learnings from Grassroot Innovation
Week 6 : Systemic Approach to Biomed Innovations
Week 7 : Research to Innovation
Week 8 : Smartcane for the Blind

Course Provider : NPTEL
Professor : Prof. B. K. Chakravarthy
University : IIT Bombay

Total: 30 Hours

COURSE CODE	COURSE TITLE	W	H	C
10213CD425	Innovation by Design	4	-	1

Course Contents

Week 1:
Module 1 – Introduction,
Module 2 - First C: The Cause
Week 2:
Module 3 - Second C: The Context,
Module 4 - Third C: The Comprehension
Week 3:
Module 5 - Fourth C: The Check,
Module 6 - Fifth C: The Conception
Week 4:
Module 7 - Sixth C: The Crafting,
Module 8 - Seventh C: The Connection

Course Provider : NPTEL
Professor : Prof. B. K. Chakravarthy
University : IIT Bombay

Total: 15 Hours

Annexure – V

[Ratification of new Program Elective Courses for B.Tech CSD]

COURSE CODE	COURSE TITLE	L	T	P	C
10212CD252	Windows Client Administration Operating System	2	0	2	3

A. Preamble

This course aims to equip students with a thorough comprehensive understanding of the Windows operating system and its key features. By means of a blend of theoretical lectures, practical exercises, and assignments, students will become proficient in navigating the Windows interface, managing files and folders, personalizing system settings, and resolving common problems. Upon completion of this course, students will be able to gain valuable technical skills, career opportunities, practical experience, certification preparation, and problem-solving skills students will have acquired the skills and expertise to utilize Windows proficiently, both in personal and professional settings.

B. Prerequisite Courses

10211CD130 - Fundamentals of Computer Networks
10211CD103 - Operating Systems

C. Course Objectives

Learners are exposed to

- Navigating the Windows user interface and Managing files and folders, including creating, renaming, moving, and deleting files and folders
- Managing network connections, including configuring and troubleshooting network settings.
- Implementing security measures, including user authentication, password policies, and firewalls
- Troubleshooting hardware issues, including diagnosing and replacing faulty hardware components

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K – Level
CO1	Create and manage user accounts in Windows, including creating new accounts, modifying account settings, and managing user privileges.	**K3**
CO2	Manage disk storage in Windows, including creating and formatting partitions, extending or shrinking volumes, and managing disk quotas.	**K3**
CO3	Configure network settings in client operating systems, including IP addressing, subnetting, and DNS configuration.	**K3**
CO4	Configure and manage user accounts and permissions to enforce access control and minimize security risks.	**K3**
CO5	Develop skills in troubleshooting network connectivity and communication issues.	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3		3				2					
CO2	3	3	3	3	3	2			2					3
CO3	3	3	3	3	3	3		3	3				2	3
CO4	2	3	3	3	3	3		3	3				2	2
CO5	2		2		3	2		2						2

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Windows Client Operating System and User Management 6 hours

Overview of Windows operating systems: Windows 10 OS, Introduction to User Management in Windows Client: Overview of user accounts, groups, and permissions, Types of user accounts (local, domain, built-in), User account in GUI, User account in CLI, Powershell.

Unit 2 Managing storage and device drivers in Windows Client Administration 6 hours

Introduction to Storage Management in Windows Client, Overview of disk storage types (HDD, SSD, NVMe), Basic disk concepts (partitions, volumes, file systems), MBR, GPT, Basic Disk and Dynamic Disk, File System Types

Unit 3 Network Management in Client Administration **6 hours**

IP Configuration, Remote desktop, Remote Assistance, Quick Assist, Network Commands and trouble shooting, Sharing Folders, Permissions, Mapping Network Drive

Unit 4 Security in Client Administration **6 hours**

Windows Security Fundamentals: Windows Firewall- Inbound and Outbound Traffic, Local Policy, Local Security Policy, Bit Locker Management: Enabling BitLocker, Key Management, Group Policy, Encryption, Event Viewer: Types of Event Logs, Filtering and Searching, Event ID and Description, Auditing

Unit 5 Troubleshooting **6 hours**

Introduction to Trouble Shooting, Windows Client Architecture, Hardware, Software, Networking and Security Troubleshooting, Troubleshooting Tools, Best Practices of Troubleshooting, Overview of OS Disaster Recovery: Planning, Backup, Recovery, Testing and Maintenance

Total: 30 Hours

G. Laboratory Experiments

Task 1. Configuring Installing and configuring a Windows client operating system in a virtual machine environment
Task 2. Configuring user accounts, groups, and permissions to manage access control
Task 3. Configuring and managing Windows Firewall to allow and block traffic
Task 4. Configuring and managing Group Policy to control system settings and user configurations
Task 5. Configuring and managing network adapters and protocols to enable connectivity
Task 6. Configuring and managing DNS and DHCP services to provide name resolution and IP address management
Task 7. Configuring and managing virtual private network (VPN) connections for secure remote access
Task 8. Configuring and managing backup and restore operations to protect data and system configurations
Task 9. Configuring and managing Windows Update to ensure system security and performance updates
Task 10. Creating and managing shared folders and permissions
Task 11. Configuring and managing printers and print services
Task 12. Configuring and managing remote management tools, such as Remote Assistance and Remote Desktop
Task 13. Configuring and managing system monitoring and performance tools, such as Task Manager and Resource Monitor
Task 14. Configuring and managing disk management, including disk partitions and file systems

Task 15. Configuring and managing system security policies, such as password policies and account lockout policies

Total: 30 Hours
Total: 60 Hours

H. Learning Resources

i. Text Books:

1. E. Bott and C. Siechert, "Windows 10 Inside Out," 3rd ed. Redmond, WA, USA: Microsoft Press, 2019.

ii. Online References Books:

1. M. Russinovich, A. Margosis, and A. Solomon, "Windows Internals, Part 1: System Architecture, Processes, Threads, Memory Management, and More," 7th ed. Redmond, WA, USA: Microsoft Press, 2017.
2. W. Stanek, "Windows 10 Administrator's Pocket Consultant," 2nd ed. Redmond, WA, USA: Microsoft Press, 2016.
3. Microsoft Community, "Windows Community," Available: https://answers.microsoft.com/
4. Microsoft, "Windows Support Center," Available: https://support.microsoft.com/en-us/windows
5. Microsoft, "Windows Blog," Microsoft, Available: https://blogs.windows.com/.
6. Microsoft, "Windows Dev Center," Microsoft Developer, Available: https://developer.microsoft.com/en-us/windows/.

COURSE CODE	COURSE TITLE	L	T	P	C
10212CD253	Windows Server Administration Operating System	2	0	1	3

A. Preamble

This course is designed to provide students with a comprehensive understanding of the Windows server administration operating system and its key features. Through a combination of lectures, hands-on exercises, and practical assignments, students will learn how to install, configure, and maintain various types of hardware and software, which often involves creating user accounts, carrying out backup and recovery functions, and monitoring the performance of servers at all times. By the end of this course, students will have developed the skills and knowledge necessary to use Windows effectively in a variety of personal and professional contexts.

B. Prerequisite Courses

10211CD130 - Fundamentals of Computer Networks
10211CD103 - Operating Systems

C. Course Objectives

Learners are exposed to

- Familiarize students with the basic features and functions of the Windows operating system, including the user interface, file management, and system settings
- Provide students with an understanding of the different versions of Windows and their respective capabilities and limitations
- Introduce students to the security features of Windows and the best practices for keeping a Windows-based system secure from external threats
- To troubleshoot common issues that may arise when using Windows, such as driver errors, system crashes, and software compatibility issues

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K – Level
CO1	Understand the configuration and management of the Windows server administration and power shell.	**K2**
CO2	Apply Domain Control technique to store and manage the objects using AD DS and TCP/IP on window server.	**K3**
CO3	Demonstrate with Filter, Restore, Backup and Common issues in windows server using DHCP DORA and DNS Server.	**K2**
CO4	Implementation of group policy, files, print server, troubleshooting and also classify data using FSRM.	**K3**
CO5	Use IIS and WDS to deploy and manage web application and network based installation through windows server and backup.	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3		3				2					
CO2	3	3	3	3	3	2			2					
CO3	3	3	3	3	3	3		3	3				2	
CO4	2	3	3	3	3	3		3	3				2	
CO5	2		2		3	2		2						

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Deploying & Managing server 2019 **6 Hours**

Windows Server 2019 Overview, Installing and Post-Installation Configuration of Windows Server 2019, Overview of Windows Server 2019 Management, Introduction to Windows PowerShell.

Unit 2 Introduction to AD DS **6 Hours**

Overview of AD DS, Overview of Domain Controllers, Installing a Domain Controller, User management, Group Management, Overview of TCP/IP, Understanding IPv4 & IPv6 Addressing

Unit 3 DNS and DHCP **6 Hours**

DHCP DORA Process, Configuring Scopes Reservation and Exclusion. Overview of DHCP Configuration files, DHCP Filters, DHCP Backup and restore, Common Issues in DHCP Server. Introduction to DNS, Name Resolution Methods- Hierarchy - Records. DNS Working and Query Process. Common issues in DNS Server

Unit 4 Implementing Group Policy, File and Print Services **6 Hours**

Introducing Group Policy, Implementing and administering GPOs, Scope and Group Policy processing (LSDOU), Troubleshooting the application of GPOs, Implementing administrative templates, Configuring Folder Redirection, Software installation, and scripts Configuring Group Policy preferences. Overview of FSRM, Using FSRM to Manage Quotas, File Screens and Storage Reports. Overview of DFS and DFS Replication

Unit 5 IIS, WDS and WDUS **6 Hours**

Overview of IIS and Components, Overview of WDS,WDS Server Roles, WDS Multicasting, PXE booting, Windows Images, Overview Of Patch management Process, Data Protection Overview, Implementing Windows Server Backup.

Total: 30 Hours

G. Laboratory Experiments

Task 1. Add\remover remove roles using server manager, PowerShell

Task 2. Installing a Domain Controller, Promoting as a Forest

Task 3. Create, Delete, OU, Users

Task 4. Installing and Configuring DNS

Task 5. Verify Name resolution from client

Task 6. Installing DHCP Role, Authorizing DHCP Role.

Task 7. Creating, Activating and Deactivating Scope

Task 8. Configure DHCP filters, DHCP backup and restore

Task 9. Creating, editing, Linking Group Policy

Task 10. Creating password policies & account Lockout policies.

Task 11. Installing and Configuring IIS

Task 12. Installing & Configure WDS

Task 13. Configuring WDS Properties

Task 14. Deploying OS from WDS to WDS Client

Task 15. Back up files from client to server and folders restores them from server after Deleting

Task 16. Backup and BareMetal recovery

Total: 30 Hours
Total: 60 Hours

H. Learning Resources

i. Text Books:

1. Thomas, Orin. 'Windows server 2019 inside out". Microsoft Press, 2020.
2. Jordan Krause, "Mastering Windows Server 2019", Packt Publishing Limited; 2nd edition (18 March 2019)

ii. Reference Books:

1. William R. Stanek, Jr. Stanek, William R." Windows Server 2016: The Administrator's Reference", Createspace Independent Pub (1 September 2016)
2. Jason Eckert, "Hands-On Microsoft Windows Server 2019", (MindTap Course List), Cengage Learning; 3rd edition (June 5, 2020)

iii. Online References:

1. "Windows Server documentation", Accessed on Apr. 04, 2023 [Online]. Available: https://learn.microsoft.com/en-us/windows-server/
2. "Microsoft Certified: Windows Server Hybrid Administrator Associate" Accessed on Apr. 04, 2023 [Online]. Available: https://learn.microsoft.com/en- us/certifications/windows-server-hybrid-administrator/

Annexure – VI

[Ratification of courses offered by Industry Experts for B.Tech CSD]

S. No	Course code	Course Name	L	T	P	C
1	10215CD924	IoS Application Creation	1	0	0	1

1. 10215CD924 - IoS Application Creation

Course content

- Basic Programming
- iOS Development installation and Demonstration
- Swift Programming
- UIKit Frameworks
- Application Demo Live
- Developing Live applications

Annexure – VII

[Ratification of Value-added courses]

COURSE CODE	COURSE TITLE	L	T	P	C
10218CD941	Java Programming Fundamentals	2	0	0	0

A. Preamble

Java Programming Fundamentals is designed to introduce the fundamentals of Java programming and its object-oriented features. It will help out the learners to understand various keywords available in Java and Java's architecture. Also, this course will help learners to know the working of Java APIs through hands on approach.

B. Course Outcomes

The Students will be able to proficiently:

- Create Java programs using the fundamental programming constructs
- Implement and design a class based on attributes and behaviors of objects
- Develop Java code that demonstrates the working of different keywords in Java
- Explain and implement different Object-Oriented concepts in Java
- Develop Java code that uses the appropriate access modifiers, package declarations, import statements
- Identify, apply and understand the working of the most common APIs used in Java
- Explains about Exception Handling, Collections Framework and, Generics
- Determine the best practices that are to be followed in Java

C. Course Contents

Module – 1: **6 Hour**

About Java Programming Fundamentals, Introduction and Features of Java, Java Architecture, Java Development Kit

Module – 2: **6 Hour**

Data Types, Keywords and Identifiers, Operators, Type Casting, Widening and Narrowing, Conditional Statements, Control Flow and Looping, Arrays: Introduction to Arrays, Enhanced for loop

Module – 3: **6 Hour**

Object Oriented Concepts using Java, Class and Object, Constructors, this Keyword, Inheritance, Polymorphism, super keyword

Module – 4: **4 Hour**

Final Keyword, static Modifier, Variable Arguments, Enumerated Data Types, Abstract class Interface Package Access Modifiers Java Libraries

Module – 5: **4 Hour**

Exceptions, Generics, The Collections Framework, Date/Time APIs.

H. Learning Resources:

1. "Infosys Springboard", Accessed on December, 2023 [Online]. Available: https://infyspringboard.onwingspan.com/web/en/page/home

COURSE CODE	COURSE TITLE	L	T	P	C

10218CD942	**Data Structures and Algorithms using Python - Part 1**	**2**	**0**	**0**	**0**

A. Preamble

Provides foundation of Data Structures using python programming. Discuss frequently used linear data structures like Stack, Queue, and List ADT. Discuss the commonly performed operations on linear data structures like insert, update, delete, search etc. Provide insights on non - linear data structures.

B. Course Outcomes

The Students will be able to proficiently:

- Create python program for all data structure ADT
- Implements list ADT using Array and Linked List
- Explain and implement Stack and Queue ADT
- Implements non-linear data structure such as Tree and Graph ADT using python programming.
- Visualizing linear data structures such as Linked List, Stack and Queue

C. Course Contents

Module – 1: **6 Hour**

Introduction to Data Structure using Python, List ADT implementation using Array - CRUD Operation- Assessment on List using string, object and array.

Module – 2: **6 Hour**

List ADT implementation using Linked List -CRUD Operation- Comparison between Array and Linked List Implementation. Exercise on Linked List basics, number and object. Assessment on Linked List using character, object and numbers

Module – 3: **6 Hour**

Stack ADT implementation using Array and Linked List such as push and pop operation- Application of Stack- Exercise on stack of number and object

Module – 4: **6 Hour**

Queue ADT implementation using Array and Linked List such as enqueue and dequeue operation- types of queue- stack vs queue- Exercise on queue of number and object

Module – 5: **5 Hour**

Non Linear Data Structures – Tree ADT – Graph ADT- Visualizing Linear Data Structures- Linked List, Stack and Queue ADT.

D. Learning Resources:

1. "Infosys Springboard", Accessed on December, 2023 [Online].
Available: https://infyspringboard.onwingspan.com/web/en/page/home

Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)
Avadi, Chennai-600062, Tamil Nadu, India

4th MEETING of BOARD of STUDIES

Minutes

for

B.Tech Computer Science and Engineering

(Cyber Security)

Programme

[CBCS]

On

19.07.2024

Department of Computer Science and Engineering (Cyber Security)
School of Computing

Department of Computer Science and Engineering (Cyber Security)
School of Computing

4th MEETING of BOARD of STUDIES

Index

Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)
Avadi, Chennai-600062, Tamil Nadu, India

Department of Computer Science and Engineering (Cyber Security)
School of Computing

4th MEETING of BOARD of STUDIES
For
B.Tech. Computer Science and Engineering (Cyber Security)

Date: 19.07.2024
Time: 11 AM **Venue: 33023**

AGENDA

Item No	Agenda
	A. Opening
1.	Confirmation of 3rd BoS meeting minutes held on 05.01.2024 (Annexure-I)
2.	To review the Action Taken Report on the minutes of the 3rd meeting of the Board of Studies (Annexure-II)
	B. Items to be considered
3.	To discuss and approve the new courses and course contents to be offered under Program Core category for the B. Tech Computer Science and Engineering (Cyber Security) programme under the regulation VTRUGE2021 with effect from Summer Semester 2024-2025. (Annexure-III)
4.	To discuss and approve the new course and course contents to be offered under Program Elective category for the B. Tech Computer Science and Engineering (Cyber Security) programme under the regulation VTRUGE2021 with effect from Summer Semester 2024-2025. (Annexure-IV)
	C. Items to be ratified
5.	To ratify the value-added courses offered in Winter Semester 2023 -24 for B. Tech ComputerScience and Engineering (Cyber Security) under the regulation VTRUGE2021. (Annexure-V)
6.	Any other cognate item.

Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology
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Avadi, Chennai-600062, Tamil Nadu, India

Department of Computer Science and Engineering (Cyber Security)
School of Computing

4th Meeting of Board of Studies
For
B. Tech Computer Science and Engineering (Cyber Security)

Date: 19.07.2024
Time: 11 AM **Venue: 33023**

Members Present

Sl.No	Name and Designation	Nominee
1	Dr. S.P. Chockalingam Professor and Dean, SoC, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology.	Chairperson
2	Dr. Sibi Chakkaravarthy Sethuraman Associate Professor & Research Head - AI, VIT-AP University, Andhra Pradesh	Academic Expert Nominee
4	Mr. Vinod Senthil, CEO, InfySec, Chennai, Tamil Nadu	Industry Expert Nominee
5	Mr. Anupam Mathur, Software Engineer, CISCO, Bengaluru.	Alumni
6	Dr.M.Kavitha, Professor, Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Professor Nominee
7	Dr.N.R.Rajalakshmi , Professor, Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Professor Nominee
8	Dr.S.Sridevi, Professor, Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Professor Nominee
9	Dr.V.Dhilip kumar, Professor & Head Department of AI & DS Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Professor Nominee

10	Dr.M.S.Muralidhar, Associate Professor & Head Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Associate Professor Nominee
11	Dr. Rajendran T Associate Professor & Head, Department of CSE (Cyber Security), Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Associate Professor Nominee
12	Dr.R.Thangaselvi, Assistant Professor, Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Assistant Professor Nominee
13	Mrs.K.Prema, Assistant Professor, Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Assistant Professor Nominee

Invited Members

S. No	Name	Designation
1	Dr. J. Visumathi,	Professor and Head – IT
2	Dr. S. Lalitha	Associate Professor – Head – CSE (AIML)
3	Dr. P. Jose	Associate Professor – Head – CSE (DS)
4	Dr. R. Parthasarathy	Associate Professor and Head – CSD

Department of Computer Science and Engineering (Cyber Security)
School of Computing

The Chair expressed his happiness in welcoming all the members for the 4th meeting of BOS and thanked them for sparing their valuable time.

04-BoS-01	Confirmation of 3rd BoS meeting minutes held on 05.01.2024
Action Taken	Chairman BoS presented the confirmation of 3rd BoS meeting minutes held on 05.01.2024 in the programme B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTR UGE 2021. (Annexure-I)
04-BoS-02	To review the Action Taken Report on the minutes of the 3rd meeting of the Board of Studies.
Action Taken	Chairman BoS presented the action taken report on the 3rd BoS meeting minutes held on 05.06.2023 in the programme B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTR UGE 2021. (Annexure-II)
04-BoS-03	To discuss and approve the changes made in the courses and course contents of **Program Core** courses to be offered in the programme B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTR UGE 2021 with effect from 2024-2025**.** Course Structure and Course details are shown in (Annexure-III)
Discussion	1. Chairman BoS presented the proposed program core courses to be offered during the summer semester 2024-2025 in the programmme B.Tech. Computer Science and Engineering (Cyber Security) under the regulation VTR UGE 2021. 2. Experts suggested to include advanced tools and technologies such as Power BI, XDR, OSINET, advanced defense tools, OWASP-based application testing and easy machines and DDOS in program core courses.
Resolution	1. The members approved the changes made in the courses and course contents of Program Core courses to be offered in the programme B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTR UGE 2021 with effect from 2024-2025. Course Structure and Course details are shown in (Annexure-III). 2. Based on the expert's suggestions the specified major changes of those courses will be modified in the upcoming new regulation of the programme B.Tech Computer Science and Engineering (Cyber Security).

4th-BoS-04	To discuss and approve the few courses and course contents under **Program Elective** category to be offered in the programme B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTR UGE 2021 with effect from 2024-2025. Course Structure and Course details are shown in (Annexure-IV).
Discussion	1. Chairman BoS presented the proposed programme elective courses to be offered during the summer semester 2024-2025 in the programme B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTR UGE 2021. 2. Experts suggested to modify the syllabus of Data Privacy and Security course by removing the overlapping topics in other courses and recommended to include the Data Loss Prevention (DLP) techniques and solutions.
Resolution	1. The members approved the courses and course contents under Program Elective category to be offered in the programme B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTR UGE 2021 to be offered with effect from 2024-2025. Course Structure and Course details are shown in (Annexure-IV). 2. Based on the experts suggestions the Data Privacy and Security has been modified such as removed the 2nd unit Cryptography Mechanisms from the syllabus which is already covered in the CNS course and including a 5th unit that covers Data Loss Prevention (DLP) techniques and solutions. The revised course syllabus are shown in (Annexure-IV).
04-BoS-05	To Ratify the value added course offered in Winter Semester 2023-24 for B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTR UGE 2021. Course Structure and Course details are shown in (Annexure-V).
Discussion	Chairman BoS presented the Value-added course offered during Winter Semester 2023-24 in the programme B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTR UGE 2021.
Resolution	The members ratified the Value-added course offered during Summer Semester 2023-24. in the programme B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTR UGE 2021.
4th-BoS-06	Any other Cognate Item
Resolution	The Chairman informed next BoS meeting may be scheduled in the month of December 2024.

Annexure – I

1.	Confirmation of 3rd BoS meeting minutes held on 05.01.2024

3rd BOS Minutes of the Meeting of B.Tech. CSE (Cyber Security) - Reg. External Inbox ×

HOD CSE(Cyber Security) Vel Tech, Chennai <hodcsecs@veltech.edu.in> Wed, Jul 3, 4:36 PM
to chandravadhana.kumaran@atos.net, Saravanan, RV, masila@iiitdm.ac.in, deansoc

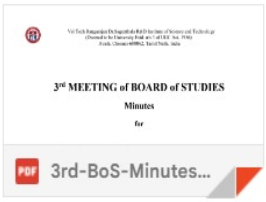
Dear Sir / Madam,

Herewith I am attaching the 3rd BOS Meeting Minutes of B.Tech.Computer Science and Engineering (Cyber Security) for your kind reference.

--

Dr. Rajendran T
Associate Professor & Head
Department of CSE (Cyber Security)
Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology,
Chennai | India.
Contact: 9941010112

One attachment • Scanned by Gmail



Annexure – II

2.	To review the Action Taken Report on the minutes of the 3rd meeting of the Board of Studies

Item No	Item	Decision taken	Action Taken
ITEMS FOR DISCUSSION AND APPROVAL			
03-BoS-3	To discuss and approve the courses and course contents of Program Core courses to be offered in the programme B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTRUGE2021 with effect from 2023-2024.	The proposed courses and course contents under Program Core category to be offered were discussed and approved by the members.	The approved courses were offered during Winter 2023-2024.
03-BoS-4	To discuss and approve the Value-added courses to be offered in the programme B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTRUGE2021 during Winter Semester 2023-2024. (Annexure-IV)	The proposed value added courses and its course contents to be offered were discussed and approved by the members	The approved value added courses were offered during Winter 2023-2024.
03-BoS-5	To ratify the value added courses offered in Summer Semester 2023 - 24 for B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTRUGE2021 with effect from 2023-2024. (Annexure-V)	The ratified value added courses and its course contents to be offered were discussed and approved by the members	The ratified value added courses were offered during Summer 2023-2024.

Annexure – III

3.	To discuss and approve the new courses and course contents under the **Program Core** category for B. Tech Computer Science and Engineering (Cyber Security) to be offered under regulation VTRUGE 21, with effect from Summer 2024-2025

B.Tech - COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)
(Specialization / Honors)
(With effect from 2022-2023)

Preamble:

B.Tech Computer Science and Engineering (Cyber Security) is designed to address the industry's increasing demand for skilled security professionals in the public and private sector, both in the Data Security and in the Network/Cloud Security domains. The programme covers core computer science subjects as well as Cyber Security specific courses. The emphasis of the program is to nurture students with the knowledge and skills required to secure computers, detect and analyze attacks and threats, respond to attacks, develop security policies, procedures, and standards.

The students shall earn 164 credits in various course categories given below for the award of degree of B.Tech Computer Science and Engineering (Cyber Security).

Programme Structure

Course Category	Minimum Credits Required
Foundation Courses (FC)	56
Program Core (PC)	58
Program Elective (PE)	18
Open Elective (OE)	12
Independent Learning (IL)	14
Industry / Higher Institute Learning Interaction (IHL)	2
Professional Proficiency Courses (PPC)	4
TOTAL	**164**

Minor Degree Requirement:

Minimum credits required for regular students in various course categories for B.Tech Computer Science and Engineering (Cyber Security) with Minor

The students shall earn 164 credits in various course categories and additional 18 to 20 credits in the specialized tracks / areas from other branches/Schools by satisfying the prerequisite courses for the award of degree of B.Tech Computer Science and Engineering (Cyber Security) with minor subject to the regulations.

Honors Degree Requirement:

Minimum credits required for regular students in various course categories for B.Tech. Computer Science and Engineering (Cyber Security) with Honors

The students shall earn 164 credits in various course categories and an additional 18 to 20 credits in the specialized tracks/areas courses by satisfying the prerequisite courses for the award of a degree of B.Tech Computer Science and Engineering (Cyber Security)with Honors subject to the regulations.

Program Core (58 Credits)

L - Lecture, T - Tutorial, P - Practical, C – Credit

S.No	Course Code	Course Name	L	T	P	C
		Theory Courses				
1	10211CC101	Data Structures	3	0	0	3
2	10211CC103	Operating Systems	3	0	0	3
3	10211CC129	Modern Computer Architecture	3	0	0	3
4	10211CC130	Fundamentals of Computer Networks	3	0	0	3
5	10211CC106	Formal Languages and Automata Theory	3	0	0	3
6	10211CC107	Compiler Design	3	0	0	3
7	10211CC109	Microprocessors	2	0	0	2
8	10211CC119	Cryptography and Network Security	3	0	0	3
		Integrated Courses				
9	10211CC202	Design and Analysis of Algorithms	3	0	2	4
10	10211CC204	Programming Using Java	3	0	2	4
11	10211CC207	Database Management Systems	3	0	2	4
12	10211CC208	Software Engineering	2	0	2	3
13	10211CC210	Big Data Analytics	3	0	2	4
14	10211CC212	Web and Mobile Application Development	3	0	2	4
15	10211CC219	Cyber Security	3	0	2	4
		Laboratory Courses				
16	10211CC301	Data Structures Laboratory	0	0	2	1
17	10211CC312	Fundamentals of Computer Networks Laboratory	0	0	2	1
18	10211CC304	Operating Systems Laboratory	0	0	2	1
19	10211CC305	Microprocessors Laboratory	0	0	2	1
20	10211CC306	Competitive Coding-I	0	0	2	1
21	10211CC307	Competitive Coding-II	0	0	2	1
22	10211CC310	IoT and Cloud Laboratory	0	0	2	1
23	10211CC313	Problem Solving Techniques	0	0	2	1
		Total Credits				**58**

COURSE CODE	COURSE TITLE	L	T	P	C
10211CC106	Formal Languages and Automata Theory	3	0	0	3

A. Preamble

This course deals with the concepts of automata theory, formal languages, grammar, computability and decidability. Students learn concrete implementations, manipulations of discrete structures and their use in design and analysis of non-trivial problems for a given computational task. This course can be applied in Compilers, -Artificial Intelligence, Robotics and Natural Language Processing.

B. Prerequisite Course

10210MA110-Discrete Mathematical Structures

C. Course Objectives

Learners are exposed to

- Understand overview of theoretical foundations of computer science from the perspective of formal languages.
- Illustrate various automata to solve problems in computing.
- Familiarize Regular grammars, context free grammar, recursive and recursively enumerable languages.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K -Level
CO1	Design the finite automata to recognize the regular languages.	**K3**
CO2	Construct regular expression for regular grammar and its equivalence with finite automata.	**K3**
CO3	Develop push down automata and context-free grammar representations for context-free languages.	**K3**
CO4	Model Turing Machines for accepting recursive languages and its capabilities.	**K3**
CO5	Apply the notions of decidability and undecidability to examine complex problems.	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-RememberK2-UnderstandK3-ApplyK4-AnalyzeK5-EvaluateK6-Create		

E. Correlation of Cos with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		3									
CO2	3	3	3		3								2	2
CO3	3	3	2	1	3								3	
CO4	3	3	3	3	3								2	2
CO5	3	3	2	2									2	

3-High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Formal Languages and Finite Automata L–10 Hours

Introduction to automata and automata theory, Basic concepts of formal Languages, Finite Automata – DFA, NFA, Epsilon NFA, Equivalence of DFA, NFA and Epsilon NFA, Minimization of Automata, FA with output. Case Studies: Implementation of Spell checkers, Text search, Text editors, Simulation of FA using JFLAP.

Unit 2 Regular Languages and Expressions L–8 Hours

Regular Grammar, Regular Expressions, Converting Regular Expression to Epsilon NFA, Equivalence of regular expressions and NFA with Epsilon moves, Converting DFA to Regular Expressions, Pumping Lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular sets. Case Studies: Pattern for Mobile numbers with country code, email address

Unit 3 Context Free Languages and Push Down Automata L–10 Hours

Context-Free Languages and Grammar, Derivation trees, Ambiguity, Simplification of CFG, Chomsky Normal Form, Greibach Normal Forms, Deterministic Push Down Automata, Non-Deterministic Pushdown Automata (NPDA), Equivalence of acceptance by final state and empty stack in PDA, Equivalence between NPDA and CFG, Closure properties of CFLs, Pumping Lemma for CFLs. Case Studies: Tower of Hanoi, Evaluating Arithmetic expression, Transaction Process System.

Unit 4 Turing Machine L–9 Hours

Context-sensitive Grammar, Turing Machine (TM) – Basics and formal definition, Instantaneous Description, TMs as language acceptors, TMs as Transducers, Designing Turing Machines, Variants of TMs, Checking of Symbols, Encoding a Turing Machine and Universal Turing Machine. Case Study: Lambda Calculus

Unit 5 Recursive and Recursively Enumerable Languages **L–8 Hours**

Recursive Functions, Recursive languages and Recursively Enumerable Languages, Properties of Recursively Enumerable Languages and Recursive Languages, Decidability and Halting Problem, Reduction, P and NP, NP- completeness, Post Correspondence Problem, Rice Theorem and Chomsky Hierarchy.
Case Studies: Knapsack Problem, SAT Problem using Turing machine.

Total: 45 Hours

G.Learning Resources

i.Text Books:

1. John E Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, "Introduction to Automata Theory, Languages, and Computation", 3/e, Pearson Education, 2013. [Unit 1 – 3]
2. John C. Martin, "Introduction to Languages and the theory of computation", 4/e, TMH, 2011. [Unit 4, 5]

ii.Reference Books:

1. Michael Sipser, "Introduction to the Theory of Computation", 3rd edition, Cengage Publishers, 2013.
2. Peter Linz, "An Introduction to Formal Language and Automata",5th edition,Cathleen Sether Publishers, 2012.
3. S.P.Eugene Xavier, "Theory of Automata, Formal Languages and Computation", New Age International Publishers,2005.

iii.Online References:

1. "Theory of Computation" Sep. 09, 2016. Accessed on: Feb. 16, 2021, [Online]. Available: https://nptel.ac.in/courses/106/104/106104148/
2. "Automata Theory", Accessed on: Apr. 21, 2021, [Online]. Available: https://www.edx.org/course/automata-theory
3. "Lambda Expressions" [Online] Accessed on: Apr. 28, 2021, https://www.udemy.com/course/java-8-functional-programming-with-lambda-expression/

COURSE CODE	COURSE TITLE	L	T	P	C
10211CC210	Big Data Analytics	3	0	2	4

A.Preamble

Thekey objective of this course is to make the students to be familiar with the concepts of data warehouses, modelling and design of data warehouse. This course includes the most significant technologies used for manipulating, storing, and analyzing big data. In addition, the basic tools of data warehouse and big data analytics will be explored. These tools make the students to understand the strategies involved in data warehouse design and Big Data Platform.

B.Prerequisite Course

10211CC207 - Database Management Systems

C.Course Objectives

Learners are exposed to

- Understand the principles of data warehousing, multidimensional data model.
- Familiar with the data warehouse architecture and OLAP tools.
- Impart the architectural concepts of big data file management system.
- Explore PIG and HIVE tools to develop applications in Big data analytics.
- Implement best practices for Big Data Optimization.

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Build and process the data warehouse modelfor given application.	K3
CO2	Design Job Execution procedures in Map Reduce and Apache SparkParadigm.	K3
CO3	Design memory efficient solutions for Big Data Applications Procedures.	K3
CO4	Build Big Data Solutions for social media network applications.	K3
CO5	Apply cloud and optimization techniques to develop the solutions for real time scenarios.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Program Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	3		3	3										3
CO2		2	2	2	3									3
CO3	2		3		3	2							2	2
CO4	2	3		3	3	3							3	3
CO5	2	2		3		3							3	3

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Data Warehousing and Business Analysis L-9 Hours

Introduction to Data warehousing – Evolution of Decision Support systems – Modeling a Data Warehouse – Granularity in the Data Warehouse - Data Warehousing Components, Building a Data Warehouse, Warehouse Database- Extract, Transform and Load: ETL Overview, ETL Requirements and Steps, Data Transformation, Data Loading, ETL Tools. –. Reporting and Query tools and Applications –Online Analytical Processing (OLAP) – Need – Multidimensional Data Model.

Unit 2 Big Data Processing L-9 Hours

Introduction to Big Data, Big Data Analytics, Evolution of Big data – Best Practices for Big data Analytics – Big data characteristics- Understanding Big Data Storage – A General Overview of High-Performance Architecture – HDFS – Map Reduce Programming Model-Understanding the basics of MapReduce, Loading data into HDFS, Introduction-Apache Spark, Features, Components, Resilient Distributed Datasets, Data Sharing using Spark RDD, Spark Programming.

Unit 3 Big Data Storage System L-9 Hours

Apache Camel- Introduction, Overview, features, camel context, architecture,message queues. Apache Ignite-Memory Architecture, Memory Pages, Lifecycle, In-Memory Data Grid, Caching Support, Streaming Support. Cassandra-Architecture, Data Model, Referenced Api, Cqlsh, Keyspace Operations, Table Operations, Batch, CRUD Operations. Apache Kafka- Fundamentals, Cluster Architecture, Work Flow, Basic Operations, Producer and Consumer Example.

Unit 4 Big Data Visualization and Prediction L-9 Hours

Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions, NoSQL Databases : Schema-less Models‖: Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores – Tabular Stores – Object Data Stores – Graph Databases Hive – Sharding- Hbase – Analyzing big data with twitter – Big data for E-Commerce Big data for blogs.

Unit 5 Big Data Cloud Concepts and Optimization L-9 Hours

Big data Cloud Computing-Features, Cloud Deployment Models, Cloud Delivery Models, Cloud for Big Data,Real time Analytics Platform(RTAP) applications – Using Graph Analytics for Big Data: Graph Analytics, Big Data Optimization- Smooth Convex Optimization-Projection-free methods, Accelerated gradient descent methods, Non smooth Convex Optimization-Smoothing techniques, Mirror-Prox method, Sparsity learning,Large-scale kernel machines.

Total: 45 Hours

G.Laboratory Experiments

PART- 1

Task 1: Design an multi-dimensional data model schema namely Star, Snowflake and Fact Constellations for a Categorical data using SQL Server Management Studio (SSMS).
(Perform the above for Banking, Healthcare, Manufacturing, Sales and Automobile)
Tools: SQL Server Management Studio (SSMS), Microsoft Azure SQL Pool

Task 2: To configure, monitor, and administer a Data warehouse and perform basic Query operations on the DW.
Tools: SQL Server Management Studio (SSMS), Microsoft Azure SQL Pool

Task 3: Perform Data Cube Operations (OLAP Operations) using SQL Queries
Rollup
Rolldown
Slicing
Dicing
Database: MySQL

Task 4: Implement matrix multiplication with Map Reduce.
Tools:LINUX

Task 5: Write a Spark application to perform word count in the input file.
Tools: APACHE SPARK

Task 6: Implement CURD operations on Casandra
Tools: Casandra

Task 7: Implementing Producer and Consumer problem in Kafka.
Tools: Kafka

Task 8:
i. Implement basis commands in HIVE.
ii. Use Hive to create, alter, and drop databases, tables, views, functions, and indexes **Tools: HIVE , LINUX**

Task 9: Write Pig Latin scripts sort, group, join, project, and filter the data
Tools: Pig, LINUX

Task 10:
i.Construct the Pig Latin Scripts to find character Count
ii.Construct the Pig Latin Scripts to find a max temp for each and every year.
Tools: Pig, LINUX

Task 11: Collect any Social Media Data from a Twitter to a Local File with the Topic 'covid 19'. Download and Set Up MongoDB Server and a Client Mongo shell.
Tools: MongoDB, Python: SciPy

Task 12: Retrieve Analytic Information given below from MongoDB created in task 9:
i. For each "place_type", Find total favorite_count
ii. For each "country_code", find total "retweet_count"
iii. Find out top 10 most frequent topic words of the entire tweet message texts of your collection after lemmatization/stemming and removing all the Stop Words.
Tools: MongoDB, Python: SciPy

PART - 2

Use Cases :

Use Case – 1:

Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together.
Write a single Spark application that:

a. Transposes the original Amazon food dataset, obtaining a PairRDD of the type: user-id – list of the product-ids reviewed by user-id
b. Counts the frequencies of all the pairs of products reviewed together;
c. Writes on the output folder all the pairs of products that appear more than once and their frequencies.
d. The pairs of products must be sorted by frequency.

Use Case – 2:

Construct MapReduce program to perform data analysis on weather dataset.
Dataset is available at: https://www.kaggle.com/datasets/zaraavagyan/weathercsv

Use Case – 3:Apache Hive for Rea in real-world applications

It is often the case that data has to be retrieved in real-time from the source. The processing is done as soon as the data is inputted. For example, Google maps processes traffic data in real-time. As soon as it receives information from the source, the data is output onto its application. Develop the Real-time data processing using Apache Hive for analysing the Google Map data.

Use Case – 4:Build a Data Pipeline based on Messaging using PySpark and Hive

Implement a data pipeline that ingests raw data from a source and moves this data to a destination where it can be stored or processed further for analysis. The pipeline should also able to filter or clean the data for various purposes. Then create a Hive external on top of HDFS which will allow the cleaned, processed data to be deployed.

Total: 30 Hours

Course Total: 75 Hours

H.Learning Resources

i.Text Books:

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012. [Unit 1]
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015. [Unit 2-5]

ii.Reference Books:

1. W.H. Inmon, "Building the Data Warehouse", John Wiley & Sons, Inc, 4th Edition, 2005-(Online Publication: 2014).
2. Capriolo, E., Wampler, D., & Rutherglen, J., "Programming Hive", O'Reilly Media, Inc.",2012.

iii.Online References:

1. "Data Warehouse Design: Modern Principles and Methodologies", Accessed on Oct 27, 2022 [online]. Available: https://cdn.ttgtmedia.com/searchDataManagement/downloads/Data_Warehouse_Design.pdf
2. "Big data Analytics", Accessed on Apr. 5, 2022 [online]. Available: https://www.analyticsvidhya.com/learning-paths-data-science-business-analytics-business-intelligence-big-data/learning-path-data-science-python/
3. "Apache Spark Tutorial", Accessed on Oct 28, 2022 [online]. Available: https://www.tutorialspoint.com/apache_spark/apache_spark_deployment.htm
4. "Apache Camel Tutorial", Accessed on Oct 28, 2022 [online]. Available: https://www.tutorialspoint.com/apache_camel/apache_camel_quick_guide.htm

COURSE CODE	COURSE TITLE	L	T	P	C
10211CC212	Web and Mobile Application Development	3	0	2	4

A.Preamble

This course provides basic concepts about HTML5, CSS3, Bootstrap Framework and java script technologies to create the interactive client-side design of web applications. This course also teaches the server-side programming using Node JS, PHP and MVC frontend design for web applications using Angular. The conversion of web application to mobile apps can be performed using Angular. Finally, the creation and deployment of micro services using Seneca and Dockers will be discussed.

B.Prerequisite Course

10211CC204- Programming Using Java

C.Course Objectives:

Learners are exposed to

- Design the interactive and responsive web application.
- Build the efficient server-side applications.
- Develop the single page MVC application.
- Construct and deploy the Microservices.
- Conversion of web apps to Mobile apps using Angular.

D.Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Design web applications using Hypertext Mark-up Language and Cascading style sheets through bootstrap.	K3
CO2	Build the interactive and dynamic web page using Java Script Technology.	K3
CO3	Implement the server-side business logic to handle client request using NodeJS and PHP.	K3
CO4	Make use of MVC framework for integrating the window controls and its corresponding actions through event handlers.	K3
CO5	Transform the function as Microservice components to enhance the Reusability concept.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1		2	3		3	1	1						3	
CO2		3	3	1	2	1	1						3	
CO3		3	2		3	2	2						2	
CO4		3	3		3	2	2						3	
CO5		3	3		3	2	2						3	

High- 3; Medium-2; Low-1

F.Course contents

Unit 1 Front End design using HTML5, CSS3 and BOOTSTRAP Framework L-9 Hours

Introduction to HTML5: Basic Elements, Form Elements, Media Elements, HTML5 Graphics (Canvas, SVG), **CSS3:** Selector String, Box Model, Text Properties, CSS 3D Transformation, CSS Animation, **Bootstrap Framework:** BS Grid, Tables, Images, Alerts, Form Elements. Case study: Online Blog Creation.

Unit 2 Dynamic web page design using Java Script and jQuery L-9 Hours

Java Script: Data Types and Variables - Operators - Control Statements - Functions -Objects - Build in Objects - DOM - Java Script Event Handling - Form Handling and validations - **AJAX &JQuery:** Introduction to AJAX and JQuery: Introduction - JQuery Selectors - JQuery Animations - Effects - Event Handling - JQuery DOM Traversing-JSON - JQuery AJAX. Case Study: Web Scraping and Automation.

Unit 3 Server-side Programming using PHPand Node JS L-9 Hours

PHP: Introduction - Variables - Program control - Builtin Functions - Connecting to Database using MySQLi - Cookies - Sessions - Regular Expression; **Node JS:** Introduction - Architecture - Features of Node JS - Installation and setup - Function - Module - Creating Web Servers with HTTP (Request & Response) - Event Handling - Express JS - Get and Post Implementations - Database connectivity. Case Study: online Book Store.

Unit 4 Single Web Page Design using Angular L-9 Hours

TypeScript: Introduction to Type Script - Variables - Datatypes - Enum - Array - Tuples - Functions - OOP concepts - Interfaces - Generics - Modules - Namespaces - Decorators. **Angular:** components and Modules - Data Binding - Event Binding - Templates - Directives - Services - Dependency Injection - Routing and Navigation pages - Template based Form - Reactive Forms - Validating - Pipes - Sorting and Filtering -Decorator - HTTP Client - Data storage - Observables &RxJS Case study: Todo list.

Unit 5 Creating Forms and Mobile app Conversions L-9 Hours

Microservices: Introduction - Microservices Architecture - Microservices in Node.js: Installing Node.js, NPM, Seneca and PM2-SOLID Design Principles - Seneca Toolkit: Inversion of control(IOC) - Pattern Matching - Reusing Patterns - Writing Plugins - Web Server Integration - Data Storage - PM2 Task Runner for Node.js - Writing Microservices - Integrating with Express - Testing and Documenting Microservices - Monitoring Microservices using PM2 and Keymetrics - Deploying Microservices. **Converting Web App to Mobile App Development** - Install Capacitor Package - Configuration Setup - Native IOS and Android packages - Build and Deploy the application. Case study:Chat Bot.

Total: 45 Hours

G.Laboratory Experiments

PART – 1

Task1:	Develop a Simple College Website including all the Department Information using HTML5 and CSS3.
Task 2:	Create Home Page, Sign up and Login Page for Clinic Management Service using Bootstrap Framework.
Task 3:	Validate the Registration, user login, user profile and payment by credit card pages using JavaScript.
Task 4:	Parse the web page to get the required information using JQuery and DOM Traversing.
Task 5:	Create a simple HTTP web server using Node.js to generate a dynamic response
Task 6:	Create a three-tier application using Node.js and MySQL data base.
Task 7:	Create an Reactive form for User Registration using Angular for Online Exam portal.
Task 8:	Develop web application to implement routing and navigation in Angular.
Task 9:	Develop a micro service for finding what people think by asking 500 people's opinion for any consumer product in Node.js using Seneca Toolkit.
Task 10:	Build the Web application and convert it into Mobile app.

PART-2

Use Cases:

Use Case – 1: Bike Rental System

This system is named as **Bike on Rent Management System**. This system is designed to help the customers to take bikes or two-wheelers on rent. When we go on any trip outside the town or country we want to be free of time so instead of going through metros and taxis we prefer to have our own vehicle for rent. Using this system vehicle owner can register assellers and customers who want to take bikes on rent can register them as renters and can take any bike on rent. Address of the both are required as the customer can only take bike by going to the address provided and the vehicle owners can know the address that a customer is verified or not. The customer also has to upload some proofs to take the bike on rent. Proofs like license, pan card and identity card are compulsory so that no one could run taking the bike. Any customer whose proofs are not uploaded and are not valid will not be allowed to take any bike on rent. This has one admin account who verifies the registering user and two types of the user account. One for bike sellers and one for customers who take the bike on rent. This system has only one admin account and cannot have more than one admin account. There will be simple chat room needs to be added to make instant interactions between customer and admin. Admin can verify and register the user who is registering. If the admin does not verify, the user cannot register.

Tools:HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, JQuery

Use Case – 2: Clinic Management Service

This system is named as Clinic management service. This system is made to keep the records about the patients, doctors and other staff members working at a clinic or hospital receptionist. One can login into the clinic management service using the email id or the user id and password. After signing in into this system there are the options to add new patients, new doctors and other new staff members like nurses and ward boys etc. This system is designed to easily maintain the data of the patients specifically. Daily many new patients visit the clinic so adding the new patient's details and keeping the records using it is very easy. There is also an option to add and delete doctors and other staff member's details. New and unique ids are given to everyone who gets registered over this system. There are also the options to check the patient's disease and course the patient is going through. Fees paid by any customer or patient can be saved on it and it is easy to calculate daily that the money is collected. Doctors and another staff member like nurses, ward boys, janitor and maid leaves can be deducted from their salary and rest of the salary can be paid easily using this clinic management service. It is easy to calculate money and handle account on monthly basis also. This system also has an option to use the backup that means if we are backing up the database it can never be lost. So, overall, this clinic management service is a solution to all the problems that we face in a clinic or hospital.

Tools:HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, Java Script

Use Case – 3: E-commerce service

Online shopping is a process in which people (specifically customers) are being provided with the option of purchasing goods and services directly from the seller, all in real-time environment. Online shopping is an application of the internet as electronic commerce (Like Amazon). From the business perspective, customers usually find the products more attractive, on websites, as they get all the details available there. People in large number are doing online shopping today, and it is not only because it is convenient as one can shop from home, but also because there are ample amount of varieties available, with high competition of prices, and also it is easy to navigate for searching regarding any particular item. For sellers, their products have access to World Wide market, which also increases the number of customers and enhances the customer relationships. Also the web stores are a means for the small scale companies to launch their products at global level. The main objective behind this project is to develop a web oriented application which can provide an online shopping feature to the users. In other words, the project aimed at creating a virtual shop environment for users, in some handy form, which will be available to them through internet. This system has been designed keeping in mind all the aspects such as loading the data, complexity and maintaining the security of user credentials.

Here in this system, complexity refers to the total number of features being provided to users, and their smooth arrangement and functioning required. Following are some of the key features of our system, which distinguishes it from others:

- Display of all the available categories for shopping on the home page.
- Display all the sub-categories on the home page; those are associated with any particular item.
- Admin has the authority to add new particulars to the items list whenever needed.
- Permission to administrator to remove items, anytime.
- Allows the admin to modify the price of each item, whenever required or felt like.
- Admin has the authority to update the description of each item.
- Permission to the admin to view information about each customer who checkouts the items list.

Tools:HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, Java Script

Use Case – 4: College management service

This application college management system based on Internet that aims to all the levels of management providing information within an organization. This system can be used as an information management system for the college. For a given student/staff (Technical / Non-technical) the Administrator creates login id & password, using these student/ staff (Technical / Non-technical) can access the system to either upload or download some information from the database. Not only will this added user also get to know about the events and extra curriculum activities which will hold into the college campus.

The main menu will contain six parts which are as follow:

- Student Login
- Teacher login

- Deposit Fee
- Ask Queries Forum
- About Us
- Contact Us

Now, we can see that nearly everything is very much possible to perform with a single click, so this application will help you to computerize the system of college management so that student and other staff members can access the system online.

These are some key features of the system which is as follow:

- ✓ To reduce the headache of maintaining the record of students and teachers related documents.
- ✓ To reduce the cumbersome job of maintaining several documents like
- ✓ It will eliminate the delays in the generation of results and free updating of the students; this system will help in maintaining the records of absent students.
- ✓ Searching will become more efficient and fast in comparison of manual searching.
- ✓ It will also provide assurance that each employee of the college marked their attendance timely.
- ✓ Overall it will reduce the cost and time of the college head in taking care of the college.

Tools:HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, Java Script

Use Case – 5: E-Payment

In all E-commerce and other online services, payment activity is the most important section and this section mostly having the common procedures. If we make the payment service as the micro service component any web application full stack developer can easily integrate with his project instead of redesigning which is extra burden to developer. So, create the component for the Payment activity with the following operations:

- ✓ Getting card details
- ✓ Pin verification
- ✓ Encryption of card details
- ✓ Crediting and debiting the money on respective accounts.
- ✓ Payment Acknowledgement.
- ✓ Invoice Generation.

Convert this application to Mobile app

Tools: Node.js, Angular

Total: 30 Hours

Course Total: 75 Hours

H.Learning Resources

i.Text Books:

1. Ben Frain“ResponsiveWeb DesignwithHTML5 and CSS:Developfuture-proofresponsive websites using the latest HTML5 and CSS techniques”, Packt

PublishingLimited,3rd Edition, 2020. [Unit 1]
2. MaryDelamater,“Murach'sJavaScriptandjQuery(4thEdition)Paperback–Illustrated”,MikeMurach&AssociatesInc, August26, 2020. [Unit2]
3. DavidHerron“Node.jsWebDevelopment:Server-sidewebdevelopmentmadeeasywith Node14usingpracticalexamples”,PacktPublishing Limited,5thEdition,2020.[Unit3]
4. YakovFain“AngularDevelopmentwithTypeScript”,ManningPublications, 2ndEdition,December2018.[Unit 4]

ii.ReferenceBook:

1. AzatMardan,“PracticalNode.js:BuildingReal-WorldScalableWebApps”,1stEdition.2018.

iii.OnlineReferences:

1. “Angularthecompleteguide(2021Edition)”,Accessedon:May.6,2021[Online],Availabl e:https://www.udemy.com/course/the-complete-guide-to angular-2/
2. “Server-sideDevelopmentwithNodeJS,ExpressandMongoDB”,Accessedon:May.06,2021 [Online],Available: https://www.coursera.org/learn/server-side-nodejs
3. “Node.jsMicroservicesfor beginners”,Accessedon:May.06,2021[Online],Available:https://www.udemy.com/cou rse/nodejs-microservices-for-beginners/

COURSE CODE	COURSE TITLE	L	T	P	C
10211CC219	Cyber Security	3	0	2	4

A. Preamble

Cyber Security is the body of technologies, processes, and practices designed to protect networks, computers, and data from attack, damage, and unauthorized access. This course provides the skills in cyber security in view of cybercrime, cyber offenses, frauds in mobile and wireless devices, handling techniques of cybercrime, organizational implications and cyber terrorism.

B. Prerequisite Course

10211CC130 - Fundamentals of Computer Networks

C. Course Objectives:

Learners are exposed to,

- Assess threat models and their influence on an organization
- Compare the various uses and approaches to cryptography
- Prepare for and respond to security incidences
- Design effective and efficient password schemes
- Plan environments that are resistance to malware

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Understand the basic concepts of cyber security and its principles.	**K2**
CO2	Identify the attacks, security issues, and management standards in mobile and wireless devices.	**K2**
CO3	Apply the tools and methods to detect cyber attacks	**K3**
CO4	Identify the phishing techniques and associated vulnerabilities.	**K3**
CO5	Use the preventive measures for cyber security safeguards.	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2	2					2	2	1					
CO2	2	3		3			2	2	1				2	2
CO3	1	2		2	3		2	2	2				2	3
CO4	1	3			3		2	2	2				3	3
CO5	2		3	2	3		2	2	2				3	3

High- 3; Medium-2; Low-1

F. Course contents

Unit 1 Introduction L-9 Hours

Introduction: Definition and Scope- Risks- Threats- Classifications of Cybercrimes- The Legal Perspectives: Indian Perspective- Global Perspectives. Cyber offenses: Categories of Cybercrime- Social Engineering and its classification- Cyberstalking- Cybercafe and Cybercrimes- Botnets.

Unit 2 Cybercrime: Mobile and Wireless Devices L-9 Hours

Trends in Mobility: Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phone - Identity and access management – Architecture – IAM Standards.

Unit 3 Tools and Methods used in Cybercrime L-9 Hours

Introduction: Proxy Servers and Anonymizers, Password Cracking: Online Attacks, Offline Attacks, - Control Mechanisms - Preventive and Detective controls - Metasploit framework - Keyloggers and Spywares: Software Keyloggers, Hardware Keyloggers, Antikeylogger, Spywares.

Unit 4 Phishing and Organizational Implications L-9 Hours

Phishing and Identity Theft: Phishing, Types of Phishing - Phishing Countermeasures - Virus- Worms- Trojan Horse-Identity Theft (ID Theft)- Cybersecurity vulnerabilities – vulnerabilities in software and system administration- Web threats for organizations.

Unit 5 Cyberterrorsim L-9 Hours

Introduction- Access control- Audit- Authentication- Biometrics- Cryptography- Deception- Denial of Service Filters- Ethical Hacking- Firewalls- IDS- IPS- Scanning- Security policy- Threat Management.

Total: 45 Hours

G.Laboratory Experiments

PART – 1

Task 1: Installation of VM work station and Kali Linux Operating System.

Task 2: Identify the vulnerabilities and exploit attack vectors on a target device by scanning different parameters to accomplish common platform enumeration and common vulnerabilities exposure using legion in kali linux.

Task 3: Retrieving PII of a host such as a registrant name, organization, country, name servers, and date of creation, expiry, and updation.

Task 4: Port Scanning using network mapper (nmap) in kali linux to expose the active and non-active ports and its associated vulnerabilities.

Task 5: Managing network traffic using wireshark tool.

Task 6: Apply steganography attack using OpenStego.

Task 7: Create and verify the virus file**.**

Task 8: Terminate and Stay Resident (TSR) program for identify the virus.

Task 9: Introduction to operations on Metasploit framework and Scripting for penetration testing – Recon and Enumeration scripts

Task 10: Configuring Windows and Linux firewall and managing user permissions

PART – 2

Use Cases:

Use Case - 1:

A National Vehicles Insurance company contacting you for assistance regarding a cyber-incident raised by the company. The company customers' data leaked to the internet and some investigations indicate that their Customer Management System which runs on IP Address was targeted by somebody and had stolen critical data. Using your penetration testing skills & techniques, find the system weaknesses & investigate the incident.

Use Case - 2:

In a Denial-of-Service (DoS) attack, threat actors flood a targeted system's network by directing lots of traffic towards it, from multiple systems under their control. It is a common tactic used by attackers via a network of compromised systems to render an online service unusable. DoS attacks can end up hurting an organization's reputation by affecting its services uptime, customer activity, and business operations. The motives behind DoS attacks can also include extortion, hacktivism, cyber warfare, etc., Explain the process to Detect and respond to break DOS attacks.

Total: 30 Hours

Course Total : 75 Hours

H.Learning Resources

i.Text Books:

1. Nina Godbole, SumitBelapure, “Cyber Security”, Willey India, Edition 1, 2012.
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, “Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives”, CRC Press, ISBN 9780815371335, 2018.
3. Raef Meeuwisse, “Cyber Security for Beginners”, Cyber Simplicity Ltd., 2017.

ii.References Books:

1. Gary M. Jackson, “Predicting Malicious Behavior: Tools and Techniques for Ensuring Global Security”, John Wiley & Sons Publisher, June 2012.
2. Roger Grimes, “Hacking the Hacker”, Wiley India, 2017.
3. Donaldson, S., Siegel, S., Williams, C.K., Aslam, A., “Enterprise Cybersecurity -How to Build a Successful Cyber defense Program against Advanced Threats”, A-press, 2015.

iii. Online References:

1. The Complete Cyber Security Course: Hackers Exposed”, 2018. [online]. Available: https://www.udemy.com/the-complete-internet-security-privacy-course-volume-1/, [Accessed: May 2022].
2. Cyber Security Pentesting Tools**,** [online]. Available: https://www.cybrary.it /0p3n/7-cyber-security-pentesting-tools/ , [Accessed: May 2022].
3. Cyber security insights, [online], Available: https://www.sans.org/reading-room/, [Accessed: May 2022].

COURSE CODE	COURSE TITLE	L	T	P	C
10211CC307	Competitive Coding -II	0	0	2	1

A. Preamble

This course is recommended for students hoping to learn how to solve difficult problems that appear in multi-stage programming contests. The students will learn to design time and space efficient algorithms to solve challenging contest problems, and produce bug-free code under the pressure of time in contest. Students will learn to handle corner cases, invalid inputs, recursion conditions, memory leaks and test cases effectively. Learning by doing true end goal is to produce all-rounder computer scientists/ programmers who are much readier to produce better software and to face harder CS research problems in the future.

B. Prerequisite Course

10211CC306 – Competitive Coding - I

C. Course Objectives

Learners are exposed to

- Understand the basic concepts for solving real world problems
- Impart and implement the concepts of data structures
- Identify the basic properties of Trees and Graphs.
- Hands on Experience in analysis of algorithms for various algorithmic techniques
- Implement algorithm design methods such as dynamic programming and greedy method.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Apply advanced Array, String and mathematical algorithms for problem solving.	K3
CO2	Demonstrate stack, queue and sorting algorithms to solve the problems.	K3
CO3	Implement classical algorithms for trees and graphs with backtracking concepts, being aware of their trade-offs in terms of complexity in time/space	K3
CO4	Analyse efficient algorithms to provide solution for computational problems using advanced data structures.	K3
CO5	Solve complex problems using dynamic programming and greedy algorithm.	K3

Knowledge Level (Based on revised Bloom's Taxonomy)
K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create

E. Correlation of Cos with Program Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3								3	3	2
CO2	3	3	3	3								3	3	3
CO3	3	3	3	3								3	3	3
CO4	3	3	3	1								3	3	1
CO5	3	3	3	3								3	3	3

High - 3, Medium - 2, Low - 1

F. Course Contents

This course introduces advanced algorithms and data structures concepts useful for competing effectively in programming contests. This course provides familiarity with and proficiency in solving intermediate-difficulty algorithmic programming problems using dynamic programming, graph algorithms, mathematics, computational geometry, combinatorial games, and standard library data structures. It includes connectivity-based dynamic programming, multi-dimensional computational geometry, advanced string algorithms, advanced data structures, advanced graph and tree algorithms, linear programming, and satisfiability.

Task 1: Mathematics-Why math in coding? Greatest Common Divisor, Lowest Common Multiple, Euclidean Algorithm, Extended Euclidean Algorithm, Prime Numbers, divisibility of numbers and Sieve of Eratosthenes and Segmented Sieve, Modulo arithmetic, Modulo exponentiation and Modulo inverse, Math Probability, Counting, Game Theory, Group Theory, Generating functions, Permutation Cycles.

Practice Problems:

i) Sqrt(x):https://leetcode.com/problems/sqrtx/
ii) Trapping rain water: https://leetcode.com/problems/trapping-rain-water-ii/
iii) Permutation sequence: https://leetcode.com/problems/permutation-sequence/
iv) Ugly Number: https://leetcode.com/problems/ugly-number-ii/
v) Allocate Mailboxes: https://leetcode.com/problems/allocate-mailboxes/

Additional Problems:

i) Sum of square numbers: https://leetcode.com/problems/sum-of-square-numbers/
ii) Next permutation: https://leetcode.com/problems/next-permutation/
iii) Product of array:https://leetcode.com/problems/product-of-array-except-self/
iv) Trapping rain water: https://leetcode.com/problems/trapping-rain-water/

v) Find the median problem:https://www.hackerrank.com/challenges/find-the-median/problem
vi) Straight Line: https://leetcode.com/problems/check-if-it-is-a-straight-line/
vii) Number of digit one: https://leetcode.com/problems/number-of-digit-one/
viii) Largest component size by common factor:https://leetcode.com/problems/largest-component-size-by-common-factor/
ix) Reaching Points: https://leetcode.com/problems/reaching-points/
x) Beautiful Numbers: https://codeforces.com/problemset/problem/300/C
xi) Number Expression:https://practice.geeksforgeeks.org/problems/check-if-a-number-can-be-expressed-as-xy1606/1
xii) Pairs of Prime Numbers:https://practice.geeksforgeeks.org/problems/pairs-of-prime-number/0
xiii) Fibonacci number:https://practice.geeksforgeeks.org/problems/check-if-the-number-is-fibonacci4654/1/
xiv) Maximum product of three numbers:https://leetcode.com/problems/maximum-product-of-three-numbers/
xv) Count all valid options:https://leetcode.com/problems/count-all-valid-pickup-and-delivery-options/
xvi) Largest divisible subset:https://leetcode.com/problems/largest-divisible-subset/

Task 2: Advanced concept on Arrays – Two Pointer problem One maintains two pointers (indices) into either one array or two arrays, and move the pointers based on values at the pointers.

Practice Problems:

i) Interval list intersections:https://leetcode.com/problems/interval-list-intersections/
ii) Merge Intervals: https://leetcode.com/problems/merge-intervals/
iii) Merge sorted array: https://leetcode.com/problems/merge-sorted-array/
iv) Three sum: https://leetcode.com/problems/3sum/
v) Smallest range covering element:https://leetcode.com/problems/smallest-range-covering-elements-from-k-lists/

Additional Problems:

i) Longest substring without repeating characters:https://leetcode.com/problems/longest-substring-without-repeating-characters/
ii) Push dominoes: https://leetcode.com/problems/push-dominoes/

Task 3: Advanced concept on String – String searching, Knuth–Morris–Pratt algorithm, Boyer–Moore string-search algorithm, Manacher's algorithm and z-function, suffix and prefix.

Practice Problems:

i) Longest Prefix Suffix:https://practice.geeksforgeeks.org/problems/longest-prefix-suffix2527/1

ii) Palindrome substring: https://codeforces.com/gym/101806/problem/Q
iii) Password problem: https://codeforces.com/problemset/problem/126/B
iv) Prefixes and suffixes: https://codeforces.com/problemset/problem/432/D
v) Pattern find: https://www.spoj.com/problems/NAJPF/

Additional Problems:

i) Palindrome:https://onlinejudge.org/index.php?option=com_onlinejudge&Itemid=8&category=26&page=show_problem&problem=2470
ii) Chef and String: https://www.codechef.com/problems/CHSTR
iii) Anthem of Berland: https://codeforces.com/contest/808/problem/G

Task 4: Stacks and Queues

Practice Problems:

i) Sort characters by frequency:https://leetcode.com/problems/sort-characters-by-frequency/
ii) Valid Anagram: https://leetcode.com/problems/valid-anagram/
iii) Stack using Two queue :https://practice.geeksforgeeks.org/problems/stack-using-two-queues/1
iv) Bag of numbers : https://www.hackerearth.com/practice/data-structures/stacks/basics-of-stacks/practice-problems/algorithm/bag-of-numbers/
v) Disk tower : https://www.hackerearth.com/practice/data-structures/queues/basics-of-queues/practice-problems/algorithm/disk-tower-b7cc7a50/

Additional Problems:

i) Queries with fixed length problem: https://www.hackerrank.com/challenges/queries-with-fixed-length/problem
ii) Eerie Planet : https://www.hackerearth.com/practice/data-structures/queues/basics-of-queues/practice-problems/algorithm/weird-planet-2000a170/
iii) Number of atoms:https://leetcode.com/problems/number-of-atoms/

Task 5: Linked List-Single linked list, Doubly liked list, operations on linked list.

Practice Problems:

i) Add two Numbers: https://leetcode.com/problems/add-two-numbers/
ii) Remove nth Node:https://leetcode.com/problems/remove-nth-node-from-end-of-list/
iii) Merge two sorted list: https://leetcode.com/problems/merge-two-sorted-lists/
iv) Insertion sort list: https://leetcode.com/problems/insertion-sort-list/
v) Remove element:https://leetcode.com/problems/remove-linked-list-elements/

Additional Problems:

i) Sort List: https://leetcode.com/problems/sort-list/
ii) Reverse nodes in k groups: https://leetcode.com/problems/reverse-nodes-in-k-group/
iii) Remove duplicates:https://leetcode.com/problems/remove-duplicates-from-sorted-list-ii/

iv) Linked List cycle ii: https://leetcode.com/problems/linked-list-cycle-ii/
v) Odd Even linked list: https://leetcode.com/problems/odd-even-linked-list/
vi) Add two numbers II: https://leetcode.com/problems/add-two-numbers-ii/
vii) Swap nodes in pairs: https://leetcode.com/problems/swap-nodes-in-pairs/

Task 6: Sorting- Counting sort, Radix sort, Heap sort, Bucket sort

Practice Problems:

i) First non repeating character in a stream:https://practice.geeksforgeeks.org/problems/first-non-repeating-character-in-a-stream/0/
ii) LRU Cache: https://leetcode.com/problems/lru-cache/
iii) Finding pairs: https://www.hackerearth.com/practice/algorithms/sorting/counting-sort/practice-problems/algorithm/finding-pairs-4/
iv) Cube change :https://www.hackerearth.com/practice/algorithms/sorting/heap-sort/practice-problems/algorithm/cube-change-qualifier2/
v) Descending Weights: https://www.hackerearth.com/practice/algorithms/sorting/bucket-sort/practice-problems/algorithm/sort-the-array-5/

Additional Problems:

i) Binary Land: https://www.codechef.com/MAY20A/problems/BINLAND
ii) Divide Apples : https://www.hackerearth.com/practice/algorithms/sorting/heap-sort/practice-problems/algorithm/divide-apples/
iii) Shil and birthday present: https://www.hackerearth.com/practice/algorithms/sorting/counting-sort/practice-problems/algorithm/shil-and-birthday-present/

Task 7: Trees: Introduction, tree traversal (in-order, pre-order, post-order), Binary search tree

Practice Problems:

i) Longest Uni value Path:https://leetcode.com/problems/longest-univalue-path/
ii) Path Sum-III:https://leetcode.com/problems/path-sum-iii/
iii) Distinct count : https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/distinct-count/
iv) MST revisited :https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/mst-revisited-3f9d614c/
v) Vertical order:https://leetcode.com/problems/vertical-order-traversal-of-a-binary-tree/

Additional Problems:

i) Level order traversal:https://leetcode.com/problems/binary-tree-zigzag-level-order-traversal/

ii) Level order traversal -ii:https://leetcode.com/problems/binary-tree-level-order-traversal-ii/
iii) Preorder and inorder:https://leetcode.com/problems/construct-binary-tree-from-preorder-and-inorder-traversal/

Task 8: Graph - Introduction Adjacency Matrix and List, Depth First search, Breadth First Search, Manacher's algorithm

Practice Problems:

i) Decode string:https://leetcode.com/problems/decode-string/
ii) Cheapest Flights:https://leetcode.com/problems/cheapest-flights-within-k-stops/
iii) Network delay time:https://leetcode.com/problems/network-delay-time/
iv) Keys and rooms:https://leetcode.com/problems/keys-and-rooms/
v) Minimum cost to connect:https://leetcode.com/problems/minimum-cost-to-connect-two-groups-of-points/

Additional Problems:

i) Clone Graph:https://leetcode.com/problems/clone-graph
ii) Find the town judge:https://leetcode.com/problems/find-the-town-judge
iii) Bipartite:https://leetcode.com/problems/is-graph-bipartite/
iv) Path with minimum effort:https://leetcode.com/problems/path-with-minimum-effort/

Task 9: Backtracking-Introduction, Backtrack vs Divide and Conquer

Practice Problems:

i) Letter combination:https://leetcode.com/problems/letter-combinations-of-a-phone-number/
ii) Regular expression matching:https://leetcode.com/problems/regular-expression-matching/
iii) Generate parentheses:https://leetcode.com/problems/generate-parentheses/
iv) Combination sum:https://leetcode.com/problems/combination-sum/
v) Sequential digits:https://leetcode.com/problems/sequential-digits/

Additional Problems:

i) Permutations:https://leetcode.com/problems/permutations/
ii) Subsets:https://leetcode.com/problems/subsets/
iii) Path with maximum gold:https://leetcode.com/problems/path-with-maximum-gold/

Task 10: Heap Introduction, min-max heap, Segment tree &Trie

Practice Problems:

i) Find k pairs with smallest sums:https://leetcode.com/problems/find-k-pairs-with-smallest-sums/
ii) Last stone weight:https://leetcode.com/problems/last-stone-weight/
iii) Kth largest element in an array:https://leetcode.com/problems/kth-largest-element-in-an-array/

iv) K-closest points to origin:https://leetcode.com/problems/k-closest-points-to-origin/
v) Sliding window maximum:https://leetcode.com/problems/sliding-window-maximum/
vi) Range sum Query:https://leetcode.com/problems/range-sum-query-mutable/
vii) Maximum number of events:https://leetcode.com/problems/maximum-number-of-events-that- can-be-attended/
viii) Minimum number of increments:https://leetcode.com/problems/minimum-number-of- increments-on-subarrays-to-form-a-target-array
ix) Cost of Data : https://www.hackerearth.com/practice/data-structures/advanced-data-structures/trie-keyword-tree/practice-problems/algorithm/cost-of-data-11/
x) RandomGenerator:https://www.hackerearth.com/practice/data-structures/advanced-data-structures/trie-keyword-tree/practice-problems/algorithm/dexters-random-generator/

Additional Problems:

i) Skyline problem:https://leetcode.com/problems/the-skyline-problem/
ii) Count of smaller numbers:https://leetcode.com/problems/count-of-smaller-numbers-after-self/

Task 11: Dynamic programming - Introduction, Tabulation and memorization algorithms

Practice Problems:

i) Maximum sub array:https://leetcode.com/problems/maximum-subarray/
ii) Partition equal subset:https://leetcode.com/problems/partition-equal-subset-sum/
iii) Best time to buy and sell stock:https://leetcode.com/problems/best-time-to-buy-and-sell-stock/
iv) House robber:https://leetcode.com/problems/house-robber/
v) Minimum cost for tickets:https://leetcode.com/problems/minimum-cost-for-tickets/

Additional Problems:

i) Unique Paths:https://leetcode.com/problems/unique-paths/
ii) Minimum path sum:https://leetcode.com/problems/minimum-path-sum/
iii) Unique binary search:https://leetcode.com/problems/unique-binary-search-trees/
iv) Unique paths-ii:https://leetcode.com/problems/unique-paths-ii/
v) Longest increasing subsequence:https://leetcode.com/problems/longest-increasing-subsequence/
vi) Integer Break:https://leetcode.com/problems/integer-break/
vii) Longest palindromic substring:https://leetcode.com/problems/longest-palindromic-substring/

Task 12: Greedy algorithm -Introduction, algorithms based on greedy

Practice Problems:

i) Lemonade change:https://leetcode.com/problems/lemonade-change/
ii) Water bottles:https://leetcode.com/problems/water-bottles/

iii) Best time to buy and sell stock:https://leetcode.com/problems/best-time-to-buy-and-sell-stock-with-transaction-fee/
iv) Couples holding hands:https://leetcode.com/problems/couples-holding-hands/
v) Wildcard matching:https://leetcode.com/problems/wildcard-matching/

Additional Problems:

i) Partition labels:https://leetcode.com/problems/partition-labels/
ii) Queue reconstruction:https://leetcode.com/problems/queue-reconstruction-by-height/
iii) Reorganize string:https://leetcode.com/problems/reorganize-string/
iv) Jump game II:https://leetcode.com/problems/jump-game-ii/
v) Minimum number of taps:https://leetcode.com/problems/minimum-number-of-taps-to-open-to-water-a-garden/

Total: 30 Hours

G.Learning Resources

i.Text Books:

1. Antti Laaksonen, "Guide to Competitive Programming: Learning and Improving Algorithms Through Contests", 2nd ed. 2020 Edition,UTiCS, Springer.
2. Antti Laaksonen, "Competitive Programmer's Handbook", 3rd ed. 2020 Edition, Springer.
3. Steven Skiena, "The Algorithm Design Manual" 3rd Edition,2020 Springer.
4. Steven Halim and Felix Halim, "Competitive Programming, 3rd Edition", Springer.

ii.Reference Books:

1. Johan Sannemo "Principles of Algorithmic Problem Solving", 2nd eition, 2018.
2. Thomas H.Cormen, "Introduction to Algorithms",3rd Edition,2009, MIT Press Cambridge.
3.Gayle Laakmann McDowell "Cracking the Coding Interview", 3rd Ed, career cup publisher, 2015.

iii.Online References:

1."Number Theory", Accessed on April 20, 2021 [Online]. Available: https://www.hackerearth.com/practice/math/number-theory/
2."All Problem sets from Leet code", Accessed on April 20, 2021 [Online]. Available: https://leetcode.com/problemset/all/

ANNEXURE – IV

4.	To discuss and approve the new course and course contents to be offered under Program Elective category for the B.Tech Computer Science and Engineering (Cyber Security) programme under the regulation VTRUGE2021 with effect from Summer Semester 2024-2025.

Program Electives (18 Credits)

Program Electives are the courses offered in the programme which covers depth and breadth. The students may register for appropriate electives offered in the programme based on their area of interest. One course under this category shall be taken from the list of approved MOOCs.

L-Lecture, T-Tutorial, P-Practical, C-Credit

S.No	Course Code	Course Name	L	T	P	C
		Cyber Security – Core Electives				
1	10212CC112	Cyber Security Policy, Law & Ethics*	3	0	0	3
2	10212CC119	Cryptography and Network Security	3	0	0	3
3	10212CC123	Data Privacy and Security	2	0	0	2
4	10212CC211	Artificial Intelligence Techniques*	3	0	2	4
5	10212CC230	Forensics in Cyber Security *	3	0	2	4
6	10212CC232	Vulnerability Analysis and Penetration Testing*	3	0	2	4
7	10212CC250	Identity Access Management	3	0	2	4
8	10212CC225	Ethical Hacking	3	0	2	4
9	10212CC126	Information Security*	3	0	0	3
10	10212CC226	Secure Coding *	3	0	2	4
11	10212CC228	Blockchain Technology *	2	0	2	3
12	10212CC229	IoT and Cloud Computing	3	0	2	4
		Honors				
13		Reverse Engineering & Malware Analysis *	3	0	2	4
14		Operating System Forensics *	3	0	2	4
15		IoT and Cloud Security *	3	0	2	4
16		Incident Response Management *	3	0	0	3
17		Social Network Security *	3	0	2	4
18		Computer Security Audit and	3	0	2	4

S.No	Course Code	Course Name	L	T	P	C
		Cyber Security – Core Electives				
		Assurance *				
19		Disaster Recovery and Business Continuity Planning *	3	0	0	3
20		Artificial Intelligence for Cyber Security *	3	0	2	4
* The proposed course and the course content are subject to approval/ratification in the upcoming BoS meetings						

COURSE CODE	COURSE TITLE	L	T	P	C
10212CC123	Data Privacy and Security	2	0	0	2

A. Preamble

The purpose of this course is to cover the broad range of data security controls to protect data against compromises of confidentiality, integrity and availability by dealing with various security concepts like cryptography and network security, safeguarding of sensitive personal and corporate data against inadvertent disclosure. This course also includes the security and privacy policies and legislations

B. Prerequisite Course

10211CC130 - Fundamentals of Computer Networks

C. Course Objectives

Students undergoing this course are expected to

- Perceive the Fundamentals of Data Security.
- Comprehend Data Privacy and Its Importance.
- Learn Data Anonymization Techniques.
- Explore Privacy-Preserving Test Data Generation.
- Understand Data Loss Prevention methods.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Understand the basics of Data Security	K2
CO2	Describe privacy protection mechanisms and their importance	K2
CO3	Implement the Anonymization technique to balance data and Privacy	K3
CO4	Explain the generation of Privacy Preserving Test Data	K2
CO5	Interpret the Data Loss Prevention Policies and Strategies	K2
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2						2						
CO2	2	2											2	
CO3	2	2			3								2	
CO4	2	2			3			2					2	
CO5	3	1	3		2	1		1					2	1

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Data Security Fundamentals L-6 Hours

Introduction - The Need for Security - Threat - Attacks & Services - Security policies - cookie policy - Confidentiality - Integrity - Availability - Layering - Abstraction - Data Hiding - Security Controls - Access control structures - Security governance - Risk Analysis - Assessment - Response - Security planning.

Unit 2 Data Privacy and its Importance L-6 Hours

Data discovery and classification - need for sharing data - data subject access request - methods of protecting data - data breaches - policies, regulations, privacy models, importance of balancing data privacy and utility - disclosure methods: de-identification - suppression - statistical disclosure limitation(SDL) - coarsening - swapping - sampling - noise infusion - Emerging Applications: Social Network Privacy, Location Privacy, Query Log Privacy, Biomedical Privacy.
Case Study : Privacy issues in Healthcare and Social Network.

Unit 3 Data Anonymization L-6 Hours

Anonymization design principles, Multidimensional Data**:** Privacy Preservation methods - Group based anonymization: k-anonymity, i-diversity, t-closeness - Algorithm comparison - Complex Data**:** Privacy Preservation - Graph Data - Time Series Data - Longitudinal data - Synthetic Data Generation - Dynamic Data Protection - Tokenization - Threats to anonymity.
Case Study : Theft of Unencrypted Laptop.

Unit 4 Privacy Preserving and Test Data Generation **L-6 Hours**

Privacy Preservation of Association Rule Mining - Privacy Preserving Clustering algorithms – Privacy - Preserving Synthetic Data Generation - Design for Privacy Preservation of Test Data Generation - Test Data Fundamentals - Utility of Test Data: Test Coverage - Privacy Preservation of Test Data - Quality of Test Data - Insufficiencies of Anonymized Test Data - Data Removal.

Unit 5 Data Loss Prevention **L-6 Hours**

Introduction and Objectives - Types of Data Loss - Key Components - Strategies For Data Inventories And Risk Assessments - DLP Policies, Procedures, and Controls - Deploying DLP Tools and Technologies - User Education and Awareness - Emerging Trends: Data Exfiltration Techniques and Insider Threats.

Total: 30 Hours

H. Learning Resources

i.Text Books:

1. NatarajVenkataramanan, AshwinShriram, "Data Privacy: Principles and Practice", Chapman and Hall/CRC, first edition, 2016. (ISBN No.: 978-1-49-872104-2). – (UNIT I, II, III,IV).
2. Kris Hermans, "Mastering DLP: A Comprehensive Guide to Data Loss Prevention" Format: Kindle Edition. (ASIN No. : B0CD8D95S7). – (UNIT V).

ii.Reference Books:

1. Stephen Massey, "The Ultimate GDPR Practitioner Guide (2nd Edition): Demystifying Privacy & Data Protection", Fox Red Risk; 2nd edition, 2020
2. Micki Krause, Harold F. Tipton, "Data Protection and Privacy:", Hart Publishing, (ISBN No. 978- 1509919345), 2017.
3. David Kim and Michael G.Solomon, "Fundamentals of Information Systems Security", Jones and Bartlett Publishers, Inc, 2018.
4. VishwajitBarbudhe, Shraddha N Zanjat, Bhavana S Karmore, "Cryptography and Network Security Principles", Lambert Academic Publishing , 2020.

iii.Online References:

1. William satallings,2021, williamstallings.com/Extras/Security-Notes/
2. Introduction to Cryptography and Computer Security,2015, http://cs.brown.edu/courses/csci1510/
3. Woodrow Hartzog, Northeastern University, Data Privacy Fundamentals, 2020, https://www.coursera.org/learn/northeastern-data-privacy.
4. "Data Loss Prevention" by The Art of Service, https://www.udemy.com/course/data-loss-prevention/?couponCode=ST3MT72524.

COURSE CODE	COURSE TITLE	L	T	P	C
10212CC225	Ethical Hacking	3	0	2	4

A. Preamble

This course enables to provide the skills in hacking techniques, methodologies, tools, tricks and security measures to secure an organization's IT systems. Starting from basics of networking, network security, and cryptography, the course will cover various attacks, vulnerabilities, and ways to secure them. There will be hands-on demonstrations that will implement the security frameworks including preventive and detective controls which be helpful to the students.

B. Prerequisite Course

10211CC130 - Fundamentals of Computer Networks

C. Course Objectives

Students undergoing this course are expected to

- Understand the concepts of ethical hacking with terminologies.
- Familiarize the tools to help competitive intelligence, DNS zone, and port scanning.
- Mitigate enumeration in the system and its vulnerabilities.
- Understand how to hack the server and applications, procure knowledge of attacks, and standards in technology.
- Analyze different attacks, and avalanche analysis viz IDS and NPS.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Identify and classify attacks and threat vectors.	K2
CO2	Execute reconnaissance on a target network using a variety of scanning and probing techniques.	K3
CO3	Explore Microsoft and Linux Operating Systems, Network vulnerabilities.	K3
CO4	Demonstrate various web application vulnerabilities and wireless network attacks.	K3
CO5	Operate cryptography and hashing methods, Intrusion Detection and Prevention System.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3		3	3	3		2						
CO2	2	1	1	1	3	1		1						2
CO3	3	2	3	3	3	1								3
CO4	3	1		1	3			1						3
CO5	3		2		3									3

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Ethical Hacking Overview — L-9 Hours

Introduction to Ethical Hacking – Types of hackers – Attack Types, and Vectors – Threat categories – Malicious Software - Protecting against malware attacks – Intruder Attacks – Physical Security.

Unit 2 Reconnaissance and Scanning — L-9 Hours

Introduction to Reconnaissance, Types of Reconnaissance - Footprinting – Web Tools – DNS Zone Transfers – Social Engineering – Port Scanning – Types of Port Scanning – Port Scanning tools – Ping Sweeps – Scripting.

Unit 3 Enumeration — L-9 Hours

Introduction to Enumeration Tools and Techniques – Windows, Unix Operating System – NetBIOS – NetBIOS Null Session, NetBIOS Enumeration Tools– Windows OS Vulnerabilities – Hardening Windows OS- Linux OS Vulnerabilities, Network Vulnerabilities.

Unit 4 Web Server and Wireless Hacking — L-9 Hours

Understanding Web Application – Web Application vulnerabilities –OWASP - Web Application Injection Attacks - Code injection, SQL injection, cross-site scripting -Tools for Web Attackers and Security Testers – Wireless Technology – Wireless network standard – Authentication – Wardriving – Wireless Hacking

Unit 5 Cryptography Attacks and Network Protection Systems — L-9 Hours

Basics of Cryptography attacks – Brute Force Attacks, Replay Attack, Frequency Analysis and the Ciphertext Only Attack, Network Protection systems: Routers – Firewalls – Intrusion Detection and Prevention System - Honey pots.

Total: 45 Hours

G. Laboratory Experiments

PART - 1

Task 1: Installation of VM work station and Kali Linux/Parrot Operating System.

Task 2: Scan and identify the network range, different types of ports available on different networks, and Operating systems used by the target system/network.
Tool: Nmap

Task 3: Test the different web applications on the internet and write about security issues found for each website. Demonstration of man-in-the-middle attack.
Tool: Burpsuite

Task4: Perform the vulnerability scan and identify the different types of vulnerabilities present in the network.
Tool: OpenVAS

Task5: Perform vulnerability Scan, Exploitation, and Hardening on Windows/Linux OS using Shell Script/C/Python Program.

Task6: Perform code injection attacks on any Database and take over it.
Tools: SQL Map

Task7: Gain access to the WIFI router without having a password and modify configurations.
Tools: Aircrack ng, Airsnort, Ettercap

Task8: Configure Windows and Linux firewalls/Snort and manage user permissions by writing firewall rules.
Tools: Windows firewall, Snort

Task9: Install and Configure IDS system and identify the attacks performed on it. Mitigate the attacks by modifying the rules.
Tools: Snort, Suricata, Sagan

Task10: Configure, Perform, and Detect attacks on Honeypot.
Tool: Cowire

PART-2

Use Cases:

Use Case 1:

On April 11th 2011, at nine in the evening, Barracuda Networks posted a grim entry on their blog. Their network had been hacked. Thousands of their confidential customer and employee records were stolen. In an ironic twist of fate, the company that advocates security through its own Web Application Firewall were victims to the most common and oldest type of attack against web servers. Explain the different tools used by the Hacker. To analyze the effect that different training regimens have on player performance

Use Case 2:

A while back, the IT Help Desk received several complaints that one of the employee's computers was sending out spam. They checked it out, band the reports were true: a hacker had installed a program on the computer that made it automatically send out tons of spam email without the computer owner's knowledge. Explain the hacker's technique to get into the computer to set this up.

Use Case 3:

Contactless technology was developed by Visa card and Mastercard with the mindset of never sacrificing security for convenience. The cards and devices contain an embedded chip and a radio frequency (RFID) antenna that provide a wireless link with the contactless reader. When the card or device is tapped against the reader, information is transmitted in a highly secure manner within a fraction of a second. Investigate how card payment frauds are occurring in Retail and Online shopping.

Total: 30 Hours
Course Total : 75 Hours

H.Learning Resources

i.Text Books:

1. Michael T. Simpson, Kent Backman, James Corley, "Hands-On Ethical Hacking and Network Defense", Cengage Learning, Second Edition, 2012. [Unit 1-3,5]
2. "Ethical Hacking and Countermeasures", EC-Council, Publisher: Course Technology; 2nd edition, 2016. [Unit 4]

ii.Reference Books:

1. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, "Gray Hat Hacking The Ethical Hackers Handbook", McGraw Hill Education, Third Edition, 2017.
2. Sean Philip Oriyano and Michael Gregg, "Hacker Techniques, Tools and Incident Handling".
3. Jon Ericson, "Hacking: The Art of Exploitation", Second Edition, No Starch Press, 2008, ISBN 978-1593271442.
4. Michael Sikorski, Andrew Honig, "Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software", No Starch Press, 2012.

iii.Online References:

1. Grey Campus - "Ethical Hacking". Accessed on: April, 20, 2021 [Online]. Available: https://www.greycampus.com/opencampus/ethical-hacking.

Annexure-V

5.	To ratify the value added courses offered in Winter Semester 2023 -24 for B.Tech ComputerScience and Engineering (Cyber Security) under the regulation VTRUGE2021.

To Ratify the Value Added course offered in Winter Semester 2023-24 for B.Tech Computer Science and Engineering (Cyber Security) under the regulation VTR UGE 2021 (Annexure-V).

L-Lecture T-Tutorial P-Practical C-Credits

S. No	Course Code	Course Name	L	T	P	C
1	10218CC947	Data Structures and Algorithms using Python - Part 1	3	0	0	0
2	10218CC936	Bash Shell Scripting Administration	3	0	0	0
3	10218CC941	Java Programming Fundamentals	3	0	0	0

Tutorial hour is not considered for credit calculation of the hours

COURSECODE	COURSETITLE	Total Hours
10218CC947	Data Structures and Algorithms using Python - Part 1	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester2023-2024

C. Branch: B.Tech-CSE(CS)

D. Course Handling Faculty: Dr. Chidambaramani

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Implement modular algorithms to find solution for computational problem with time and space complexities using suitable data structure.
- Solve structured problem using array and linked list in list concepts
- Develop modular algorithms to find solution for computational problems with linear Data structures using Stack concepts
- Develop modular algorithms to find solution for computational problems with linear Data structures using Queue concepts
- Solve unstructured problem using tree algorithm. Implement an appropriate algorithm using graph ADT for an application.

G. Preamble:

The Course introduce fundamentals of Data Structures. Discuss frequently used linear data structures like Stack, Queue, List etc. Discuss the commonly performed operations on linear data structures like insert, update, delete etc. Provide insights on non - linear data structures.

H. Course Contents

Module–1: Introduction to Data Structures **6 Hours**

Definition and Importance of Data Structures-What is a data structure?- Types of Data Structures- Arrays: Definition and properties,-Advantages and disadvantages-Operations: insertion, deletion, traversal, searching, and sorting

Module–2: List **6 Hours**

List using Array-add operation-Insert operation-Delete Operation-An Analysis-Memory Usage-Introduction-List using Linked List-Introduction-Creation-Display Operation-Algorithm-Add Operation-Algorithm-Search Operation--Insert Operation- Algorithm-Delete Operation-Algorithm- List using Array vs Linked list

Module–3: Stack **6 Hours**

Stack-Introduction-Push Operation-Algorithm-Pop Operation-Algorithm-Application Areas.

Module–4: Queue **6 Hours**

Queue- Enqueue Operation- Algorithm- Dequeue Operation- Algorithm

Module–5: Non-Linear Data Structures **6 Hours**

Non-Linear Data Structures - Introduction-Graph-Tree

Total: 30 Hours

I. Learning Resources

i. Text Book:

1. Bradley N. Miller, David L. Ranum ,“Problem Solving with Algorithms and Data Structures using Python", Franklin, Beedle & Associates,3rd Edition,ISBN-13: 978-1590282571
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser Publisher: Wiley,"Data Structures and Algorithms in Python", Wiley, 2nd Edition

ii. Reference Book

1. Benjamin Baka, "Python Data Structures and Algorithms", Packt Publishing, 978-786467355

iii. Online Resources

1. https://www.edx.org/learn/python/the-university-of-michigan-python-data-structures
2. https://www.coursera.org/specializations/data-structures-algorithms.

COURSE CODE	COURSE TITLE	Total Hours
10218CC936	Bash Shell Scripting Administration	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech.,CSE(CS)

D. Course Handling Faculty: Dr. R Rajesh

E. Duration of the Course: 27.12.23to27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Familiarity with command-line interface and basic commands
- Ability to work with files, test conditions, and patterns.
- Ability to configure access levels and system environment variables.
- Using regular expressions and substring operations effectively.
- Understanding input types and the pipe operator for command chaining.

G. Preamble:

This comprehensive course delves into Bash Shell scripting, providing participants with practical knowledge and skills to automate tasks, manipulate data, and optimize workflows. Starting from the basics of Bash Shell, participants progress through advanced topics, such as regular expressions and file processing commands. With real-world examples and hands-on exercises, participants gain proficiency in using Bash Shell scripting for various tasks.

H. Course Contents

Module–1: Introduction to Bash Shell **5 Hours**

Definition and Importance of Data Structures-What is a data structure?- Types of Data Structures- Arrays: Definition and properties,-Advantages and disadvantages-Operations: insertion, deletion, traversal, searching, and sorting

Module–2: Getting Started **5 Hours**

File Text Size, Test Numbers, Checking Conditions, Multiple Digit Pattern, Checking If File Exists, Test File Exists, Script Output

Module–3: Shell Environment **5 Hours**

Introduction to Shell Environment, Command Program, Access Level Configuration, Booting Level Configuration, Booting Level Configuration Continue, System Admin Level

Configuration, Networking Level Configuration, System Environment, User Configuration Files, Shell Special Variables. Array Declaration, Variable Declaration, Variable Declaration and Assignment

Module–4: Usage with String Manipulations **5 Hours**

String Manipulation and Internal Commands, Topic Structure, Regular Expressions, Square Bracket Round Bracket, Dot Character, Substring Length, Substring Removal.

Module–5: Commands-External and Internal **5 Hours**

Quick Revision on String Manipulation, Types of shell commands-External and Internal, Types of User Input, Pipe Operator. Lecture Introduction, Awk Introduction, Syntax and Dataset Familiarity, AWK for Column, Columns Extraction, Skipping the Header Row, Awk for Pattern Matching, Awk for Pattern Matching Continue, Dynamic Redirection of File Output, AWK Keyword, Status Variable, AWK for Grouping, What is Array, Statement Output, Total Female Population, Total Male Population, Percentage of Population, Peplinski Population

Module–6: Reading **5 Hours**

Internal Command, Reading from Single Variable, Reading from Array, Reading From File Introduction to Stacks Data Structure, Introduction to Stacks Data Structure Continue, Set Command Internal Command Set, Internal Command Unset, Intro to External Commands, External Command Cat External Command WC, Character Mode, Numerical Mode, Numerical Mode Continue, Searching Patterns in Multiple Files, Single File, Count Pattern Occurrence, Suppress Filename Headers Etc., Changing Ownership, Filter by Owner Before Change, External Command ENV, External Command CP, External Command MV, External Command Date, External Command ln, External Command ln Continue, Dataset Explanation for File Processing Commands, External Command-Essa-Jump to Line, Search for Pattern, External Command-Tail, External Command-Sort, External Command-Unit, External Command-PS, External Command Find, External Command Conclude

Total: 30 Hours

I. Learning Resources

i. Online Resources

Search Results Page | Infosys Springboard (onwingspan.com)

COURSE CODE	COURSETITLE	Total Hours
10218CC914	Java Programming Fundamentals	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester2023-2024

C. Branch: B.Tech-CSE(CS)

D. Course Handling Faculty: Dr. Peter Soosai Anandraj

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Create Java programs using the fundamental programming constructs
- Implement and design a class based on attributes and behaviors of objects
- Develop Java code that demonstrates the working of different keywords in Java
- Explain and implement different Object-Oriented concepts in Java
- Develop Java code that uses the appropriate access modifiers, package declarations, import statements
- Identify, apply and understand the working of the most common APIs used in Java
- Explains about Exception Handling, Collections Framework and, Generics.

G. Preamble:

Java Programming Fundamentals is designed to introduce the fundamentals of Java programming and its object-oriented features. It will help out the learners to understand various keywords available in Java and Java's architecture. Also, this course will help learners to know the working of Java APIs through hands on approach

H. Course Contents

Module–1: **6 Hours**

About Java Programming Fundamentals, Introduction and Features of Java, Java Architecture, Java Development Kit

Module–2: List **6 Hours**

Data Types, Keywords and Identifiers, Operators, Type Casting, Widening and Narrowing, Conditional Statements, Control Flow and Looping, Arrays: Introduction to Arrays, Enhanced for loop

Module–3: Stack **6 Hours**

Object Oriented Concepts using Java, Class and Object, Constructors, this Keyword, Inheritance, Polymorphism, super Keyword

Module–4: Queue **6 Hours**

Final Keyword, static Modifier, Variable Arguments, Enumerated Data Types, Abstract class Interface Package Access Modifiers Java Libraries.

Module–5: Non-Linear Data Structures **6 Hours**

Exceptions, Generics, The Collections Framework, Date/Time APIs.

Total: 30 Hours

I. Learning Resources

i. Online Resources

"Infosys Spring Board ", Available: https://infyspringboard.onwingspan.com/web/en/page/home

Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)
Avadi, Chennai-600062, Tamil Nadu, India

4th MEETING of BOARD of STUDIES

Minutes

for

B. Tech Computer Science and Engineering

(Data Science) Programme

[CBCS]

On

27.07.2024

Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)
Avadi, Chennai-600062, Tamil Nadu, India

B. Tech Computer Science and Engineering (Data Science)

School of Computing

4th MEETING of BOARD of STUDIES

Date : 27.07.2024
Time : 2.00 pm
Venue : 33023

Index

Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)
Avadi, Chennai-600062, Tamil Nadu, India

B. Tech Computer Science and Engineering (Data Science)

School of Computing

4th MEETING of BOARD of STUDIES
For
B. Tech Computer Science and Engineering (Data Science)

Date : 27.07.2024
Time : 2.00 pm
Venue : 33023

AGENDA

Item No	Agenda
A. Opening	
1	Confirmation of 3rd BoS meeting minutes held on 05.01.2024 (Annexure-I)
2	To review the Action Taken Report on the minutes of the 3rd meeting of the Board of Studies (Annexure-II)
B. Items to be considered	
3	To discuss and approve the new courses and course contents to be offered under Program Core category for the B.Tech Computer Science and Engineering (Data Science) programme under the regulation VTR UGE 2021 with effect from Summer Semester 2024-2025. (Annexure-III)
4	To discuss and approve the new course and course contents to be offered under Program Elective category for the B.Tech Computer Science and Engineering (Data Science) programme under the regulation VTR UGE 2021 with effect from Summer Semester 2024-2025. (Annexure-IV)
5	To discuss and approve the courses and course contents to be offered under Open Elective category for the B.Tech Computer Science and Engineering (Data Science) programme under the regulation VTR UGE 2021 with effect from Summer Semester 2024-2025.(Annexure-V)
C. Items to be ratified	
6	To ratify the value added courses offered in Winter Semester 2023 -24 for B.Tech Computer Science and Engineering (Data Science) under the regulation VTR UGE 2021. (Annexure-VI)
7	Any other cognate item

School of Computing

4th MEETING of BOARD of STUDIES
For
B. Tech CSE(Data Science)

Date: 27.07.2024 – 2.00 pm
Venue: 33023
Members Present:

Sl.No	Name and Designation	Nominee	Signature
1	Dr. Chokkalingam, Professor and Dean.	Chairperson	
2	Dr.Rajendra Prasath Associate Professor, Indian Institute of Information Technology, Sri City, Chittoor. +91-9701700544 rajendra.prasath@iiits.in	Academic Experts Nominee	
3	Dr.Dilip Singh Sisodia, Associate Professor, National Institute of Information Technology, Raipur. 8462808174 dssisodia.cs@nitt.ac.in	Academic Experts Nominee	
4	Mr.Kolla Ravikanth Yadav, Data Scientist, APAC Business Operations, Hyderabad, +91-9701812355 Ravikanth.3leo@gmail.com	Industry Experts Nominee	
5	Mr.Raghav Rajvanshi Network Consulting Engineer Cisco Systems Pune	Alumini	
6	Dr.P. Jose Associate Professor & Head Department of CSE(DS), Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Associate Professor Nominee	
7	Dr.M. Kavitha Professor, Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Professor Nominee	

8	Dr.N.R.Rajalakshmi Professor & Head Department of AI & ML Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Professor Nominee	
9	Dr.S.Sridevi Professor, Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Professor Nominee	
10	Dr.M.S.Muralidhar Associate Professor & Head Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Associate Professor Nominee	
11	Dr.V.Dhilip kumar Associate Professor & Head Department of AI & DS Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Associate Professor Nominee	
12	Dr.R.Thangaselvi Assistant Professor, Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Assistant Professor Nominee	
13	Mrs.K.Prema Assistant Professor, Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Assistant Professor Nominee	

Sl.No	**Name and Designation**	**Nominee**	**Signature**
1	Dr. Partasarathi	Associate Professor and Head CSD	
2	Dr.Visumathi	Professor and Head IT	
3	Dr.Lalitha S	Associate Professor and Head (AI&ML)	
4	Dr.Rajendiran	Associate Professor and Head CSE(CS)	

The Chair expressed his happiness in welcoming all the members for the 4th meeting of BOS and thanked them for sparing their valuable time.

04-BoS-01	Confirmation of 3rd BoS meeting minutes held on 05.01.2024
Action taken	Chairman BoS presented the confirmation of 3rd BoS meeting minutes held on 05.01.2024 in the new programme B.Tech Computer Science and Engineering (Data Science) under the regulation VTR UGE 2021. (Annexure-I)
04-BoS-02	To review the Action Taken Report on the minutes of the 3rd meeting of the Board of Studies.
Action Taken	Chairman BoS presented the action taken report on the 3rd BoS meeting minutes held on 05.01.2024 in the new programme B.Tech Computer Science and Engineering (Data Science) under the regulation VTR UGE 2021. (Annexure-II)
04-BoS-03	To discuss and approve the changes made in the courses and course contents of Program Core courses to be offered in the programme B.Tech Computer Science and Engineering (Data Science) under the regulation VTR UGE 2021 with effect from 2024-2025.
Discussion	1.Chairman BoS presented the curriculum structure of B.Tech CSE (Data science) under the regulation VTR UGE 2021. The Course related to Computer Science and Engineering (Data Science) domain specific courses,Formal Langauges and Automata Theory, Data Science, Web and Mobile application Development , Big Data Analytics and R for Data Science. 2. Experts suggested to incorporate the Solar tool in Task 11 and Task 12 of Big Data Analytics Course.
Resolution	1.The members approved the courses and course contents of Program Core courses to be offered in the programme B.Tech Computer Science and Engineering (Data Science) under the regulation VTR UGE 2021 with effect from 2024-2025. Course Structure and Course details are shown in (Annexure-III) 2. Based on the expert suggestions Solar tool is incorporated in Task11 and Task12 of Big Data Analytics Course.
04-BoS-04	To discuss and approve the Program Elective course to be offered in the programme B.Tech Computer Science and Engineering (Data Science) during Summer 2024-2025.
Discussion	Chairman BoS presented the Programme Elective courses. The BoS members suggested to rename the course Machine Learning Techniques to “Applied Machine Learning” and requested to include the topic Reinforcement Learning.
Resolution	The members approved the Program Elective course to be offered during Summer semester 2024-2025. Based on the expert suggestions the changes will be incorporated in the upcoming revision of course. The course content is available (Annexure-IV)
04-BoS-05	To discuss and approve the Open Elective course to be offered to the other School programmes during Summer 2024-2025.
Discussion	Chairman BoS presented the Open Elective courses to be offered to the other school programme during Summer 2024-2025 and the experts approved.
Resolution	The members reviewed and approved the Open Elective course and course contents to be offered during Summer semester 2024-2025. The course content is available (Annexure-IV)

04-BoS-06	To ratify the value added course offered in summer semester 2024-2025 for B.Tech Computer Science and Engineering (Data Science). The chairman BoS presented the value added course offered during summer semester 2024-2025.
Resolution	The members ratified the value added course offered during winter 2023-2024. (Annexure-V)
04-BoS-06	**Any other Cognate Item**
Resolution	The Chairman informed next BoS meeting may be scheduled in the month of December 2024

ANNEXURE-I

1. Confirmation of 3rd BoS meeting minutes held on 05.01.2024

3rd BoS -Meeting Minutes of B.Tech-CSE(Data Science)-Reg

HOD CSE(Data Science) Vel Tech, Chennai <hodcseds@veltech.edu.in>
to masila@iiitdm.ac.in, chandravadhana.kumaran@atos.net, Saravanan, RV

Sir/Madam,

Herewith I attached the 3rd BOS Meeting Minutes of B.tech-CSE(Data Science) held on 5.01.2024 .for your reference.

Thank You

regards
Dr.P.Jose
Associate Professor,
HoD-CSE(Data Science)
Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology
e:hodcseds@veltech.edu.in
w:www.veltech.edu.in

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology

One attachment • Scanned by Gmail

PDF CSE(DS)- 3rd BoS...

ANNEXURE-II

To review the Action Taken Report on the minutes of the 4th meeting of the Board of Studies held on 27.07.2024

Item No	Item	Decision taken	Action Taken
ITEMS FOR DISCUSSION AND APPROVAL			
03-BoS-3	1,Discussion of credit structure and course categories to be offered in B.Tech Computer Science and Engineering (Data Science) under the regulation VTR UGE 2021.	The members discussed and approved the credit structure and course categories to be offered	Proposed Credit Structures and Courses were offered with effect from Academic Year 2024-2025
03-BoS-3	2.To Discuss and approve the course contents of Program core courses to be offered in B.Tech Computer Science and Engineering (Data Science) under the regulation VTR UGE 2021 with effect from 2023-2024.	The proposed Program Core and its course contents to be offered were discussed and approved bythe members	The approved program Core Courses were offered during Winter 2023-2024.
03-BoS-4	To Discuss and approve the course contents of Value Added Courses to be offered in the programme B.Tech Computer Science and Engineering (Data Science) under the regulation VTR UGE 2021 with effect from 2023-2024.	The proposed Value Added Courses and its course contents to be offered were discussed and approved by the members	The approved value added course were offered during Winter 2023-2024.
03-BoS-5	To ratify the value added courses offered in Winter 2023-24 for B.Tech Computer Science and Engineering (Data Science) under the regulation VTR UGE 2021 with effect from 2023-2024. (Annexure-V)	The ratified value added courses and its course contents to be offered were discussed and approved by the members	The ratified value added course were offered during Summer 2023-2024.

ANNEXURE-III

To discuss and approve the changes made in the courses and course contents of Program Core courses to be offered in the new programme B.Tech Computer Science and Engineering (Data Science) under the regulation VTR UGE 2021 with effect from 2023-2024.

B. Tech–COMPUTER SCIENCE AND ENGINEERING (Data Science)
CURRICULUM
(CBCS)
Honors / Specialization
(With effect from 2022-2023)

Preamble:

Data Science is an interdisciplinary field with the ability to extract knowledge/insights from data, be it structure, unstructured, or semi-structured data. Twinned with Artificial Intelligence more efficient solutions to find meaningful information from huge pools of data are possible today, with data from multiple sources-sensors, images, streaming video, satellite, medical imagery and the cloud.
The students shall earn 164 credits in various course categories given below for the award of degree of B. Tech (Computer Science and Engineering (Data Science)).

Course Category	Minimum Credits Required
Foundation Courses (FC)	56
Program Core (PC)	58
Program Elective (PE)	18
Open Elective (OE)	12
Independent Learning (IL)	14
Industry / Higher Institute Learning Interaction (IHL)	2
Professional Proficiency Courses (PPC)	4
TOTAL	**164**

Minimum credits required for regular students in various course categories for B.Tech Computer Science and Engineering (Data Science) with minor

The students shall earn 164 credits in various course categories and additional 18 to 20 credits in the specialized tracks / areas from other branches/Schools by satisfying the prerequisite courses for the award of degree of B. Tech Computer Science and Engineering (Data Science) with minor subject to the regulations.

Minimum credits required for regular students in various course categories for B.Tech Computer Science and Engineering (Data Science) with Honors

The students shall earn 164 credits in various course categories and additional 18 to 20 credits in the specialized tracks / areas courses by satisfying the prerequisite courses for the award of degree of B. Tech Computer Science and Engineering (Data Science) with Honors subject to the regulations.

Program Core (58 Credits)

L-Lecture, T-Tutorial, P-Practical, C-Credit

S.No	Course Code	Course Name	L	T	P	C	PG NO
Theory Courses							
1	10211DS101	Data Structures	3	0	0	3	15
2	10211DS103	Operating Systems	3	0	0	3	18
3	10211DS129	Modern Computer Architecture	3	0	0	3	20
4	10211DS130	Fundamentals of Computer Networks	3	0	0	3	23
5	10211DS106	Formal Languages and Automata Theory	3	0	0	3	26
6	10211DS107	Compiler Design	3	0	0	3	29
7	10211DS109	Microprocessors	2	0	0	2	32
Integrated Courses							
8	10211DS202	Design and Analysis of Algorithms	3	0	2	4	35
9	10211DS204	Programming Using Java	3	0	2	4	41
10	10211DS207	Database Management Systems	3	0	2	4	45
11	10211DS208	Software Engineering	2	0	2	3	51
12	10211DS210	Big Data Analytics	3	0	2	4	55
13	10211DS211	Artificial Intelligence Techniques	3	0	2	4	60
14	10211DS212	Web and Mobile Application Development	3	0	2	4	65
15	10211DS217	Data Science	2	0	2	3	71
Laboratory Courses							
16	10211DS301	Data Structures Laboratory	0	0	2	1	76
17	10211DS312	Fundamentals of Computer Networks Laboratory	0	0	2	1	82
18	10211DS304	Operating Systems Laboratory	0	0	2	1	87
19	10211DS305	Microprocessors Laboratory	0	0	2	1	92
20	10211DS306	Competitive Coding-I	0	0	2	1	95
21	10211DS307	Competitive Coding-II	0	0	2	1	100
22	10211DS311	R for Data Science Laboratory	0	0	2	1	107
23	10211DS313	Problem Solving Techniques	0	1	2	1	110
Total Credits						**58**	

COURSE CODE	COURSE TITLE	L	T	P	C
10211DS106	Formal Languages And Automata Theory	3	0	0	3

A. Preamble

This course deals with the concepts of automata theory, formal languages, grammar, computability and decidability. Students learn concrete implementations, manipulations of discrete structures and their use in design and analysis of non-trivial problems for a given computational task. This course can be applied in Compilers, Artificial Intelligence, Robotics and Natural Language Processing.

B. Prerequisite Course

10210MA110- Discrete Mathematical Structures

C. Course Objectives

Learners are exposed to

- Understand overview of theoretical foundations of computer science from the perspective of formal languages.
- Illustrate various automata to solve problems in computing.
- Familiarize Regular grammars, context free grammar, recursive and recursively enumerable languages.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K -Level
CO1	Design the finite automata to recognize the regular languages.	K3
CO2	Construct regular expression for regular grammar and its equivalence with finite automata.	K3
CO3	Develop push down automata and context-free grammar representations for context-free languages.	K3
CO4	Model Turing Machines for accepting recursively enumerable languages and its capabilities.	K3
CO5	Apply the notions of decidability and undecidability to examine complex problems.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		3									
CO2	3	3	3		3									
CO3	3	3	2	1	3									
CO4	3	3	3	3	3									
CO5	3	3	2	2										

High-3;Medium-2;Low-1

F. Course Contents

Unit 1 Formal Languages and Finite Automata L-10 Hours

Introduction to automata and automata theory, Basic concepts of formal Languages, Finite Automata – DFA, NFA, Epsilon NFA, Equivalence of DFA, NFA and Epsilon NFA, Minimization of Automata, FA with output.

Case Studies: Implementation of Spell checkers, Text search, Text editors, Simulation of FA using JFLAP.

Unit 2 Regular Languages and Expressions L-8 Hours

Regular Grammar, Regular Expressions, Converting Regular Expression to Epsilon NFA, Equivalence of regular expressions and NFA with Epsilon moves, Converting DFA to Regular Expressions, Pumping Lemma for Regular Languages, Applications of Pumping Lemma, and Closure Properties of Regular sets.

Case Studies: Pattern for Mobile numbers with country code, email address

Unit 3 Context Free Languages and Push Down Automata L-10 Hours

Context-Free Languages and Grammar, Derivation trees, Ambiguity, Simplification of CFG, Chomsky Normal Form, Greibach Normal Forms, Deterministic Push Down Automata, Non-Deterministic Pushdown Automata (NPDA), Equivalence of acceptance by final state and empty stack in PDA, Equivalence between NPDA and CFG, Closure properties of CFLs, Pumping Lemma for CFLs.

Case Studies: Tower of Hanoi, Evaluating Arithmetic expression, Transaction Process System.

Unit 4 Turing Machine L- 9 Hours

Context-sensitive Grammar, Turing Machine (TM) – Basics and formal definition, Instantaneous Description, TMs as language acceptors, TMs as Transducers, Designing Turing Machines, Variants of TMs, Checking of Symbols, Encoding a Turing Machine and Universal Turing Machine.

Case Study: Lambda Calculus

Unit 5 Recursive and Recursively Enumerable Languages **L- 8 Hours**

Recursive Functions, Recursive languages and Recursively Enumerable Languages, Properties of Recursively Enumerable Languages and Recursive Languages, Decidability and Halting Problem, Reduction, P and NP, NP- completeness, Post Correspondence Problem, Rice Theorem and Chomsky Hierarchy.

Case Studies: Knapsack Problem, SAT Problem using Turing machine.

Total: 45 Hours (L)

G. Learning Resources

i. Text Books:

1. John E Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, 3/e, Pearson Education, 2013. [Unit 1– 3]
2. John C. Martin, Introduction to Languages and the theory of computation, 4/e, TMH, 2011 [Unit 4, 5]

ii. Reference Books:

1. Michael Sipser, Introduction to the Theory of Computation, 3rd edition, Cengage Publishers, 2013.
2. Peter Linz, "An Introduction to Formal Language and Automata", 5th edition, Cathleen Sether Publishers, 2012.
3. S.P.Eugene Xavier, Theory of Automata, Formal Languages and Computation, New Age International Publishers, 2005.

iii. Online References:

1. "Theory of Computation" Sep. 09, 2016. Accessed on: Feb. 16, 2021, [Online]. Available: https://nptel.ac.in/courses/106/104/106104148/
2. "Automata Theory", Accessed on: Apr. 21, 2021, [Online]. Available: https://www.edx.org/course/automata-theory
3. "Lambda Expressions" [Online] Accessed on: Apr. 28, 2021, https://www.udemy.com/course/java8-functional-programming-with-lambda-expression/

COURSE CODE	COURSE TITLE	L	T	P	C
10211DS210	Big Data Analytics	3	0	2	4

A. Preamble

The key objective of this course is to make the students to be familiar with the concepts of data warehouses, modelling and design of data warehouse. This course includes the most significant technologies used for manipulating, storing, and analyzing big data. In addition, the basic tools of data warehouse and big data analytics will be explored. These tools make the students to understand the strategies involved in data warehouse design and Big Data Platform.

B. Prerequisite Course

10211DS207 -Database Management Systems

C. Course Objectives

Learners are exposed to

- Understand the principles of data warehousing, multidimensional data model.
- Familiar with the data warehouse architecture and OLAP tools.
- Impart the architectural concepts of big data file management system.
- Explore PIG and HIVE tools to develop applications in Big data analytics.
- Implement best practices for Big Data Optimization.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Build and process the data warehouse model for given application	**K3**
CO2	Design Job Execution procedures in MapReduce and Apache Spark Paradigm operations.	**K3**
CO3	Design memory efficient solutions for Big Data Applications procedures	**K3**
CO4	Build Big Data Solutions for social media network applications	**K3**
CO5	Apply cloud and optimization techniques to develop the solutions for real time scenarios	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Program Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3	3										3
CO2		2	2	2	3									3
CO3	2		3		3	2							2	2
CO4	2	3		3	3	3							3	3
CO5	2	2		3		3							3	3

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Data Warehousing and Business Analysis L-9 Hours

Introduction to Data warehousing – Evolution of Decision Support systems – Modeling a Data Warehouse – Granularity in the Data Warehouse - Data Warehousing Components, Building a Data Warehouse, Warehouse Database- Extract, Transform and Load: ETL Overview, ETL Requirements and Steps, Data Transformation, Data Loading, ETL Tools. –. Reporting and Query tools and Applications –Online Analytical Processing (OLAP) – Need – Multidimensional Data Model.

Unit 2 Big Data Processing L-9 Hours

Introduction to Big Data, Big Data Analytics, Evolution of Big data – Best Practices for Big data Analytics – Big data characteristics- Understanding Big Data Storage – A General Overview of High-Performance Architecture – HDFS – MapReduce Programming Model-Understanding the basics of MapReduce, Loading data into HDFS, Introduction-Apache Spark, Features, Components, Resilient Distributed Datasets, Data Sharing using Spark RDD, Spark Programming.

Unit 3 Big Data Storage System L-9 Hours

Apache Camel- Introduction, Overview, features, camel context, architecture, message queues. Apache Ignite-Memory Architecture, Memory Pages, Lifecycle, In-Memory Data Grid, Caching Support, Streaming Support. Cassandra-Architecture, Data Model, Referenced Api, Cqlsh, Key space Operations, Table Operations, Batch, CRUD Operations. Apache Kafka- Fundamentals, Cluster Architecture, Work Flow, Basic Operations, Producer and Consumer Example.

Unit 4 Big data Visualization and Prediction L-9 Hours

Graph Analytics for Big Data: Graph Analytics - The Graph Model - Representation as Triples-Graphs and Network Organization - Choosing Graph Analytics - Graph Analytics Use Cases – Graph-Analytics Algorithms and Solution Approaches - Technical Complexity of Analyzing Graphs-Features of a Graph Analytics Platform.

Unit 5 Big Data Cloud Concepts and Optimization L-9Hours

Big data Cloud Computing-Features, Cloud Deployment Models, Cloud Delivery Models, Cloud for Big Data, Real time Analytics Platform (RTAP) applications – Using Graph Analytics for Big Data: Graph Analytics, Big Data Optimization- Smooth Convex Optimization-Projection-free methods, accelerated gradient descent methods, Non smooth Convex Optimization-Smoothing techniques, Mirror-Prox method, Sparsity learning, Large-scale kernel machines.

Total: 45 Hours

G. Laboratory Experiments

Total: 30 Hours

Part- 1

Task 1: Design a multi-dimensional data model schema namely Star, Snowflake and Fact Constellations for a Categorical data using SQL Server Management Studio (SSMS). (Perform the above for Banking, Healthcare, Manufacturing, Sales and Automobile)
Tools: SQL Server Management Studio (SSMS), Microsoft Azure SQL Pool

Task 2: To configure, monitor, and administer a Data warehouse and perform basic Query operations on the DW.
Tools: SQL Server Management Studio (SSMS), Microsoft Azure SQL Pool

Task 3: Perform Data Cube Operations (OLAP Operations) using SQL Queries
Rollup
Roll down
Slicing
Dicing
Database: MySQL

Task 4: Implement matrix multiplication with MapReduce.
Tools: LINUX

Task 5: Write a Spark application to perform word count in the input file.
Tools: APACHE SPARK

Task 6: Implement CRUD operations on Casandra
Tools: Casandra

Task 7: Implementing Producer and Consumer problem in kafca.
Tools: kafca

Task 8: i. Implement basic commands in HIVE.
ii. Use HIVE to create, alter, and drop databases, tables, views, functions, and indexes
Tools: HIVE, LINUX

Task 9: Write Pig Latin scripts sort, group, join, project, and filter the data

Tools: Pig, LINUX

Task 10

i. Construct the Pig Latin Scripts to find character Count
ii. Construct the Pig Latin Scripts to find a max temp for each and every year.

Tools: Pig, LINUX

Task 11: Collect any Social Media Data from a Twitter to a Local File with the Topic 'covid 19'. Download and Set Up MongoDB Server and a Client Mongo shell.
Tools: MongoDB, Python: Scipy,Solar

Task 12: Retrieve Analytic Information given below from MongoDB created in task 9:

i. For each "place_type", Find total favorite_count
ii. For each "country_code", find total "retweet_count"
iii. Find out top 10 most frequent topic words of the entire tweet message texts of your collection after lemmatization/stemming and removing all the Stop Words.

Tools: MongoDB, Python: Scipy,Solar

Part – 2

Use Cases:

Use case 1:

Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together.

Write a single Spark application that:

a. Transposes the original Amazon food dataset, obtaining a Pair RDD of the type: user-id – list of the product-ids reviewed by user-id
b. Counts the frequencies of all the pairs of products reviewed together;
c. Writes on the output folder all the pairs of products that appear more than once and their frequencies.
d. The pairs of products must be sorted by frequency.

Use case 2:

Construct MapReduce program to perform data analysis on weather dataset.
Dataset is available at: https://www.kaggle.com/datasets/zaraavagyan/weather.csv

Use case 3: Apache Hive for Rea in real-world applications

It is often the case that data has to be retrieved in real-time from the source. The processing is done as soon as the data is inputted. For example, Google maps processes traffic data in real-time. As soon as it receives information from the source, the data is output onto its application. Develop the Real-time data processing using Apache Hive for analysing the Google Map data.

Use case 4: Build a data Pipeline based on Messaging using PySpark and Hive

Implement a data pipeline that ingests raw data from a source and moves this data to a destination where it can be stored or processed further for analysis. The pipeline should also able to filter or clean the data for various purposes. Then create a Hive external on top of HDFS which will allow the cleaned, processed data to be deployed.

i. Textbooks:

1. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012. [Unit 1]
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015 [Unit 2-5].

ii. Reference books:

1. W.H. Inmon, "Building the Data Warehouse", John Wiley & Sons, Inc, 4th Edition, 2005-(Online Publication: 2014).
2. Capriolo, E., Wampler, D., & Rutherglen, J., "Programming Hive", O'Reilly Media, Inc.",2012

iii. Online resources:

1. "Data Warehouse Design: Modern Principles and Methodologies", Accessed on Oct 27, 2022 available: https://cdn.ttgtmedia.com/searchDataManagement/downloads/Data_Warehouse_Design.pdf
2. "Big data Analytics", Accessed on Apr. 5, 2022 [online]. Available: https://www.analyticsvidhya.com/learning-paths-data-science-business-analytics-business-intelligence-big-data/learning-path-data-science-python/
3. "Apache Spark Tutorial", Accessed on Oct 28, 2022 [online]. Available: https://www.tutorialspoint.com/apache_spark/apache_spark_deployment.htm
4. "Apache Camel Tutorial", Accessed on Oct 28, 2022 [online]. Available: https://www.tutorialspoint.com/apache_camel/apache_camel_quick_guide.htm

COURSE CODE	COURSE TITLE	L	T	P	C
10211DS212	Web And Mobile Application Development	3	0	2	4

A. Preamble

This course provides basic concepts about HTML5, CSS3, Bootstrap Framework and java script technologies to create the interactive client-side design of web applications. This course also teaches the server-side programming using Node JS, PHP and MVC frontend design for web applications using Angular. The conversion of web application to mobile apps can be performed using Angular. Finally, the creation and deployment of micro services using Seneca and Dockers will be discussed

B. Pre-requisite course

10211DS204-Programming Using Java

C. Course Objectives

Learners are exposed to,

- Design the interactive and responsive web application.
- Build the efficient server-side applications.
- Develop the single page MVC application.
- Construct and deploy the Micro services.
- Conversion of web apps to Mobile apps using Angular.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO Nos	Course Outcomes	K - Level
CO1	Design web applications using Hypertext Mark-up Language and Cascading style sheets through bootstrap	K3
CO2	Build the interactive and dynamic web page using Java Script Technology.	K3
CO3	Implement the server-side business logic to handle client request using NodeJS and PHP.	K3
CO4	Make use of MVC framework for integrating the window controls and its corresponding actions through event handlers.	K3
CO5	Transform the function as Micro service components to enhance the Reusability concept.	K3

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2	3		3	1	1						3	
CO2		3	3	1	2	1	1						3	
CO3		3	2		3	2	2						2	
CO4		3	3		3	2	2						3	
CO5		3	3		3	2	2						3	

High- 3; Medium-2; Low-1

F. Course contents

Unit 1 Frontend design using HTML5, CSS3 and BOOTSTRAP Framework L-9Hours

Introduction to HTML5: Basic Elements, Form Elements, Media Elements, HTML5 Graphics (Canvas, SVG), CSS3: Selector String, Box Model, Text Properties, CSS 3D Transformation, CSS Animation, Bootstrap Framework: BS Grid, Tables, Images, Alerts, Form Elements.
Case study: Online Blog Creation.

Unit 2 Dynamic webpage design using Java Script and jQuery L-9 Hours

Java Script: Data Types and Variables - Operators - Control Statements - Functions -Objects - Build in Objects - DOM - Java Script Event Handling - Form Handling and validations - AJAX & JQuery: Introduction to AJAX and JQuery: Introduction - JQuery Selectors - JQuery Animations - Effects - Event Handling - JQuery DOM Traversing-JSON - JQuery AJAX.
Case Study: Web Scraping and Automation

Unit 3 Server-side programming using PHP and Node JS L-9 Hours

PHP: Introduction - Variables - Program control - Builtin Functions - Connecting to Database using MySQLi - Cookies - Sessions - Regular Expression; Node JS**:** Introduction - Architecture - Features of Node JS - Installation and setup - Function - Module - Creating Web Servers with HTTP (Request & Response) - Event Handling - Express JS - Get and Post Implementations - Database connectivity.
Case Study: online Book Store.

Unit 4 Single Web Page Design using Angular L-9 Hours

Type Script: Introduction to Type Script - Variables - Datatypes - Enum - Array - Tuples - Functions - OOP concepts - Interfaces - Generics - Modules - Namespaces - Decorators. Angular**:** components and Modules - Data Binding - Event Binding - Templates - Directives - Services - Dependency Injection - Routing and Navigation pages - Template based Form - Reactive Forms - Validating - Pipes - Sorting and Filtering -Decorator - HTTP Client - Data storage - Observables & RxJS
Case study: Todo list

Unit 5 Creating Forms and Mobile App Conversions L-9 Hours

Micro services: Introduction – Micro services Architecture – Micro services in Node.js: Installing Node.js, NPM, Seneca and PM2-SOLID Design Principles - Seneca Toolkit: Inversion of control (IOC) - Pattern Matching - Reusing Patterns -Writing Plugins - Web Server Integration - Data Storage - PM2 Task Runner for Node.js - Writing Micro services - Integrating with Express - Testing and Documenting Micro services - Monitoring Micro services using PM2 and Key metrics - Deploying Micro services. Converting Web App to Mobile App Development - Install Capacitor Package - Configuration Setup - Native IOS and Android packages - Build and deploy the application.
Case study: Chat Bot

Total: 45 Hours

G. Laboratory Experiments

Total: 30 Hours

Part – 1

Task 1:	Develop a simple college web site including all the department information using HTML and CSS.
Task 2:	Create home page, sign up and login page for clinic management service using Bootstrap Framework.
Task 3:	Validate the Registration, user login, user profile and payment by credit card pages using JavaScript.
Task 4:	Parse the web page to get the required information using JQuery and DOM Traversing.
Task 5:	Create a simple HTTP web server using Node.js to generate a dynamic response
Task 6:	Create a three-tier application using Node.js and MySQL data base.
Task 7:	Create a Reactive form for User Registration using Angular for Online Exam portal.
Task 8:	Develop web application to implement routing and navigation in Angular.
Task 9:	Develop a micro service for finding what people think by asking 500 people's opinion for any consumer product in Node.js using Seneca Toolkit.
Task 10:	Build the Web application and convert it into Mobile app.

Part-2

Use Cases:

Use case .1: Bike Rental System

This system is named as **Bike on Rent Management System**. This system is designed to help the customers to take bikes or two-wheelers on rent. When we go on any trip outside the town or country, we want to be free of time so instead of going through metros and taxis we prefer to have our own vehicle for rent. Using this system vehicle owner can register as sellers and customers who want to take bikes on rent can register them as renters and can take any bike on rent. Address of the both are required as the customer can only take bike by going to the address provided and the vehicle owners can know the address that a customer is verified or not. The customer also has to upload some proofs to take the bike on rent. Proofs like license, pan card and identity card are compulsory so that no one could run taking the bike. Any customer whose proofs are not uploaded and are not valid will not be allowed to take any bike on rent. This has one admin account who verifies the registering user and two types of the user account. One for bike sellers and one for customers who take the bike on rent. This system has only one admin account and cannot have more than one admin account. There will be simple chat room needs to be added to make instant interactions between customer and admin. Admin can verify and register the user who is registering. If the admin does not verify, the user cannot register.
Tools: HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, JQuery

Use case .2: Clinic Management Service

This system is named as Clinic management service. This system is made to keep the records about the patients, doctors and other staff members working at a clinic or hospital receptionist. One can login into the clinic management service using the email id or the user id and password. After signing in into this system there are the options to add new patients, new doctors and other new staff members like nurses and ward boys etc. This system is designed to easily maintain the data of the patients specifically. Daily many new patients visit the clinic so adding the new patient's details and keeping the records using it is very easy. There is also an option to add and delete doctors and other staff member's details. New and unique ids are given to everyone who gets registered over this system. There are also the options to check the patient's disease and course the patient is going through. Fees paid by any customer or patient can be saved on it and it is easy to calculate daily that the money is collected. Doctors and another staff member like nurses, ward boys, janitor and maid leaves can be deducted from their salary and rest of the salary can be paid easily using this clinic management service. It is easy to calculate money and handle account on monthly basis also. This system also has an option to use the backup that means if we are backing up the database it can never be lost. So, overall, this clinic management service is a solution to all the problems that we face in a clinic or hospital.
Tools: HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, Java Script

Use case .3: E-commerce service

Online shopping is a process in which people (specifically customers) are being provided with the option of purchasing goods and services directly from the seller, all in real-time environment. Online shopping is an application of the internet as electronic commerce (Like Amazon). From the business perspective, customers usually find the products more attractive, on websites, as they get all the details available there. People in large number are doing online shopping today, and it is not only because it is convenient as one can shop from home, but also because there are ample amount of varieties

available, with high competition of prices, and also it is easy to navigate for searching regarding any particular item. For sellers, their products have access to World Wide market, which also increases the number of customers and enhances the customer relationships. Also the web stores are a means for the small scale companies to launch their products at global level. The main objective behind this project is to develop a web-oriented application which can provide an online shopping feature to the users. In other words, the project aimed at creating a virtual shop environment for users, in some handy form, which will be available to them through internet. This system has been designed keeping in mind all the aspects such as loading the data, complexity and maintaining the security of user credentials. Here in this system, complexity refers to the total number of features being provided to users, and their smooth arrangement and functioning required. Following are some of the key features of our system, which distinguishes it from others:

- Display of all the available categories for shopping on the home page.
- Display all the sub-categories on the home page; those are associated with any particular item.
- Admin has the authority to add new particulars to the items list whenever needed.
- Permission to administrator to remove items, anytime.
- Allows the admin to modify the price of each item, whenever required or felt like.
- Admin has the authority to update the description of each item.
- Permission to the admin to view information about each customer who checkouts the items list.

Tools: HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, Java Script

Use case. 4: College management service

This application college management system based on Internet that aims to all the levels of management providing information within an organization. This system can be used as an information management system for the college. For a given student/staff (Technical / Non-technical) the Administrator creates login id & password, using these student/ staff (Technical / Non-technical) can access the system to either upload or download some information from the database. Not only will this added user also get to know about the events and extra curriculum activities which will hold into the college campus. The main menu will contain six parts which are as follow:

- Student Login
- Teacher login
- Deposit Fee
- Ask Queries Forum
- About Us
- Contact Us

Now, we can see that nearly everything is very much possible to perform with a single click, so this application will help you to computerize the system of college management so that student and other staff members can access the system online. These are some key features of the system which is as follow:

- ✓ To reduce the headache of maintaining the record of students and teachers related documents.
- ✓ To reduce the cumbersome job of maintaining several documents
- ✓ It will eliminate the delays in the generation of results and free updating of the students; this system will help in maintaining the records of absent students.
- ✓ Searching will become more efficient and faster in comparison of manual searching.
- ✓ It will also provide assurance that each employee of the college marked their attendance timely.
- ✓ Overall, it will reduce the cost and time of the college head in taking care of the college.

Tools: HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, Java Script

Use case. 5: E-Payment

In all E-commerce and other online services, payment activity is the most important section and this section mostly having the common procedures. If we make the payment service as the micro service component any web application full stack developer can easily integrate with his project instead of redesigning which is extra burden to developer. So, create the component for the Payment activity with the following operations:

- ✓ Getting card details
- ✓ Pin verification
- ✓ Encryption of card details
- ✓ Crediting and debiting the money on respective accounts.
- ✓ Payment Acknowledgement.
- ✓ Invoice Generation. Convert this application to Mobile app

Tools: Node.js, Angular

H. Learning Resources

i. Text Books:

1. Ben Frain “Responsive Web Design with HTML5 and CSS: Develop future-proof responsive websites using the latest HTML5 and CSS techniques”, Packt Publishing Limited, 3rd Edition, 2020. [Unit 1]
2. Mary Delamater, “Murach's Java Script and jQuery (4th Edition) Paper back–Illustrated”, Mike Murach & Associates Inc, August26, 2020. [Unit2]
3. David Herron “Node.js Web Development: Server-side web development made easy with Node 14 using practical examples”, Packt Publishing Limited, 5th Edition, 2020. [Unit3]
4. Yakov Fain “Angular Development with Type Script”, Manning Publications, 2nd Edition, December 2018. [Unit 4].

ii. Reference Book

1. Azat Mardan, “Practical Node.js: Building Real-World Scalable Web Apps”, 1st Edition. 2018.

iii. Online Resources

1. "Angular the complete guide (2021 Edition)", Accesse don: May.6, 2021 [Online], vailable: https://www.udemy.com/course/the-complete-guide-to-angular-
2. "Server-side Development with NodeJS, Express and MongoDB", Accessed on: May.06, 2021 [Online], Available: https://www.coursera.org/learn/server-side-nodejs
3. "Node.js Micro services for beginners", Accessed on: May.06,2021 [Online], Available: https://www.udemy.com/course/nodejs-microservices-for-beginners/

COURSE CODE	COURSE TITLE	L	T	P	C
10211DS217	Data Science	2	0	2	3

A. Preamble

This course provides an introduction to data science and highlights its importance in business decision making. It provides an overview of commonly used data science tools along with spreadsheets, relational databases, statistics, and programming assignments to lay the foundation for data science applications.

B. Prerequisite Course

10210MA103 - Probability, Statistics and Queuing Theory

C. Course Objectives

Learners are exposed to

- Identify general statistical techniques for data analysis
- Determine how to summarize data to present information using descriptive statistics
- Use a correlation chart to determine the strength of a correlation.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K – Level
CO1	Implement the life cycle of data science process for building real world applications	**K3**
CO2	Use the different types of data and variables	**K3**
CO3	Demonstrate statistical analysis of data using regression techniques	**K3**
CO4	Apply Data wrangling concepts to convert and map the raw data and to make the data ready for analysis.	**K3**
CO5	Build a model for a given real time applications	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 11	PSO 22
CO1	3	3	3										2	
CO2	2	3	2	3					1	1			2	2
CO3	2	3	2	3					1	1			2	2
CO4	3	3	2	3					1	1			3	2
CO5	3	3	2	3					1	1			3	2

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction L-6 Hours

Introduction to Data Science – Evolution of Data Science – Data Science Roles – Life cycle of Data Science Project - Data Science: Benefits and uses – facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation – Exploratory Data analysis – Descriptive –Diagnostic-Predictive-Prescriptive- feature engineering –algorithm selection- Build the model– algorithm tuning - presenting findings and building applications

Unit 2 Describing Data L-6 Hours

Types of Data - Qualitative –Quantitative – Categorical –Nominal –ordinal –numerical -discrete – continuous –interval –ratio- Types of Variables –Univariate analysis – Bivariate analysis – Multivariate analysis-Describing Data with Tables and Graphs –Measures of variability - Describing Data with Averages – Describing Variability – Normal Distributions and Standard (z) Scores

Unit 3 Describing Relationships L-6 Hours

Covariance - Correlation –positive – negative –simple – partial – multiple - linear – non-linear –Pearson correlation - spearman ranking- Scatter plots – box plot – cross table - Histogram –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression - Simple and Multiple Regression – best fit line –least squares regression line- Polynomial Regression- – ridge – lasso regression - Regression assumptions –Standard error of estimate – Mean Square Error –root mean square error -Mean Absolute error/deviation–mean absolute percentage error - interpretation of r2 –adjusted R square - multiple regression equations –regression towards the mean

Unit 4 Data Wrangling L-6 Hours

Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – Slicing of arrays –concatenate – reshape –broadcasting – transpose -structured arrays – Multidimensional –numpy universal functions - Pandas series – data frame –describe – modifying data types - duplicates- drop- windowing operations- date time- time series -Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping –merge –sorting - pivot tables

Unit 5 Model Development **L-6 Hours**

Binary Classification – Multiclass Classification – Multi target – Decision Tree –Gini / information gain – root node – branch node –leaf node - interpretation of decision tree- Pruning – Model Evaluation metrics – Accuracy – confusion matrix – Precision –recall – Auc RoC curve - Residual Plot – Distribution Plot —degree of polynomial – Bias – Variance –under fitting - over fitting –-Generalised model - Pipelines – Measures for In-sample Evaluation – Prediction and Decision Making – Imbalanced classification – under sampling – over sampling - Smote– Hyper parameter tuning – Best parameter – Cross validation – Grid and Randomised search cross validation- deployment – monitoring –MLOps

Total: 30 Hours

G. Laboratory Experiments — Total: 30 Hours

Part – I

Task 1: Exploration of Python Modules, Data types and Functions for data collection.

Exploratory Data Analysis

Task 2: Write programs to perform descriptive statistics, subset of dataset.

Task 3: Write programs to perform exploratory data analysis: variance, standard derivation, summarization, distribution and statistical inference.

Task 4: Write programs to find the data distributions using box and scatter plot, outliers using plot on sample dataset

Task 5: Write programs to plot the data using X-Y graph, Bar- chart, histogram, pie chart and using other plotting techniques on sample dataset

Task 6: Find the correlation matrix, covariance, plot the correlation plot on dataset and visualize giving an overview of relationships among data on sample dataset.

Model Building, Evaluation and Visualization

Task 7: Write a program to build, evaluate the model using regression for a sample dataset. Apply multiple regressions, if data have a continuous independent variable

Task 8: **Consider a Dataset and perform the following tasks**

a. Write a program to identify the column(s) of a given Data Frame which have at least one missing value.

b. Write a program to count the number of missing values in each column of a given Data Frame.

c. Write a program to find and replace the missing values in a given Data Frame which do not have any valuable information.

d. Write a program to drop the rows where at least one element is missing in a given Data Frame.

e. Write a program to drop the columns where at least one element is missing in a given Data Frame.

f. Write a program to drop the rows where all elements are missing in a given Data Frame.

Task 9: Write a program to build, evaluate the model using Decision Tree for a sample dataset. Choose classifier for binary classification problem. Evaluate the performance of classifier.

Task 10: Write a program to build, evaluate the model using Decision Tree for a sample dataset. Choose classifier for Multiclass classification problem. Evaluate the performance of classifier.

Part – II

Use Case 1: Let us use the built-in dataset air quality which has Daily air quality measurements in NewYork, May to September 1973. Create a histogram by using appropriate arguments for the following statements.

a. Assigning names, using the air quality data set.
b. Change colors of the Histogram
c. Remove Axis and Add labels to Histogram
d. Change Axis limits of a Histogram
e. Create a Histogram with density and Add Density curve to the histogram

Use Case 2: Create a dataset or table [‘Smart Phone”] in an excel sheet that stores the mobile information [price, company name, model, Sale Percent] of five different companies. Store at least 20 rows. Write the scripts and find out the output for the following information.

a. Maximum price of the mobile of each company
b. Minimum price of mobile of each company
c. Average price of mobile of each company
d. Total Price of mobile of each company

Use Case 3: The Tooth Growth data are from a study which examined the growth of teeth in guine apigs (n=10) in response to three dose levels of Vitamin C (0.5, 1, and 2 mg), which was administered using two delivery methods (orange juice or ascorbic acid). Data from the Tooth Growth Study is available as an R dataset and information about this study can be found by using R help.

a. How many rows are there is Tooth Growth?
b. What is the mean and standard deviation of Tooth length?
c. Which treatment is the best in terms of tooth growth? Derive the findings based on correlation between Dosage and Length for both supplements.

Use Case 4: Predict the sales of any product by performing the following

a. Data collection from any source
b. Data cleaning
c. Model Building, Evaluation and Visualization

Use Case 5: Perform the Customer Churn analysis for a banking application with the following.

a. Data collection from any source
b. Data cleaning
c. Model Building Evaluation and Visualization

Total: 60 Hours

H. Learning Resources

i. Text Books:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit I)
2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017. (Units II and III)
3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016. (Units IV and V)

ii. Reference Books:

1. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.

iii. Online References:

1. “Introduction to Data Science”, April. 11. 2021. Accessed on April. 22.2021 [Online]. Available: https://rafalab.github.io/dsbook/
2. "Introducing Data Science" 2016, Accessed: April 20, 2021, [Online]. Available: http://bedford-computing.co.uk/learning/wp-content/uploads/2016/09/introducing-data-science-machine-learning-python.pdf

COURSE CODE	COURSE TITLE	L	T	P	C
10211DS311	R for Data Science Laboratory	0	0	2	1

A. Preamble

This course is designed to develop skills to handle, store and analyze data that will be used for data analysis and statistical modeling. This laboratory gives a way for students to construct the means for extracting business insights from data. This course provides students to get hands on experience using comprehensive libraries in R to make data visualization.

B. Prerequisite Course

10210MA103 - Probability, Statistics and Queuing Theory

C. Course Objectives

Learners are exposed to

- Understand the R Programming Language
- Solve Data Science problems
- Implement the classification, clustering and Regression Model

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Construct an application and find descriptive statistics using R scripts.	K3
CO2	Illustrate data exploration and data visualization for Different Types of Datasets using R scripts.	K3
CO3	Implement R script to perform statistical analysis and also apply Chi Square Test to model correlation between two variables.	K3
CO4	Apply linear and logistic regression model to predict the data for a given dataset	K3
CO5	Apply Clustering and Classification model for a given dataset	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-EvaluateK6-Create		

E. Correlation of COs with Program Outcomes and Programme SpecificOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3									2	3
CO2	3	3	3	3									2	
CO3	3	3	3	3									2	
CO4	3	3	3	3									2	
CO5	3	3	3	3									2	

3-High,2-Medium,1-Low

List of Experiments Total:30 Hours

Task 1: R as Calculator Application

i. Build a R script, to create R objects for calculator application and save in a specified location in disk

Task 2: Descriptive Statistics in R

i. Implement a R script to find basic descriptive statistics using summary
ii. Implement a R script to find subset of dataset by using subset ()

Task 3: Data Exploration

i. Build a R script to read different types of files e.g. CSV, Excel, JSON etc. from web and disk and writing in file in specific disk location and analyse .csv file.

Task 4: Data Visualization

i. Build a R script for Data Visualization with charts like a. Pie Chart b. Bar Chart c. Boxplot for the given data set
ii. Build a R script for Data Visualization with a. Histogram b. Line Graph c. Scatter Plot for the given data set

Task 5: Statistical analysis and Correlation

i. Implement R script to perform statistical analysis – Mean, Median, Mode
ii. Build a R script to plot the correlation plot on dataset and visualize giving an overview of relationships among data for the given data set.
iii. Apply Chi Square Test to model correlation between two variables

Task 6: Linear Regression Model

Apply linear Regression tool to model relation between two variables for any data set

Task 7: Logistic Regression Model

Apply Logistic Regression tool to model relation between two variables for any data set

Task 8: Regression Model for Prediction

Build a Decision Tree in R to predict an email as spam or not spam

Task 9: Classification Model

Implement a R script to evaluate and analyze the performance of classifier for any dataset.

Task 10: Clustering Model

Implement any clustering algorithm for unsupervised classification and plot the cluster data using R visualizations.

Part-2

Use cases

Use case 1:

The problem comes from the 5th edition of Moore and McCabe's Introduction to the Practice of Statistics and can be found on pp. 466-467. The data consists of the emissions of three different pollutants from 46 different engines. You will look at the carbon monoxide data which is one of the columns of the data set. First you will transform the data so that it is close to being normally distributed. You will then find the confidence interval for the mean and then perform a significance test to evaluate whether or not the data is away from a fixed standard. Finally, you will find the power of the test to detect a fixed difference from that standard. You will assume that a confidence level of 95% is used throughout.

Use case2:

The authors examine the trends of several studies of cholesterol levels of Americans. The studies have been conducted in 1960-1962, 1988-1994, 1976-1980, 1988-1994, and 1999-2002. Studies of the studies previous to 1999 have indicated that overall cholesterol levels are declining. The authors of this paper focus on the changes between the two latest studies, 1988-1994 and 1999-2002. They concluded that between certain populations cholesterol levels have decreased over this time. One of the things that received a great deal of attention is the linkage the authors drew between lowered cholesterol levels and increased use of new drugs to lower cholesterol. Here is a quote from their conclusions: The increase in the proportion of adults using lipid-lowering medication, particularly in older age groups, likely contributed to the decreases in total and LDL cholesterol levels observed. *C*alculate the power of the test to detect a prescribed difference in cholesterol levels.

F. Learning Resources

i. Text Books:

1 Grolemund G and Wickham H, "R for Data Science", First Edition, O'Reilly, 2017.

2 Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", Third Edition, No Starch Press, 2019

ii. Reference Books:

1 Robert Knell, "Introductory R A beginner's guide to data visualization and statistical analysis and programming in R", Second Edition, Amazon Digital South Asia Services, 2015
2 Yanchang Zhao, "R and Data Mining: Examples and Case Studies", Elsevier, 1st Edition, 2015
3 Mark Gardener, "Beginning R: The Statistical Programming Language", Second Edition, Wiley, 2016.

iii. Online References:

1 http://www.r-bloggers.com/how-to-perform-a-logistic-regression-in-r/
2 http://www.ats.ucla.edu/stat/r/dae/rreg.htm
3 http://www.coastal.edu/kingw/statistics/R-tutorials/logistic.html
4 http://www.ats.ucla.edu/stat/r/data/binary.csv

ANNEXURE-IV

Program Electives (18 Credits)

Program Electives are the courses offered in the programme which covers depth and breadth. The students may register for appropriate electives offered in the programme based on their area of interest. One course under this category shall be taken from the list of approved MOOCs.

L-Lecture, T-Tutorial, P-Practical, C-Credit

S. No	Course Code	Course Name	L	T	P	C	PG NO
		Data Science Core					
1	10212DS218	Modeling for Data Science	3	0	2	4	115
2	10212DS214	Data Visualization	3	0	2	4	119
3	10212DS223	Machine Learning Techniques	3	0	2	4	123
4	10212DS215	Deep Learning*	3	0	2	4	
5	10212DS216	Natural Language Processing*	3	0	2	4	
6	10212DS229	IoT and Cloud Computing*	3	0	2	4	
7	10212DS228	Block chain Technology*	2	0	2	3	
8	10212DS123	Data Security and Privacy*	2	0	0	2	
		Honors					
9		Predictive Analytics*	3	0	2	4	
10	10212DS234	Time Series and Forecasting*	3	0	2	4	
11	10212DS224	Computer Vision *	3	0	2	4	
12	10212DS110	Optimization Techniques*	3	0	0	3	
13	10212DS233	Social Media Analytics*	3	0	2	4	

***The proposed course and the course content are subject to approval/ratification in the upcoming BoS meetings.**

COURSE CODE	COURSE TITLE	L	T	P	C
10212DS223	Machine Learning Techniques	3	0	2	4

A. Preamble

This course introduces students to new and actively evolving interdisciplinary field of modern data analysis. The interplay between known data and unknown ones give rise to complex pattern structures and machine learning methods that are the focus of the study. In the course we will consider methods of Machine Learning and Data Mining Learning. It also includes dimensionality reduction techniques which help to deal with huge datasets.

B. Prerequisite Course

10210MA103- Probability, Statistics and Queuing theory

C. Course Objectives

Students are exposed to

- Apply the concepts of supervised and unsupervised learning algorithms for real time applications
- Executing classification and association models to overcome the problem of over fitting
- Analyse and suggest appropriate machine learning approaches for various types of problems
- Demonstrate the aspects of simple perceptron and multilayer perceptron

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Examine the basic concepts of data mining and machine learning concepts	K3
CO2	Design and evaluate the dimensionality reduction algorithms using real world datasets	K3
CO3	Apply various algorithms of Classification and Association.	K3
CO4	Demonstrate experiments to evaluate and compare different unsupervised learning algorithms	K3
CO5	Use the concept of neural networks for learning linear and non-linear activation functions	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2	2							1	1				
CO2	3	3	3	2	2				1	1			2	2
CO3	3	3	3	2	2				1	1			2	2
CO4	3	3	3	2	2				1	1			2	2
CO5	3	2	2	2	2	1	1		1	1			2	2

3-High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Data Mining and Machine Learning L-9 Hours

Introduction to Data mining and Knowledge Discovery – Data – Data Mining Functionalities – Steps in Data Mining Process, Architecture of Typical Data Mining systems - Interesting Pattern - Classification of Data Mining Systems – Machine Learning -Types of machine learning– Model selection and generalization- Evaluation Metric-Perspectives and Issues in Machine Learning – Concept Learning Task – Applications of Data Mining and Machine Learning

Unit 2 Dimensionality reduction

L-9 Hours

Data Pre-processing- Needs Pre-processing the Data- Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation- Dimensionality Reduction – Feature Extraction- Variable Selection- Variable ranking- Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis –Cross Validation Resampling methods

Unit 3 Association and Classification L-9 Hours

Association Rule Mining- Mining Multilevel Association Rules- Mining Multidimensional Association Rule-Constraint Based Association Mining –Decision Tree Induction - Bayesian Classification –Support Vector Machines – Linear Regression - Logistic Regression- Decision Trees – Univariate Tree – Multivariate Tree – Regression Trees – ID3- Random forest- Probability and Learning – Gaussian Mixture Models – Nearest Neighbor Methods.

Unit 4 Clustering Techniques L-9 Hours

Cluster Analysis - Types of Clustering methods – Partitioning Clustering- K-means, K- Medoid, K Mode- Density-Based Clustering- DBSCAN Algorithm - Distribution Model Based Clustering - Maximum Likelihood Estimation- Expectation-Maximization Algorithm- Hierarchical Clustering- Agglomerative Hierarchical algorithm- Fuzzy Clustering- Fuzzy C-means algorithm Agglomerative and Divisive Clustering –BRICH - ROCK- Chameleon

Unit 5 Neural Networks L-9 Hours

ANN- Simple Perceptron- Gate implementation- Multi-Layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation- Optimization- Hyper parameter tuning

Total: 45 Hours

Laboratory Experiments **Total: 30 Hours**

Part – 1

Task 1: Apply and demonstrate the FIND-S algorithm for finding the most specific Hypothesis based on a given set of training data samples.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 2: Implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 3: Apply LDA algorithm to select the appropriate data from the given data set. Use XG boost algorithm for classification.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator.

Task 4: Build a classification model that can effectively analyze and extract features from an image. Apply PCA algorithm to find the appropriate feature.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator.

Task 5: Write a program to demonstrate the working of the decision tree based on ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
Tools: Weka, Python, Scikitlearn, Anaconda navigator

Task 6: Write a program to implement the Gaussian mixture model. Compute the accuracy of the classifier, considering few test data sets.
Tools: Rapid Miner, Python, Scikitlearn, Anaconda navigator

Task 7: Apply unsupervised learning to implement K – means clustering to perform cluster analysis, find the optimal number of clusters, identify appropriate features and interpret results.
Tools: Weka, Python, Scikitlearn, Anaconda navigator

Task 8: Apply unsupervised learning to implement Hierarchical clustering to perform cluster analysis, find the optimal number of clusters, identify appropriate features and interpret results.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 9: Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 10: Apply back propagation neural network on image data. The idea is to build a Artificial Neural Network model that can effectively analyze and extract features from an image.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 11: Assuming a set of documents that need to be classified, use the Radial basis function Classifier model to perform this task. Calculate the classification rate, accuracy, precision, and recall for your data set.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 12: Write a program to implement artificial neural network with back propagation.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 13: Create a perceptron with appropriate number of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Part-2
Use Cases:

Use case 1: Medical Data Diagnosis
Use case 2: Text Classification
Use case 3: Biometrics pattern analysis
Use case 4: Climatic prediction
Use case 5: Credit Card Fraud Detection

G. Learning Resources

i. Text Books

1. Ethem Alpaydin,, “Introduction to Machine Learning”, 4th edition, MIT Press, 2020 [Unit 1-4]
2. Christopher M Bishob, “Pattern Recognition and Machine Learning”, Springer-Verlag New York Inc, 2018
3. Tom Mitchell, “Machine Learning: A Guide to Current Research”, Kluwer academic publisher, 2019.

ii. Reference books

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An Introduction", Second Edition, MIT Press, 2019.[Unit 5]

2. Oliver Theobald,“ Machine Learning for Absolute Beginners", Scatterplot Press,3rd edtition, 2020
3. Beattie, Guy, “Machine Learning: Start with Machine Learning with all new tips tricks 2020. Understand how machine learning can help”, 2020

iii. Online References

1. Machine Learning, accessed online April 20, 2021 [online] Available: https://www.coursera.org/learn/machine-learning
2. Machine Learning by Georgia Tech, accessed online April 20, 2021[online], Available: https://www.udacity.com/course/machine-learning--ud2

ANNEXURE-V

To discuss and approve the courses and course contents of Open Elective courses to be offered inthe regulation VTR UGE 2021 with effect from summer 2024-2025.

S.No.	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1	10213DS401	Introduction to Internet of Things	NPTEL	12 Weeks	3
2	10213DS402	Social Networks	NPTEL	12 Weeks	3
3	10213DS403	Google Cloud Computing Foundations	NPTEL	8 Weeks	2
4	10213DS404	Demystifying Networking	NPTEL	4 Weeks	1

COURSE CODE	COURSE TITLE	W	H	C
10213DS401	Introduction to Internet of Things	**12**	**-**	**3**

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1: Introduction to IoT: Part I, Part II, Sensing, Actuation, Basics of Networking: Part-I

Week 2: Basics of Networking: Part-II, Part III, Part IV, Communication Protocols: Part I, Part II

Week 3: Communication Protocols: Part III, Part IV, Part V, Sensor Networks: Part I, Part II

Week 4: Sensor Networks: Part III, Part IV, Part V, Part VI, Machine-to-Machine Communications

Week 5: Interoperability in IoT, Introduction to Arduino Programming: Part I, Part II, Integration of Sensors and Actuators with Arduino: Part I, Part II

Week 6: Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi

Week 7: Implementation of IoT with Raspberry Pi (contd), Introduction to SDN, SDN for IoT

Week 8: SDN for IoT (contd), Data Handling and Analytics, Cloud Computing

Week 9: Cloud Computing(contd), Sensor-Cloud

Week 10: Fog Computing, Smart Cities and Smart Homes

Week 11: Connected Vehicles, Smart Grid, Industrial IoT

Week 12: Industrial IoT (contd), Case Study: Agriculture, Healthcare, Activity Monitoring

Course Provider	**:**	**NPTEL**
Professor	**:**	Prof. Sudip Misra
University	**:**	IIT Kharagpur

COURSE CODE	COURSE TITLE	W	H	C
10213DS402	Social Networks	**12**	**-**	**3**

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1: Introduction

Week 2: Handling Real-world Network Datasets

Week 3: Strength of Weak Ties

Week 4: Strong and Weak Relationships (Continued) & Homophily

Week 5: Homophily Continued and +Ve / -Ve Relationships

Week 6: Link Analysis

Week 7: Cascading Behaviour in Networks

Week 8: Link Analysis (Continued)

Week 9: Power Laws and Rich-Get-Richer Phenomena

Week 10: Power law (contd..) and Epidemics

Week 11: Small World Phenomenon

Week 12: Pseudocore (How to go viral on web)

Course Provider	**:**	NPTEL
Professor	**:**	Prof. Sudarshan Iyengar
University	**:**	IIT Ropar

COURSE CODE	COURSE TITLE	W	H	C
10213DS403	Google Cloud Computing Foundations	**8**	**-**	**2**

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 0: Introduction to the course

Week 1: So, What's the Cloud anyway? Start with a Solid Platform

Week 2: Use GCP to build your Apps

Week 3: Where do I store this stuff?

Week 4: There's an API for that! You can't secure the Cloud right?

Week 5: It helps to network!

Week 6: It helps to network (continued)

Week 7: Let Google keep an eye on things. You have the data, but what are you doing with it?

Week 8: Let machines do the work

Course Provider	**:**	**NPTEL**
Professor	**:**	Prof. Soumya Kanti Ghosh
University	**:**	IIT Kharagpur, Google Cloud

COURSE CODE	COURSE TITLE	W	H	C
10213DS404	Demystifying Networking	**4**	**-**	**1**

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1: Layers of Computer Networks and Network Addressing

Week 2: Routing

Week 3: Transport and Application Layers

Week 4: Introduction to Security and Troubleshooting

Course Provider	**:**	**NPTEL**
Professor	**:**	Prof. Sridhar Iyer
University	**:**	IIT BOMBAY

ANNEXURE - VI

Ratification of Value Added Course offered in Winter Semester 2023-24

To Ratify the Value Added course offered in Winter Semester 2023-24 for B.Tech Computer Science and Engineering (Data Science) under the regulation VTR UGE 2021.

L-Lecture, T-Tutorial, P-Practical, C-Credits

S. No	Course Code	Course Name	L	T	P	C
1	10218DS947	Data Structures and Algorithms using Python - Part 1	3	0	0	0
2	10218DS936	Bash Shell Scripting Administration	3	0	0	0
3	10218DS941	Java Programming Fundamentals	3	0	0	0
4	10218DS942	Mongodb Essentials	3	0	0	0

Tutorial hour is not considered for credit calculation of the hours

COURSECODE	COURSETITLE	Total Hours
10218DS947	Data Structures and Algorithms using Python - Part 1	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech-CSE(DS)

D. Course Handling Faculty: Dr. Nitya

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Implement modular algorithms to find solution for computational problem with time and space complexities using suitable data structure.
- Solve structured problem using array and linked list in list concepts
- Develop modular algorithms to find solution for computational problems with linear Data structures using Stack concepts
- Develop modular algorithms to find solution for computational problems with linear Data structures using Queue concepts
- Solve unstructured problem using tree algorithm. Implement an appropriate algorithm using graph ADT for an application.

G. Preamble:

The Course introduce fundamentals of Data Structures. Discuss frequently used linear data structures like Stack, Queue, List etc. Discuss the commonly performed operations on linear data structures like insert, update, delete etc. Provide insights on non - linear data structures.

H. Course Contents

Module–1: Introduction to Data Structures 6 Hours

Definition and Importance of Data Structures-What is a data structure? - Types of Data Structures-Arrays: Definition and properties, -Advantages and Disadvantages-Operations: insertion, deletion,

traversal, searching, and sorting

Module–2: List **6 Hours**

List using Array-add Operation-Insert Operation-Delete Operation-An Analysis-Memory Usage-Introduction-List using Linked List-Introduction-Creation-Display Operation-Algorithm-Add Operation-Algorithm-Search Operation--Insert Operation- Algorithm-Delete Operation-Algorithm- List using Array Vs Linked list

Module–3: Stack **6 Hours**

Stack-Introduction-Push Operation-Algorithm-Pop Operation-Algorithm-Application Areas.

Module–4: Queue **6 Hours**

Queue- Enqueue Operation- Algorithm- Dequeue Operation- Algorithm

Module–5: Non-Linear Data Structures **6 Hours**

Non-Linear Data Structures - Introduction-Graph-Tree

Total: 30 Hours

I. Learning Resources

i. Text Book:

1. Bradley N. Miller, David L. Ranum ,“Problem Solving with Algorithms and Data Structures using Python", Franklin, Beedle & Associates,3rd Edition,ISBN-13: 978-1590282571
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser Publisher: Wiley,"Data Structures and Algorithms in Python", Wiley, 2nd Edition

ii. Reference Book

1. Benjamin Baka, "Python Data Structures and Algorithms", Packt Publishing, 978-786467355

iii. Online Resources

1. https://www.edx.org/learn/python/the-university-of-michigan-python-data-structures
2. https://www.coursera.org/specializations/data-structures-algorithms.

COURSE CODE	COURSE TITLE	Total Hours
10218DS936	Bash Shell Scripting Administration	30

A. **Course Category: Value Added Course**

B. **Offered Semester: Winter Semester 2023-2024**

C. **Branch: B.Tech., CSE(DS)**

D. **Course Handling Faculty: Mr. T.Anand**

E. **Duration of the Course: 27.12.23 to 27.04.24**

F. **Course Outcome:**

The Students will be able to proficiently:

- Familiarity with command-line interface and basic commands
- Ability to work with files, test conditions, and patterns.
- Ability to configure access levels and system environment variables.
- Using regular expressions and substring operations effectively.
- Understanding input types and the pipe operator for command chaining.

G. Preamble:

This comprehensive course delves into Bash Shell scripting, providing participants with practical knowledge and skills to automate tasks, manipulate data, and optimize workflows. Starting from the basics of Bash Shell, participants progress through advanced topics, such as regular expressions and file processing commands. With real-world examples and hands-on exercises, participants gain proficiency in using Bash Shell scripting for various tasks.

H. Course Contents

Module–1: Introduction to Bash Shell — 5 Hours

Definition and Importance of Data Structures-What is a data structure? - Types of Data Structures-Arrays: Definition and properties, -Advantages and Disadvantages-Operations: insertion, deletion, traversal, searching, and sorting

Module–2: Getting Started — 5 Hours

File Text Size, Test Numbers, Checking Conditions, Multiple Digit Pattern, Checking If File Exists, Test File Exists, Script Output

Module–3: Shell Environment **5 Hours**

Introduction to Shell Environment, Command Program, Access Level Configuration, Booting Level Configuration, Booting Level Configuration Continue, System Admin Level Configuration, Networking Level Configuration, System Environment, User Configuration Files, Shell Special Variables. Array Declaration, Variable Declaration, Variable Declaration and Assignment

Module–4: Usage with String Manipulations **5 Hours**

String Manipulation and Internal Commands, Topic Structure, Regular Expressions, Square Bracket Round Bracket, Dot Character, Substring Length, Substring Removal.

Module–5: Commands-External and Internal **5 Hours**

Quick Revision on String Manipulation, Types of shell Commands-External and Internal,
Types of User Input, Pipe Operator. Lecture Introduction, Awk Introduction, Syntax and Dataset Familiarity, AWK for Column, Columns Extraction, Skipping the Header Row, Awk for Pattern Matching, Awk for Pattern Matching Continue, Dynamic Redirection of File Output, AWK Keyword, Status Variable, AWK for Grouping, what is Array, Statement Output, Total Female Population, Total Male Population, Percentage of Population, Peplinski Population

Module–6: Reading **5 Hours**

Internal Command, Reading from Single Variable, Reading from Array, Reading From File Introduction to Stacks Data Structure, Introduction to Stacks Data Structure Continue, Set Command Internal Command Set, Internal Command Unset, Intro to External Commands, External Command Cat External Command WC, Character Mode, Numerical Mode, Numerical Mode Continue, Searching Patterns in Multiple Files, Single File, Count Pattern Occurrence, Suppress Filename Headers Etc., Changing Ownership, Filter by Owner Before Change, External Command ENV, External Command CP, External Command MV, External Command Date, External Command ln, External Command ln Continue, Dataset Explanation for File Processing Commands, External Command-Essa-Jump to Line, Search for Pattern, External Command-Tail, External Command-Sort, External Command-Unit, External Command-PS, External Command Find, External Command Conclude

Total: 30 Hours

I. Learning Resources

i. Online Resources

Search Results Page | Infosys Springboard (onwingspan.com)

COURSE CODE	COURSETITLE	Total Hours
10218DS914	Java Programming Fundamentals	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester2023-2024

C. Branch: B.Tech -CSE(DS)

D. Course Handling Faculty: Mr. Ayyappa

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Create Java programs using the fundamental programming constructs
- Implement and design a class based on attributes and behaviors of objects
- Develop Java code that demonstrates the working of different keywords in Java
- Explain and implement different Object-Oriented concepts in Java
- Develop Java code that uses the appropriate access modifiers, package declarations, import statements
- Identify, apply and understand the working of the most common APIs used in Java
- Explains about Exception Handling, Collections Framework and, Generics.

G. Preamble:

Java Programming Fundamentals is designed to introduce the fundamentals of Java programming and its object-oriented features. It will help out the learners to understand various keywords available in Java and Java's architecture. Also, this course will help learners to know the working of Java APIs through hands on approach

H. Course Contents

Module–1: 6 Hours

About Java Programming Fundamentals, Introduction and Features of Java, Java Architecture, Java Development Kit

Module–2: List 6 Hours

Data Types, Keywords and Identifiers, Operators, Type Casting, Widening and Narrowing, Conditional Statements, Control Flow and Looping, Arrays: Introduction to Arrays, Enhanced for loop

Module–3: Stack **6 Hours**

Object Oriented Concepts using Java, Class and Object, Constructors, this Keyword, Inheritance, Polymorphism, super Keyword

Module–4: Queue **6 Hours**

Final Keyword, static Modifier, Variable Arguments, Enumerated Data Types, Abstract class Interface Package Access Modifiers Java Libraries.

Module–5: Non-Linear Data Structures **6 Hours**

Exceptions, Generics, The Collections Framework, Date/Time APIs.

Total: 30 Hours

I. Learning Resources

i. Online Resources

“Infosys Spring Board “,
Available: https://infyspringboard.onwingspan.com/web/en/page/home

COURSE CODE	COURSE TITLE	Total Hours
10218DS942	Mango DB Essentials	30

A. Course Category : Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B. Tech –CSE(DS)

D. Course Handling Faculty: Ms.Annal Priyadharsihini

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcomes after successful completion of this course, the students are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Illustrate the MongoDB queries to perform CRUD operations on document database.	K3
CO2	Apply Sharding Techniques to do backup and recovery	K3
CO3	Solve Aggregation problems using Map Reduce.	K3

G. Preamble

The course places a strong emphasis on MongoDb Essentials as a tool. It introduces essential techniques of performing CRUD operations on Modern Database. Additionally, it offers a brief overview of Sharding techniques, including replicas and cluster collections. These practices are essential for working with aggregation operators, exploring different aggregation stages, using MongoDB map reduce.

H. Course Content:

Module I: MongoDB Overview: Install MongoDB, Access MongoDb Using Mongo 3T Studio, Introduction to MongoDB, MongoDB Document, Creating an AWS Server Instance, Establish Connection Using Putty. **MongoDb Replication:** Introduction to MongoDb Replication,S etting up Replica Set Servers, Configure Replica set, Connection Using Mongo Chef.

Module II: Working with Replica set Members: Election Process,Test Replica Set Election,

Configure Priority, Configure Delayed, Hidden, and Arbitter Members.

Module III: Sharding your MongoDb Cluster: Components of Sharded Cluster, Sharding Workflow**, Sharding Techniques:** Setting up replica sets, setting Up config servers and MongoS Server, Adding Shards, Sharding a Collection**.**

Module IV Administration and security: Practicing MongoDB backup and Restore Techniques, Exploring User Roles and authorization, working with Journaling, Discovering importance of Profiler,

Module V Aggregation Techniques: Working with Aggregation operators, Exploring different Aggregation Stages, Using MongoDB Map Reduce.

Total : 30 Hours

I. Learning Resources

i. Text Books:

MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow, O'Reilly

ii. Software configuration and installation:

MongoDB TOC - MongoDB Essentials - A Complete MongoDB Guide | Infosys Springboard (onwingspan.com)

iii. Online Resources:

https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_013177169294712832113_shared/overv iew (MongoDB)

39th MEETING of BOARD of STUDIES

Minutes

for

B.Tech(Computer Science & Engineering)

M.Tech(Computer Science and Engineering)

M.Tech(Big Data Analytics)

[CBCS]

On

13.07.2024

Department of Computer Science & Engineering

School of Computing

Department of Computer Science and Engineering

School of Computing

39th MEETING of BOARD of STUDIES

For

B.Tech(CSE), M.Tech(CSE), M.Tech(BDA)

INDEX

School of Computing
39th MEETING of BOARD of STUDIES

For
B.Tech(CSE), M.Tech(CSE), M.Tech(BDA)

Date: 13.7.2024 – 11.00 am, Venue: 33023

Sl.No	Name and Designation	Nominee	Signature
1	Dr. SP Chokkalingam Professor & Dean(SoC)Vel Tech	Chairperson	
2	Dr. Debasis Samanta Associate Professor Department of Computer Science andEngineering, IIT Kharagpur,	Academic ExpertNominee	
3	Dr. Sarma Venkataraman (Retired as Group Director from ISRO/DoS inJune 2020) Director, CR Rao AIMSCS. University ofHyderabad Campus, Gachibowli, Telangana.	Academic Expert Nominee	
4	Mr. Ashwin RaghunathaChari Vice President, Global InsuranceCapgemini, India	Industry Expert Nominee	
5	Dr. Arish Senior Associate in Innovation Hub, PWC,Bangalore	Industry Expert Nominee	
6	Mr. Beniston Alumni, 2011 Passed outAssociate Director, Bounteous, Chennai	Alumni	
7	Dr. M. S. Murali Dhar, Head, CSE, Vel Tech	Associate Professor Nominee	
8	Dr. E. Kannan, Professor, CSE, Vel Tech	Professor Nominee	
9	Dr. N. Malarvizhi, Professor, CSE, Vel Tech	Professor Nominee	
10	Dr. R. Suguna, Professor, CSE, Vel Tech	Professor Nominee	
11	Dr. N. Gomathi, Professor, CSE, Vel Tech	Professor Nominee	
12	Dr. M. Kavitha, Professor, CSE, Vel Tech	Professor Nominee	
13	Dr. N. R. Rajalakshmi, Professor, CSE, Vel Tech	Professor Nominee	
14	Dr. R. Srinivasan, Professor, CSE, Vel Tech	Professor Nominee	
15	Dr. S. Sridevi, Professor, CSE, Vel Tech	Professor Nominee	
16	Dr. A. Bhagyalakshmi, Professor, CSE, Vel Tech	Professor Nominee	
17	Dr. S. Jagan, Professor, CSE, Vel Tech	Professor Nominee	
18	Mrs. V. Usha, Associate Professor, CSE,Vel Tech	Assistant Professor Nominee	
19	Mr. A. S. Syed Fiaz, Assistant Professor, CSE, VelTech	Assistant Professor Nominee	

Invited Members

SI NO	NAME	DESIGNATION	SIGNATURE
1	Dr. V. DhilipKumar	Professor & Head, Dept of AI&DS	
2	Dr. R. Parthasarathy	Associate Professor & Head, Dept of CSD	
3	Dr. P. Jose	Associate Professor & Head, Dept of CSE(DS)	
4	Dr. S. Lalitha	Associate Professor & Head, Dept of CSE(AIML)	
5	Dr. J. Visumathi	Professor & Head, Dept of B.Tech(IT)	
6.	Dr. T. Rajendran	Associate Professor & Head, Dept of CSE(CS)	

Department of Computer Science and Engineering
School of Computing
39th MEETING of BOARD of STUDIES
For
B.Tech(CSE), M.Tech(CSE) and M.Tech(BDA)

Date: 13.07.2024
Venue: SOC Block

AGENDA

Item No	Agenda
A. Opening	
39-BoS-1	Confirmation of 38th BoS meeting minutes held on 09.12.2023.
Action Taken:	The minutes of 38th BoS meeting minutes held on 09.12.2023 was circulated to members through e-mail, the members confirmed the minutes. [Annexure - I]
39-BoS-2	To review the Action Taken Report on the minutes of the 38th meeting of the Board of Studies.
Action Taken:	The members reviewed the action taken report on the decisions of 38th BoS meeting minutes held on 09.12.2023 [Annexure - II]
B. Items to be considered	
39-BoS-3	Stakeholder's feedback on curriculum of B.Tech CSE taken for the academic year 2023-2024.
Discussion	The Chair presented the Feedback on curriculum received from various stake holders and action taken with respect to feedback. Members appreciated the efforts taken for collecting the feedback and also for the action taken by including the suggested courses in the Curriculum
Resolution	The members reviewed the stakeholders' feedback on curriculum of B.Tech CSE and the action taken report with respect to feedback. [Annexure - III]

39-BoS-3

To discuss and approve the new courses under Program Elective category, to be offered in various specialization in the **existing B.Tech CSE curriculum VTR UGE 2021** keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills.

Program Elective

Track: Artificial Intelligence, Data Science, Artificial Intelligence Machine Learning & Artificial Intelligence Data Science

S.No	Course Code	Course Name	L	T	P	C
1	10212CS218	Modelling for Data Science	3	0	2	4
2	10212CS224	Computer Vision	3	0	2	4
3	10212CS276	Generative AI	1	0	2	2

Track: Animation & Gaming

S.No	Course Code	Course Name	L	T	P	C
1	10212CS239	3D Character Modeling	3	0	2	4

Track: Cyber Security

S.No	Course Code	Course Name	L	T	P	C
1	10212CS230	Forensics in Cyber Security	3	0	2	4
2	10212CS250	Identity Access Management	3	0	2	4

Track: Cloud Infrastructure Management

S.No	Course Code	Course Name	L	T	P	C
1	10212CS255	Administering Microsoft Exchange Server	2	0	2	3
2	10212CS256	Office 365 Administration	2	0	2	3

Track: Network and Server Management

S.No	Course Code	Course Name	L	T	P	C
1	10212CS262	Storage Management	2	0	2	3

Track: Application Modernization Service

S.No	Course Code	Course Name	L	T	P	C
1	10212CS265	Web Sphere Application Server	2	0	2	3
2	10212CS303	WebSphere MQ	0	0	2	1
3	10212CS267	Middleware Technologies	2	0	2	3
4	10212CS269	Oracle Database Administration	2	0	2	3

<table>
<tr><td>Discussion</td><td>Members reviewed the courses and recommended to make the following changes
Modelling for Data Science – Dr. P. Arish suggested to include topics like how to use Entropy, error reduction and evaluation of metrics as one unit.
Computer Vision – Dr. Sarma Venkatraman said that 1st order and 2nd order moments can be added in 3rd unit. He also suggested to include calculation of moments and edge detection tools like open CV.
Generative AI – Dr. P. Arish said that Lang Graph can be included and also Use-cases can be given in the form of Audio, video and image files.
3D Character Modeling – Dr. Sarma Venkatraman said that topics like DEMS, DTM, and LOD to be included along with grid modelling.
Forensics in Cyber Security – Dr. Sarma Venkatraman suggested to include topics like Mitigation, Stenography in the syllabus and also suggested to collaborate with CFSL lab for quality services in the Scientific Examination/Analysis of the evidential materials.
Identity Access Management – Dr. Sarma Venkatraman suggested to include Biometric features like palm vein sensor.

The members appreciated the initiatives taken to offer the Program Elective courses as per the industry requirements. As per the requirement of ATOS Cloud Infrastructure Management, Network Management, Application Modernization Service and Mainframe. Under these domains ATOS industry trained (one week in industry) 40 faculty members to handle the courses. As a result of offering ATOS IBM Mainframe course, 30 students got Internship Cum Placement</td></tr>
<tr><td>Resolution</td><td>The suggestion of the members is considered and changes will be made in the forthcoming revision of course. Experts approved the courses and course contents of Industry (ATOS) collaborated courses to be offered under Program Elective Category from Summer 2023-2024. Course structure and details are available in [Annexure - IV]</td></tr>
<tr><td>39-BoS-4.</td><td>To discuss and approve the new courses under Open Elective category, to be offered in various specialization in the <u>existing B.Tech CSE curriculum VTR UGE 2021</u> keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills.
<table>
<tr><th>S.No</th><th>Course Code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10213CS107</td><td>Design and Analysis of Algorithms</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>2</td><td>10213GE103</td><td>Software Development and Maintenance</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
</table></td></tr>
<tr><td>Discussion</td><td>The Chairman presented the courses to be offered in Open Elective category during the Summer 2024 – 2025. Members reviewed and suggested to add complexity ordering and complexity classes in DAA and Version control system in SDM.</td></tr>
<tr><td>Resolution</td><td>The suggestion of the members is considered and changes will be made in the forthcoming revision of course. Course structure and details are available in [Annexure - V]</td></tr>
</table>

39-BoS-5.

To discuss and approve the courses to be offered in Online MOOCs platforms under Open Elective & Program Elective Category for B.Tech CSE under regulation VTR UGE 2021 during the Summer 2024-2025.

NPTEL Platform – OPEN ELECTIVE

S.No	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1.	10213CS442	Social Networks	NPTEL	12	3
2.	10213CS443	Introduction to Industry 4.0 and Industrial Internet of Things	NPTEL	12	3
3.	10213CS444	Responsible & Safe AI Systems	NPTEL	12	3
4.	10213CS445	Python for Data Science	NPTEL	4	1
5.	10213CS446	Google Cloud Computing Foundations	NPTEL	8	2
6.	10213CS447	Introduction to Internet of Things	NPTEL	12	3
7.	10213CS448	Machine Learning for Engineering	NPTEL	12	3

NPTEL Platform – PROGRAM ELECTIVE

S.No	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1.	10212CS401	Social Networks	NPTEL	12	3
2.	10212CS402	Design & Implementation of Human-Computer Interfaces	NPTEL	12	3
3.	10212CS403	Introduction to Industry 4.0 and Industrial Internet of Things	NPTEL	12	3
4.	10212CS404	Reinforcement Learning	NPTEL	12	3
5.	10212CS405	Responsible & Safe AI Systems	NPTEL	12	3

<table>
<tr><td></td><td>
<table>
<tr><td>6.</td><td>10212CS406</td><td>Deep Learning for Computer Vision</td><td>NPTEL</td><td>12</td><td>3</td></tr>
<tr><td>7.</td><td>10212CS407</td><td>Practical Cyber Security for Cyber Security Practitioners</td><td>NPTEL</td><td>12</td><td>3</td></tr>
<tr><td>8.</td><td>10212CS408</td><td>Software Testing</td><td>NPTEL</td><td>12</td><td>3</td></tr>
</table>
</td></tr>
<tr><td>Discussion</td><td>Chairman presented new Open Elective course to be offered to B.Tech CSE under the regulation VTR UGE 21 during Summer 2024-2025.</td></tr>
<tr><td>Resolution</td><td>The members approved the MOOC courses and course content to be offered under Open Elective & Program Elective Category during the academic year Summer 2024-2025. Course structure and details are available in [Annexure - VI]</td></tr>
<tr><td>39-BoS-6.</td><td>To discuss and approve the new courses under Program Elective category, to be offered in following PG programmes under the regulation VTR PGE 2023 keeping in view of AICTE and National Education Policy (NEP) 2020 and employability skills to be implemented with effect from the academic year 2024-2025
1. M. Tech Computer Science and Engineering
<table>
<tr><th>S.No</th><th>Course Code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>20232CS205</td><td>Natural Language Processing</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
</table>
2. M. Tech Big Data Analytics
<table>
<tr><th>S.No</th><th>Course Code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>20232CS205</td><td>Natural Language Processing</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>2</td><td>20232CS212</td><td>Data Science</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
</table>
</td></tr>
<tr><td>Discussion</td><td>Chairman presented new Program Elective course offered to M.Tech Big Data analytics and M. Tech Computer Science and Engineering under the regulation VTR PGE 2023 during Summer 2024-2025.
Dr. Sarma Venkataraman suggested to swap unit 3 and unit 4 and change the name of Unit 3 as ML Models and suggested to include PCA inference in unit 5 of the course Data Science, in the course Natural Language Processing experts suggested to add transformers and auto encoders topics under unit 5</td></tr>
<tr><td>Resolution</td><td>Experts' suggestions are well taken. The Program Elective Course to be offered during the Summer 2024-2025 was approved. Course Content is available in [Annexure-VII]</td></tr>
<tr><td>39-BoS-7.</td><td>To discuss and approve the courses to be offered in Online MOOCs platforms <u>under Independent Learning Category (MOOCs)</u> during the Summer 2024-2025 for PG programmes.</td></tr>
<tr><td>Discussion</td><td>Chairman presented the courses to be offered in Online MOOCs platforms under Independent Learning Category (MOOCs) during the Summer 2024-2025 for PG programmes.</td></tr>
<tr><td>Resolution</td><td>Experts approved the courses to be offered in Online MOOCs platforms under Independent Learning Category (MOOCs). Course Content is available in [Annexure-VIII & XI]</td></tr>
<tr><td>C</td><td>Items to be Ratified</td></tr>
<tr><td>39-BoS-8.</td><td>Ratification of courses offered by <u>Industry Experts</u> for B.Tech CSE for <u>Skill enhancement and Employment opportunities</u> under Industry/Higher Institute Interaction Learning Category during the Winter Semester of academic year 2023-2024 for B.Tech CSE</td></tr>
</table>

Discussion	The Chairman presented the courses offered by Industry Experts for B.Tech CSE for Skill enhancement and Employment opportunities under Industry/Higher Institute Interaction Learning Category during the Winter Semester of academic year 2023-2024 for B.Tech CSE
Resolution	Experts ratified the courses offered by Industry Experts during the Winter 2023-2024 for B.Tech(CSE). Course Content is available in [Annexure-X]
39-BoS-9.	Ratification of **Value added Courses** offered during the Winter Semester of academic year 2023-2024 for B.Tech CSE programme.
Discussion	The Chairman presented the Value added Courses offered for B.Tech CSE under the regulation VTR UGE 21 during Winter 2023-2024
Resolution	Experts ratified the **Value added Course** offered during the Winter 2023-2024 for B.Tech(CSE). Course Content is available in [Annexure-XI]
39-BoS-10.	Any other cognate item Chairman said that Institute is in process of changing the regulation and curriculum structure of the B.Tech programmes and requested the members to give their valuable suggestions in the forthcoming Next Meeting is Tentatively scheduled in the month of December 2024.

ANNEXURE - I

Vel Tech

HOD CSE Vel Tech, Chennai <hodcse@veltech.edu.in>

Minutes of 38th BOS Meeting Regarding

3 messages

HOD CSE Vel Tech, Chennai <hodcse@veltech.edu.in> Tue, Jul 9, 2024 at 10:57 AM
To: Debasis Samanta <debasis.samanta.iitkgp@gmail.com>, SarmaV <Sarma6019@gmail.com>, Arish Pitchai <arish.p@gmail.com>, beniston.j@outlook.com

Dear Sir,

Kindly refer to the Minutes of the 38th Board of Studies for the department of B.Tech(Computer Science & Engineering), M.Tech(Computer Science and Engineering), M.Tech(Big Data Analytics) & M.Tech(Network Engineering) that was held on 09.12.2023 for your kind perusal.

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Thanks & Regards ,

Dr M. S. Murali Dhar M.E, Ph.D
Associate Professor & Head, Department of Computer Science & Engineering
School of Computing
Vel Tech Rangarajan Dr.Sagunthala
R&D Institute of Science and Technology
(Deemed to be University)
400 feet Outer Ring Road, Avadi,
Chennai-600 062, Tamil Nadu, India
Mobile No : 8925830393
e: hodcse@veltech.edu.in
w: www.veltech.edu.in

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

38th BoS Minutes-ver1.0-09.12.2023.pdf
4643K

ANNEXURE – II

To review the Action Taken Report on the minutes of the 38th meeting of the Board of Studies

Item No	Item	Decision taken	Action Taken
ITEMS FOR DISCUSSION AND APPROVAL			
38-BoS-3	To discuss the stakeholders feedback on curriculum of B.Tech CSE taken for the academic year 2022-2023 The Chair presented the Feedback on curriculum received from various stake holders and action taken with respect to feedback.	Experts reviewed the feedback and suggested that percentage of weight shall be given to stakeholders' feedback and based on that analysis shall be done	The members suggestion are considered
38-BoS-4	To discuss and approve the existing curriculum structure of B.Tech CSE under the Regulation VTR UGE 2021 for program core courses required for CSE students to be implemented with effect from the academic year Winter 2023-2024.	The members approved the proposed curriculum structure of B.Tech CSE under the Regulation VTR UGE 2021 for program core courses with effect from Winter Semester Academic Year 2023 – 2024.	Proposed Courses will be offered with effect from the Academic Year 2023-2024
38-BoS-5	To discuss and approve the Program Electives to be offered in various specialization in the existing B.Tech CSE curriculum VTR UGE 2021 keeping in view of NEP 2020 to be implemented with effect from the academic year Winter 2023 - 2024 in view of breadth, depth and employability Skills.	The members approved the courses under Program Elective category for implementation from Academic Year Winter Semester 2023-2024	The proposed course was offered with effect from the Academic Year Winter Semester 2023-2024
38-BoS-6	To discuss and approve the introduction of new Program Elective courses in various domains under Industry Institute Interaction (III) Initiatives collaboration of ATOS in the existing B.Tech CSE curriculum under the regulation VTR UGE 2021 to be implemented with effect from the academic year Winter 2023-2024 in view of employability skills.	The members approved the industry (ATOS) collaborated courses under Program Elective category for implementation from Academic Year Winter Semester 2023-2024	The proposed course was offered with effect from the Academic Year Winter Semester 2023-2024
	To discuss and approve the courses to be offered in Online MOOCs platforms under Open Elective Category for B.Tech CSE under regulation VTR	The members approved the Online MOOCs platforms Courses under Open Elective Category for implementation	The proposed course was offered with effect from the Academic Year Winter Semester 2023-2024

38-BoS-7	UGE 2021 and under Independent Learning for B.Tech CSE under regulation VTU R15 during the Winter 2023-2024.	from Academic Year Winter Semester 2023-2024	
38-BoS-8	To discuss and approve the course structure and course contents of Program Core and few Program Electives of following PG programmes under the regulation VTR PGE 2023 keeping in view of AICTE and National Education Policy (NEP) 2020 and employability skills to be implemented with effect from the academic year 2023-2024 1. M.Tech Computer Science and Engineering 2. M.Tech Big Data Analytics 3. M.Tech Network Engineering	The members approved the courses under Program Core and Program Elective category for implementation from Academic Year Winter Semester 2023-2024	The proposed course was offered with effect from the Academic Year Winter Semester 2023-2024
38-BoS-9	To discuss and approve the courses to be offered in Online MOOCs platforms under Independent Learning Category (MOOCs) during the Winter 2023-2024 for PG programmes.	The members approved the Online MOOCs platforms Courses under Open Elective Category for implementation from Academic Year Winter Semester 2023-2024	The proposed course was offered with effect from the Academic Year Winter Semester 2023-2024
38-BoS-10	To discuss and approve the following new course and the course contents under Open Elective – General Engineering Category to be offered during Winter Semester 2023-2024 for B.Tech(CSE) under regulation VTR UGE 21 in view of Skill enhancement and Employability suggested by Genpact Industry, Chennai.	The members approved the courses under Open elective - General Engineering category for implementation from Academic Year Winter Semester 2023-2024	The proposed course was offered with effect from the Academic Year Winter Semester 2023-2024
38-BoS-11	To ratify the Program Core courses and Program Elective courses offered in the following PG programmes under the regulation VTR PGE 2023 implemented with effect from the academic year Summer 2023- 2024, keeping in view of National Education Policy (NEP) 2020, AICTE,	The members approved the courses under Program Core and Program Elective courses category for implementation from Academic Year Winter Semester 2023-2024	The ratified course was offered with effect from the Summer Semester 2023-2024

	employability and research foundations 1. M.Tech Computer Science and Engineering 2. M.Tech Big Data Analytics		
38-BoS-12	To ratify the course and the course contents under Open Elective – General Engineering Category offered during Summer Semester 2023-2024 for B.Tech(CSE) under regulation VTR UGE 21	Experts ratified the Open Elective Course offered during the Summer 2023-2024 for B.Tech(CSE)	The ratified course was offered with effect from the Summer Semester 2023-2024
38-BoS-13	Ratification of courses offered by Industry Experts for B.Tech CSE for Skill enhancement and Employment opportunities under Industry/Higher Institute Interaction Learning Category during the Summer Semester of academic year 2023-2024 for B.Tech CSE	Experts ratified the courses offered by Industry Experts for B.Tech(CSE) for Skill enhancement and Employment opportunities under Industry/Higher Institute Interaction Learning Category during the Summer semester of academic year 2023-2024 for B.Tech(CSE)	Experts ratified the Value added Course offered during the Summer 2023-2024 forB.Tech(CSE)
38-BoS-14	Ratification of Value added Courses offered during the Summer 2023-2024 for B.Tech CSE programme	Experts ratified the **Value added Course** offered during the Summer 2023-2024 for B.Tech(CSE)	Experts ratified the Value added Course offered during the Summer 2023-2024 forB.Tech(CSE)

Annexure - III

To discuss the stakeholders feedback on curriculum of B.Tech CSE taken for the academic year 2023-2024

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Faculty Feedback on Curriculum 2023-2024

PROGRAM ELECTIVE

1. Recommended to include courses like System Programming.
2. Proposed to include courses like Generative AI, Explainable AI,
3. Suggested incorporating Robotic Process Automation (RPA) into the curriculum.
4. Recommended to include interdisciplinary courses to the curriculum.
5. Suggested to include the courses like Cyber Security, Forensics, and Natural Language Processing, and Computer Vision with practical components.

INDEPENDENT LEARNING

1. Proposed to include Prompt Engineering, Responsible AI, Quantum AI, Ethics AI, and Edge AI.
2. Recommend to include Cloud Computing, Cloud with IoT

INDUSTRY / HIGHER INSTITUTE LEARNING INTERACTION (IHL)

- Recommended to include courses like Data Analytics and Fundamentals of MEMS
- Suggested to offer cognitive computing Application.

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Action Taken: Academic Year 2023-2024 Curriculum Feedback

Based on the faculty feedback analysis few courses were introduced and some courses were revised in the curriculum under various category:

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Introduction to System Programming z/OS commands and Panel on IBMZ	Program Elective	39th BOS 13-07-2024
2	Generative AI	Program Elective	39th BOS 13-07-2024
3	Cyber Security	Program Elective	39th BOS 13-07-2024
4	Forensics in Cyber Security	Program Elective	39th BOS 13-07-2024
5	Computer Vision	Program Elective	39th BOS 13-07-2024
6	Natural Language Processing	Program Elective	39th BOS 13-07-2024
7	Programming for Data Analytics	Industry / Higher Institute Learning Interaction	39th BOS 13-07-2024
8	Fundamentals of MEMS	Industry / Higher Institute Learning Interaction	39th BOS 13-07-2024
9	Cognitive Computing and Applications	Industry / Higher Institute Learning Interaction	39th BOS 13-07-2024

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Employer Feedback on Curriculum 2023-2024

The employer are the most important stakeholders of B. Tech Computer Science and Engineering Programme. Suggestions collected in the form of structured feedback from the Employers. Received 10 employer's feedback on curriculum and the major suggestions are listed below:

1. Suggested to include courses which focuses on Machine Learning concepts into the curriculum.
2. Recommended to include courses such as Azure Fundamentals.
3. Recommended students to gain knowledge in various Data Visualization Techniques and Generative AI.
4. It is essential for students to develop a strong understanding of Software Development and Programming Fundamentals, as well as design patterns and best practices.
5. Students should become expertise in Excel, SQL, and programming languages such as Python.
6. Students should develop their communication and interpersonal skills.
7. Proficient in the fundamental aspects of Cyber Security, including principles, threat analysis, and incident response.

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Action Taken: Academic Year 2023-2024 Curriculum Feedback

Based on the employer feedback analysis few courses were introduced and some courses were revised in the curriculum under various category:

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Machine Learning	Program Elective	39th BOS 13-07-2024
2	Azure Fundamentals	Program Elective	39th BOS 13-07-2024
3	Data visualization techniques	Program Elective	38th BOS 09.12.2023
4	Generative AI	Program Elective	39th BOS 13-07-2024
5	Cyber security	Program Elective	39th BOS 13-07-2024

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Students Feedback on Curriculum 2023-2024

The students are the most important stakeholders of B. Tech Computer Science and Engineering Programme. In the academic year 2023-2024, suggestions collected in the form of structured feedback from B. Tech CSE students. Received twenty-nine student's feedback on curriculum and the major suggestions are listed below:

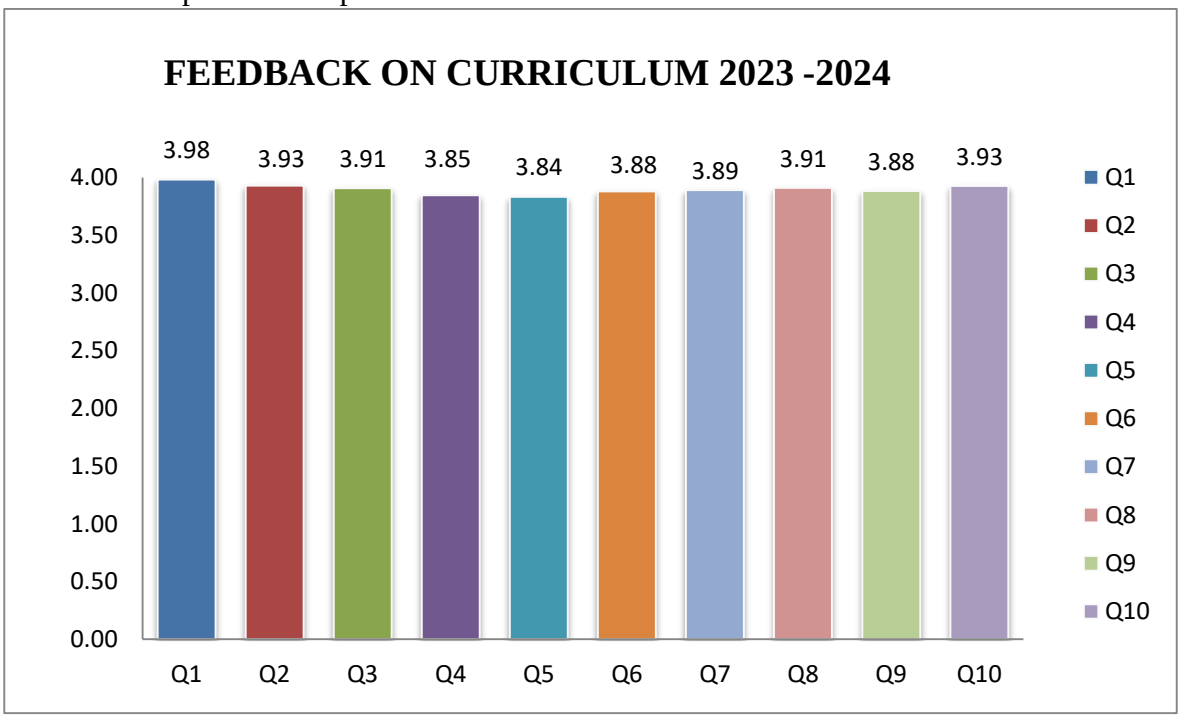
- Requested for new courses like Generative AI, Responsible AI, Prompt engineering courses.
- Suggested to conduct Slip tests for all the subjects every week.
- Asked for new courses like Mobile Development AI, Quantam AI, Edge AI, Explainable AI, Natural Language processing, Prompt engineering, Generative AI.
- Suggested to incorporate courses that teach highly sought-after skills
- Recommended courses on Parallel Processing Compiler and coding concepts.
- Suggested to conduct frequent test and provide official YouTube links for main concepts.
- Requested for courses related to Cloud Computing, Augmented Reality and Virtual Reality, Cyber Security, Cyber Forensics, Computer Vision, Blockchain technology, Data Analytics, Ethical Hacking.

The following questions are given to the students about feedback on curriculum and the response is mentioned in the below graph:

Q1	How do you rate the curriculum offered in relation to the Technological advancements?
Q2	How do you rate the syllabus in related to the needs of industry/society?
Q3	How do you rate the relevance of the courses for providing employability?
Q4	Did the course curriculum intellectually motivate you?
Q5	Was the course curriculum fulfilling your expectations?
Q6	How much has your experience at this curriculum contributed to your job-related knowledge and skills?
Q7	Does the syllabus create any interest to pursue post-graduation/research in the particular subject?
Q8	We're reading material and references regarding curriculum / subject easily found?

Q9 How do you rate the objectives stated for each of the courses

Q10 How do you rate the syllabus of the courses that you have studied in relation to the competencies expected out of the courses?



The above feedback analysis, students given 3.84/4 rating for Q5 i.e., Was the course curriculum fulfilling your expectations. Students are highly satisfied with the curriculum offered in relation to the Technological advancements(3.98/4) and the ratings for the syllabus in related to the needs of industry/society(Q2) and the syllabus of the courses that you have studied in relation to the competencies expected out of the courses(Q10) are (3.93/4), also rated the relevance of the courses for providing employability (3.91/4).

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Action Taken: Academic Year 2023-2024 Curriculum Feedback

Based on the student feedback analysis few courses were introduced and some courses were revised in the curriculum under various category

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Generative AI	Program Elective	39th BOS 13-07-2024
2	Cyber Security	Program Elective	39th BOS 13-07-2024
3	Forensics in Cyber Security	Program Elective	39th BOS 13-07-2024
4	Computer Vision	Program Elective	39th BOS 13-07-2024
5	Natural Language Processing	Program Elective	39th BOS 13-07-2024
6	Virtual and Augmented Reality	Program Elective	39th BOS 13-07-2024
7	Block Chain Technology	Program Elective	39th BOS 13-07-2024
8	Ethical Hacking	Program Elective	39th BOS 13-07-2024

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Summary on Alumni Feedback on Curriculum 2023-2024

The Alumni are one of the stakeholders of B. Tech CSE Programme. In the academic year 2023-2024, suggestions collected in the form of structured feedback from B. Tech CSE Alumni Received 221 Alumni feedback on curriculum and the major suggestions are listed below:

- More Hours can be planned for Coding practices for students can be allotted so that they will be well versed with the company needs
- Data Structures and Algorithms can be separated as two subjects and more basics can be given to students
- Now Companies are expecting more security related courses. It better to add Network security, Cyber Forensics courses
- More Video Sessions can be implemented for better understanding of Concepts
- More Practical oriented courses and real time industry need courses can be added to curriculum
- New Social oriented courses can be added to the existing curriculum which will add more service knowledge to the students
- Java advanced concepts, Angular JS and Reactive JS can be taught to students for better improvement
- Generative AI, and AI related courses can be given to students for better understanding
- Ethical hacking and Block Chain Technology courses may be taught to the Students as companies are more focusing on this topics

- Modern web development tools can be introduced and to be practiced by the students for more knowledge and exposure
- Students can be focused on collaboration of teams and task based projects can be given for better improvement

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Action Taken: Academic Year 2023-2024 Curriculum Feedback

Based on the Alumni feedback analysis few courses were introduced and some courses were revised in the curriculum under various category

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Generative AI	Program Elective	39th BOS 13-07-2024
2	Computer Vision	Program Elective	39th BOS 13-07-2024
3	Forensics in Cyber Security	Program Elective	39th BOS 13-07-2024
4	Computer Vision	Program Elective	39th BOS 13-07-2024
5	Ethical Hacking	Program Elective	39th BOS 13-07-2024
6	Virtual and Augmented Reality	Program Elective	39th BOS 13-07-2024
7	Block Chain Technology	Program Elective	39th BOS 13-07-2024
8	Natural Language Processing	Program Elective	39th BOS 13-07-2024
9	Cyber Security	Program Elective	39th BOS 13-07-2024

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Industry Feedback on Curriculum 2023-2024

The industry are the most important stakeholders of B. Tech Computer Science and Engineering Programme. Suggestions collected in the form of structured feedback from the industries. We have received 10 industries feedback on curriculum and the major suggestions are listed below:

- Recommend to include courses such as Windows Server administration, advanced routing techniques with a focus on security, server technologies, and Database administration.
- Suggested to include Azure Fundamentals courses.
- Suggested to include courses like Office 365 Administration, Microsoft Exchange Server, Middle Technologies and Websphere MQ in curriculum.
- Courses like Development of Application using java GenAI
- Advised to include a course on generative artificial intelligence to increase students' proficiency in such areas.
- Recommend to include courses like Machine Learning.
- Proposed to enhance the curriculum with practical, hands-on projects aligned with current industry trends.
- Focus on soft skills development, including communication, problem-solving, and teamwork, to prepare students for dynamic professional environments.

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Action Taken: Academic Year 2023-2024 Curriculum Feedback

Based on the industry feedback analysis few courses were introduced and some courses were revised in the curriculum under various category:

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Windows Server administration Operating System	Program Elective	38th BOS 09.12.2023
2	Machine Learning	Program Elective	39th BOS 13-07-2024
3	Advanced Routing Techniques and Security	Program Elective	38th BOS 09.12.2023
4	Application Server Technologies	Program Elective	38th BOS 09.12.2023
5	Database Administration using MSSQL Server	Program Elective	38th BOS 09.12.2023
6	Generative AI	Program Elective	39th BOS 13-07-2024
7	Middleware Technologies	Program Elective	39th BOS 13-07-2024
8	WebSphere MQ	Program Elective	39th BOS 13-07-2024
9	Administering Microsoft Exchange Server	Program Elective	39th BOS 13-07-2024
10	Office 365 Administration	Program Elective	39th BOS 13-07-2024

ANNEXURE – IV

To discuss and approve the Program Electives to be offered in various specialization in the **existing B.Tech CSE curriculum VTR UGE 2021** keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills.

S.No	Course Code	Course Name	L	T	P	C
		Theory Courses				
1	10212CS110	Optimization Techniques	3	0	0	3
2	10212CS112	Cyber Security Policy, Law & Ethics*	3	0	0	3
3	10212CS113	Reinforcement Learning	3	0	0	3
4	10212CS119	Cryptography and Network Security	3	0	0	3
5	10212CS121	High Performance Computing	3	0	0	3
6	10212CS122	Cognitive Computing*	3	0	0	3
7	10212CS123	Data Security and Privacy*	2	0	0	2
8	10212CS126	Information Security*	3	0	0	3
9	10212CS127	Introduction to FinTech*	3	0	0	3
10	10212CS128	Financial Accounting	3	0	0	3
		Integrated Courses				
11	10212CS210	Big Data Analytics	3	0	2	4
12	10212CS211	Artificial Intelligence Techniques	3	0	2	4
13	10212CS214	Data Visualization	3	0	2	4
14	10212CS215	Deep Learning	3	1	2	4
15	10212CS216	Natural Language Processing	3	0	2	4
16	10212CS217	Data Science	2	0	2	3
17	10212CS218	Modelling for Data Science*	3	0	2	4
18	10212CS219	Cyber Security	3	0	2	4
19	10212CS220	Animation Engineering	3	0	2	4
20	10212CS221	Game Design	3	0	2	4
21	10212CS222	Virtual and Augmented Reality	2	0	2	3
22	10212CS224	Computer Vision*	3	0	2	4
23	10212CS225	Ethical Hacking	3	0	2	4
24	10212CS226	Secure Coding*	3	0	2	4
25	10212CS228	Blockchain Technology	2	0	2	3
26	10212CS229	IoT and Cloud Computing	3	0	2	4
27	10212CS230	Forensics in Cyber Security*	3	0	2	4
28	10212CS232	Vulnerability Analysis and Penetration Testing*	3	0	2	4
29	10212CS239	3D Character Modeling*	3	0	2	4
30	10212CS243	Mobile Game Development Tools*	3	0	2	4
31	10212CS244	Computer Graphics	3	0	2	4
32	10212CS245	Story Telling*	2	0	2	3

Track: Cyber Security **L-Lecture T-Tutorial P-Practical C-Credits**

S.No	Course Code	Course Name	L	T	P	C
Cyber Security – Core Electives						
1	10212CS219	Cyber Security	3	0	2	4
2	10212CS225	Ethical Hacking	3	0	2	4
3	10212CS230	Digital Forensics*	3	0	2	4
4	10212CS232	Vulnerability Assessment and Penetration Testing*	3	0	2	4
5	10212CS250	Identity Access Management*	3	0	2	4
6	10212CS112	Cyber Security Policy, Law & Ethics*	3	0	0	3
7	10212CS119	Cryptography and Network Security	3	1	0	3
8	10212CS228	Blockchain Technology	2	0	2	3
9	10212CS229	IoT and Cloud Computing	3	0	2	4
10	10212CS226	Secure Coding*	3	0	2	4
Honors						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
11		Disaster Recovery and Business Continuity Planning*	3	0	0	3
12		Computer Security Audit and Assurance*	3	0	2	4
13		Incident Response Management*	3	0	0	3
14		Reverse Engineering & Malware Analysis*	3	0	2	4
15		Social Network Security *	3	0	2	4
16		IoT and Cloud Security	3	0	2	4
17		Artificial Intelligence in Cyber Security*	3	0	2	4

Track: Cloud Infrastructure Management

S.No	Course Code	Course Name	L	T	P	C
1	10212CS251	Virtualization Techniques	2	0	2	3
2	10212CS252	Windows Client Administration Operating System	2	0	2	3
3	10212CS253	Windows Server Administration Operating System	2	0	2	3
4	10212CS254	Cloud Fundamentals using Azure	2	0	2	3
5	10212CS255	Administering Microsoft Exchange Server*	2	0	2	3
6	10212CS256	Office 365 Administration*	2	0	2	3

Track: Network and Server Management

S.No	Course Code	Course Name	L	T	P	C
1	10212CS257	Data Center Hosting – Windows operating System	2	0	2	3
2	10212CS258	Data Center Hosting – Unix operating System*	2	0	2	3
3	10212CS259	Advanced Switching and Networking Techniques	2	0	2	3
4	10212CS260	Advanced Routing Techniques and Security	2	0	2	3
5	10212CS261	Juniper Networking Techniques*	2	0	2	3
6	10212CS262	Storage Management	2	0	2	3

Track: Application Modernization Service

S.No	Course Code	Course Name	L	T	P	C
1	10212CS263	IIS Web Server Technologies	2	0	2	3
2	10212CS264	Application Server Technologies	2	0	2	3
3	10212CS265	Web Sphere Application Server*	2	0	2	3
4	10212CS303	WebSphere MQ*	0	0	2	1
5	10212CS267	Middleware Technologies*	2	0	2	3
6	10212CS268	Database Administration Using MSSQL Server	2	0	2	3
7	10212CS269	Oracle Database Administration *	2	0	2	3

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS218	Modelling for Data Science	3	0	2	4

A. Preamble

Modelling is the process of applying statistical analysis to a dataset. A statistical model is a mathematical model of observed data. This course applies statistical models to the data by investigating, understanding and interpreting the information more strategically. Rather than sifting through the raw data, this practice allows the students to identify the relationships between variables, make predictions about future sets of data, and visualize the data so that non-analysts and stakeholders can consume and leverage it.

B. Prerequisite Course

10210MA103- Probability, Statistics and Queuing theory

C. Course Objectives

Learners are exposed to:

- Apply statistical methods to hypotheses testing and inference problems.
- Interpret the results in a way that addresses the question of interest.
- Use data to make evidence-based decisions that are technically sound.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Apply fundamental statistical modeling techniques to interpret linear regression model	K3
CO2	Perform least square procedure to find the best fit for set of data points	K3
CO3	Build interference in Linear regression to fit a linear equation to observed data	K3
CO4	Analyze the linear regression and predict the data through R studio	K3
CO5	Apply the Regression analysis and investigate the assumptions made about the data and the model	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1									3	3	
CO2	3	3	3	3	3	1	1	1	1	1			3	3	
CO3	3	3	3	3	3	1	1	1	1	1			3	3	
CO4	3	3	3	3	3	1	1	1	1	1			3	3	
CO5	3	3	3	3	3	1	1	1	1	1			3	3	

3-High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Statistical Models **L-9Hours**

Frameworks and Goals of Statistical Modelling - The Assumption of Concept Validity - The Linear Regression Model - Matrix Representation of the Linear Regression Model - Assumptions of Linear Regression - The Appropriateness of Linear Regression - Interpreting the Linear Regression Model I - Interpreting the Linear Regression Model II

Unit 2 Linear Regression Parameter Estimation **L-9Hours**

Introduction to Least Squares - Linear Algebra for Least Squares - Deriving the Least Squares Solution - Regression Modelling in R: a First Pass - Justifying Least Squares: The Gauss-Markov Theorem and Maximum Likelihood Estimation - Sums of Squares and Estimating the Error Variance - The Coefficient of Determination - The Problem of Non-identifiability - Regression Modelling in R: a Second Pass

Unit 3 Inference in Linear Regression **L-9Hours**

Motivating Statistical Inference in the Linear Regression Context - The Sampling Distribution of the Least Squares Estimator - T-Tests for Individual Regression Parameters - T-Tests in R - Motivating the F-Test: Multiple Statistical Comparisons - The F-Test - The F-Test in R - Confidence Intervals in the Regression Context

Unit 4 Prediction and Explanation in Linear Regression Analysis **L-9Hours**

Differentiating Prediction and Explanation - Point Estimates for Prediction - Interval Estimates for Prediction - Making Predictions Using Real Data in R - When Prediction Goes Wrong - Defining Causality

Unit 5 Regression Diagnostics **L-9Hours**

Linear Regression Diagnostic Methods - Violations of the Linearity Assumption - Violations of the Independence Assumption - Violations of the Constant Variance Assumption - Violations of the Normality Assumption - Diagnostics in R

Total: 45 Hours

G. Laboratory Experiments

Part - 1

Task 1	Implement the Linear Regression model to predict the salary. Consider the dataset with the following attributes i)Year of experience ii)Qualification iii)Salary. **Tool: Python**
Task 2	Implement the Linear Regression model to predict the age of the person. Consider the dataset with the following attributes i)Height ii)Weight iii)Gender **Tool: Python**

Task 3	Do a least squares regression with an estimation function defined by use of direct inverse method. **Tools: RStudio, Python**
Task4	Implement the linear regression model that uses a straight line to describe the relationship between the variables. i) Use only one independent variable in simple linear regression ii) Use two or more independent variable in Multiple linear regression **Tools: RStudio, Python**
Task5	Perform the test in statistics by use of t.test () in R, to determine the means of two groups are equal to each other in normal distribution **Tools: RStudio, Python**
Task6	Implement the F-Test in R Programming and calculates the ration between the larger variance and the smaller variance **Tools: RStudio, Python**
Task7	Build a linear regression model to predict that stopping distances of cars on the basis of the speed. **Tools: RStudio, Python**
Task8	Use the predict () function to make predictions from that model on new data. The new dataset must have all of the columns from the training data, but they can be in a different order with different values **Tools: RStudio, Python**
Task9	Implementation of regression diagnostics by using R base functionplot () or the autoplot() function. **Tools: RStudio, Python**
Task10	Conduct the test using R's build in function called Durbin Watson test to check the assumption of independence. **Tools: RStudio, Python**

Part-2
Use Cases:

Use Case 1: I wanted to see if there was a significant linear relationship between the number of fish meals consumed per week and the total mercury levels found amongst fishermen. The dataset used in this analysis is attached as an appendix item at the end of the article. Since we have data between two variables only, I looked at applying a simple linear regression model to the dataset in question.

Let us use the Linear Regression in R to evaluate the extent of a linear relationship between two variables in a dataset using R.

Use Case 2: You're planning a road trip to Las Vegas with two of your best friends. You start off in San Francisco and you know it's going to be a ~9h drive. While your friends are in charge of the party operations, you're in charge of the all the logistics involved. You have to plan every detail: the schedule, when to stop and where, make sure you get there on time.

Prepare a dataset and use Linear Regression in R to find how much money should allocate for fuel? With the attributes of Total Payed, Total Miles.

Total: 30 Hours

Total: 75 Hours

H.Learning Resources

i.Text Books:

1. Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, "*Introduction to Linear Regression Analysis*", Wiley Publication, Fourth edition, 2013
2. Alvin C. Rencher, G. Bruce Schaalje, "*Linear Models in Statistics*", Wiley Publication, Second edition, 2007.

ii.Reference books:

1. James D.Miller, "*Statistics for Data Science*", Packt Publishing, 2017.

iii.Online References:

1. "Statistical Modelling for Data Science Applications Specialization", by coursera https://www.coursera.org/specializations/statistical-modeling-for-data-science-applications

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS224	Computer Vision	3	0	2	3

A. Preamble

This course offers broad area of computer vision algorithms, methods and concepts which will enable the student to implement computer vision systems with emphasis on applications and problem solving. Students will learn principles of image processing algorithms, image segmentation/classification techniques, 3D vision and 3D motion.

B. Prerequisite Courses

10212CS223 –Machine Learning Techniques

C. Course Objective

Learners are exposed to:

- Apply statistical methods to hypotheses testing and inference problems.
- Interpret the results in a way that addresses the question of interest.
- Use data to make evidence-based decisions that are technically sound

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Apply filters and edge detection techniques to process the images	K3
CO2	Use though transform for line and object detection	K3
CO3	Perform various segmentation techniques on images	K3
CO4	Implement known methods to process 2D images to obtain 3D representations.	K3
CO5	Explore state-of-the-art techniques for digital video processing	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3		3								3		
CO2	3	3	3		3								3		
CO3	3	3	2		3								3		
CO4	3	3	2		3								3		
CO5	3	3	3		3								3		

3 -High, 2 – Medium, 1-Low

F. Course Contents

Unit 1 Introduction To Computer Vision **L-9 Hours**

Introduction to Computer Vision, Fundamentals of Image Formation - Camera ImagingGeometry – Camera Calibration – Color Representations - Linear Filters and Convolution (Discrete/Continuous) – Gradient-Based Edge Detection - Vector Quantization and Textons – Synthesis by Sampling Local Models - Binocular Camera Geometry and the EpipolarConstraint

Unit 2 Hough Transform **L-9Hours**

Line detection – Hough Transform (HT) for line detection – The Foot-of-Normal Method - RANSAC for straight line detection – HT based circular object detection – Unknown Circle Radius – speed problem – ellipse detection

Unit 3 Image Segmentation And Classification **L-9Hours**

Shot Boundary Detection - Interactive Segmentation - Forming Image Regions - TheWatershed Algorithm - Segmentation Using K-means - Encoding Layout with GIST Features -Summarizing Images with Visual Words - The Spatial Pyramid Kernel - Classifying images ofsingle objects

Unit 4 3D Vision **L-9 Hours**

Methods for 3D vision - Projection Schemes - Shape from Shading - Photometric Stereo – The Assumption of Surface Smoothness - Shape from Texture – Horaud's Junction Orientation Technique - 3D object recognition – Multiple View Vision

Unit 5 Digital Video Processing **L-9Hours**

Video Sampling and Interpolation, Motion Detection and Estimation, Video Enhancement and Restoration, Video Quality Assessment, Video Segmentation, Motion Tracking, Video Surveillance

Total: 45 Hours

G. Laboratory Experiments **Total: 30 Hours**

Part - 1

Task 1 Implement the linear and non-linear calibration algorithm.
Tool: python

Task 2 Using the given spectra data set, fit a finite-dimensional linear model to a set of illuminants and surface reflectances using principal components analysis, render the resulting models, and compare your rendering with an exact rendering.
Tool: python

Task 3 Detect the edges of the given image using gradient-based approach.
Tool: python

Task4 Use k-means clustering algorithm to do vector quantization.
Tool: python

Task5 Implement the non-parametric texture synthesis algorithm. Use your implementation to study:

(a) the effect of window size on the synthesized texture;

(b) the effect of window shape on the synthesized texture; and

(c) the effect of the matching criterion on the synthesized texture (i.e., using a weighted sum of squares instead of a sum of squares, etc.).
Tool: python

Task6 Implement a mean shift segmenter.
Tool: python

Task7 Implement the two version of graph-based segmenter discussed in the lecture hours. Use your graph-based segmenter to build an interactive segmentation system.
Tool: python

Task8 Build a classifier that classifies materials using the given dataset. Compare the performance of your system using the main feature constructions described here (GIST features; visual words; spatial pyramid kernel). Investigate the effect of varying the feature construction; for example, is it helpful to use C-SIFT descriptors?
Tool: python

Task9 Implement photometric stereo for the given set of similar images.
Tool: python

Task10 Perform 3D object detection using ZED SDK.
Tool: python

Task11 Process the 2D image to obtain a 3D image representation.
Tool: python

Task12 For a moving object, detect its motion and track it using python and OpenCV. **Tool: python**

Task13 Compute the depth map of a given image programmatically
Tool: python

Task14 Implement a Bayesian Model for optimizing the Video Quality.
Tool: python, OpenVeno

Part-2 Use Cases:

Use case 1: Human Iris Location for determining the gaze direction.

Use case 2: Face detection and recognition for security applications.

Use case 3: Surveillance in transport to monitor traffic and people.

Use case 4: Application of Computer Vision in Visual Hulls: Tracing Intersection Curves,Clipping Intersection Curves, Triangulating Cone Strips, Carved Visual Hulls.

Total: 75 Hours

H. Learning Resources

i. Text Books:

1. David A. Forsyth, Jean Ponce, "*Computer Vision - A Modern Approach*", Pearson Education, Second Edition, 2003 (UNIT I, III)
2. E. R. Davies , "*Computer Vision: Principles, Algorithms, Applications, Learning*", Academic Press, Fifth Edition, 2018 (UNIT II, IV)
3. Alan C Bovik, "*The Essential Guide to Video Processing*", Academic Press, Second Edition, 2009 (UNIT V)

ii. Reference Books:

1. Richard Szeliski, "*Computer Vision: Algorithms and Applications*", Springer-VerlagLondon Limited, 2011
2. Simon J. D. Prince, "*Computer Vision - Models, Learning, and Inference*", CambridgeUniversity Press, 2012

iii. Online Resources:

1. Computer Vision, onlinecourses.nptel.ac.in/noc21_ee23/preview, 2021 [Online]

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS276	Generative AI	1	0	2	2

A. Preamble

The Generative AI course introduces students to the principles and applications of deep learning, focusing on generative models. The course covers the rise of deep learning, large language models (LLMs), prompt engineering, Langchain, and diffusion models. It integrates theoretical knowledge with practical lab exercises to enhance learning and application.

B. Prerequisite Courses

Machine Learning Techniques

C. Course Objectives

Students will be able to:

- Understand the fundamentals of deep learning and its applications. (K2)
- Describe large language models and their architectures. (K1)
- Apply principles and techniques of prompt engineering. (K3)
- Explore Langchain and its components. (K3)
- Explain diffusion models and their use in generative AI. (K2)

D. Course Outcomes

Upon successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Comprehend the fundamentals and rise of deep learning	K2
CO2	Apply knowledge of large language models in various NLP tasks	K3
CO3	Develop and utilize prompt engineering techniques	K3
CO4	Implement Langchain architecture for generative AI applications.	K3
CO5	Apply diffusion models to progressively refine noise into high-quality images and videos	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program Outcomes and Program Specific Outcomes

3- High; 2-Medium; 1-Low

CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3		2	1								3		1
CO 2	3	3	3	2	2								3	2	2
CO 3	1	2	3	2	3								1	2	2

CO 4	1	2	2	2	3								1	1	2
CO 5	3	3	2	2	3								3		2

F. Course Contents

Unit I: Rise of Deep Learning — L - 3 Hours

AI vs ML vs DL, Need for DL, Power of Neural Networks, Tools for sequence models: RNNs, Transformers, attention, Deep vision by CNNs, Deep Generative Modeling, Responsible and ethical use of Deep Learning tools.

Unit II: Large Language Models (LLMs) — L - 3 Hours

History of NLP, Tokenization and embeddings, Positional encoding of Transformers, Text generation process, LLM model architecture: BERT, GPT, Training LLMs: Base, Instruction Tuned, Fine Tuning, Limitations of LLMs, API calling of OpenAI, Hugging Face, Google, Meta models.

Unit III: Prompt Engineering — L - 3 Hours

System-user-assistant format, Principles of prompting, chaining prompts, using delimiters to avoid prompt injections, Iterative prompt development, Zero and few shots prompting, Chain-of-thoughts prompting, Program-aided language prompting, ReAct prompting, Building a chatbot using prompt engineering (use cases: healthcare, education, e-commerce).

Unit IV: Langchain — L - 3 Hours

Langchain architecture, LangChain Expression Language (LCEL), Runnable interface, Chat models, Prompt templates, Example selectors, Output parsers, Chat history, Document loaders, Text splitters, embedding models, Vector stores, Retrievers, Agents, Callbacks, RAG using langchain and chromadb.

Unit V: Diffusion Models — L - 3 Hours

Variational Autoencoder, Generative Adversarial Networks, Diffusion Process: Forward Noising, Reverse Denoising, Stable Diffusion models, U-Net, Text encoder, Video generation, generating images from natural language using Hugging Face API, Beyond images: molecular design

G. Laboratory Experiments (30 Hours)

Task 1	Introduction to Python & NLP, familiarizing with NLTK and Transformers. **Tools:** Python, NLTK, Transformers
Task 2	Create a text generator using any Hugging Face LLM that can generate realistic sentences or paragraphs. **Tools:** Python, Hugging Face Transformers
Task 3	Build a language translation tool using an LLM that can translate given text from one language to another with high accuracy. **Tools:** Python, Hugging Face Transformers
Task 4	Create a sentiment analysis tool that can analyze the sentiment of text data and classify it as positive, negative, or neutral. **Tools:** Python, Hugging Face Transformers
Task 5	Develop a text summarization tool that can generate concise summaries of long articles and documents. **Tools:** Python, Hugging Face Transformers

Task 6	Create a recipe generator that can generate new and unique recipes based on user preferences and dietary restrictions. **Tools:** Python, Hugging Face Transformers
Task 7	Develop a legal research tool that can search and retrieve relevant case details from the database based on user queries. **Tools:** Python, Hugging Face Transformers
Task 8	Develop a story generator using any Hugging Face LLM that can generate creative and engaging storylines and plot twists. **Tools:** Python, Hugging Face Transformers
Task 9	Build a painting generator using a model like Stable Diffusion that can create unique oil paintings. **Tools:** Python, Stable Diffusion, TensorFlow
Task 10	Develop a logo generator using a model like Stable Diffusion that can create unique and professional logos for businesses or organizations. **Tools:** Python, Stable Diffusion, TensorFlow
Task 11	Develop a program that generates random modern Disney-style avatars or character images with different facial features, hairstyles, and accessories. **Tools:** Python, Stable Diffusion, TensorFlow

Part – 2

Use Cases:

Use Case 1: Generate Cricket Match Summaries
Use Case 2: Automated Art Creation for E-commerce
Use Case 3: Interactive Storytelling for Children's Education
Use Case 4: Brand Identity Creation for Startups
Use Case 5: Personalized Recipe Suggestions for Health Apps

H. Learning Resources

i. Text Books:

1. Foster D, *et al*. “Generative deep learning ", O'Reilly Media, Inc, 2022.
2. Dhamani N, *et al.* “Introduction to Generative AI”, Simon and Schuster, 2024.
3. Phoenix J, Taylor M. “Prompt Engineering for Generative AI”, O'Reilly Media, Inc, 2024.
4. Omar Sanseviero, *et al*. “Hands-On Generative AI with Transformers and Diffusion Models”, O'Reilly Media, Inc, 2024.

ii. Reference Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville. "Deep Learning", 2021.
2. Delip Rao and Brian McMahan, "Natural Language Processing with Transformers", 2021.
3. David Foster. "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play", 2020.

iii. Online References:

“Generative AI with Large Language Models” (online): Coursera.
“Generative AI and Language Models” (online): NPTEL.

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS230	FORENSICS IN CYBER SECURITY	3	0	2	4

A.Preamble

This course will address methods to properly conduct a computer forensics investigation. It includes digital evidence collection and evaluation of network and host system intrusions with hands-on use of powerful forensic analysis tools.

B.Prerequisite Courses

10211CS130 – Fundamentals of Computer Networks
10211CS103- Operating systems

C.Course Objectives

Learners are exposed to

- Introduction to Digital Forensics and Evidences
- Network Forensics
- Forensic Approaches and Forensic Duplication
- Digital Forensic Tools
- Incident Response

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Outline and Explore the fundamentals of cyber forensic analysis.	K2
CO2	Infer and conduct basic network forensic analysis	K3
CO3	Classify the evidence acquisition and forensics duplication	K2
CO4	Evaluate and validate the types of Forensic tools	K2
CO5	Detect cyber security incidents and its response	K2
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	1		1									2		
CO2	1	1	1	1	1	1		1					2		
CO3	1	2				2		3				2		2	
CO4	2		2		2							1			2
CO5		3		3	3				2						

3 -High, 2 – Medium, 1-Low

F. Course Outcomes

Unit 1 Forensic Science **L-9 Hours**

Principles and Methods: Scientific approach to Forensics, Identification and Classification of Evidence, **Location of Evidence:** Storage Media, Hard drives, Hardware Interfaces, RecoveringData, Media File Forensic Steps-**Forensic Analysis:** Planning, Case Notes and Reports, QualityControl.

Unit 2 Network Forensic **L-9 Hours**

Network forensics overview-Securing a Network- Developing procedures for network forensics-Investigating virtual networks-Examining Honeynet projects-E-mail Investigations: Role of client and server in E-mail, Investigating E-mail crimes and violations, E-mail Servers, E-mail Forensic tools.

Unit 3 Digital Forensic Approaches and Forensic Duplication **L-9 Hours**

Introduction - Policy and Procedure Development - Evidence Assessment Evidence Acquisition - Evidence Examination - Documenting and Reporting - **Introduction to Forensic Duplication** - Rules of Forensic Duplication (Thumb Rule) - Necessity of Forensic Duplication - Forensic Duplicates as Admissible Evidence - Important Terms in Forensic Duplicate - Forensic Duplication Tool Requirements - Creating a Forensic Duplicate of a Hard Drive - Creating a Qualified Forensic Duplicate of a Hard Drive.

Unit 4 Forensics Tools **L-9 Hours**

Evaluating Forensics Tool Needs- Tasks performed by forensics tools- **Forensics Software Tools:** Command-line forensic tools, Linux forensic tools- **Forensics Hardware Tools:** Forensic work station, Write-Blocker- Validating and Testing Forensics Software.

Unit 5 Incident Response **L-9 Hours**

Incidence Response Goals of Incident Response - People Involved in Incident Response Process - Incident Response Methodology - Activities in Initial Response - Phases after Detection of anIncident - Report Writing and Presentation

Total: 45 Hours

G. Laboratory Experiments **Total: 30 Hours**

Part-1

TASK 1	Study of Computer Forensics and different tools used for forensic investigation
TASK 2	To extract Exchangeable image file format (EXIF) Data from Image Files. **Tool**-Exifreader Software
TASK 3	Forensics Case Investigation using live data **Tool**-Autopsy
TASK4	To Recover Deleted Files using Forensics Tools **Tool**- FTK / File Analyzer
TASK5	To Find Last Connected USB on your system **Tool**- Parse
TASK6	To View Last Activities on Your PC **Tool**- Register Editor / Registry Explorer
TASK7	To analyze network-related incident **Tool**- Wireshark
TASK8	To make the forensic image of the hard drive to find the suspicious activity **Tool**-EnCase
TASK9	To Restore the Evidence Image to find criminal activity **Tool**- EnCase
TASK10	To hide and extract any text file behind an image file/ Audio file using CommandPrompt. **Shell comments / Shell Bags Explorer**
TASK11	To capture the physical memory of a computer and analyze artifacts in memory **Tool**- Magnet RAM Capture
TASK12	To Collect Email Evidence in Victim PC **Tool**-E Mail Analyzer

Part-2

Use cases 1:

You are on-site, conducting a preliminary examination of a Linux system. The hardware suite includes a 56KB modem. What areas of search should be included in your examination? Prepare an examination plan that details what you will look for, and why.

Use cases 2:

You receive a Windows OS X system and are asked to summarize the applications and data on the hard drive. In addition, you are asked to report any recent system usage and any signs of encryption, external storage media, or clock tampering.

Use cases 3:

As a security investigator, you have been asked to determine if company confidential information (intellectual property) has been copied from enterprise computers. Investigationcenters on a particular computer that has shown a high volume of network traffic at unusualtimes. In the course of conducting your investigation you discover that large capacity removable media has been attached to the suspect computer. A preview

examination revealsthat software used for secure deletion had been downloaded to the desktop. Prepare an investigative plan listing the lines of investigation that you plan to pursue.

Use cases 4:

A large accounting MNC company is going to audit certain activities by officers of a medium size, publicly traded bank. During the investigation, the appointed auditor needed to examine several computer systems used by certain Bank employees. After collecting the evidence, the digital forensic examiners were immediately dispatched and sent in to arrange for the formal investigation of those systems to search for corroborating evidence in support of the audit team's suspicions and findings.

Use cases 5:

Discover you have known the existence of threatening e-mails being sent to the CEO of your company at that time predict will you do the examination of the e-mails revealed that they originated from outside of the country? Describe the steps you would take in your investigation. In particular, address the issue of jurisdiction and locating your counterparts in the target country.

H.Learning Resources

i. Text Books:

1. Chuck Eastom,"Certified Cyber Forensics Professional Certification, McGraw Hill, July 2017.(Unit 1)
2. Bill Nelson, Amelia Philips and Chris Steuart, "Guide to Computer Forensics and Investigations",Cengage Learning, 6th Edition, 2019(Unit 2)
3. Greg Gogolin, "Digital Forensics Explained", CRC Press Taylor and Francis Group, 2013 (Unit 3,5)
4. Nilakshi Jain and Dhananjay R Kalbande, "Digital Forensic: The Fascinating World of DigitalEvidences", Wiley Press, 2017 (Unit 4)

ii. Reference Books:

1. Nhien-An Le-Khac, "Security, Privacy, and Digital Forensics in the Cloud" Wiley Press, 2019,ISBN-13: 978-1119053286ISBN-10: 1119053285.
2. Nihad A. Hassan "Digital Forensics Basics A Practical Guide Using Windows OS", ApressPublishers, 2019.
3. Mike Sheward "Digital Forensic Diaries" Secureowl, 2017, ISBN: 9781521514467.
4. Gerard Johansen, "Digital Forensics and Incident Response A practical guide to deploying digital forensic techniques in response to cyber security incidents".

iii. Online References:

1. https://online.norwich.edu/academic-programs/resources/5-steps-for-conducting- computer-forensics-investigations
2. http://resources.infosecinstitute.com/computer-forensics-tools
3. http://www.cybrary.it/course/computer-hacking-forensics-analyst

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS239	3D Character Modelling	3	0	2	4

A. Preamble

3D Character Modelling will be able to transform a concept/idea into a three-dimensional model, with a desire to learn modern character modelling and sculpture workflows. It helps the students to blend the organic and hard surface modelling concepts into a cohesive design with a basic understanding of prop modelling.

B. Prerequisite Course

10211CS220 - Animation Engineering

C. Course Objectives

- Aims to equip students with the fundamental knowledge required for the development of 3D character models for interactive digital environments
- The course also aims to provide practical sessions, to enable students explore the theoretical knowledge and express their ideas as animated 3D Character Models

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Develop a 3D Character model using modeling techniques	K3
CO2	Identify the use of surface modeling concepts in 3D Character modeling	K3
CO3	Use Materials to Improve the Visuals of 3D character	K3
CO4	Build textures for 3D characters	K3
CO5	Apply Rigging and Animation techniques on 3D Character model	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO 3
CO1	2		2		2				1	1					2
CO2	2		2		2				1	1					2
CO3	2		3		2				2	1					2
CO4	2		3		2				2	1					2
CO5	2		3		2				2	1					2

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Modeling L-9 Hours

Introduction to Modeling - 3ds Max/Blender Modeling interface - Poly Modeling – Low poly Vs High Poly– Using Primitives – Modelling with Modifiers – Subdivision Surfaces

Unit 2 Surface Modeling L-9 Hours

Patch Grid – Patch modelling, Compound Objects Modelling – 2D to 3D - 3D to 2D - Introduction to NURBS - NURBS Splines and Surfaces - Working with NURBS Curves and Surfaces - NURBS Curves Modelling - NURBS Surface Modelling

Unit 3 Material Creation L-9 Hours

External References – Objects and Scenes - File Formats - Materials – 2D Maps - 3D Maps - Compositors and Compound Materials – Blend - Composite - Double Sided Materials - Smoothing Polygons - Subdivide Polygons

Unit 4 Texture Mapping L-9 Hours

Working with poly sub-object - modeling a Low poly Character model for Game Design - Creating Texture for object model - UVs and Mapping - Material using UVW Mapping - Unwrap Mapping - UVW Mapping - Edit UVW modifier

Unit 5 Rigging and Animation L-9 Hours

Rigging techniques - Setting Biped Animation for character model - Rendering Techniques – Arnold - Art - Scan line – Ray tracer, Radiosity

Total: 45 Hours

G. Laboratory Experiments Total:30 Hours

Part – 1

TASK 1	**Conceptualizing and creating the storyboard:** a) Prepare a storyboard for a given concept. b) Identify the 3D Character's Properties
TASK 2	For the given 3D animation/Game concept perform the following operation, Use various transformations and modifiers to bring realistic 3D Character. a) Model the Head b) Model the Arms/Legs c) Model the Eyes d) Model the Body **Tool: Blender**

TASK 3	For the developed 3D model perform the following operation, a) Create an image texture to apply on the 3D Character b) Import the texture to the 3D animation tool c) Apply texture on the 3D Character **Tool: Blender**
TASK 4	For the developed 3D character perform the following operation, a) Create Joints - Leg Joints, Arm Joints, Backbone Joints, Head and Neck Joints. b) Setting Up Controls - Leg Controls, Arm Controls, Root and Hip Controls, Shoulder Controls and Neck Control c) Finishing up the Controls d) Finishing up the rig **Tool: Blender**
TASK 5	Animate the 3D character in following way: Moving as a whole object a) Changing their position, b) Orientation or size in time **Tool: Blender**
TASK 6	Animate the 3D character in following way: By Deforming them a) Animating their vertices or control points **Tool: Blender**
TASK 7	Inherited animation • Causing the object to move based on the movement of another object **Tool: Blender**
TASK 8	Render the Animated 3D Model/Character Using following render methods. • Extra Easy Virtual Environment Engine (Eevee) • Blender's physically-based path tracer for production rendering (Cycles) • The Workbench Engine **Tool: Blender**
TASK 9	For the rendered 3D Character perform the following operations. a) Compositing - Assemble video clips together and enhance them b) Motion Tracking & Masking - perform masking and tracking with the Movie Clip Editor **Tool: Blender**
TASK 10	To bring the final output perform the following operations **a)** Add audio and Lip sync to the Developed 3D character **b)** Display result of rendering Sequencer timeline - Sequencer preview **Tool: Blender**

Part - 2

Use Cases:

Use Case 1: A Game Development company requested to model a 3D female character for their 3D car game. As a 3d modeler design and model the 3D character using any 3D modeling tool.

Use Case 2: A film production company needs a 10 years old boy character for a 3D animation movie. As a 3D modeler design and model the 3D character using any 3D modeling tool.

H. Learning Resources

i. Text Books:

1. Bill Culbertson. "3Ds Max Basics; for Modeling Video Game Assets Model, Rig and Animate Characters for Export to Unity or Other Game Engines". CRC Press; 2021

ii. Reference Books:

1. Oliver Villar "Learning Blender: A Hands-On Guide to Creating 3D Animated Characters" Addison-Wesley, 2017

iii. Online References:

1. "Blender: Character Modelling – Easy Beginner's Guide", [Online]. Available: https://all3dp.com/2/blender-2-8-character-modeling-simply-explained
2. "Blender 3D Modeling Tutorials for Beginners: The Ultimate Collection", [Online]. Available: https://conceptartempire.com/blender-modeling-tutorials

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS250	Identity and Access Management	3	0	2	4

A. Preamble

This course focuses on managing and maintaining Identity of the users in an organization and operations. The course helps the learners to understand the access management and role engineering procedures and policies and their applicability over various contexts and situations. The identity and access management's necessity in a cloud environment are also dealt in the course along with its challenges and operations.

B. Prerequisite Courses

10211CS105/10211CS130 – Computer Networks/Fundamentals of Computer Networks

C. Course Objectives

Learners are exposed to

- Understand the basic concepts in identity and access management
- Identify the identity based restrictions created over various organization
- Utilize the access control principles and procedures to get acquainted with role engineering process
- Infer the policies and governance associated with identity and access management
- Identify the necessity of identity and access management in cloud environment

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Understand the concepts and functionalities of identity and access management	K2
CO2	Identify the standards and management of identities in IAM environment	K3
CO3	Utilize the Access management controls and principles for end user access management	K3
CO4	Infer the necessity of Policies and governance in identity and access management	K2
CO5	Identify the importance of Cloud based Identity and access management and its standards	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of Cos with Program Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2													
CO2		2	2	2	3										
CO3		2	2	2	3										
CO4		2	2		3										
CO5		2			3										

High- 3; Medium-2; Low-1

F. Course Contents

Unit 1 Introduction 9 Hours

Cybersecurity and its necessity – Context based Cyber security – Types of Cyber threats - Introduction to Identity and access management - IAM Concepts and terms - IAM Architecture - IAM Operational activities – User Identification, Authentication and Authorization –Roles in identity and access management – Identity vs Access management – Functional aspects of IAM – Key Service Components of IAM – IAM Risks - Drivers for Identity and access management

Unit 2 Identity Management 9 Hours

Digital Identity and ID creation – Identity life cycle - Authentication: Security assertion markup language - Open ID - Open ID Connect Protocol Suite –Types of Digital authentication - Joiner, mover, leaver processes - Authorization: Access control lists - Role based, attribute based and identity based – Active Directory -Lightweight directory access protocol - Open Authentication- Extensible access control markup language –Password Management - Biometrics - Federated identity management - Tomcat Server – DB ServerAuth0 tool – Open VAS tool.

Unit 3 User Access Management 9Hours

User management: Service provisioning markup language - User identity and attribute management -–Role Engineering -Access Control Models: Discretionary access control – Mandatory access control - Role based access control –Rule based access control — Multi factor Authentication - Privileged access management– Provisioning management and its types - Kerberos authentication protocol for access management –Open SSL- Okta access management tool

Unit 4 IAM Policy Management 9 Hours

Policy management in IAM - Types of policies: Identity based policy – Resource based Policy - Session Policy –Admin roles vs IAM policies –Admin and Break glass accounts - Effective Permission Boundaries – Difference between rule and policy - Role of IAM in UEM unified endpoint management –Data governance and protection –Auditing and logging - Compliance and Governance administration.

Unit 5 Identity and access management for Cloud 9 Hours

Cloud Identity and access management - Comparison of Enterprise and Consumer Authentication Standards and Protocols– IAM practices in cloud - Cloud Identity administration: Single Sign on – Federated SSO - Identity management as a service – Cloud Authorization management: Tag based access control - Replication and Disaster recovery – Availability Management in cloud – Access management in AWS Cloud.

Total: 45 Hours

G. Laboratory Experiments **Total: 30 Hours**

Task1: Install and run the tomcat server and DB server and test whether the server is started and running.
Task 2: Create a user identity and manage the credential and its associated vulnerability using green bone security assistant in OpenVAS through Kali Linux Platform.

Task 3: Create and manage keys in 'Openssl' for certificate management including identification of certificate information and verification of SSL through Kali Linux.
Task 4: Create multiple user accounts with its credentials and manage to retrieve those created credentials through the command line interface password cracking built-in tool in Kali Linux and audit the passwords.

Task 5: Implement the firewall rules for access control management and create restrictions for 'services' based on their 'names' and 'port numbers' using kali Linux.
Task 6: Create new user accounts and groups and manage the access control/levels of authorization or ownership between different users under each created groups using kali Linux.
Task 7: Getting administrator rights using Burp Suite.
Authentication Bypass: Getting access to server-side script and changing the password and access the server-side applications.
Task 8: Identity management using Auth0
i) Creation of customer managed policy
ii) Permit users to manage their credentials
Task 9: Delegate access Management across AWS console using following roles.
i) User identity creation
ii)User roles
iii)Admin roles
Task 10: Manage the access on AWS console and add the created users to different user groups based on which access restrictions will be created to other users using attribute-based access control. Check the Permissions of each user created, using 'IAM users' sign in link in AWS console to check the access restrictions over the instances created over S3, EC2 for validating the access restriction.
Task 11: Develop a web application to use Social Login using open Authentication to authenticate
Task 12: Develop a web application to authenticate using SAML protocol by creating an account with Okta and registering SAML application for authentication.

H. Learning Resources

i. Text Books:

1. Ertem O smanoglu, "Identity and Access Management: Business performance through connected Intelligence", Second Edition, Syngress, O'Reilly ISBN: 9780124104334 2013.
2. Tim Mather, Subra Kumaraswamy, ShahedLatif, "Cloud Security and Privacy, An Enterprise perspective on risk and compliance", O'Reilly ISBN: 978-0-596-80276-9, 2017.

ii. Reference Books:

1. Ken Hess, "Unified Endpoint management for Dummies", IBM Limited edition Pearson Education, John Wiley jand Sons, 2017.
2. Atlice Labs, "Identity and Access Management", by Atlice labs Whitepaper, 2017.

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS255	Administering Microsoft Exchange Server	2	0	2	3

A. Preamble

This course provides with the knowledge and skills that are necessary to administer and manage a Microsoft Exchange Server 2016/2019 messaging environment. Specifically, this course will give students the skills to configure and manage Exchange Server organization, recipients, address policies and objects, as well as, perform messaging compliance and auditing. This training will also help students gain an understanding of how to deploy and manage Exchange Online in an Office 365 environment.

B. Prerequisite Courses

10212CS253 - Windows Server Administration Operating System

C. Course Objectives

Students are able to

- Elaborate on the utilization of management tools for the purpose of managing Exchange.
- Learn how to administer and support Exchange Server.
- Learn how to install and configure Exchange Server
- Manage Exchange Online.
- Implement and manage Exchange Online deployments.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Demonstrate the way of deploying and managing Exchange Server, including its architecture, storage, and management tools.	K2
CO2	Identify the recipient object and use cmdlets and scripts for Managing Exchange Servers	K3
CO3	Make use of Exchange Server to configure, manage and restore client access, outlook and mobile messaging services.	K3
CO4	Utilize Exchange Server to configuring and managing messaging transport services, Antivirus and AntiSpam solutions.	K3
CO5	Apply security in Microsoft Exchange Server by using RBAC.	K2
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	3		1		3					2	3	2			2
CO2	3		1	2	3					2	3	2			2

CO3	**3**		**1**		**3**				**2**	**2**	**3**	**2**			**2**
CO4	**3**		**1**		**3**					**2**		**2**			**2**
CO5	**3**		**1**		**3**			**2**	**2**			**2**			**2**

High- 3; Medium-2; Low-1

F. Course Contents

UNIT I Deploying and Managing Exchange Server **L-6**

Exchange Server: Overview- requirements-Architecture-Management Tools-Pros and cons. Deploying: Management Tools. Exchange Storage: Overview- architectures, Mailbox databases: Creation- properties.

UNIT II Managing recipients and Exchange servers **L-6**

Recipient objects: Management of user mailboxes- Types: User- Linked- Microsoft 365/Office 365- - Resource- System mailboxes, Distribution groups, Exchange Management Shell: Overview -Exchange Server using cmdlets and scripts.

UNIT III Implementing client connectivity **L-6**

Exchange Server: Management of client access services- Client Connectivity - Outlook on the web- mobile messaging, Managing high availability: Mailbox Databases-Client Access Services. Disaster Recovery: Server Backup-Server Recovery.

UNIT IV Configuring and managing message transport **L-6**

Message transport: Overview- Transport rules: components- properties- Rule storage and replication, Message security: Edge Transport server: Internet mail flow- Mail flow rules, AntiVirus- AntiSpam.

UNIT V Monitoring and troubleshooting **L-6**

Monitoring - Troubleshooting, Securing: Audit Logging, Using RBAC: Overview- Requirements- Service Principals- Application Roles, Exchange Online and Office365: Overview - Migration - Hybrid Environment.

TOTAL: 30 hours

G. Laboratory Experiments **Total: 30 Hours**

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

TASK 1	Setup the environment for Microsoft Exchange Server
TASK 2	Create mailbox databases to manage data's associated with mails.
TASK 3	• Implement and manage recipient objects to enable users to send and receive emails as well as other forms of communication within an organization. • Create and manage public folder mailboxes to store and share information within an organization.

TASK 4	Configure address lists and policies to control the visibility and accessibility of email addresses and distribution groups for users and recipients • Create and manage email address policies to assign multiple SMTP email addresses to recipients by using different combinations of the local part and domain values. • Create and manage the address lists and address book policies to segment users into specific groups to give them customized global address lists (GALs) in Outlook and Outlook on the web.
TASK 5	Manage Exchange Server and recipient objects by using Exchange Management Shell to provide administrators with a powerful and flexible command-line interface for managing their Exchange environment • Manage recipients using Exchange Management Shell. • Manage Exchange Server using Exchange Management Shell.
TASK 6	Configuring client access services • Configuring namespaces for client access • Configuring certificates for client access • Configuring custom MailTips
TASK 7	Deploying and configuring client access services on Exchange Server • Configuring Exchange Server for Outlook • Configuring Outlook on the web • Configuring Microsoft Exchange ActiveSync
TASK8	Implement DAGs • Create and configure a DAG(Database Availability Group) to store relevant information about the DAG, such as server membership information and some DAG configuration settings.
TASK9	Implement and testing high availability • Deploy a high availability solution for Client Access services to ensure uninterrupted and reliable access to critical client-facing applications and services. • Test the high availability configuration. • Configure highly available mailbox databases.
TASK10	To create a copy(Backup) of the data stored on the server to recover the data in the event of a primary data failure. • Backing up an Exchange Server mailbox database.
TASK11	To restore the Exchange Server data in case of data loss. • Restore Exchange Server mailbox • Restore a database availability group (DAG) member (optional)
TASK12	To Configure and manage message transport to facilitate the routing and delivery of email messages between mailboxes and other messaging systems. • Configure the message transport

	• Monitor and verifying message delivery • Configure a disclaimer transport rule • Configure a DLP policy for financial data
TASK13	Configure message security in Exchange Server to send encrypted messages to people inside or outside your organization • Configure and testing EdgeSync • Configure antivirus, antispam and malware protection features to prevent and address computer virus, worm, spyware, malware, and other types of malicious software.
TASK14	Monitoring and troubleshooting Exchange Server to track performance and security issues • Monitoring Exchange Server • Troubleshooting database availability • Troubleshooting Client Access servers
TASK 15	Securing and maintaining Exchange Server to protect Exchange from viruses, phishing, denial-of-service attacks, malware and spam. • Configure Exchange Server permissions • Configure audit logging • Maintaining Exchange Server
TASK 16	Managing Exchange Online • Implement and manage Exchange Online deployments

Stand alone systems with 16 GB RAM and 1TB Hard Disk 30 Nos.

H. Learning Resources

i. Text Book(s):

1. Edward Van Biljon," Microsoft Exchange Server 2019 Administration Guide", BPB Publications, April 2021.
2. Clifton Leonard and David Elfassy, "Mastering Microsoft Exchange Server 2016", Sybex, December 2016.
3. Paul Robichaux, "Microsoft Exchange Server 2019: Administration and Support", O'Reilly Media, October 2019.

ii. Reference Book(s):

1. Jonas Andersson,"Microsoft Exchange Server 2016 PowerShell Cookbook", Packt Publishing, September 2016.
2. Tony Redmond," Microsoft Exchange Server 2013 Inside Out", Microsoft Press, October 2013.

iii. Online References:

1. https://learn.microsoft.com/en-us/exchange/exchange-server?view=exchserver-2019

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS256	Office 365 Administration	2	0	2	3

A. Preamble

This course focuses on the administration, configuration, troubleshooting and operations of the Microsoft Office 365 platform. It also makes us to learn how to adjust user and subscription settings, configure Exchange mailboxes and groups, set up SharePoint sites, manage Microsoft Teams, and perform advanced configurations, such as multifactor authentication and PowerShell scripting.

B. Prerequisite Courses

10212CS253 - Windows Server Administration Operating System

C. Course Objectives

Learners are exposed to,

- Understand the basic concepts of Identity and Access Management, Zero Trust Security and user management.
- Learn how to develop and implement an effective security strategy.
- Equip students with the knowledge and skills needed to manage mobile devices and protect sensitive information in an organization.
- Equip students with the knowledge and skills needed to plan for and manage compliance requirements in Microsoft 365, including archiving and retention, content search and investigation, and data governance troubleshooting.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Understand the fundamentals of Microsoft 365 and learn about Role Based Access Control (RBAC)	K2
CO2	Analyze and identify gaps in current Microsoft 365 security posture using Secure Score.	K3
CO3	Compute Advanced Threat Analytics and learn to identify attacks using attack simulator in Microsoft 365.	K3
CO4	Manage and configure devices with MDM and domains for MDM.	K3
CO5	Create useful retention tags and retention policy.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO 3
CO1	3							2	3		3				
CO2	3	3	3	2											2
CO3	3	3	3		3							2			2
CO4	3				2				3		2				2
CO5	3		3	2	2			2		2	2	2			2

High- 3; Medium-2; Low-1

F. Course Content

UNIT I User and Group Protection L-6

User and Group Protection: Identity and Access Management Concepts-Zero Trust Security-User Accounts -Administrator Roles and Security Groups - Password Management in Microsoft 365-**Identity Synchronization**:Azure AD Connect-Planning- Implementation- Identity Protection -Managing Synchronized Identities - Federated Identities-**Access Management:**Conditional access-Manage device access-Role Based Access Control (RBAC)-Solutions for external access.

UNIT II Security in Microsoft 365 L-6

Threat vectors and data breaches-Security strategy, principles and solutions -Microsoft Secure Score.**Advanced Threat Protection:**Exchange Online Protection- Azure -Microsoft Defender-Advanced Office365 Threat Protection-Manage Safe Attachments and Links-**Threat Management:**Threat investigation and response-Azure Sentinel.

UNIT III Mobility and Information Protection L-6

Mobility: Plan for Mobile Application Management-**Mobile Device Management**-Plan, Deploy and Enroll Devices -**Information Protection**: Concepts - Azure protection-Advance Windows Information Protection.

UNIT IV Rights Management and Encryption L- 6

Rights Management and Encryption: Information Rights Management- S/MIME-Office 365 Message Encryption**, Data Loss Prevention:** An Overview- Create and Customize Policies-Policy Tips, **Cloud Application Security:** An Overview.

UNIT V Compliance in Microsoft 365 L-6

Compliance in Microsoft 365: Plan for compliance requirements- Build ethical walls in Exchange Online-Manage Retention in Email-Troubleshoot Data Governance, **Archiving and Retention:** Archive-Retention and its policies -In-place Records Management in SharePoint-**Content Search and Investigation**- Overview-Audit Log Investigations-Advanced eDiscovery.

TOTAL: 30 hours

G.Laboratory Experiments — Total: 30 Hours

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

TASK 1	To Discover and Manage Azure Resources to create, update, and delete resources in your Azure account. • Assign Directory Roles • Activate and Deactivate PIM Roles • Directory Roles (General) • PIM Resource Workflows • View audit history for Azure AD roles in PIM.
TASK 2	Use Conditional Access to enable MFA to make the right decisions as well as to enforce effective organizational policies. • MFA Authentication Pilot (require MFA for specific apps) • MFA Conditional Access (complete an MFA roll out)
TASK 3	Use Microsoft Secure Score to measure an organization's security posture, with a higher number indicating more recommended actions taken. • Improve your secure score in the Microsoft 365 Security Center.
TASK 4	Manage Microsoft 365 Security Services to assist organizations to detect threats early and help minimize the impact of a breach. • Implement ATP Policies.
TASK 5	Using Attack Simulator • Conduct a simulated Spear phishing attack to recognize and respond to these types of cyber threats. • Conduct simulated password attacks to assess the security posture of an organization's user accounts and identify potential vulnerabilities.
TASK 6	Configure Azure AD for Intune to establish a secure and streamlined environment for managing and protecting devices, applications, and data within an organization. • Enable Device Management to manage and secure the devices used by the employees to access O365 resources. • Create Intune Policies to manage and protect corporate data, applications, and resources on various types of devices, including Windows, iOS, Android, and macOS.
TASK 7	Implement Azure Information Protection and Windows Information Protection • Implement Azure Information Protection to enhance data protection and control by classifying, labelling, and protecting sensitive information in an organization • Implement Windows Information Protection to protect sensitive data on Windows devices by applying security controls and preventing data leakage or unauthorized access.
TASK 8	Configure Advanced Threat Analytics to detect and prevent attacks.

TASK 9	Configure Office 365 Message Encryption to protect sensitive information in emails and other communications by encrypting them and ensuring that only authorized recipients can access them. • Validate Information Rights Management
TASK 10	Implement Data Loss Prevention policies to protect an organization's sensitive and confidential data from being disclosed or lost. • Manage DLP Policies • Test MRM and DLP Policies
TASK 11	Compliance and Retention to ensure that an organization's data is managed, retained, and disposed of in a compliant and secure manner. • Initialize Compliance • Configure retention tags and policies
TASK 12	Manage Search and Investigation to ensure that an organization is in compliance with data protection regulations and to fulfill the rights of data subjects. • Investigate your Microsoft 365 Data • Conduct a Data Subject Request

Standalone systems with 16 GB RAM and 1TB Hard Disk 30 Nos.

H. Learning Resources

i. Text Book(s):

1. Aaron Guilmette, Darryl Kegg, Ed Fisher ," Microsoft 365 Administration Inside Out",3rd Edition, The Microsoft Press Store by Pearson, 2023.
2. Carpe, Thomas," Mastering Office 365 Administration",Packt, 2018

ii. Reference Book(s):

1. Randy Nordell, Kathleen Stewart, Pat Graves, and Annette Easton,"Microsoft Office 365: In Practice, 2019 Edition",McGraw-Hill Education, 2019.
2. "Microsoft Office 365 Administration Cookbook",Packt Publishing, 2020

iii. Online References:

1.https://learn.microsoft.com/en-us/microsoft-365/admin/admin-overview/admin-center-overview?view=o365-worldwide

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS262	STORAGE MANAGEMENT	2	0	2	3

A. Preamble

This course aims at molding the learner to understand the various networking components and the storage management techniques. The course helps the learners to expertise in simulating backup and recovery methods and also acquire the knowledge of virtualization.

B. Prerequisite Courses

10212CS253 - Fundamentals of Computer Networks

C. Course Objectives

Learners are exposed to,

- Understand the basics of networking protocols and server storage techniques.
- Simulate Illustrate the various cloud based storage allocation and reallocation principles using EMC SAN Simulator.
- Implement the server storage technique using NetApp simulator.
- Summarize various Backup & Recovery and Virtualization strategies.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Implement storage management protocols SAN and NAS	K2
CO2	Implement the methods for the Provisioning and deprovisioning of host and Pool of network storage Using EMC SAN Simulator.	K3
CO3	Simulate the various cloud based storage techniques using NetApp Simulator.	K3
CO4	Describe various storage backup and recovery strategies.	K3
CO5	Infer the concepts of Data Center Virtualization.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO 3
CO1	3														

CO2	3														
CO3		2		2							2				
CO4	3	3	2		2	2		2				2		2	2
CO5	3	3	2		2	2		2				2		2	2

High- 3; Medium-2; Low-1

F. Course Content

Unit 1: SAN and NAS Technologies **6 Hours**

Storage (SAN & NAS) - Storage Fundamentals- NAS Protocols- SAN Protocols- RAID concepts - Types of disks -storage health check - storage vendors - storage architecture - vendor coordination - hardware components

Unit 2 –EMC SAN **7 Hours**

EMC SAN - Unity - allocation of storage both SAN & NAS - deprovisioning of storage host creation -pool creation

Unit 3 NetApp **4 Hours**

Aggr - volume - qtree - quota - vserver - subnet - lif - cifs - nfs -iscsi -lun mgmt - snapshot & restore - snapmirror

Unit 4: Introduction to Backup and Restore **8 Hours**

Introduction to Backup and recovery, Backup server monitoring, Disable & enable agent, backup Removal tasks - configurations, library, media agent, servers & zoning for media server Restore & Retention extend request, Backup info & status request, Different type of backup failures - CompTIA Linux+ Backup & Restore- Backup & Recovery: Enterprise Backup Strategies, Windows Client Backup and Recovery Tools, Business Continuity & Disaster Recovery, Backup & Recovery Strategies.

Unit 5: Virtualization **5 Hours**

VM-Memory expansion & Disk expansion-VM Planned move & datastore addition - Certification Checks - ESXi Host Restart--Resource allocation – increase & decrease - Data Center Virtualization: vSphere & ESXi - Data Center Virtualization: vCenter Server

Total: 30 hours

LAB TASKS: **30 Hours**

1.Perform the following system health checks issues before they arise

- CPU or memory Health

- Connectivity Heal
- Host Health

2. Construct a RAID array and Implement the System (aggr)
3. Configure vserver according to the type of pool
4. Creation of aggregate nad volumes
5. Modifying the volumes and options
6. Implementation of NAS protocols- NFS
    6.a subnet creation
    6.b lif creation
    6.c export policy creation
    6.d export policy rule creation
7. Implementation of NAS protocols- CIFS
    7.a subnet creation
    7.b lif creation
    7.c cifs share creation

8. Implementation of SAN protocols - LUN Mapping
    8.a network config
    8.b volume creation
    8.c iscsi creation
    8.d lun creation
    8.e lun mapping
    8.1 On windows host
        8.1.a. configure iscsi initiator
        8.1.b. discover portal
9. Snapshot
    9.a creating snapshot
    9.b deleting snapshot
    9.c resizing snapshot

10. Understand the Snapmirror concepts (replication)

Mandatory Training and Certification

- DCA-ISM - Information Storage and Management, Certification Number - DEA-1TT5 (Exam price $230)
- DELLEMC Storage Softwares , https://www.dell.com/en-in/dt/hands-on-labs/index.htm#tab0=3
    - PowerStore T - Administration and Management
    - PowerScale OneFS – Getting Started
    - PowerMax – Provisioning, Data Reduction and Role Based Access Control
    - Dell EMC PowerFlex - Overview and Operations including Replication
    - CloudIQ
    - https://www.dell.com/en-in/dt/storage/unity.htm#tab0=0 – Unity Simulators
    - iDRAC9 for PowerEdge Servers

    - PowerProtect Cyber Recovery
    - Data Protection Suite - Avamar and Networker 19.4
  -

- Storage NETAPP simulators - https://kb.netapp.com/Advice_and_Troubleshooting/Data_Storage_Software/ONTAP_OS/Where_can_the_NetApp_ONTAP_9_Simulator_be_downloaded
- Virtualization Free Labs - VMware -
  - https://www.vmware.com/in/products/vsphere/vsphere-hol.html
- Nutanix - https://www.nutanix.com/products/community-edition

Online Resources

- Series of NETAPP storage free YouTube videos https://www.youtube.com/watch?v=wlW9rbeTdmQ - www.flackbox.com
- VMware Some Free YouTube Trainings
  https://www.youtube.com/watch?v=_wRRXEZkeXo
  https://www.youtube.com/watch?v=a_VyvjGeEcQ
  https://www.youtube.com/watch?v=beqAIHSbkfc
  https://www.youtube.com/watch?v=xxbcE7PMd5I
  https://www.youtube.com/watch?v=iqkQXaFr-to
  https://www.youtube.com/watch?v=tEfOP96vJRc
  https://www.youtube.com/watch?v=gudC4JQyyGg

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS265	WebSphere Application Server	2	0	2	3

A. Preamble

This course covers the essentials to installing and administering Websphere Application Server. Websphere Application Server covers vital topics like choosing your server roles, IBM server environments, server modernization and migration efforts, storage options, identity and access, and virtualization. This course also highlights the benefits of upgrading to the Websphere Application and shows how to automate installation, Efficiency for cloud-native applications, Application modernization, and automated operations and security. This course is to learn the essentials of Websphere Application Server and looks at configuring and deploying to WebSphere Application server environments,

B. Pre-requisite course

10212CS264 - Application Server Technologies

C. Course Objectives:

Learners are exposed to:

- Enable and configure WebSphere Application Server and its Building blocks
- Install and Manage Control-M Automation API and modern application release process
- Monitor and optimize the performance of Red Hat - Jboss Application Server
- Troubleshoot AutoSys Automation platforms and their service delivery
- Create and managing Unix Commands used in the WebSphere Application Server

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Design web server application by enabling the WebSphere application server in windows platform and also create database connections using system management administration	K3
CO2	Build an interactive Profiles creation with WAS Configuration tools using Console and Command Line Administration.	K3
CO3	Utilize SSL Certificate in WebSphere Application Server to secure client server communication using SSL configurations	K3
CO4	Make use of monitoring standard operations procedures, and deployment manager procedure for troubleshooting the WebSphere application server.	K3
CO5	Apply Applying service packs to upgrade WAS and Troubleshoot WAS Admin Issues using Installation, Rollback of ifix/fix packs	K3

Knowledge Level (Based on revised Bloom's Taxonomy)
K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO 1	PO2	P O3	PO 4	P O 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	3	3					2	2	2		3	3
CO2	3	2	3	3	3					2	2	2		3	3
CO3	3	2	3	3	3					2	2	2		3	3
CO4	3	2	3	3	3					2	2	2		3	3
CO5	3	2	3	3	3					2	2	2		3	3

High- 3; Medium-2; Low-1

F. Course Contents

UNIT 1 Introduction to WebSphere Application Server 06 Hours

WAS Introduction: IBM WebSphere family and edition - WebSphere Application Server (WAS) - WAS Architecture - operational modernization components - **WAS Administration:** System Management Administration - Database Connections. **Introduction to WAS Management:** hardware and software prerequisites - WebSphere Application server installation.

UNIT 2 WAS Administration and Session Management 06 Hours

WAS System Management - System Management Overview – System Management functionality - problem understanding- Support Assistant. **Installation and Configuration tools –** WAS Installation - WAS Configuration - Managing Profiles. **WAS Administration** - Console Administration - Command Line Administration - WebSphere Processes Administration. **Managing Database Connections:** WAS support policy **–** troubleshooting pool issues in WAS database connections. **Session Management:** Session configuration – Session identifiers - Session properties - Session security

UNIT 3 Security Management in WebSphere Application Server 06 Hours

WebSphere Application Server Application Deployment: Installation process –updating process - enabling process. **Security Management:** Security in applications - Security in resources - WebSphere Application Server Performance Monitoring**. SSL Configuration:** Secure Sockets Layer (SSL) configurations – outbound and inbound connections - client certificate - server

certificate – Trust store - Handshaking protocol – Client/server authentication - **Log rotation** - **Port Assignment:** Default Port Assignments - **Security Management in Port Assignment:** Manage security configurations - Security Management topologies - **Backup and Restoration**

UNIT 4 WebSphere Application Server Standard Operations **06 Hours**

Standard Operations Procedures: configurations - Application Migration Toolkit - WebSphere Application Server Migration planning - Troubleshooting migration. **Deployment Manager Procedure:** Deployment Manager Start and Stop - Node agent Start and Stop - Application Server Start and Stop - Web Server Start and Stop - Deployment Manager Migration Restrictions

UNIT 5 WAS Admin Issues Handling **06 Hours**

Applying service packs: WAS Patches/Upgrade process overview - Installation Manager - **Installation of ifix/fix packs**: Download interim fixes – Install the interim fix – Procedure – configurations – command line. Install the fix – Procedure – configurations – command line. **Rollback of ifix/fix packs:** Uninstalling interim fixes – Procedure - configurations – command line. Uninstalling fixes – Procedure - configurations – command line.

Total: 30 Hours

H. LAB EXPERIMENTS

Total: 30 Hours

UNIT 1 (LAB)

TASK 1: Downloading WebSphere Application server from the IBM Cloud server using Guest user

TASK 2: WebSphere Application Server Database Connections Procedure using Console and Command-Line

TASK 3: Practical study about Security Management Monitoring and Performance result for SSL Configuration and Port Assignment

UNIT 2 (LAB)

TASK 4: WAS Installation and handling configuration tools

TASK 5: Practical study of efficient and errorless WAS Configuration and its procedural aspects

TASK 6: Managing Profiles for WebSphere Application Server with Errorless Connections Procedure.

TASK 7: Practical study of WebSphere Application Server updating process and enabling process

TASK 8: Secure Sockets Layer (SSL) configurations based on outbound and inbound SSL connection attributes, which include:

A. Client Certificate SSL configurations
B. Server Certificate SSL configurations

TASK 9: Practical Steps to modify the existing SSL configuration by enabling the Handshaking protocol and verify the following

A. Trust manager control of certificate trust decisions
B. Key manager control of certificate identities
C. Certificate revocation checking with the trust manager

TASK 10: Write and study about Console and Command-Line for the following:

A. Default Port Assignments
B. Backup and Restoration

UNIT 4 (LAB)

TASK 11: Practical study of WebSphere Application Server's Application Migration Toolkit configurations

TASK 12: working principles for WebSphere Application Server Migration Troubleshooting

TASK 13: Write and study about Console and Command-Line for the following

A. Deployment Manager Start and Stop
B. Node agent Start and Stop
C. Application Server Start and Stop
D. Web Server Start and Stop

UNIT 5 (LAB)

TASK 14: Downloading Installation Manager and Installing and Rollback the following

A. Installing ifix/fix packs and configuring using the command line.
B. Rollback of ifix/fix packs using the command line

TASK 15: Working principles of Admin Issues Handling by listing Known issues and resolving with the associated solutions using the command line.

Total: Theory + Lab= 60 Hours

Use Case1 : Websphere Application server Installation and Configuration

To build a Websphere Application server, Install WebSphere Application Server 9.0.5 and also use the Identity Manager Service Center while WebSphere Application Server Network Deployment 9.0.5. using IBM® Installation Manager. Also Create clusters with WebSphere Application Server 9.0.5 for balance workload. For this, user must create two server clusters in WebSphere Application Server environment. One cluster hosts the Identity Manager application and cluster is used as a messaging service.

Tools: Websphere Application server

Use Case2 : Installation and configuration of IBM HTTP Server and WebSphere Web Server plug-in

Install the IBM HTTP Server and the WebSphere Web Server plug-in on the same computer that has the deployment manager. Also, install the IBM HTTP Server and the WebSphere Web Server plug-in on a separate computer for additional security and load balancing. In this concern, if any Performance issues arise, user must create WebSphere Application Server performance tuning tasks to make WebSphere Application Server initial configuration actions can take to ensure that WebSphere Application Server runs correctly.

Tools: IBM HTTP Server and WebSphere Application server

Use Case 3: SSL Configuration and Port Assignment

In the context of SSL Configuration and Port Assignment in smaller projects, users need to do the following step to improve the configuring SSL for secure communication, followed by the installation and configuration of the Identity Manager Server. Subsequently, the IBM Global Security Kit (GSKit) is to be utilized to generate the necessary certificates. Additionally, the installation and configuration of the Identity Manager Server, along with the required supported middleware, including the directory server, should be conducted. In the case of a cluster configuration where the directory server is situated on a separate computer, it is crucial to verify the correct operation of the initial configuration. It is recommended to consult the IBM Security Identity Manager Configuration Guide for further information. The IBM Global Security Kit (GSKit) is provided as part of the IBM Security Directory Server, which is installed during the initial configuration.

Tools : IBM® Global Security Kit (GSKit) and WebSphere Application server

I. Learning Resources

i. Text Books:

1. A. Black, M. Everett, D. Draeger, K. Miller, R. Iyer, K. McGuinnes, D. Patel, M. Herescu, T. Gissel, M. Betancourt, M. Casile, Y. Tang, A. Beaubien, "IBM WebSphere Application Server for Distributed Platforms and z/OS: An Administrator's Guide", IBM Press. 2005 [Unit 1 - 5]

ii. Reference Books:

1. IBM Redbooks, "WebSphere Application Server V6 Scalability and Performance Handbook", IBM 2005. [All Units]
2. IBM Redbooks, " WebSphere Application Server V6 System Management & Configuration Handbook", IBM 2005. [All Units]
3. Carla Sadtler, "IBM WebSphere Application Server V5.1 system management and configuration : WebSphere handbook series", IBM International Technical Support Organization, WebSphere handbook series.; ITPro collection.; IBM redbooks 2005. [All Units]

iii. Online Resources:

1. "WebSphere Hybrid Edition", Accessed on: JAN, 2024 [Online], Available: https://www.ibm.com/docs/en/WebSphere-hybrid

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS303	WebSphere MQ	0	0	2	1

A. Preamble

The course provides a comprehensive overview of WebSphere MQ, a market-leading messaging integration middleware product. This course is focused on providing a reliable, scalable, secure, and high-performance transport mechanism using MSSC commands, Queue Manager Configuration, Channel Triggering, and Troubleshooting. Additionally, the course covers various interfaces and services for configuring, managing, and monitoring operations, as well as log management and channel troubleshooting in WebSphere MQ.

B. Pre-requisite course

10212CS264 - Application Server Technologies

C. Course Objectives:

Learners are exposed to:

- Enable applications to send messages to a queue, where the receiving application can process them.
- Basic Configuration of WebSphere, Queue Manager and Channels, Remote Queue, Security Policy, Queue Handling
- Use of Backup and Restore Queue Manager in an Application
- Monitor the WebSphere MQ Channels intercommunication and triggering with other platforms.
- Troubleshoot and maintain the Log management.

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Build and configure the WebSphere MQ for the given application	**K3**
CO2	Design the Queue manager and handle various types of messages and properties	**K3**
CO3	Apply regular backup and recovery procedures for MQ configurations for data.	**K3**

CO4	Organize Interprocess Communication to manage message channels for inter-queue manager	**K3**
CO5	Experiment the log management, diagnose, and resolve the common issues.	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO 2	PO 3	P O4	P O5	P O 6	P O7	PO 8	P O 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	**2**				**3**										**2**
CO2	**2**	**2**	**3**		**3**										**2**
CO3	**2**	**2**	**3**		**3**										**2**
CO4	**2**	**2**	**3**		**3**										**2**
CO5	**2**	**2**	**3**		**3**										**2**

High- 3; Medium-2; Low-1

F. Course Contents

TASK 1: Study on Message Queue overview, Architecture and managing Queue Manager Objects.

TASK 2: WebSphere MQ Installation and software prerequisites for MQ installation and MQ Administration.

TASK 3: Implementation of MQSC commands

1. Queue Managers
2. Clusters
3. Channels
4. Queues
5. Name lists
6. Process definitions
7. Authentication Information Object.
8. Disaster recovery/ failover procedures and Reset channel procedure

TASK 4: Creation, Configuration, Dumping, and Restoring a Queue Managers configuration and MQ objects

TASK 5: Study and implement Dead Letter Queue Handling (DLQ).

1. Invoking the DLQ Handlers
2. Display the DLQ handler rules Table
3. Operation on rules table.

TASK 6: Import/Export and Backup messages from the queue in WebSphere MQ

TASK 7: Queue manager intercommunication and client connections in WebSphere MQ

TASK 8: Troubleshooting error in Queue manager intercommunication and client connections

TASK 9: Study and Implementation of Channel triggering process in the message queue.

TASK 10: Demonstrate messaging with WebSphere MQ with the following process

1. Send/Receive a message from the queue manager
2. Cold start recovery of queue manager

TASK 11: Implement the Standard Operations Procedures for Queue Manager Stop/Start

TASK 12: Study and Implementation of different types of Logging.

TASK 13: Build the WebSphere MQ infrastructure with Log Management

TASK 14: Implement the messaging activity with WebSphere MQ

TASK 15: Demonstrate how to implement Channel troubleshooting with WebSphere MQ

TASK 16: Demonstrate to Applying service packs in

A. Patch process

B. Certificate validation policies

TASK 17: Demonstrate the standard operations procedures for the Installation of fix packs

TASK 18: Demonstrate the Standard Operations Procedures for the Rollback of fix packs

TASK 19: Demonstrate the Standard Operations Procedures for Performing version upgrade

TASK 20: Study on overview of MQ reason.

Use Case 1 : Healthcare Information Exchange

A hospital needs to exchange patient information securely between different departments (radiology, pharmacy, billing) and external partners (insurance companies, laboratories). Ensure secure and reliable exchange of sensitive patient information. Deploy WebSphere MQ to create a secure messaging infrastructure that encrypts and delivers messages between the hospital's internal systems and external partners. Configure security settings to comply with healthcare regulations like HIPAA.

Use Case 2 : Customer Support Ticketing System

A global company needs to manage customer support tickets and ensure they are routed to the appropriate support teams based on region and issue type. Efficiently route and manage support

tickets. Implement WebSphere MQ to create a messaging system that routes support tickets to the appropriate teams. Use message selectors and channel triggering to ensure tickets are automatically assigned based on predefined criteria (e.g., region, issue type).

Use Case 3 : Financial Transactions Processing

A financial institution needs to process millions of transactions daily with high reliability and security. The system must ensure that transactions are processed in order and without loss. Implement a reliable messaging system to handle transaction messages between various banking applications. Use WebSphere MQ to set up a message queue that ensures all transaction messages are delivered and processed in sequence. Configure queue managers to handle load balancing and failover to maintain high availability.

G. Learning Resources

i. Text Books:

1. "WebSphere MQ Primer: An Introduction to Messaging and WebSphere MQ" by Chris Lovett and Timothy J. Parkin
2. “IBM WebSphere MQ V7.1 and V7.5 Features and Enhancements” Cezar Aranha, Craig ,BothBarry Dearfield · 2013
3. "IBM WebSphere MQ V7.0 Features and Enhancements" by Saida Davies, T.Rob Wyatt, et al.

ii. Reference Books:

1. IBM WebSphere MQ A Complete Guide Kindle Edition by Gerardus Blokdyk (Author) Format: Kindle Edition
2. “IBM MQ V8 Features and Enhancements" by Valerie Lampkin, Saida Davies, et al.

iii. Online Resources:

1. “IBM MQ Documentation”, https://www.ibm.com/docs/en/ibm-mq/9.1
2. “IBM WebSphere Application Server V9 - IBM Training” https://www.ibm.com/training/path/ibm-websphere-application-server-v9-2118

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS267	Middleware Technologies	2	0	2	3

A. Preamble

This course delivers comprehensive course on Unix Commands, Operating System Administration, Workload Scheduler Concepts, BMC Control-M Administration, Database Concepts, Data Backup Strategies, and Data Disaster Recovery. This course is designed to equip you with essential skills and knowledge in managing and optimizing IT infrastructures, ensuring smooth operation and resilience against potential disruptions. Throughout this course, you will delve into the foundational principles and advanced techniques required to effectively administer operating systems, automate workload scheduling, and implement robust data protection strategies. Students will be well-equipped to design, implement, and manage middleware solutions that enable efficient and secure communication and data exchange between diverse systems and applications.

B. Pre-requisite course

10212CS264 - Application Server Technologies

C. Course Objectives:

Learners are exposed to:

- Understand and effectively utilize essential Unix commands for system management and troubleshooting.
- Effectively plan, automate, and manage complex workflows and job scheduling in IT environments.
- Install, configure, and utilize BMC Control-M for efficient workload scheduling and management.
- Understand database concepts, database languages, and SQL queries for effective data manipulation and management.
- Optimize resource utilization and scheduling efficiently.
- Implement effective backup and recovery strategies

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Apply essential Unix utility commands to perform basic system operations.	K3
CO2	Implement scheduling techniques to manage server workloads.	K3

CO3	Utilize SSH and Control-M Configuration Manager (CCM) functions to manage and secure server communications.	**K3**
CO4	Make use of fundamental database concepts to understand and manage data effectively.	**K3**
CO5	Develop and execute backup plans using internal resources, ensuring regular data backups and quick restoration capabilities.	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PS O1	PS O2	PSO 3
CO 1	2	2	3	3	3					2	2	2		3	2
CO 2	2	2	3	3	3					2	2	2		3	2
CO 3	2	2	3	3	3					2	2	2		3	2
CO 4	2	2	2	3	3					2	2	2		3	2
CO 5	2	2	2	3	3					2	2	2		3	2

High- 3; Medium-2; Low-1

F. Course Contents

UNIT 1 Unix Commands & Operating System Administration 3 Hours

Unix commands - Utility commands - directories commands - File creation - listing of files and folder command -File Permission - File operation - Introduction to server architecture - Unix Command Line & GUI - GNU & Unix Commands - Getting Started with PowerShell - Introduction to Server Storage.

Unit 2: Introduction to Workload Scheduler Concepts 3 Hours

Server Overview: Server Architecture - Scheduler - Scheduling Terminology - Types of Schedules - Workload automation - Tools for Workload Scheduling: BMC Control-M – Installation – Control-M Architecture - Benefits of Scheduling.

Unit 3: BMC Control-M 3 Hours

Control-M Administration: Overview of Control-M - Resource Planning - Create and edit new and existing jobs - Manage job definitions and calendars - modify job parameters & Restart jobs -

View and Modify – NDP – Job Monitoring - Log Management - Time Management and - Workload management – Control-M/Server security configuration – SSH – CCM Functions

Unit 4: CCM Functions, Job Forecasting and Database Concepts 3 Hours

Database concepts - Database Languages - SQL Concepts and Queries - Keys in Database. Data Backup: Resilience strategies - Backup Considerations - Techniques to protect and store sensitive data - Data Classifications - Data Breach and its cost - Business Impact Assessment - Assessing Risk- Planning for Continuity - Service Levels.

Unit 5: Data Disaster recovery 3 Hours

Data Protection Solutions - Roles and Responsibilities - Recovery time and recovery point - Storage solutions, Replication technology - Backup and recovery strategies: In-house, Outsourced and Cloud.

Total: 15 Hours

G. Lab Experiments **Total: 30 Hours**

Task 1 : Enter these commands at the UNIX prompt, and try to interpret the output: echo, passwd, date, who, cal, man, uname, pwd, which, whereas and also give proper command for the following scenarios

a. Change back into your home directory.
b. Make subdirectories called work and play.
c. Delete subdirectory called work.
d. Copy file /etc/passwd into your home directory.
e. Move it into the subdirectory play.

Task 2: Create a one or more files and directories using unix commands and reports the following information on the file:

a. File type
b. Number of links
c. Time of last access
d. Read, write, and execute permission
e. Fetch unique data from a file
f. Sort File Content

Task 3: Use the vim Editor for the following scenarios

. Create File, Make Changes and Close file without saving
   a. Insert data to file
   b. Insert data in new line
   c. Save content of file

Task 4: Use the Command Line Interface to perform the following operations

a. Changing file permission
b. Changing ownership of file/directory
c. Show the difference between Grep/ sed/ awk commands

Task 5: Use powershell cmdlets to perform following operations

a. Create a new Folder named "Lab" and change the location to the Lab folder
b. Create a new CSV file and enter the students' details.
c. Read the CSV file content and display the student's name.

Task 6: Installation and getting started with workload scheduler

Task 7: Simulate Workload Automation Job Schedule Changes using workload scheduler

Task 8: Create and run an application server in workload scheduler

Task 9: Create the n number of process and added to your Process Library with the same specifications as the original jobs.

Manage the Scheduler jobs in this environment and perform modification in calendars.

Task 10: Create a job depending on your business needs, you can complete the following actions:

a. **Run a job immediately.**
b. **Move the workload to the Dynamic Workload Console to run your job with more complex scheduling conditions.**
c. **Monitor your Job from the admin control.**

Task 11: Demonstrate how to view and modification of system parameters in process and log management.

Task 12: Implementation of DDL and DML commands of SQL with suitable examples

DDL commands:

a. CREATE
b. ALTER
c. DROP
d. RENAME
e. TRUNCATE

DML COMMANDS:

a. INSERT
b. UPDATE
c. DELETE
d. SELECT

Task 13: Implement the Aggregate functions along with filtering and Sorting on table in database.

Task 14: Implementation of Database Backup & Recovery Commands.

a. Rollback
b. Commit
c. Save point

Task 15: Make a database on cloud platform

a. Create a database on Relational Database Service (RDS) of Amazon Web Services

(AWS)

b. Building Resilience through Cloud Databases

Total: Theory + Lab= 45 Hours

Use Case 1 : Scheduling Optimization

You are tasked with optimizing the scheduling of various batch jobs on your company's server. The goal is to automate as many tasks as possible to reduce manual intervention and increase efficiency.

- Understand the server architecture and its scheduling capabilities.
- Learn and use scheduling terminology to communicate effectively with your team.
- Implement different types of schedules (time-based, event-based) for various tasks.
- Use workload automation techniques to streamline processes.
- Install BMC Control-M and configure it to manage the server's workload.
- Describe the benefits of scheduling to your management to justify further investment in automation tools.

Use Case 2 : Data Breach

Your company has experienced a data breach, and you need to implement a comprehensive data protection and disaster recovery plan to prevent future incidents and minimize downtime.

- Apply data protection solutions to safeguard sensitive information.
- Define roles and responsibilities for data protection within your organization.
- Establish recovery time and recovery point objectives to guide your recovery efforts.
- Evaluate and implement appropriate storage solutions to ensure data availability.
- Use replication technology to enhance data redundancy and availability.
- Develop backup and recovery strategies, considering in-house, outsourced, and cloud options.
- Perform a business impact assessment to understand the effects of data loss.
- Assess risks and implement mitigation strategies.
- Plan for continuity to ensure business operations can resume quickly after a disaster.
- Set and measure service levels to ensure data management and recovery meet organizational requirements.

Use Case 3 : System Upgradation

Your company is planning a major system upgrade, and you need to ensure that all scheduled jobs and database operations continue to run smoothly during and after the transition.

- Use CCM functions to configure Control-M for the upcoming changes.
- Perform job forecasting to predict the impact of the upgrade on scheduled jobs.
- Understand database concepts to manage the underlying database supporting your applications.

- Write SQL queries to retrieve and manipulate data as needed.
- Implement data backup strategies to ensure data resilience during the upgrade.
- Classify data to determine the appropriate protection measures.
- Assess the risk of data breaches and plan for continuity in case of system failure.
- Define service levels to ensure that critical operations have the required performance and availability.

H. Learning Resources

i. Text Books:

1. Kerrisk, M. (2010). *The Linux Programming Interface*. No Starch Press. ISBN 978-1-59327-220-3. [Unit 1-2]
2. Ding, Q. (2021). *Control-M: A Practical Guide* (1st ed.). Packt Publishing. [Unit 3]
3. Price, J. (2023). *Learning SQL: Master SQL Fundamentals*. O'Reilly Media. [Unit 4-5]

ii. Reference Books:

1. Stevens, W. R., & Rago, S. A. (2013). *Advanced Programming in the UNIX Environment*. Addison-Wesley Professional.
2. Forta, B. (2023). *SQL in 10 Minutes, Sams Teach Yourself.*

iii. Online Resources:

1. "Control-m Documentation", Accessed on: June, 2024 [Online], Available: https://www.bmcsoftware.es/it-solutions/control-m.html
2. "Database Creation", Accessed on: May, 2024 [Online], Available: https://aws.amazon.com/free/database/

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS269	Oracle Database Administration	2	0	2	3

A. Preamble

This course trains the student to control over the databases in Oracle DataBase System Architecture. It encompasses how to administrate, mitigate, monitor, risk control in database administration, configure in cloud, migration from one to another, etc. It addends the existing capability of programming practice.

B. Prerequisite Courses

10211CS207 Database Management Systems

C. Course Objectives

Learners are exposed to

- exercise SGA instance management, file & tablespace management,
- perform user administration & security and table & index management.
- install and configure a working Oracle database, create tablespaces and files,
- manage security and user access, and
- create tables, index-organized tables, cluster tables,
- managing indexes, bitmap indexes, function-based indexes and bitmap join indexes.
- migration from Oracle database to cloud-based infrastructure.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Perform data retrieval using SQL.	K3
CO2	Report aggregated data from single and multiple databases using SQL.	K3
CO3	Employ database using Oracle.	K3
CO4	Articulate Oracle database architecture with manageable schema objects.	K3
CO5	Manage data movement, backup, security with database.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of Cos with Program Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3	3		3									2	2
CO2	2	3	3		3									2	2
CO3	1	3	3		3									2	2
CO4	2	2	2	1	3									2	2
CO5	1		3		3									2	2

High- 3; Medium-2; Low-1

F. Course Contents

Unit 1 Basic SELECT and Interactive SQL 6 Hours

Full Syntax of SELECT Command- capabilities- execution- query estimation-Limiting rows-sorting rows in filtering- Interactive SQL- Single-Row Functions- customized output- Using conversion functions and Conditional Expressions.

Unit 2 Reporting Aggregated Data and Using Joins, SubQueries 6 Hours

Identifying Group Functions- use- GROUP BY clause- Include or Exclude-Having clause-Displaying data from Multiple Tables using equijoins and non-equijoins- self-join- Outer joins-Cartesian product- cartesian join- SubQuery- types of problems- fixing subqueries- single-row and multiple row subqueries- Set Operators- Using set operator to combine multiple queries-Union- UnionAll- Intersect- IntersectAll- Controlling Order of rows- Order By Clause.

Unit 3 Data Manipulation and Data Definition 6 Hours

Data Manipulation Language- statement- INSERT INTO- INSERT-SELECT- UPDATE-DELETE- Control Transactions- Data Definition Language- Categorize the main database objects-Reviewing Table Structure-CREATE- CREATE-SELECT- CreateX- List of data types-work-creating a simple table- constraints- types of constraints at the time of table creation- Constrains manipulation after table creation-ALTER- TRUNCATE-RENAME- schema working- schema objects.

Unit 4 Oracle Database Architecture, Environment and Managing Objects 6 Hours

Memory Structures- Process Structures- Overview of Storage Structures- Tools identification for Administering Oracle Databases- Planning Oracle Database Installation- Thin Client- Thick Client- Network Installation- Install Software- Creating database by Database Configuration Assistant (DBCA)- setting initialization parameters- Stages of Storage Startup – Shutdown- Using Alert Log files and trace files- Using data dictionary ad dynamic performance views- Configuring and manage Oracle Network- Managing Schema Objects- Create and Modify tables- Managing Constraints revisited- Create Indexes- Create and use of Temporary tables – views.

Unit 5 Security, Maintenance, Backup Management and moving data 6 Hours

Transactions and UNDO data- Managing UNDO- Security- Principle of least privilege- Standard Database Auditing- Use and Manage Optimizer Statistics- Use and Manage Automatic Workload Repository (AWR)- Manage alerts and thresholds- Automatic Memory Management-Troubleshoot invalid and unusable objects- Identifying types of failure in Oracle databases- Flash Recovery area- configure ARCHIVELOG mode- Creating consistent database backups and backup without Shutdown- creating incremental Backups- Automate database backups- Moving Data: General Architecture- Oracle Data Pump: Overview, Benefits – SQL Loader: Overview,

Review- Data Pump Export and Import Clients-Data Pump Interfaces and Modes-Data Pump Import Transformations- Maintenance- Auto Tasks- Database Patching.

Total: 30 Hours

G.Laboratory Tasks: **Total: 30 Hours**

Task-01: Data Retrieval using SQL-Select Statement (Tool: Oracle19c, OEM, Toad)

i) Basic SELECT usage Queries

Task-02: Data Limiting, Substitute Restriction, Sort Output (Tool: Oracle19c, OEM, Toad)

i) SQL data retrieval queries without using LIMIT clause
ii) SQL data retrieval queries with using LIMIT Clause
iii) Interactive SQL using ampersand operator
iv) Interactive SQLqueries for sorting filtered results at runtime

Task-03: Conditional Expressions and Functions in SQL- DATE, NUMBER and CHARACTER (Tool: Oracle19c, OEM, Toad)

i) SQL data retrieval using character functions
ii) SQL data retrieval using number functions
iii) SQL data retrieval using date functions
iv) Queries using to_char conversions
v) Queries using to_number conversions
vi) Queries using to_date conversions
vii) Conditional expressions in SELECT statement.

Task-04: Reporting Aggregation using Group functions(Tool: Oracle19c, OEM, Toad)

i) Queries using GROUP BY clause
ii) Include and exclude rows using by HAVING clause.

Task-05: Joins and Subqueries (Tool: Oracle19c, OEM, Toad)

i) Queries for data retrieval from multiple tables using Equi-Joins, self-joins
ii) Queries for data retrieval from multiple tables using Outer Joins
iii) Controlling order of rows using ORDER BY clause

Task-06: Subqueries and Set Operators (Tool: Oracle19c, OEM, Toad)

i) Data retrieval using subqueries
ii) Combining multiple queries using set operators-UNION, UNION ALL, INTERSECT, INTERSECT ALL, DIVIDE, MINUS

Task-07: Usage of schema objects with DML and DDL (Tool: Oracle19c, OEM, Toad)

i) Using CREATE, Create-Select, creating tables
ii) Using Alter, Modifying database schemas and objects
iii) Using Constraints by create-add, alter, delete

iv) Row manipulation using INSERT INTO, INSERT FROM, UPDATE-SET

Task-08: Plan, install, manage, configure Oracle database (Tool: Oracle19c, OEM, Toad)

i) Planning and installation of Oracle Environment- Thin client and Thick client
ii) Creating Database using DBCA
iii) Managing Instances – Startup and shutdown progress.

Task-09: **Tracing instance, alert log, DDL log using ADRCI utility** (Tool: Oracle 19c/ARDCI)

i) Deploying Net services, log services and
ii) interpreting alert log fies, trace files, view alert log file, DDL logging, Tracing instances, namespaces, timestamp validation in logs using listener control

Task-10: **Viewing Dynamic Performance and Oracle Net** (Tool: OracleNetlog, LSNRCTL)

i) Dynamic Performance views (Netlog)
ii) Naming Methods: Easy Connect, Local naming
iii) Naming Methods: Directory Naming, LSNRCTL and NETCA

Task-11: **Mitigating Logical vs Physical Storage** (Tool: OEM Express)

i) System Table space, Sysaux tablespace, Temp Tablespace
ii) Undo and users tablespaces
iii) Segment Information, Extent Information, DB block and Data File information
iv) Creating a table space using EM Express
v) Extend Allocation-Automatic or Uniform
vi) Logging: Force Logging, Nologging

Task-12: Handling Segment Space management and Table Full Error (Tool: EMExpress, Netlog)

i) Automatic vs manual space management
ii) Moving, copying and renaming database files
iii) Simulating TableFull Error

Task-13: Database Maintenance and performance management (Tool: Oracle19c, OEM, Toad)

i) Using Optimizer statistics
ii) Using Automatic Workload Repository (AWR)
iii) Managing Alerts an thresholds
iv) Auto task
v) Database Patching

Task-14: Consistent Database Backups (Tool: Oracle19c, OEM, Toad)

i) Creating consistent database backup
ii) Backing up without shutting down

iii) Creating incremental backup
iv) Automating database backup

Task-15: Perform Moving Data (Tool: Oracle19c, Data Pump, OEM, Toad)

i) Using Data Pump Export and Import to move data between Oracle Databases

Total: 60 Hours

Part- B

Implementing Use case/ case study (Part-B) satisfying the following.

- Retrieving Data Using the SQL SELECT Statement, Restricting and Sorting Data, Single-Row functions, Conversion functions, Reporting Aggregated Data Using the Group Functions, Displaying Data from Multiple Tables, Using Subqueries to Solve Queries, Using the Set Operators, Manipulating Data
- Using DDL Statements to Create and Manage Tables
- Exploring the Oracle Database Architecture
- Preparing, creating, managing the Database Environment, Configuring the Oracle Network Environment, Managing Schema Objects, Managing Undo Data, Implementing Oracle Database Security, Database Maintenance, Performance Management,
- Backup and Recovery Concepts, Performing Database Backups, Moving Data, Maintenance Task, Data Guard, Standby Tools, Oracle Support, Known issues and solutions.

Use Case-01: Large Advertising & Marketing Services Company @

The project: build a secure Oracle APEX environment on Oracle Cloud for the company's internet-facing applications.

Starting point: one virtual machine running a pre-created database with APEX installed
End point: the full Apache/Tomcat/ORDS/APEX/database stack, SSL enabled.

As with any cloud provider, it takes a while to understand how to use the cloud infrastructure, particularly the networking and security. Once you have got past that, you can start work. First, the Oracle Enterprise Linux default configuration isn't good enough. You need to install a graphical desktop and also various RPMs and update OpenSSL. The firewall needs some configuration too.

Then the usual: download and install Tomcat; download ORDS, configure and deploy to Tomcat; download the Apache http server plus the APR libraries and compile. Need to be added an OpenVPN server for SQL*Net and ssh access, so that only the Apache listening ports would be exposed to the internet. Everything configured for automatic start on boot up.

Use case-02: Foremost Farms @

Foremost Farms is a milk solids processing business owned by the dairy farm families who supply our milk. That's what it means to be a cooperative – and it's why our farmer-members have a vested interest in providing the highest-quality milk possible. They own Foremost Farms.

Project: Research running Oracle Data Appliance (ODA) in Virtualized Environments. This project was about investigating the ODA virtualized architecture and understanding how best to use it with single instance databases. Not because of RAC, because of licences. One can run ODA as “bare metal” or “virtualized”. Typically, people who installed ODA more than, say, two years ago run bare metal: the two ODA nodes run normal Linux and the databases reside on ASM disc groups. This is all straightforward and should present no surprises to the DBA or the SA. However, most people installing now follow Oracle’s recommendation and run it virtualized. The configuration can strike you as bizarre the first time you see it. The nodes run Xen Linux (Oracle’s version, of course) and everything happens in virtual machines. The databases reside on ACFS file systems, and are created from ACFS snapshots of preconfigured databases. The networking may take a while to get your head around.
In general, the virtualized platform is probably the way to go, but you do need to be a bit of a wizard with Grid Infrastructure and Xen to understand what is going on.
There are many GI facilities that can be used for fault tolerance and failover without RAC, which is not something that Is very well documented. Perhaps, it should be.

@ internet sources **Total: 60 hours**

G. Learning Resources (in IEEE Format)

i. Text Books:

1. Tanveer A, “Oracle 19c Database Administration: Oracle Simplified” Kindle Edition, 2020.

ii. Reference Books:

Ravinder Gupta, “Oracle Database 19c DBA By Examples: Installation and Administration”, Independently published (June 26, 2021), ISBN-13 : 979-8469226970.

ANNEXURE-V

To discuss and approve the new courses under Open Elective category, to be offered in various specialization in the **existing B.Tech CSE curriculum VTR UGE 2021** keeping in view of NEP 2020 to be implemented with effect from the academic year Summer 2024 - 2025 in view of breadth, depth and employability Skills.

COURSE CODE	COURSE TITLE	L	T	P	C
10213CS107	Design And Analysis of Algorithms	3	0	0	3

A. Preamble

The course introduces the basics of computational complexity analysis and various algorithm design paradigms. The goal is to provide students with solid foundations to deal with a wide variety of computational problems, and to provide a thorough knowledge of the most common algorithms and data structures.

B. Prerequisite Course

10213CS101- Data Structures

C. Course Objectives

Students are able to

- Develop the problem-solving ability and algorithmic analytical skills
- Produce optimized code
- Understand the different techniques involved in solving a problem
- Analyze the logic in terms of Efficiency, Time & Space Complexity
- Break the large size algorithm into smaller size components

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Analyze the time complexity of algorithms using various asymptotic notations.	K3
CO2	Implement solution for the given problems using Brute force and Divide and Conquer techniques.	K3
CO3	Apply Dynamic programming and Greedy techniques to solve the given problems.	K3
CO4	Solve the problems using Backtracking and Branch & Bound techniques.	K3
CO5	Interpret the computational efficiency using iterative approaches	K2
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3					1	1		1	3	
CO2	3	3	3	3					1	1		1	3	
CO3	3	3	3	3					1	1		1	3	
CO4	3	3	3	3					1	1		1	3	
CO5	3	3	3	3					1	1		1	3	

High- 3; Medium-2; Low-1

F. Course Contents

Unit 1 Introduction L-9 Hours

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Analysis of Algorithm Efficiency - Introduction to Asymptotic Notations– Solving Recurrence relations – Master's theorem - Mathematical analysis for Recursive and Non-recursive algorithms.

(**Case Study:** Design a gaming application like Chess, Candy crush etc. and select the appropriate algorithm and solve it).

Unit 2 Brute Force and Divide & Conque L-9 Hours

Brute Force: Closest-Pair and convex-Hull Problems- Exhaustive Search - Traveling Salesman Problem - Knapsack Problem - Assignment problem. Divide and conquer methodology: Merge sort – Quick sort – Binary search- Heap sort- Closest-Pair and convex-Hull Problems

(Case Study: Brute Force: Solve the hide and seek game with a search time limit as 5 minutes and check its efficiency.)

(Case Study: Divide & Conquer: A king witha huge kingdom struggles to oversee from a single central city. Suggest how the king will handle the local problems of the smaller parts of the kingdom).

Unit 3 Dynamic Programming and Greedy Technique L-9 Hours

Dynamic Programming: Principle of optimality - Computing Binomial Coefficient - Warshall's and Floyd' algorithm – Knapsack Problem. Greedy Technique: Minimum spanning tree-Prim's algorithm- Kruskal's Algorithm- Huffman Trees and Codes- Graph algorithms: Topological sort- Dijkstra's Algorithm.

Case Study: Dynamic Programming: A Taxi Operator firm needs to design a growth strategy plan that should focus on the revenue for the next 25 years considering various constraints like car turns old, reduction in mileages etc)

(Case Study: Greedy Technique: Assumethe list of arrival and departure time; find the minimum number of platforms required for the railway as no train waits).

Unit 4 Backtracking and Branch &Bound L-9 Hours

Backtracking: n-Queens problem- Hamiltonian Circuit Problem- Subset sum problem-Branch & Bound: Assignment problem-Knapsack Problem- Traveling Salesman Problem
(Case Study: Backtracking: Solve a constraint network to find an assignment of values for each variable so that all constraints are satisfied.)
(**Case Study: Branch & Bound:** Optimize the tour to deliver the packages at randomly chosen pizza centres in the city of Chennai.)

Unit 5 Iterative Improvements and Limitations Of Algorithm Power L-9 Hours

The simplex method– The maximum-flow problem– The Maximum matching in bipartite graph- Introduction to unsolvable problem-Halting problem. Limitations of Algorithm Power--Decision Trees- Lower bound arguments- P, NP and NP-Complete Problems. The Classes NP and P.
(**Case Study:** Identify solution to the telecommunication networks to handle the crucial problems such as flow control and routing)

Total: 60 Hours

H. Learning Resources

i.Text Books:

1. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, Third Edition, Pearson Education, 2012. [Unit 1, 2 & 4]
2. Horowitz, S. Sahni, and S. Rajasekaran, “Computer Algorithms,” 2nd Edition, Galgotia Publications, 2007. [Unit 3 & 5]

ii.Reference Books:

1. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, ―Data Structures and Algorithms‖, Pearson Education, Reprint 2017.
2. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Third Edition, PHI Learning Private Limited, 2012.
3. Donald E. Knuth, “The Art of Computer Programming”, Volumes 1&3 Pearson Education, 2009.

iii.Online References:

1. “Design and analysis of algorithms”, Jan 21 2015, Accessed on: Jan 18 2021, [Online]. Available: https://onlinecourses.nptel.ac.in/noc21_cs22/preview
2. "Algorithms Specialization", Accessed on: April 21 2021, [Online], Available: https://www.coursera.org/specializations/algorithms

COURSE CODE	COURSE TITLE	L	T	P	C
10213GE103	Software Development and Maintenance	3	0	0	3

(This course is offered under General Elective Category. All School students can opt the course.)

A. Preamble

This course provides basic concepts about SDLC, Unix commands and shell operations, Object Oriented Programming, JavaScript technologies to create the interactive client-side design of web applications. This course introduces DBMS concepts, to share a common set of models, design paradigms via a Structured Query Language (SQL). More specifically, this course also deals with UI/UX concepts to develop a pleasant user interface and deploy the application using Cloud AWS services.

B. Prerequisite Course

10210CS101 - Problem Solving using C.

C. Course Objectives

Learners are exposed to:

- Make use of basic SDLC, Unix Commands.
- Practice Java basic constructs for real world problems.
- Build efficient client-side validation using javascript.
- Acquire knowledge on basic SQL queries and designing database schema
- Learn and build the workflow of UI/UX
- Deploy the application on AWS cloud

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Interpret the Software Development Life Cycle (SDLC) stages, Unix basics commands and shell operations, and OOP.	**K2**
CO2	Articulate proficiency in exception handling, inheritance, and API fundamentals.	**K3**
CO3	Design the interactive and dynamic webpage using JavaScript.	**K3**
CO4	Model the Relation Database schema and perform CRUD operations.	**K3**
CO5	Chart UI/UX and deploy the applications using AWS cloud.	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

F. Course Contents

Unit 1 Introduction to SDLC, UNIX/OS and OOP Concepts L-9 Hours

SDLC: Requirements gathering - System design - Implementation - Testing - Various types of testing - Maintenance - Documentation - Project Management - Agile. UNIX/OS: Unix Basics - Unix shell - File Operations - Process Management - Networking and Communication - System Administration - Shell Customization. OOPs Concept: Benefits and Multiple Features of OOP - Object Oriented Programming Vs Procedural Programming - Class - Cohesion and Coupling in design process - Popular OOP Languages.

Unit 2 Exception Handling, Inheritance & APIs L-9 Hours

Exception Handling - Categories of Exceptions - Hierarchy of Exception Class - Exception Types - Checked and Unchecked Exceptions. Inheritance and its Types - Creating Subclass - Method Overriding - Super keyword - Polymorphism - instanceof operator - Abstract Vs Non-Abstract classes - Interface. **API:** Introduction - API Basics - Types of API Protocols - Styles and Benefits of API Development.

Unit 3 Scripting Language - Javascript L-9 Hours

Basic Web Development Concepts - **Javascript:** Introduction to Javascript - Syntax and Basic Concepts - Document Object Model (DOM) Manipulation - Arrays and Objects - Asynchronous JavaScript - Error Handling and Debugging - ECMAScript 6 (ES6)+ Features.

Unit 4 Database Fundamentals: RDBMS, SQL L-9 Hours

DBMS: History of Data and its definition - Various formats to recognize databases - DBMS through MySQL Workbench - DBMS Types and its features - Requirements of DBMS - Roles, job-related tasks.
RDBMS: Introduction and its uses - popular RDBMS and their uses - Oracle RDBMS versions and features - SQL Server RDBMS, history and its features - MySQL RDBMS, history and its features - MySQL Workbench - Normalization - E.F. Codd.
SQL: Introduction - Connectivity - Reserved words - Data Types - SQL Commands: DDL - Alter tables - drop and truncate - table constraints - constraint violation.

Unit 5 Fundamentals of UI/UX, Generative AI and AWS Cloud Practitioner L-9 Hours

UI/UX: Introduction - importance - UI Vs UX - Future of UI/UX - User prevention on errors - flowcharts of UI/UX - journey maps of UX design - micro interactions - age-responsive design - interstitial anxiety - VR interfaces Vs normal interfaces - Modern concepts of UI/UX.

Generative AI: Definition - Working principle - Model Types - Applications.

AWS Cloud Practitioner: Introduction - AWS services - SDKs Vs APIs - AWS Management Console - Infrastructure as Code (IaC) - Deployment and Management - Serverless Computing - Data Storage and Analytics.

Total: 45 Hours

G.Learning Resources

i.Text Books:

1. "Software Engineering: A Practitioner's Approach" by Roger S. Pressman is published by McGraw-Hill Education. September 2021 , 9th edition. [Unit - 1]
2. UNIX and Linux System Administration Handbook" is published by Pearson and the 5th edition was published in 2017. [Unit - 1]
3. "Introduction to Java Programming and Data Structures, Comprehensive Version" (12th Edition) By Y. Daniel Liang, Pearson in 2018. [Unit - 1 & 2]
4. APIs: A Strategy Guide" by Daniel Jacobson, Greg Brail, and Dan Woods, O'Reilly Media, Inc.December 2011. [Unit - 2]
5. JavaScript: The Definitive Guide, 7th Edition. by David Flanagan. Released May 2020. Publisher(s): O'Reilly Media, Inc. [Unit - 3]
6. Database System Concepts" by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan 7th edition McGraw-Hill Education. [Unit - 4]
7. "Don't Make Me Think: A Common Sense Approach to Web Usability" by Steve Krug 3rd edition by New Riders. [Unit - 5]
8. AWS Certified Cloud Practitioner Study Guide" 2nd Edition by Sybex. [Unit - 5]

ii.Reference Books:

1. H.M. Deitel and P.J. Deitel," Java How to Program", Pearson Prentice Hall Seventh edition, 2018.
2. E. Balaguruswamy, "Programming in java", Sixth Edition, Tata McGraw Hill, 2019.
3. Mary Delamater, "Murach's JavaScript and jQuery (4th Edition) Paperback – Illustrated", Mike Murach& Associates Inc, August 26, 2020.
4. Elmasri Ramez, Navathe S, "Fundamentals of Database System", Seventh Edition, Pearson, 2017.
5. The Design of Everyday Things: Revised and Expanded Edition by Don Norman.
6. Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud by Mark Wilkins.

iii. Online References:

1. "Java Tutorial", June 20, 2023 [Online], Available: https://www.javatpoint.com/java-tutorial
2. "Programming in Java", Accessed on: June 20, 2023 [Online], Available: https://nptel.ac.in/courses/106/105/106105191/
3. "UI / UX Design Tutorial – Wireframe, Mockup & Design in Figma " https://www.youtube.com/watch?v=c9Wg6Cb_YlU
4. Get started with Amazon EC2 Linux instances https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/EC2_GetStarted.html
5. " AWS EC2 Instances | How to Create AWS EC2 Instance | AWS EC2 Tutorial For Beginner" https://www.youtube.com/watch?v=LZXWlF5udYs

ANNEXURE-VI

To discuss and approve the courses to be offered in Online MOOCs platforms under Open Elective & Program Elective Category for B.Tech CSE under regulation VTR UGE 2021 during the summer 2024-2025.

OPEN ELECTIVE

S.No	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1.	10213CS442	Social Networks	NPTEL	12	3
2.	10213CS443	Introduction to Industry 4.0 and Industrial Internet of Things	NPTEL	12	3
3.	10213CS444	Responsible & Safe AI Systems	NPTEL	12	3
4.	10213CS445	Python for Data Science	NPTEL	4	1
5.	10213CS446	Google Cloud Computing Foundations	NPTEL	8	2
6.	10213CS447	Introduction to Internet of Things	NPTEL	12	3
7.	10213CS448	Machine Learning for Engineering	NPTEL	12	3

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10213CS442	Social Networks	12	-	3

Course Category: Independent Learning (Self - Learning Course)

Course Contents

Week 1: Introduction
Week 2: Handling Real-world Network Datasets
Week 3: Strength of Weak Ties
Week 4: Strong and Weak Relationships (Continued) & Homophily
Week 5: Homophily Continued and +Ve / -Ve Relationships
Week 6: Link Analysis
Week 7: Cascading Behaviour in Networks
Week 8: Link Analysis (Continued)
Week 9: Power Laws and Rich-Get-Richer Phenomena
Week 10: Power law (contd..) and Epidemics
Week 11: Small World Phenomenon
Week 12: Pseudocore (How to go viral on web)

Course Provider : NPTEL

Professor : Prof. Sudarshan Iyengar

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10213CS443	Introduction to Industry 4.0 and Industrial Internet of Things	12	-	3

Course Category: Independent Learning (Self - Learning Course)

Course Contents

Week 1 : Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II

Week 2 : Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

Week 3 : Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis

Week 4 : Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

Week 5 : IIoT-Introduction, Industrial IoT: Business Model and Referece Architerture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.

Week 6 : Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

Week 7 : Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.

Week 8 : Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

Week 9 : Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II.

Week 10 : Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

Week 11 : Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Week 12 : Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies :
Case study - I : Milk Processing and Packaging Industries
Case study - II: Manufacturing Industries - Part I
Case study - III : Manufacturing Industries - Part II
Case study - IV : Student Projects - Part I
Case study - V : Student Projects - Part II
Case study - VI : Virtual Reality Lab
Case study - VII : Steel Technology Lab

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10213CS445	Python for Data Science	4	-	1

Course Category: Independent Learning (Self - Learning Course)

Course Contents

Week 1:

BASICS OF PYTHON SPYDER (TOOL)

- Introduction Spyder
- Setting working Directory
- Creating and saving a script file
- File execution, clearing console, removing variables from environment, clearing environment
- Commenting script files
- Variable creation
- Arithmetic and logical operators
- Data types and associated operations

Week 2:

Sequence data types and associated operations

- Strings
- Lists
- Arrays
- Tuples
- Dictionary
- Sets
- Range

NumPy

- ndArray

Week 3:

Pandas dataframe and dataframe related operations on Toyota Corolla dataset

1. Reading files
2. Exploratory data analysis
3. Data preparation and preprocessing

Data visualization on Toyoto Corolla dataset using matplotlib and seaborn libraries

1. Scatter plot
2. Line plot
3. Bar plot
4. Histogram
5. Box plot
6. Pair plot

Control structures using Toyota Corolla dataset

1. if-else family
2. for loop
3. for loop with if break
4. while loop

Functions

Week 4: CASE STUDY

Regression

1. Predicting price of pre-owned cars

Classification

1. Classifying personal income

Course Provider : NPTEL
Professor : Prof Ragunathan Rengasamy

University : IIT Madras

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10213CS446	Google Cloud Computing Foundations	8	-	2

Course Category: Independent Learning (Self - Learning Course)

Course Contents

Week 0 : Introduction to the course

Week 1 : So, What's the Cloud anyway? Start with a Solid Platform

Week 2 : Use GCP to build your Apps

Week 3 : Where do I store this stuff?

Week 4 : There's an API for that! You can't secure the Cloud right?

Week 5 : It helps to network!

Week 6 : It helps to network (continued)

Week 7 : Let Google keep an eye on things. You have the data, but what are you doing with it?

Week 8 : Let machines do the work

Course Provider : NPTEL
Professor : Prof. Soumya Kanti Ghosh

University : IIT Kharagpur

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10213CS444	Responsible & Safe AI Systems	12	-	3

Course Category: Independent Learning (Self - Learning Course)

Course Contents

Week 1 & 2:
AI Capabilities Improvement in last 5-10 years

- Imminent risks from AI Models: Toxicity, bias, goal misspecification, adversarial examples etc.
- Long-term risks from AI Models: Misuse, Misgeneralization, Rogue AGI
- Principles of RAI - Transparency; Accountability; Safety, Robustness and Reliability;Privacy and Security; Fairness and non-discrimination; Human-Centred Values; Inclusive
and Sustainable development, Interpretability
- Recap of Deep Learning Techniques, Language/Vision Models
- AI Risks for Gen models
- Adversarial Attacks – Vision, NLP, Superhuman Go agents

Week 3 & 4:

- ML Poisoning Attacks like Trojans
- Implications for current and future AI safety
- Explainability
- Imminent and Long-term potential for transparency techniques
- Mechanistic Interpretability
- Representation Engineering, model editing and probing
- Critiques of Transparency for AI Safety

Week 5 & 6:

Privacy & Fairness in AI

Week 7 & 8:

- Metrics and Tools for RAI - measuring bias/fairness, adversarial testing, explanations (Lime/SHAP/GradCam), audit mechanisms
- Regulation landscape - DPDP act (India), GDPR (EU), EU AI act, US presidential declaration, Ethical approvals, informed consent, participatory design, future of work, Indian context
- What is AGI? When could it be achieved?
- Instrumental Convergence: Power Seeking, Deception etc.

Week 9 & 10:

- RAI in Legal domain
- RAI in Health care domain
- RAI in Education domain
- A few other domains
- Policy issues in RAI

Week 11 & 12:

- Couple of panel discussion with industry practitioners, academic, government (possibly), and others.
- Fireside chat with eminent personalities
- Recorded Paper reading discussion

Course Provider : NPTEL
Professor : Prof Ponnurangam Kumaraguru

Prof Balaraman Ravindran
Prof Arun Rajkumar

University : IIIT Hyderabad
IIT Madras

PROGRAM ELECTIVE

S.No	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1.	10212CS401	Social Networks	NPTEL	12	3
2.	10212CS402	Design & Implementation of Human-Computer Interfaces	NPTEL	12	3
3.	10212CS403	Introduction to Industry 4.0 and Industrial Internet of Things	NPTEL	12	3
4.	10212CS404	Reinforcement Learning	NPTEL	12	3
5.	10212CS405	Responsible & Safe AI Systems	NPTEL	12	3
6.	10212CS406	Deep Learning for Computer Vision	NPTEL	12	3
7.	10212CS407	Practical Cyber Security for Cyber Security Practitioners	NPTEL	12	3
8.	10212CS408	Software Testing	NPTEL	12	3

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10212CS401	Social Networks	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1: Introduction
Week 2: Handling Real-world Network Datasets
Week 3: Strength of Weak Ties
Week 4: Strong and Weak Relationships (Continued) & Homophily
Week 5: Homophily Continued and +Ve / -Ve Relationships
Week 6: Link Analysis
Week 7: Cascading Behaviour in Networks
Week 8: Link Analysis (Continued)
Week 9: Power Laws and Rich-Get-Richer Phenomena
Week 10: Power law (contd..) and Epidemics
Week 11: Small World Phenomenon
Week 12: Pseudocore (How to go viral on web)

Course Provider : NPTEL
Professor : Prof. Sudarshan Iyengar

University : IIT Ropar

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10212CS402	Design & Implementation of Human-Computer Interfaces	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1: Introduction
Week 2: Identification of usability requirements I
Week 3: Identification of usability requirements II
Week 4: Usable interface design
Week 5: Rapid usability evaluation
Week 6: Converting design to system I
Week 7: Converting design to system II
Week 8: System implementation I
Week 9: System implementation II
Week 10: System implementation III
Week 11: Empirical usability evaluation
Week 12: Conclusion

Course Provider : NPTEL
Professor : Prof. Samit Bhattacharya

University : IIT Guwahati

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10212CS403	Introduction to Industry 4.0 and Industrial Internet of Things	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1 : Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II

Week 2 : Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

Week 3 : Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis

Week 4 : Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

Week 5 : IIoT-Introduction, Industrial IoT: Business Model and Referece Architerture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.

Week 6 : Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

Week 7 : Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.

Week 8 : Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

Week 9 : Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II.

Week 10 : Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in

IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

Week 11 : Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Week 12 : Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies :
Case study - I : Milk Processing and Packaging Industries
Case study - II: Manufacturing Industries - Part I
Case study - III : Manufacturing Industries - Part II
Case study - IV : Student Projects - Part I
Case study - V : Student Projects - Part II
Case study - VI : Virtual Reality Lab
Case study - VII : Steel Technology Lab

Course Provider : NPTEL
Professor : Prof Sudip Misra

University : IIT Kharagpur

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10212CS404	Reinforcement Learning	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1 : Introduction
Week 2 : Bandit algorithms – UCB, PAC
Week 3 : Bandit algorithms –Median Elimination, Policy Gradient
Week 4 : Full RL & MDPs
Week 5 : Bellman Optimality
Week 6 : Dynamic Programming & TD Methods
Week 7 : Eligibility Traces
Week 8 : Function Approximation
Week 9 : Least Squares Methods
Week 10 : Fitted Q, DQN & Policy Gradient for Full RL
Week 11 : Hierarchical RL
Week 12 : POMDPs

Course Provider : NPTEL
Professor : Prof. Balaraman Ravindran

University : IIT Madras

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10212CS405	Responsible & Safe AI Systems	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1 & 2:

- AI Capabilities Improvement in last 5-10 years
- Imminent risks from AI Models: Toxicity, bias, goal misspecification, adversarial examples etc.
- Long-term risks from AI Models: Misuse, Misgeneralization, Rogue AGI
- Principles of RAI - Transparency; Accountability; Safety, Robustness and Reliability;Privacy and Security; Fairness and non-discrimination; Human-Centred Values; Inclusive and Sustainable development, Interpretability
- Recap of Deep Learning Techniques, Language/Vision Models
- AI Risks for Gen models
- Adversarial Attacks – Vision, NLP, Superhuman Go agents

Week 3 & 4:

- ML Poisoning Attacks like Trojans
- Implications for current and future AI safety
- Explainability
- Imminent and Long-term potential for transparency techniques
- Mechanistic Interpretability
- Representation Engineering, model editing and probing
- Critiques of Transparency for AI Safety

Week 5 & 6:

- Privacy & Fairness in AI

Week 7 & 8:

- Metrics and Tools for RAI - measuring bias/fairness, adversarial testing, explanations (Lime/SHAP/GradCam), audit mechanisms
- Regulation landscape - DPDP act (India), GDPR (EU), EU AI act, US presidential declaration, Ethical approvals, informed consent, participatory design, future of work, Indian context
- What is AGI? When could it be achieved?
- Instrumental Convergence: Power Seeking, Deception etc.

Week 9 & 10:

- RAI in Legal domain
- RAI in Health care domain
- RAI in Education domain
- A few other domains
- Policy issues in RAI

Week 11 & 12:

- Couple of panel discussion with industry practitioners, academic, government (possibly), and others.
- Fireside chat with eminent personalities
- Recorded Paper reading discussion

Course Provider : NPTEL
Professor : Prof Ponnurangam Kumaraguru

Prof Balaraman Ravindran
Prof Arun Rajkumar

University : IIIT Hyderabad
IIT Madras

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10212CS406	Deep Learning for Computer Vision	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1: Introduction and Overview:

● Course Overview and Motivation; History of Computer Vision; Image Representation; Linear Filtering, Correlation, Convolution; Image in Frequency Domain

● (Optional) Image Formation; Image Sampling

Week 2: Visual Features and Representations:

● Edge Detection; From Edges to Blobs and Corners; Scale Space, Image Pyramids and Filter Bank; SIFT and Variants; Other Feature Spaces

● (Optional) Image Segmentation, Human Visual System

Week 3: Visual Matching:

● Feature Matching; From Points to Images: Bag-of-Words and VLAD Representations; Image Descriptor Matching; From Traditional Vision to Deep Learning

● (Optional) Hough Transform; Pyramid Matching

Week 4: Deep Learning Review:

● Neural Networks: A Review; Feedforward Neural Networks and Backpropagation; Gradient Descent and Variants; Regularization in Neural Networks; Improving Training of Neural Networks

Week 5: Convolutional Neural Networks (CNNs):

● Convolutional Neural Networks: An Introduction; Backpropagation in CNNs; Evolution of CNN Architectures for Image Classification; Recent CNN Architectures; Finetuning in CNNs

Week 6: Visualization and Understanding CNNs:

● Explaining CNNs: Visualization Methods; Early Methods (Visualization of Kernels; Backprop-to-image/Deconvolution Methods); Class Attribution Map Methods (CAM,Grad-

CAM, Grad-CAM++, etc); Going Beyond Explaining CNNs

● (Optional) Explaining CNNs: Recent Methods

Week 7: CNNs for Recognition, Verification, Detection, Segmentation:

● CNNs for Object Detection; CNNs for Segmentation; CNNs for Human Understanding: Faces

● (Optional) CNNs for Human Understanding: Human Pose and Crowd; CNNs for Other Image Tasks

Week 8: Recurrent Neural Networks (RNNs):

● Recurrent Neural Networks: Introduction; Backpropagation in RNNs; LSTMs and GRUs; Video Understanding using CNNs and RNNs

Week 9: Attention Models:

● Attention in Vision Models: An Introduction; Vision and Language: Image Captioning; Self-Attention and Transformers

● (Optional) Beyond Captioning: Visual QA, Visual Dialog; Other Attention Models

Week 10: Deep Generative Models:

● Deep Generative Models: An Introduction; Generative Adversarial Networks; Variational Autoencoders; Combining VAEs and GANs

● (Optional) Beyond VAEs and GANs: Other Deep Generative Models

Week 11: Variants and Applications of Generative Models in Vision:

● GAN Improvements; Deep Generative Models across Multiple Domains; Deep Generative Models: Image Application

● (Optional) VAEs and Disentanglement; Deep Generative Models: Video Applications

Week 12:Recent Trends:

● Few-shot and Zero-shot Learning; Self-Supervised Learning; Adversarial Robustness; Course Conclusion

● (Optional) Pruning and Model Compression; Neural Architecture Search

Course Provider : NPTEL
Professor : Prof. Vineeth N Balasubramanian

University : IIT Hyderabad

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10212CS407	Deep Learning for Computer Vision	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1: Introduction: Cyber Security Posture, Maturity, and Continuous Improvement Strategies
Week 2: Knowing your attacker: MITRE ATT&CK Framework
Week 3: Knowing your attacker: MITRE ATT&CK Framework
Week 4: Cyber Kill Chains: Lockheed Martin Cyber Kill Chain and Unified Kill Chain
Week 5: Defending Yourself: MITRE DEF3ND Framework
Week 6: Securing your Configurations: STIG Benchmarking
Week 7: Sharing Threat Intelligence: STIX and TAXII 2.0
Week 8: Cyber Security Risk Management
Week 9: Cyber Resilience Assessment
Week 10: Cyber Security Policy Formulation
Week 11: Cyber Security Policy Formulation
Week 12: Cyber Crisis Management Plan and Cyber Incident Management Plan

Course Provider : NPTEL
Professor : Prof. Sandeep K. Shukla

University : IIT Hyderabad

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10212CS408	Software Testing	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1: Techniques and algorithms for test case design: Graphs based testing- structural coverage criteria.
Week 2: Graphs based testing: Data flow coverage criteria
Week 3: Graphs based testing: Data flow coverage criteria
Week 4: Graphs coverage for source code, design elements and requirements
Week 5: Techniques and algorithms for test case design: Logic based testing- Predicates, logic based coverage criteria
Week 6: Specification based logic coverage, logic coverage on finite state machines
Week 7: Input space partitioning: Input domain modeling, combination strategies criteria
Week 8: Syntax based testing: Coverage criteria based on syntax, mutation testing
Week 9: Test case design (as learnt above) applied to object-oriented applications
Week 10: Test case design (as learnt above) applied to web applications
Week 11: Symbolic testing
Week 12: Concolic testing, Conclusion

Course Provider : NPTEL
Professor : Prof. Meenakshi D'souza

University : IIIT Bangalore

Annexure-VII

To discuss and approve the new courses under Program Elective category, to be offered in following PG programmes under the regulation VTR PGE 2023 keeping in view of AICTE and National Education Policy (NEP) 2020 and employability skills to be implemented with effect from the academic year 2024-2025

1. M.Tech Computer Science and Engineering

S. No	Subject Code	Course Name	L	T	P	C
1	20232CS201	Deep Learning	3	0	2	4
2	20232CS202	Big Data Analytics	3	0	2	4
3	20232CS203	Computer Vision	3	0	2	4
4	20232CS204	Soft Computing	3	0	2	4
5	20232CS205	Natural Language Processing	3	0	2	4
6	20232CS206	Cryptography and Network Security	3	0	2	4
7	20232CS207	Digital Forensics*	3	0	2	4
8	20232CS208	Ethical Hacking*	3	0	2	4
9	20232CS209	Quantum Computing*	3	0	2	4
10	20232CS210	Cognitive Computing*	3	0	2	4
11	20232CS101	Agile Methodologies*	2	0	0	2
12	20232CS102	Data Privacy and Security	2	0	0	2

2. M.Tech Big Data Analytics

S. No	Course Code	Course Name	L	T	P	C
1	20232CS201	Deep Learning	3	0	2	4
2	20232CS205	Natural Language Processing	3	0	2	4
3	20232CS206	Computer Vision	3	0	2	4
4	20232CS211	Data Visualization	3	0	2	4
5	20232CS212	Data Science	3	0	2	4
6	20232CS213	Healthcare Analytics*	3	0	2	4

7	20232CS214	Time series and Forecasting*	3	0	2	4
8	20232CS215	Image and Video Analytics*	3	0	2	4
9	20232CS101	Agile Methodologies*	2	0	0	2
10	20232CS102	Data Privacy and Security	2	0	0	2

COURSE CODE	COURSE TITLE	L	T	P	C
20232CS212	Data Science	3	0	2	4

A. Preamble

Data science is a multidisciplinary field that uses scientific methods, processes, algorithms, and systems to extract insights and knowledge from structured and unstructured data. It combines expertise from various domains such as statistics, mathematics, computer science, and domain-specific knowledge to analyze and interpret complex data sets.

B. Prerequisite Course

20231CS101 - Probability and Statistics

C. Course Objectives

Learners are exposed to:

- Identify general statistical techniques for data analysis
- Determine how to summarize data to present information using statistics.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Acquire and clean diverse datasets, and execute exploratory data analysis to visualize the data.	K3
CO2	Apply probability and statistics, implement regression analysis, and interpret results for informed decision-making.	K3
CO3	Implement supervised learning algorithms to train and evaluate the model.	K3
CO4	Interpret feature engineering, optimize models, and apply time series analysis for forecasting.	K3
CO5	Use data science for decision-making, culminating in a comprehensive capstone project considering emerging trends and ethical considerations.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of Cos with Program Outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2		3				2			3	2
CO2	3	2	2		3				2			3	2

CO3	3	2	2		2				2			2	2
CO4	2	2	2		3				2				2
CO5	2	2	2		2				2				2

3- High; 2-Medium; 1-Low

F. Course Contents

UNIT – I Introduction to Data Science L-9

Overview of Data Science: Definition and scope of data science-Historical perspective and evolution-Applications in various industries- Data Acquisition and Cleaning: Data sources and types-Data collection methods-Data cleaning and preprocessing techniques-Exploratory data Analysis: Descriptive statistics- Data visualization techniques-EDA tools and practices.

UNIT – II Statistical Foundations for Data Science L-9

Probability and Statistics: Probability distributions-Statistical inference-Hypothesis testing- Regression Analysis: Simple and multiple regression-Model evaluation and interpretation-Practical applications- Apply regression analysis for modeling relationships in data.

UNIT – III Machine Learning Basics L-9

Introduction to Machine Learning: Types of machine learning (supervised, unsupervised, reinforcement learning)-Model training and evaluation-Supervised Learning Algorithms: Linear regression, decision trees, and random forests-Support Vector Machines (SVM)-Neural networks and deep learning basics

UNIT – IV Feature Engineering and Model Optimization L-9

Feature selection and extraction-Hyper parameter tuning-Cross-validation techniques- Time Series Analysis-Time series data characteristics-Forecasting methods-Seasonality and trend analysis

UNIT – V Data Science for Decision Making L-9

Decision Support Systems (DSS):Introduction to decision support systems-Components and architecture of DSS-Role of data science in enhancing decision support systems -Business Intelligence and Analytics: Overview of business intelligence (BI)-Key performance indicators (KPIs) and metrics-Data visualization for business insights

Total: 45 Hours

G. Laboratory Experiments Total: 30 Hours

Part - 1

Task 1 Implement a Python program for acquiring and cleaning a dataset using the pandas library.
Task 2. Perform exploratory data analysis using descriptive statistics and visualization techniques

Task 3 Use Python to calculate probability and statistical analysis.
Task 4 Use Python to apply regression analysis techniques and evaluate models.
Task 5 Develop a model to gain hands-on experience in understanding types of machine learning and the basic process of model training.
Task 6 Implement three different classification algorithms, such as Support Vector Machines (SVM), Decision Trees, and Random Forest.Train each algorithm on 70% of the dataset and evaluate their performance on the remaining 30%. Use metrics such as accuracy, precision, recall, and F1 score for evaluatio
Task 7 Explore the impact of hyperparameter tuning on the performance of each algorithm and discuss any observed improvements or trade-offs.
Task 8 Initiate the exploration of the historical sales data, utilizing visualizations to uncover patterns, trends, and potential seasonality embedded in the dataset.
Task 9 Design and implement a basic decision support system using Python to assist in optimizing investment strategies.
Task 10 Apply analytics techniques using NumPy and SciPy to derive meaningful insights from the sales data. How can statistical analysis help identify sales patterns, correlations, and outliers within the dataset?

Tools- Jupyter Notebook, Google Colab

Libraries – NumPy, SciPy, Pandas, Matplotlib, Seaborn

Part-2 Use Cases:

Use Case – 1: A regional healthcare provider aims to improve patient care and resource allocation. The decision support system is designed to assist healthcare professionals in making informed decisions..
Use Case – 2: A retail company wants to boost sales and enhance its overall business strategy. The BI system is used to analyze sales performance and identify areas for improvement.
Use Case – 3: A financial institution aims to enhance its fraud detection capabilities. The DSS is designed to analyze transaction data and identify potential fraudulent activities.
Use Case – 4: A manufacturing company seeks to optimize its production processes. The DSS is designed to analyze data from the production line and provide insights for process improvement.
Use Case – 5: A telecommunications company wants to reduce customer churn and enhance customer satisfaction. The BI system is used to analyze customer data and develop strategies for retention.

Total:75 Hours

G. Learning Resources

i. Text books:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.

2. Data Science for Business by Foster Provost, Tom Fawcett Released August 2013, Publisher(s): O'Reilly Media, Inc.ISBN: 9781449361327

ii. Reference books:

1. Alice Zheng and Amanda Casari. 2018. Feature Engineering for Machine Learning: Principles and Techniques for Data Scientists (1st. ed.). O'Reilly Media, Inc.
2. Time Series Analysis and Its Applications: With R Examples" by Robert H. Shumway and David S. Stoffer, 2017.

iii. Online Reference Links/ Resources:

1. Data Science for Engineers - Course (nptel.ac.in)
2. Applied Data Science with Python Specialization [5 courses] (UMich) | Coursera

COURSE CODE	COURSE TITLE	L	T	P	C
20232CS205	Natural Language Processing	3	0	2	4

A. Preamble

Natural language processing deals with written text. Students will learn how to process written text from basic of fundamental knowledge starts with Finite automata, Regular expression and probabilistic model with n-grams. This course also covers basis of semantic analysis and discourse analysis and drives it to machine translation

B. Prerequisite Courses

Data Structures

C. Course Objectives (verbs)

Student will be able to

- Provide the student with knowledge of various levels of analysis involved in NLP
- Understand the applications of NLP
- Gain knowledge in automated Natural Language Generation and Machine Translation
- Understand Deep learning concepts for NLP.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

COs	Course Outcomes	K-Level
CO1	Comprehend the fundamental concepts of Natural Language Processing.	K3
CO2	Apply the concept of Probabilistic model of defining language and POS tagging for NLP applications	K3
CO3	Develop the Syntactic parser and Semantic Parser for Translation for word forms	K3
CO4	Interpret the concept of text analysis, summarization and extractions for Information Extraction.	K3
CO5	Apply the concepts of machine translation and deep learning for NLTK Modelling.	K3

Knowledge Level (Based on revised Bloom's Taxonomy)

K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2		2	2			2	
CO2	2		2	2			2	2
CO3	2		2	2			2	2
CO4	2		2	2			2	2
CO5	2		2	2			2	2

H- Strong; M-Medium; L-Low

F. Course Contents

Unit 1 Introduction to Natural Language Processing L-9 Hours

History of NLP, Components of NLP, Applications of NLP, Phases of NLP, NLP APIs, NLP Libraries, Knowledge in Speech and Language processing, Ambiguity and models and algorithm,language and understanding,brief history. Regular Expressions, Extracting Terms from Tokens, Vector Space Representation and Normalization, Similarity Computation in Text

Unit 2 Language Modelling and Part-of-Speech (POS) Tagging L-9 Hours

Unigram Language Model, , Counting Words in Corpora, Simple (Unsmoothed) N-grams, Smoothing, Back off, Deleted Interpolation, N-grams for Spelling and Pronunciation, Entropy Natural Language Generation, Parts of Speech Tagging, Morphology, Named Entity Recognition, Overview of Hidden Markov Models.

Unit 3 Words and Word Forms L-9 Hours

Context-Free Grammars for English, Lexicalized and Probabilistic Parsing, Semantic Analysis, Lexical Semantics, WordNet: A Database of Lexical Relations, Bag of words, skip-gram, Continuous Bag-Of-Words, Embedding representations for words Lexical Semantics, WordSense Disambiguation, Knowledge Based and Supervised Word Sense Disambiguation

Unit 4 Text Analysis, Summarization and Extractions L-9 Hours

Sentiment Mining, Entity Linking, Text Classification, LDA & Factorization - Text Summarization, Information Extraction, Named Entity Recognition, Relation Extraction, Question Answering in Multilingual Setting; NLP in Information Retrieval, Vector space model, Cross-Lingual IR

Unit 5 Machine Translation and Deep Learning L-9 Hours

Need of MT, Problems of Machine Translation, MT Approaches, Statistical Machine Translation (SMT), Parameter learning in SMT (IBM models) using EM, Encoder-decoder architecture, Neural Machine Translation Statistical Language Models, Kernel Methods, Word-ContextMatrix Factorization Models, Neural Language Models, Recurrent Neural Networks, SentimentAnalysis, Opinion Mining.

Total: 45 Hours

Lab Task: 30 Hours

Part - I

1. Introduction to Python NLTK. **spaCy,**Libraries (CO1)
2. Performing Word Analysis – NLTK &spaCy (CO1)
3. Analyze algorithms for Word Generation - NLTK &spaCy(CO2)
4. Morphology is important factor for word Embedding. Develop algorithms for finding morphology of Word Documents. NLTK &spaCy, Gensim (CO3)
5. Develop N-Grams for Word Document - NLTK &spaCy, Gensim (CO3)

6. Perform N-Grams Smoothing in Word Documents - NLTK &spaCy, Gensim (CO3)
7. Explore the POS Tagging using Hidden Markov Model - NLTK &spaCy, Gensim (CO3)
8. Use POS Tagging using Viterbi Decoding - NLTK (CO4)
9. Building POS Tagger for unstructured Web Documents [PyTorch, Keras] (CO4)
10. Chunking for Web Documents [PyTorch, Keras] (CO5)
11. Building Chunker for Web Documents [PyTorch, Keras] (CO5)
12. Python Visualizations Libraries – matplotlib, seaborne (CO5)

Part – II [CO1 – CO5]

13. Game Winning Prediction (Cricket)
14. Machine Translation from English-Hindi.
15. Query Expansion for Information Retrieval.
16. Emotion detection for texts.
17. Semantic Search Engine for Indian Languages.
18. Large Hindi Corpora
19. Crisp Query relevant Summary of each retrieved webpage
20. Semantic Query-Webpage Relevance

Total Hours: 75 Hours

G. Learning Resources (in IEEE Format)

i. Text Books:

1. Daniel Jurafsky, James H. Martin, –Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech‖,, Pearson Publication, 2014.(All 5 Units)
2. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python‖, First Edition, O_Reilly Media, 2009.

ii. Reference Books:

1. Breck Baldwin, –Language Processing with Java and LingPipe Cookbook‖, Atlantic Publisher, 2015
2. Charu C.Aggarwal, ―Machine Learning for Text‖- by Springer,2018 edition
3. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.

iii. Online References:

1. –Natural Language Processing‖, Mar. 2015. Accessed on: Apr. 16, 2021 [Online]: https://onlinecourses.nptel.ac.in/noc19_cs56
2. –Natural Language Processing‖ Jun 2016. Accessed on: Apr. 16, 2021 [Online]. https://www.udacity.com/course/natural-language-processingnanodegree
3. –Natural Language Processing‖ Jul. 2, 2018. Accessed on: Apr. 16, 2021 [Online]. https://www.coursera.org/learn/language-processing

ANNEXURE-VIII

To discuss and approve the courses to be offered in Online MOOCs platforms under independent Learning Category (MOOCs) during the Summer 2024-2025 for PG programmes.

S.No.	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1.	20234CS401	Research Methodology	NPTEL	8	2
2.	20234CS402	Business English: Basics	Coursera	8	2

COURSE CODE	COURSE TITLE	W	H	C
20234CS401	Research Methodology	8	-	2

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1 : A group discussion on what is research; Overview of research;
Week 2 : Literature survey , Experimental skills;
Week 3 : Data analysis, Modelling skills;
Week 4 : Technical writing; Technical Presentations; Creativity in Research
Week 5 : Creativity in Research; Group discussion on Ethics in Research
Week 6 : Design of Experiments
Week 7 : Intellectual Property
Week 8 : Department specific research discussions

Course Provider : NPTEL
Professor : Prof. Edamana Prasad
Prof. Prathap Haridoss

University : IIT Madras

COURSE CODE	COURSE TITLE	W	H	C
20234CS402	Business English- Basics	8	-	2

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1 : Welcome Module
Week 2 : Communication Basics
Week 3 : Genres and Styles
Week 4 : Audience and Purpose
Week 5 : Analyzing business cases
Week 6 : Concluding module

Course Provider : Coursera

ANNEXURE-IX

To discuss and approve the courses to be offered in Online MOOCs platforms under independent Learning under Open Elective Category (MOOCs) during the Summer 2024-2025 for PG programmes.

S.No.	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1.	20233CS407	Deep Learning for Computer Vision	NPTEL	12	3
2.	20233CS408	Responsible & Safe AI Systems	NPTEL	12	3
3.	20233CS409	Digital Image Processing	NPTEL	12	3

COURSE CODE	COURSE TITLE	W	H	C
20233CS407	Deep Learning for Computer Vision	12	-	3

Course Contents

Week 1: Introduction and Overview:

● Course Overview and Motivation; History of Computer Vision; Image Representation; Linear Filtering, Correlation, Convolution; Image in Frequency Domain

● (Optional) Image Formation; Image Sampling

Week 2: Visual Features and Representations:

● Edge Detection; From Edges to Blobs and Corners; Scale Space, Image Pyramids and Filter Bank; SIFT and Variants; Other Feature Spaces

● (Optional) Image Segmentation, Human Visual System

Week 3: Visual Matching:

● Feature Matching; From Points to Images: Bag-of-Words and VLAD Representations; Image Descriptor Matching; From Traditional Vision to Deep Learning

● (Optional) Hough Transform; Pyramid Matching

Week 4: Deep Learning Review:

● Neural Networks: A Review; Feedforward Neural Networks and Backpropagation; Gradient Descent and Variants; Regularization in Neural Networks; Improving Training of Neural Networks

Week 5: Convolutional Neural Networks (CNNs):

● Convolutional Neural Networks: An Introduction; Backpropagation in CNNs; Evolution of CNN Architectures for Image Classification; Recent CNN Architectures; Finetuning in CNNs

Week 6: Visualization and Understanding CNNs:

● Explaining CNNs: Visualization Methods; Early Methods (Visualization of Kernels; Backprop-to-image/Deconvolution Methods); Class Attribution Map Methods (CAM,Grad-CAM, Grad-CAM++, etc); Going Beyond Explaining CNNs

● (Optional) Explaining CNNs: Recent Methods

Week 7: CNNs for Recognition, Verification, Detection, Segmentation:

● CNNs for Object Detection; CNNs for Segmentation; CNNs for Human Understanding: Faces

● (Optional) CNNs for Human Understanding: Human Pose and Crowd; CNNs for Other Image Tasks

Week 8: Recurrent Neural Networks (RNNs):

● Recurrent Neural Networks: Introduction; Backpropagation in RNNs; LSTMs and GRUs; Video Understanding using CNNs and RNNs

Week 9: Attention Models:

● Attention in Vision Models: An Introduction; Vision and Language: Image Captioning; Self-Attention and Transformers

● (Optional) Beyond Captioning: Visual QA, Visual Dialog; Other Attention Models

Week 10: Deep Generative Models:

● Deep Generative Models: An Introduction; Generative Adversarial Networks; Variational Autoencoders; Combining VAEs and GANs

● (Optional) Beyond VAEs and GANs: Other Deep Generative Models

Week 11: Variants and Applications of Generative Models in Vision:

● GAN Improvements; Deep Generative Models across Multiple Domains; Deep Generative Models: Image Application

● (Optional) VAEs and Disentanglement; Deep Generative Models: Video Applications

Week 12:Recent Trends:

● Few-shot and Zero-shot Learning; Self-Supervised Learning; Adversarial Robustness; Course Conclusion

● (Optional) Pruning and Model Compression; Neural Architecture Search

Course Provider	**:**	NPTEL
Professor	**:**	Prof. Vineeth N Balasubramanian
University	**:**	IIT Hyderabad

COURSE CODE	COURSE TITLE	W	H	C
20233CS408	Responsible & Safe AI Systems	12	-	3

Course Contents

Week 1 & 2:

- AI Capabilities Improvement in last 5-10 years
- Imminent risks from AI Models: Toxicity, bias, goal misspecification, adversarial examples etc.
- Long-term risks from AI Models: Misuse, Misgeneralization, Rogue AGI
- Principles of RAI - Transparency; Accountability; Safety, Robustness and Reliability;Privacy and Security; Fairness and non-discrimination; Human-Centred Values; Inclusive
  and Sustainable development, Interpretability
- Recap of Deep Learning Techniques, Language/Vision Models
- AI Risks for Gen models
- Adversarial Attacks – Vision, NLP, Superhuman Go agents

Week 3 & 4:

- ML Poisoning Attacks like Trojans
- Implications for current and future AI safety
- Explainability
- Imminent and Long-term potential for transparency techniques
- Mechanistic Interpretability
- Representation Engineering, model editing and probing
- Critiques of Transparency for AI Safety

Week 5 & 6:

- Privacy & Fairness in AI

Week 7 & 8:

- Metrics and Tools for RAI - measuring bias/fairness, adversarial testing, explanations (Lime/SHAP/GradCam), audit mechanisms
- Regulation landscape - DPDP act (India), GDPR (EU), EU AI act, US presidential declaration, Ethical approvals, informed consent, participatory design, future of work, Indian context
- What is AGI? When could it be achieved?
- Instrumental Convergence: Power Seeking, Deception etc.

Week 9 & 10:

- RAI in Legal domain
- RAI in Health care domain
- RAI in Education domain
- A few other domains
- Policy issues in RAI

Week 11 & 12:

- Couple of panel discussion with industry practitioners, academic, government (possibly), and others.
- Fireside chat with eminent personalities
- Recorded Paper reading discussion

Course Provider : NPTEL
Professor : Prof Ponnurangam Kumaraguru

Prof Balaraman Ravindran
Prof Arun Rajkumar

University : IIIT Hyderabad
IIT Madras

COURSE CODE	COURSE TITLE	W	H	C
20233CS409	Digital Image Processing	12	-	3

Course Contents

Week 1: Introduction and signal digitization
Week 2: Pixel relationship
Week 3: Camera models & imaging geometry
Week 4: Image interpolation
Week 5: Image transformation
Week 6: Image enhancement I
Week 7: Image enhancement II
Week 8: Image enhancement III
Week 9: Image restoration I
Week 10: Image restoration II & Image registration
Week 11: Colour image processing
Week 12: Image segmentation
Week 13: Morphological image processing
Week 14: Object representation ,description and recognition

Course Provider : NPTEL
Professor : Prof. Prabir Kumar Biswas
University : IIT Kharagpur

ANNEXURE-X

Ratification of courses offered by Industry Experts for B.Tech CSE for Skill enhancement and Employment opportunities under Industry/Higher Institute Interaction Learning Category during the Winter Semester of academic year 2023-2024 for B.Tech CSE

Sno	Course code	Course title	Credit
1.	10215CS928	Computer Vision with Deep Learning	1
2.	10215CS922	Chip Design	1
3.	10215CS923	Programming for Data Analytics	1
4.	10215CS924	IoS Application Creation	1
5.	10215CS925	Programming for Data Analytics	1
6.	10215CS926	Data Science in Health Care	1
7.	10215CS927	ML Ops	1
8.	10215CS928	Fundamentals of MEMS	1
9.	10215CS929	Generative AI	1
10.	10215CS930	Cognitive Computing and Applications	1

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS928	Computer Vision with Deep Learning	1	-	-	1

- **COURSE CATEGORY**

  Industry / Institute Higher Learning

- **COURSE CONTENT**

  - Introduction to Deep Learning and Convolutional Neural Networks (CNN)
  - Different deep learning architectures
  - Data Augmentation
  - Transfer Learning
  - Ideas to make a successful deep learning model in computer vision
  - Generative Adversarial Networks (GAN)
  - Computer vision works in medical domain (a real time application)

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS922	Chip Design	1	-	-	1

- **COURSE CATEGORY**

  Industry / Institute Higher Learning

- **COURSE CONTENT**

1. Basics of Chip Design
2. High Level Programming concepts
3. Introduction to Linux AI server construction

   Install CUDA for GPU Acceleration

   Discuss Anaconda for Independent Environments
4. Fast Prototyping

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS923	Programming for Data Analytics	1	-	-	1

- **COURSE CATEGORY**

  Industry / Institute Higher Learning

- **COURSE CONTENT**

  - Introduction to Python
  - Programming for Data Analysis Introduction
  - Data cleaning and transformation
  - Data normalization and analysis
  - Classification
  - Correlation
  - Regression analysis
  - Cluster analysis
  - Deep Learning (Convolutional Neural Networks)

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS924	IoS Application Creation	1	-	-	1

- **COURSE CATEGORY**

  Industry / Institute Higher Learning

- **COURSE CONTENT**

Basic Programming

- iOS Development installation and Demonstration
- Swift Programming
- UIKit Frameworks
- Application Demo Live
- Developing Live applications

- **COURSE CATEGORY**

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS925	Programming for Data Analytics	1	-	-	1

Industry / Institute Higher Learning

- **COURSE CONTENT**

- Introduction to Python
- Programming for Data Analysis Introduction
- Data cleaning and transformation
- Data normalization and analysis
- Classification
- Correlation
- Regression analysis
- Cluster analysis
- Deep Learning (Convolutional Neural Networks)

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS926	Data Science in Health Care	1	-	-	1

- **COURSE CATEGORY**

  Industry / Institute Higher Learning

- **COURSE CONTENT**

  - Module One – Introduction to Health Informatics & Data, Information, and Knowledge
  - Module Two – Healthcare IT & History of Healthcare Information System
  - Module Three – Medical Algorithms & Medical Decision Making
  - Module Four – Modeling and Simulations & Population Health
  - Module Five – Knowledge Management and Decision Making

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS927	ML Ops	1	-	-	1

- **COURSE CATEGORY**

  Industry / Institute Higher Learning

- **COURSE CONTENT**

- The Need for MLOps: Understanding a Data Science Project's Workflow
- The concept of DevOps in ML
- The three phases of the ML lifecycle and Automating the ML process
  Real-World Use Cases Of Successful MLOps Adoption
- Implementing MLOps as a Service and Enabling MLOps using a Private Cloud Infrastructure components of MLOps
  MLOps workflow with Redhat Openshift and Cloudera Data Platform

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS928	Fundamentals of MEMS	1	-	-	1

- **COURSE CATEGORY**

  Industry / Institute Higher Learning

- **COURSE CONTENT**

  - Introduction to MEMS and transducers
  - Thermal sensors
  - Pressure sensors
  - Accelerometers
  - Biosensors
  - Thermal actuators
  - Electrostatic and magnetic actuators
  - Optical MEMS technology
  - Microfluidic valves and pumps

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS929	Generative AI	1	-	-	1

- **COURSE CATEGORY**

  Industry / Institute Higher Learning

- **COURSE CONTENT**

  - Introduction to Deep Learning and Convolutional Neural Networks (CNN)
  - Generative AI
  - Transformers
  - BERT Model
  - Generative Pre- Trained Transformer

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS930	Cognitive Computing and Applications	1	-	-	1

- **COURSE CATEGORY**

  Industry / Institute Higher Learning

- **COURSE CONTENT**

  - Fundamentals of Cognitive Computing
  - Design Principles of Cognitive Computing
  - NLP in Cognitive Computing Systems
  - Representing Knowledge in Taxonomies and Ontologies
  - Learning and Reasoning
  - Case-based Reasoning
  - Incremental Learning
  - Analogical Reasoning
  - Ethical Issues of Cognitive Systems
  - Business Implications of Cognitive Systems

ANNEXURE-XI

Ratification of Value added Courses offered during the Winter Semester of academic year 2023-2024 for B.Tech CSE programme.

List of Courses

S No	Course Code	Course title	Total Hours
1	10218CS924	Big Data Analytics	30
2	10218CS925	Power BI Data Analytics	30
3	10218CS926	Data Visualization	30
4	10218CS927	Power BI for Business Professional	30
5	10218CS928	Enrich Visualization using Tableau	30
6	10218CS929	Data Analytics in Alteryx	30
7	10218CS930	Network Hacking	30
8	10218CS931	Ethical Hacking Python Programmer	30
9	10218CS932	Blockchain Developer	30
10	10218CS933	Cloud Computing	30
11	10218CS934	IoT Engineer	30
12	10218CS935	Natural Language Processing with Projects	30
13	10218CS936	Linux Administration	30
14	10218CS937	Bash Shell Script administrator	30
15	10218CS938	Machine learning using Python	30
16	10218CS939	AWS Solution Architect	30
17	10218CS940	Full Stack Developer	30
18	10218CS941	Java Programming Fundamentals	30
19	10218CS942	Essential Mongo DB Administration	30
20	10218CS943	Enterprise Project Portfolio Management	30
21	10218CS944	Web Development from Python to Php	30
22	10218CS945	Python Developer	30
23	10218CS946	Python Automation	30
24	10218CS947	Data Structures and Algorithms using Python - Part 1	30

COURSE CODE	COURSE TITLE	Total Hours
10218CS924	Big Data	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech., CSE

D. Course Handling Faculty: Dr. S. Jagan

E. Duration of the Course: 27.12.23to27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Identify Big Data and its Business Implications.
- Access and Process Data on Distributed File System
- List the components of Hadoop and Hadoop Eco-System
- Develop Big Data Solutions using Hadoop Eco System
- Apply Machine Learning Techniques

G.Preamble:

The key objective of this course is to make the students to be familiar with the concepts of Big Data. This course includes the most significant technologies used for storing, processing and analyzing big data.

H. Course Contents

Module–1: Understanding Big Data **6 Hour**

Concepts and Terminology: Data Analytics - Big Data Characteristics - Different Types of Data - Big Data Analytics Lifecycle - Big Data

Module–2: Big Data Storage Concepts **6 Hour**

Clusters - File Systems and Distributed File Systems – NoSQL Sharding – Replication - CAP Theorem

Module–3: Big Data Processing Concepts **6 Hour**

Parallel Data Processing - Distributed Data Processing – Hadoop - Processing Workloads - Map and Reduce Tasks

Module–4: Big Data Storage Technology **6 Hour**

On-Disk Storage Devices: Distributed File Systems – RDBMS Databases - NoSQL Databases - In-Memory Storage Devices - In-Memory Databases

Module–5: Big Data Analysis Techniques **6 Hour**

Quantitative Analysis - Qualitative Analysis - Data Mining - Statistical Analysis - Machine Learning

i. Text Books

1. Thomas Erl, Wajid Khattak, and Paul Buhler, “Big Data Fundamentals - Concepts, Drivers & Techniques", Prentice Hall, 1st Edition.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

ii. Reference Books

1. Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.
2. Arvind Sathi, “Big Data Analytics: Disruptive Technologies for Changing the Game”, MC Press, 2012

iii. Online Resources

1. https://www.udemy.com/course/big-data-and-hadoop-for-beginners/
2. https://www.coursera.org/specializations/big-data.

COURSE CODE	COURSE TITLE	Total Hours
10218CS925	Power BI Data Analytics	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech., CSE

D. Course Handling Faculty: Dr. S. Jagan

E. Duration of the Course: 27.12.23to27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Identify Business Intelligence and Power BI.
- Process data Transformation in Power BI Desktop
- Analyze data with Microsoft Power BI
- Visualize data using Power BI
- Configure Power BI Service

G.Preamble:

Power BI is a business analytics service provided by Microsoft. It provides interactive visualizations with self-service business intelligence capabilities, where end users can create reports and dashboards by themselves, without having to depend on any information technology staff or database administrator.

F. Course Contents

Module–1: Introduction to Power BI **6 Hour**

Introduction to Business Intelligence - Self-Service Business Intelligence (SSBI) - Introduction to Power BI - Traditional BI vs. Power BI - Uses of Power BI

Module–2: Power BI Desktop and Data Transformation **6 Hour**

Data Sources in Power BI Desktop - Loading Data in Power BI Desktop - Views in Power BI Desktop - Query Editor In Power BI - Transform, Clean, Shape, and Model Data

Module–3: Data Analysis Expression (DAX) **6 Hour**

Introduction to DAX - Importance of DAX - Data Types in DAX - DAX Calculation Types - Steps to Create Calculated Columns - Measures in DAX

Module–4: Data Visualization **6 Hour**

Introduction to Visuals In Power BI - Visualization Charts in Power BI - Matrixes and Tables - Slicers and Map Visualizations - Gauges and Single Number Cards

Module–5: Power BI Service **6 Hour**

Introduction to Power BI - Creating a Dashboard - Quick Insights in Power BI - Configuring a Dashboard

i. Text Books

1. Greg Deckler and Brett Powell, "Mastering Microsoft Power BI - Expert techniques to create interactive insights for effective data analytics and business intelligence", Packt, Second Edition.

ii. Reference Books

1. Alan Murray, " Power BI for Jobseekers: Learn how to create interactive dashboards and reports, and gain insights from the data", bpb, 2023.

iii. Online Resources

3. https://www.udemy.com/course/powerful-reports-and-dashboards-with-microsoft-powerbi/
4. https://www.coursera.org/professional-certificates/microsoft-power-bi-data-analyst

COURSE CODE	COURSE TITLE	Total Hours
10218CS928	Enrich Visualization using Tableau	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech.,CSE

D. Course Handling Faculty: Dr. K. Seethalakshmi

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Understand Data Exploration and Tableau with basic features.
- Ability to work with Data and perform various operation on it.
- Ability to draw geo plotting and create dashboard.
- Using Tableau statistics for clustering and forecasting.
- Use to develop dashboard for real time application.

G.Preamble:

This comprehensive course delves into unravel the potential of Tableau in seven easy steps. We will create and deploy meaningful and visually appealing dashboard in each steps. This course covers the latest features of data preparation in tableau and will create table calculations, stunning charts and informative storyboards for a better understanding of data.

F. Course Contents

Module–1: Introduction to Tableau **6 Hours**

Connecting to various file type, Organizing data pane, Cardinality set by Tableau, Building understanding of graphical user interface, Data source, Create Dash board and Story board, Data Analysis, Understanding Panes, Building Chart and Graphs.

Module–2: Getting Start with Tableau, Data exploration and calculation **6 Hours**

Understanding Tableau, connecting data source, Perform joining, blending and unions on data, Exploring data- hierarchy, sorting, grouping, set and filters. Data calculation- string, number and type calculation, logic and aggregation calculation, Table calculation, Introduction to LoD calculation.

Module–3: Geo Plotting Data and Dashboard **6 Hours**

Plotting geographical data, configuration and Trouble-shooting Maps, Adding custom location, Density chart, Building Dashboard, various object in dash board, Formatting in dashboard and adding Interactivity.

Module–4: Tableau for statistics **6 Hours**

Adding Trend Lines, Reference Lines, Forecasting in Tableau, Clustering in Tableau, Tableau workbook and public sharing

Module–5: Develop Real-World Business Application Dashboards **6 Hours**

Introduction to Projects
Project Phase I: Ticket Trend Analysis
Project Phase II: Employee Performance analysis.

i. Text Book:

1. Matthew Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization Foundations, Techniques, and Applications”, 2nd Edition, A K Peters/CRC Press, 2021.

ii. Reference Book

1. Donabel Santos, “Tableau 10 Business Intelligence Cookbook”, Packt Publishing, 1786465639, 9781786465634, 2016.

iii. Online Resources

1. “Exploratory data analysis and Data visualization”, Accessed on April.11.2021 [Online]. Available: https://www.creative-wisdom.com/teaching/WBI/EDA.shtml.
2. “Visualization of Multivariate Data”, Accessed on April.11.2021 [Online].https://people.stat.sc.edu/hansont/stat730/MultivariateDataVisualization.pdf

COURSE CODE	COURSE TITLE	Total Hours
10218CS929	Data Analytics In Alteryx	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech.,CSE

D. Course Handling Faculty: Dr. R. Thanga Selvi & E.Chandralekha

E. Duration of the Course: 27.12.23to27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Illustrate basic input and output tools,data types using alteryx tools pallete.
- Apply preparation and join tools using alteryx.
- Apply Parse and transform tools using alteryx.

G.Preamble:

Alteryx is a course that introduces several tools for processing business data to obtain actionable insight and development an analytic mindset for approaching business problems using summary statistics and data visualizations.

F. Course Contents

Module 1: Introduction **1 hour**

- Overview of the course and its objectives.

Module 2: Alteryx Case Study and Configuration **1 hour**

- Understand a real-world case study where Alteryx is applied.
- Configure Alteryx settings for optimal usage.

Module 3: Extracting Tabular Data & Non-Tabular Data **2 hours**

- Learn how to extract data from tabular formats (e.g., CSV, Excel) and non-tabular formats (e.g., JSON, XML).

Module 4: Extracting Data from XML **2 hours**

Explore techniques for extracting data from XML files.

Module 5: Extracting Data from SQL Tables **2 hours**

- Understand how to connect to SQL databases and extract data using Alteryx.

Module 6: Storing and Retrieving Data from Cloud Storage **2 hours**

- Learn how to work with cloud storage services (e.g., AWS S3, Google Cloud Storage) in Alteryx.

Module 7: Merging Data Streams **2 hours**

- Combine data from multiple sources using Alteryx's merging capabilities.

Module 8: Data Cleansing and Improving Data Quality **2 hours**

- Discover methods for cleaning and enhancing data quality within Alteryx.

Module 9: Merging Sales and Product Data **2 hours**

- Merge sales and product data to gain insights.

Module 10: Data Sampling **2 hours**

- Learn about sampling techniques to analyze large datasets efficiently.

Module 11: Data Preparation **2 hours**

- Prepare data for further analysis and modeling.

Module 12: Outputting Cleaned Data **2 hours**

- Save cleaned data to desired formats (e.g., CSV, Excel).

Module 13: Merging Tables to Create a Datamart **2 hours**

- Combine tables to create a comprehensive datamart.

Module 14: Performing Analytics/Transformation of Datamart **2 hours**

- Apply analytics and transformations to the datamart.

Module 15: Creating a Report in Alteryx **2 hours**

- Generate reports based on data insights using Alteryx.

Module 16: Scheduling a Workflow in Alteryx **2 hours**

- Automate workflows and schedule data processing tasks.

H. Learning Resources

i. Online Resources

1. https://www.edx.org/learn/python/the-university-of-michigan-python-data-structures
2. https://www.coursera.org/specializations/data-structures-algorithms.

COURSE CODE	COURSE TITLE	Total Hours
10218CS930	Network hacking	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech(CSE)

D. Course Handling Faculty: Dr.T.Kamaleshwar

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Explain the basic concepts of networking and common network devices.
- Ability to work with network reconnaissance to gather information about targets using tools like Nmap and Wireshark.
- Analyze common network vulnerabilities and their impact on security.
- Understand and execute network scanning techniques to identify open ports, services, and vulnerabilities.
- Identify and mitigate network threats through traffic analysis and monitoring.

G.Preamble:

Hacking is the process of finding loopholes in a website, intrude into it and take control of the site or make it crash. To prevent malicious hackers from intruding into computer systems and networks causing severe harm, trained hackers are employed by companies to find loopholes or weaknesses in existing websites, computer networks and take measures to solve them. It is called ethical hacking. The course introduces the concept of hacking, how malicious hackers intrude into computer systems causing huge losses both in terms of data and financial for companies- How hacking has emerged as a career option and what needs to be done to achieve mastery in hacking.

Module–1: Introduction to Network security **6 Hours**

Overview of network security concepts – Importance of ethical hacking in cybersecurity – Networking fundamental concepts – TCP/IP protocol suite – OSI Model and its relevance to hacking.

Module 2: Information Gathering and Footprinting **6 Hours**

Techniques for passive and active reconnaissance – Tools for footprinting and information gathering – Nmap – Recon-ng – Scanning Networks – Port scanning techniques (TCP,UDP), Network mapping and discovery.

Module–3: Enumeration and Vulnerability Assessment **6 Hours**

Vulnerability scanning tools – Nessus, OpenVAS – Common vulnerabilities and exposure (CVE) databases – Exploitation frameworks(Metasploit) – Exploiting vulnerabilities – buffer overflows – SQL injection

Module–4: Post Exploitation and Wireless Network hacking **6Hours**

Maintaining access – backdoors – rootkits – Covering tracks – Anti-forensics – Wireless Network Hacking: Wireless standards – WEP – WPA – WPA2 – Wireless network scanning – cracking

Module–5: Web Application Hacking **6 Hours**

Web application architecture – exploiting common web vulnerabilities: XSS – CSRF – Social Engineering: Psychological principles – Phishing attacks – Mitigation strategies.

Module–6: Penetration testing and Ethical Issues **6 Hours**

Penetration testing – Methodologies: Reconnaissance – Scanning – Exploitation – Post-exploitation – Legal and Ethical Issues – Laws and regulations related to hacking – responsible disclosure.

i. Text Books:

1. Nina Godbole, SumitBelapure, “Cyber Security”, Willey India, Edition 1, 2012.
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, “Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives”, CRC Press, ISBN 9780815371335, 2018.
3. Raef Meeuwisse, “Cyber Security for Beginners”, Cyber Simplicity Ltd., 2017.

ii. References Books:

1. Gary M. Jackson, “Predicting Malicious Behavior: Tools and Techniques for Ensuring Global Security”, John Wiley & Sons Publisher, June 2012.
2. Roger Grimes, “Hacking the Hacker”, Wiley India, 2017.
3. Donaldson, S., Siegel, S., Williams, C.K., Aslam, A., “Enterprise Cybersecurity - How to Build a Successful Cyber defense Program against Advanced Threats”, A-press, 2015.

iii. Online Resources

1. The Complete Cyber Security Course: Hackers Exposed”, 2018. [online]. Available: https://www.udemy.com/the-complete-internet-security-privacy-course-volume-1
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0138431826428968 9632577_shared/overview
3. https://www.coursera.org/learn/cybersecurity-for-everyone

COURSE CODE	COURSE TITLE	Total Hours
10218CS933	Cloud Computing	30

A. Course Category: Value Added Course

B. OfferedSemester:WinterSemester2023-2024

C. Branch: B.Tech., CSE

D. Course Handling Faculty: Dr. Kishore Kumar

E. Duration of the Course: 27.12.23to27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Understanding of cloud computing concepts, including the definition, characteristics, and key components of the cloud. They will be able to distinguish between traditional IT infrastructure and cloud-based solutions
- Through hands-on experience, particularly with Amazon EC2, participants will gain practical skills in using cloud services. This includes setting up and managing virtual servers, understanding cloud service models and learning how to deploy applications in a cloud environment.
- IoT Edge computing plays a vital role in IoT Architecture and provides tools for data visualization.

G.Preamble:

This course is designed for individuals with an IT background or basic computer knowledge who want to understand cloud computing. It focuses on providing a clear and practical understanding of cloud concepts through interactive and visual learning methods. Participants will gain insights into cloud fundamentals and hands-on experience, making it an ideal introduction to cloud computing for both individuals and organizations.

F.Course Contents

Module I: Introduction **2 Hours**

Introduction To Cloud Computing – Cloud Fundamentals- Cloud Services basics

Module–2: Quick Understanding of Virtualization **4 Hours**

Virtualization Basics - Virtualization Basics- Demo - Traditional It Infra

Module–3: Cloud Components And Characteristics **4 Hours**

Cloud Components - Cloud Characteristics

Module–4: Model And Benefits **4 Hours**

Deployment Model - Cloud Delivery Models

Module 5: Benefits And Use Cases, Aws Walkthrough **8 Hours**

Benefits - Common Use Cases - Navigation Through Console - Product Categories - Billing Dashboard

Module 6: Aws Services and Open Stack Walkthrough **8 Hours**

Ec2 Instance Types And Ami - Ec2 - Provision And Details - Ec2 - Provision And Details Continues - Ebs And Snapshots - Security Groups - Light Sail- Service -S3 Service - Rds Service

i. Text Book:

1. Rajkumar Buyya, James Broberg and Andrzej Goscinski,“ Cloud Computing Principles and Paradigms ", Dreamtech Press, ISBN- 978-8126541256, 2013

ii. Reference Book

2. Sanjiva Shankar Dubey "Cloud Computing and Beyond : A Managerial Perspective ", Wiley, 978-9389520477, 2019

iii. Online Resources

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384285494442393625073_shared/overview

COURSE CODE	COURSE TITLE	Total Hours
10218CS934	Internet of Things 201	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech., CSE

D. Course Handling Faculty: Dr. Kishore Kumar

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Learn how the current digital transformation is creating unprecedented economic opportunity.
- Understand how the IoT is bridging the gap between operational and information technology systems.
- Develop critical thinking and problem-solving skills using both real equipment and Cisco Packet Tracer.
- Soft skills such as teamwork and articulating problems and solutions in a business context.

G.Preamble:

IoT Fundamentals curriculum provides students with a comprehensive understanding of the Internet of Things (IoT). It develops foundational skills using hands-on lab activities that stimulate the students in applying creative problem-solving and rapid prototyping in the interdisciplinary domain of electronics, networking, security, data analytics, and business. The student-centric approach translates into the student being able to ideate, design, prototype and present an IoT solution for an identified business or society need. Connecting Things, focuses on identifying, designing, prototyping, and presenting an IoT solution that securely solves a current business or social problem.

F. Course Contents

Module I: Guide to Raspberry Pi **8 Hours**

Getting Started with Raspberry pi - Getting Started with Raspberry pi - Getting Started with Raspberry pi

Module–2: Raspberry Pi and IoT **10 Hour**

Internet of Things using Raspberry Pi - Python Programming on Raspberry Pi - Raspberry Pi GPIO Programming - Interfacing Sensors to Raspberry Pi - Create User Alerts in IoT Cloud Platform

Module–3: Raspberry Pi Activities **7 Hours**

Web Modules - Activity 1 - Vary the brightness of an LED - Activity 2 - Connecting a Push Switch - Activity 3 - GPIO Music Box

Module–4: IoT 201 - Case Study **5 Hours**

IoT Case Study - Smart Yard Management

i. Text Book:

1. Eben Upton, Gareth Halfacree,“ Raspberry Pi User Guide ", Wiley, ISBN-9781118921661, 1118921666, 2014

ii. Reference Book

1. Carrie Anne Philbin " Adventures In Raspberry Pi ", Wiley, 9781118751237, 111875123X, 2013

iii. Online Resources

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01295630129883545613 18_shared/overview
2. www.netacad.com
3. https://www.netacad.com/portal/resources/browse/31b72594-ecf9-4223-9e16-26797941945d

COURSE CODE	COURSE TITLE	Total Hours
10218CS935	Natural Language Processing	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech. CSE

D. Course Handling Faculty: Dr. A. Aalan Babu

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Perform various cleaning and pre-processing operations on textual data using NLTK
- Work with the various elements of text data such as Tokens, N-grams, Lemma and Frequency Distributions
- Annotate text with part of speech(POS) using in-built and custom POS taggers
- Work with various lexical resources provided with NLTK to preprocess your data
- Build applications such as Spam detector, Topic Modeler, Chatbot, Sentiment Analyzer using NLP and Machine Learning techniques
- Understand the concept of word embedding, Word2Vec model with a suitable example.
- Understand deep learning for NLP like RNN for NLP
- Build a language model with the help of recurrent neural network
- Build a LSTM network model for predicting a sequence data set
- Will understand different benchmarking solutions for various NLP solutions.

G.Preamble:

Natural language processing deals with written text. Students will learn how to process written text from basic of fundamental knowledge starts with Finite automata, Regular expression and probabilistic model with n-grams. This course also covers basis of semantic analysis and discourse analysis and drives it to machine translation.

F. Course Contents

Module - 1: Basic NLP Concepts **6 Hour**

Why NLP - NLP Pipeline - Understanding Textual Data - Corpus - Wordnet, Wordlist - POS Tagging - Annotation - NER - Bag of Word and TF_IDF - Lookup tagger - Tagging pipeline and backoff

Module - 2: Embedding Words **6 Hour**

Word2vec - How to train Word2Vec on Text data - Bag of words - skip-gram - Continuous Bag-Of-Words - Visualization of trained model - Word Sense Disambiguation

Module - 3: Language Modeling **6 Hour**

Unigram Language Model - Simple (Unsmoothed) N-grams - Smoothing - Back off - Deleted Interpolation, N-grams for Spelling and Pronunciation - Morphology - Overview of Hidden Markov Models

Module - 4: Sequential Modeling for NLP **6 Hour**

Sequential Modeling for NLP using RNN - RNN - Language Modeling using RNN - Understanding RNN with Text Generation - Challenges / Limitation - Sequential Modeling for NLP using LSTM – Training using LSTM – Tuning the parameters – Bi-directional LSTM

Module - 5: Text Analysis **6 Hour**

Sentiment Mining, Entity Linking, Text Classification, LDA & Factorization - Text Summarization - Information Extraction - Named Entity Recognition - Relation Extraction, Question Answering in Multilingual Setting -NLP in Information Retrieval

Module - 6: Machine Translation **6 Hour**

Need of MT - MT Approaches - Issues - Statistical Machine Translation (SMT) - Parameter learning in SMT (IBM models) using EM - Encoder-decoder architecture - Neural Machine Translation Statistical Language Models, Kernel Methods, Word-Context Matrix Factorization Models

i. Text Book:

3. Daniel Jurafsky, James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech”,, Pearson Publication, 2014
4. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python‖, First Edition, O‘Reilly Media, 2009

ii. Reference Book

3. Breck Baldwin, “Language Processing with Java and LingPipe Cookbook”, Atlantic Publisher, 2015
4. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010

iii. Online Resources

5. “Natural Language Processing” Jul. 2, 2018. Accessed on: Apr. 16, 2021 [Online]. https://www.coursera.org/learn/language-processing
6. “Natural Language Processing” Jun 2016. Accessed on: Apr. 16, 2021 [Online]. https://www.udacity.com/course/natural-language-processingnanodegree.

COURSE CODE	COURSE TITLE	Total Hours
10218CS936	LINUX ADMINISTRATION	30

A. Preamble

Infosys launched InfyTQ- A Linux administrator must know how to manipulate and manage processes. Introduce yourself to processes, services, and daemons, and how to manage them in Linux.

B. Prerequisite course

Nil

C. Course Objectives:

Learners are exposed to:

- Understand the basics of Linux and system configuration.
- Make use of Command line proficiency to apply shell usage.
- Utilize the user and group management and software management.
- Organize various network configuration and management.
- Identify the system monitoring and performance tuning

.

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Illustrate manipulation and managing the process in Linux	K3
CO2	Apply System to start and stop the process in Linux	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2		
CO2	2	2		2	2										

High- 3; Medium-2; Low-1

E. Course contents

PROCESS AND MONITOR

List and identify running processes, recognize common running processes, moni processes and their resource utilization, start and stop processes, set or change the prior for a process.

TROUBLESHOOT AND SYSTEMD

Troubleshoot or identify problem processes, start and stop a network service, configure service to start or not start at boot, use SystemD to start services, workwith SystemD manage running services, use SystemD to manage the system.

TOTAL 30 Hours

H. Learning Resources:

i. Online Resources:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0135015524712366087298/overview

COURSE CODE	COURSE TITLE	Total Hours
10218CS937	Bash Shell Scripting Administration	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech.,CSE

D. Course Handling Faculty: Dr. R Rajesh

E. Duration of the Course: 27.12.23to27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Familiarity with command-line interface and basic commands
- Ability to work with files, test conditions, and patterns.
- Ability to configure access levels and system environment variables.
- Using regular expressions and substring operations effectively.
- Understanding input types and the pipe operator for command chaining.

G. Preamble:

This comprehensive course delves into Bash Shell scripting, providing participants with practical knowledge and skills to automate tasks, manipulate data, and optimize workflows. Starting from the basics of Bash Shell, participants progress through advanced topics, such as regular expressions and file processing commands. With real-world examples and hands-on exercises, participants gain proficiency in using Bash Shell scripting for various tasks.

F.Course Contents

Module–1: Introduction to Bash Shell **5 Hour**

Definition and Importance of Data Structures-What is a data structure?- Types of Data Structures- Arrays: Definition and properties,-Advantages and disadvantages-Operations: insertion, deletion, traversal, searching, and sorting

Module–2: Getting Started **5 Hour**

File Text Size, Test Numbers, Checking Conditions, Multiple Digit Pattern, Checking If File Exists, Test File Exists, Script Output

Module–3: Shell Environment **5 Hour**

Introduction to Shell Environment, Command Program, Access Level Configuration, Booting Level Configuration, Booting Level Configuration Continue, System Admin Level Configuration, Networking Level Configuration, System Environment, User Configuration Files, Shell Special Variables. Array Declaration, Variable Declaration, Variable Declaration and Assignment

Module–4: Usage with String Manipulations **5 Hour**

String Manipulation and Internal Commands, Topic Structure, Regular Expressions, Square Bracket Round Bracket, Dot Character, Substring Length, Substring Removal.

Module–5: Commands-External and Internal **5 Hour**

Quick Revision on String Manipulation, Types of shell commands-External and Internal, Types of User Input, Pipe Operator. Lecture Introduction, Awk Introduction, Syntax and Dataset Familiarity, AWK for Column, Columns Extraction, Skipping the Header Row, Awk for Pattern Matching, Awk for Pattern Matching Continue, Dynamic Redirection of File Output, AWK Keyword, Status Variable, AWK for Grouping, What is Array, Statement Output, Total Female Population, Total Male Population, Percentage of Population, Peplinski Population

Module–6: Reading **5 Hour**

Internal Command, Reading from Single Variable, Reading from Array, Reading From File Introduction to Stacks Data Structure, Introduction to Stacks Data Structure Continue, Set Command Internal Command Set, Internal Command Unset, Intro to External Commands, External Command Cat External Command WC, Character Mode, Numerical Mode, Numerical Mode Continue, Searching Patterns in Multiple Files, Single File, Count Pattern Occurrence, Suppress Filename Headers Etc., Changing Ownership, Filter by Owner Before Change, External Command ENV, External Command CP, External Command MV, External Command Date, External Command ln, External Command ln Continue, Dataset Explanation for File Processing Commands, External Command-Essa-Jump to Line, Search for Pattern, External Command-Tail, External Command-Sort, External Command-Unit, External Command-PS, External Command Find, External Command Conclude

G. Learning Resources

i. Online Resources

1. Search Results Page | Infosys Springboard (onwingspan.com)

COURSE CODE	COURSE TITLE	Total Hours
10218CS938	Introduction Machine Learning Using Python	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech., CSE

D. Course Handling Faculty: Dr. S. Sridevi

A. Preamble

In today's data-driven world, machine learning offers invaluable tools for extracting insights and making predictions from vast data sets. Python, with its simplicity and powerful libraries, has become the go-to language for implementing these solutions. This guide equips you with the skills to navigate the field of machine learning using Python. Starting with fundamental concepts, it progresses to advanced topics like classifier algorithms and error handling. Through theoretical explanations, code samples, and exercises, learners will gain proficiency in building and evaluating models. By the end, learners will be ready to tackle real-world challenges in predictive modeling and pattern recognition with confidence.

B. Course Outcome

Students should able to

- Learn machine learning packages in Python.
- Understand machine learning model performance.
- Implement predictive models using regression and classification techniques.
- Comprehend strategies to handle missing data.

C. Course Contents

Module I: Machine Learning using Python

Introduction: Introduction Machine Learning Using Python - Usage of Machine Learning Packages in Python - Example of Machine Learning Using Python - Example of Machine Learning Using Python Continues - Installation of Python

Module II: Linear Regression

Linear Regression in ML - Linear Regression Example - Linear Regression Example Continues - Support Vector Algorithm in ML

Module III: Classifier and Python Package

Decision Tree Classifier - Random Forest Classification - K Mean Clustering - Apriori Python Package - Apriori Python Package Continues

Module IV: Evaluation Metrics

Evaluation Metrics - Example of Evaluation Metrics - Confusion Matrix in Evaluation Metrics - Classification Reports in Evaluation Metrics - Example of MAE, MSE and Variance using Evaluation Metrics - Sea Born Example using Evaluation Metrics - Scatter Matrix using Evaluation Metrics

Module V: Missing Value

Handling Missing Values in Python - Handling Missing Values in Python Continues - Exception Handling in Python - More on Exception Handling in Python

F.Learning Resources

https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01384312868942643231498_shared?collectionType=Course&collectionId=lex_auth_013843129228853248322203_shared&pathId=lex_auth_013843127683072000032192_shared

COURSE CODE	COURSE TITLE	Total Hours
10218CS941	JAVA PROGRAMMING FUNDAMENTALS	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech., CSE

D. Course Handling Faculty: Mrs. K. PREMA

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcome:

The students will be able to proficiently:

- Create Java programs using the fundamental programming constructs
- Implement and design a class based on attributes and behaviors of objects
- Develop Java code that demonstrates the working of different keywords in Java
- Explain and implement different Object-Oriented concepts in Java
- Develop Java code that uses the appropriate access modifiers, package declarations
- Identify, apply and understand the working of the most common APIs used in Java
- Explains about Exception Handling, Collections Framework and, Generics.
- Determine the best practices that are to be followed in Java

G. Preamble:

Java Programming Fundamentals is designed to introduce the fundamentals of Java programming and its object-oriented features. It will help out the learners to understand various keywords available in Java and Java's architecture. Also, this course will help learners to know the working of Java APIs through hands on approach.

H. Course Contents

Module – 1: **6 Hour**

About Java Programming Fundamentals, Introduction and Features of Java, Java Architecture, Java Development Kit

Module – 2: **6 Hour**

Data Types, Keywords and Identifiers, Operators, Type Casting, Widening and Narrowing, Conditional Statements, Control Flow and Looping, Arrays: Introduction to Arrays, Enhanced for loop

Module – 3: **6 Hour**

Object Oriented Concepts using Java, Class and Object, Constructors, this Keyword, Inheritance, Polymorphism, super Keyword

Module – 4: **6 Hour**

Final Keyword, static Modifier, Variable Arguments, Enumerated Data Types, Abstract class Interface Package Access Modifiers Java Libraries.

Module – 5: **6 Hour**

Exceptions, Generics, The Collections Framework, Date/Time APIs.

I. Learning Resources

i. Online Resources:

1. "Infosys Springboard", Accessed on December, 2023 [Online]. Available: https://infyspringboard.onwingspan.com/web/en/page/home

COURSE CODE	COURSE TITLE	Total Hours
10218CS942	Essential Mongo DB Administration	30

A. Course Category : Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B. Tech -CSE

D. Course Outcomes

After successful completion of this course, the students are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Illustrate the MongoDB queries to perform CRUD operations on document database.	K3
CO2	Apply Sharding Techniques to do backup and recovery	K3
CO3	Solve Aggregation problems using Map Reduce.	K3

E. Preamble

The course places a strong emphasis on MongoDb Essentials as a tool. It introduces essential techniques of performing CRUD operations on Modern Database. Additionally, it offers a brief overview of Sharding techniques, including replicas and cluster collections. These practices are essential for working with aggregation operators, exploring different aggregation stages, using MongoDB map reduce.

F. Course Content:

Module I: MongoDB Overview: Install MongoDB, Access MongoDb Using Mongo 3T Studio, Introduction to MongoDB, MongoDB Document, Creating an AWS Server Instance, Establish Connection Using Putty. **MongoDb Replication:**Introduction to MongoDb Replication,S etting up Replica Set Servers, Configure Replica set, Connection Using Mongo Chef.

Module II: Working with Replica set Members: Election Process,Test Replica Set Election, Configure Priority, Configure Delayed, Hidden, and Arbitter Members.

Module III: Sharding your MongoDb Cluster: Components of Sharded Cluster, Sharding Workflow**, Sharding Techniques:** Setting up replica sets, setting Up config servers and MongoS

Server, Adding Shards, Sharding a Collection**.**

Module IV Administration and security: Practising MongoDB backup and Restore Techniques, Exploring User Roles and authorization, Working with Journaling, Discovering importance of Profiler,

Module V Aggregation Techniques: Working with Aggregation operators, Exploring different Aggregation Stages, Using MongoDB Map Reduce.

Text Books:

1]MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow, O'Reilly

Software configuration and installation:

MongoDB TOC - MongoDB Essentials - A Complete MongoDB Guide | Infosys Springboard (onwingspan.com)

Learning Resources:

Web Links:

1]https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_013177169294712832113_shared/overv iew (MongoDB)

COURSE CODE	COURSE TITLE	Total Hours
10218CS943	Enterprise Project Portfolio Management	30

A. Course Category: Value Added Course
B. Offered Semester: Winter Semester 2023-2024
C. Branch: B.Tech.,CSE
D. Course Handling Faculty: Dr. R Rajesh
E. Duration of the Course: 27.12.23to27.04.24
F. Course Outcome:

The Students will be able to proficiently:

- Identify Enterprise Project Portfolio Lifecycle
- Ability to understand how projects are planned, controlled and scheduled.
- Understand the process of Risk management.
- Using advanced features of Import, Export and Activity codes.
- Understanding custom data fields and Global changes for better management.

G.Preamble:

Enterprise Project Portfolio Management (EPPM) is a framework that helps organizations manage multiple projects and programs as a portfolio, aligning them with strategic objectives and optimizing resource allocation. This comprehensive course helps to plan and control , Create and assigning roles, resources for PPM Professional Project.

F.Course Contents

Module–1: Introduction to Project selection and prioritization 6Hour

Enterprise Project Portfolio Management (EPPM) and Traditional PPM - Enterprise Project Portfolio Lifecycle - Definition and Importance of project proposals -Evaluating project proposals - Strategic objectives and criteria - Assessing project feasibility-.

Module–2: Resource allocation and budgeting 6Hour

Resources Availability and Allocation, Capacity Planning - Budget Allocation - Resource utilization - Optimization - resource leveling and resource smoothing - contingency plans for resource over allocations- Introduction to frameworks like MoSCoW, Kano, Pareto analysis.

Module–3: Risk management and mitigation 6Hour

Introduction to project risks- Identifying, assessing, and prioritizing, Developing risk mitigation strategies, Contingency plans - Risk monitoring and control - Risk management frameworks like PMBOK ,PRINCE2.

Module–4: Monitoring and reporting 6Hour

Project Monitoring - Tracking project progress and Milestones - Performance Metrics – Project Reporting Dashboards- Project management tools – EVM , Agile Metrics.

Module–5: Understanding Continuous improvement and optimization 6 Hour

Project Portfolio Performance –Assessment and Review- Data analytics and benchmarking for project optimization- Process improvements and best practices.

i. Text Book:

1. Paul E Harris , "Planning and Control Using Oracle Primavera P6", Eastwood Harris Pty Ltd, ISBN-13978-1925185386

ii. Reference Book

1. Clifford F. Gray and Erik W. Larson , "Project Management: The Managerial Process", McGraw Hill Edition 6, ISBN-13978-0070700857

iii. Online Resources

1. https://www.infosys.com/industries/utilities/industry-offerings/portfolio-analysis-optimization.html
2. https://thedigitalprojectmanager.com/projects/leadership-team-management/enterprise-project-portfolio-management/

COURSE CODE	COURSE TITLE	Total Hours
10218CS945	Python Developer	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech-CSE

D. Course Handling Faculty: Mrs.V.Priya

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcome:

After successful completion of this course, the students were able to:

- Illustrate the operations on complex data types like list, tuples sets and dictionary
- Apply Looping and branching statement for solving real time problems.
- Illustrate functions definition and function call
- Implement lambda functions, generators,closure and decorator
- Apply error handling mechanism and deal with concepts of classes and modules

G. Preamble

Python is a beneficial language for use in a lot of development projects, In this course, students can learn the basics of Python programming, which examines the creation and usage of variable functions and complex data types like collections to perform operations and able to execute simple Python commands on Jupiter notebooks

H. Course Content:

Module -1: Operations on Complex data types **6 hour**

Lists- list indexing and slicing operations- insert and remove operations on lists- strings as a sequence of characters- the characteristics of tuples- operations on sets- dictionaries data in an associative and unordered format- Access and edit keys and values - shallow copies and deep copies in lists,tuples and dictionaries

Module -2: Looping and Conditional statements **6 hour**

Branching code blocks using if statements- branching code blocks using elif statements- if elif..else blocks- Dictionaries using for loops- multiple looping operations- list comprehension- Conditions within list comprehension

Module -3: Defining, Configuring, & Invoking functions **6 hour**

Define and invoke functions-pass values to functions -usage of the return keyword - default arguments-positional arguments and keyword arguments of

function- Python scripts from the command line-usage of local and global arguments-pass arguments to functions by value and reference-the characteristics of class functions- functions in variables and lists

Module -4: Leveraging functions with lambdas, Generators, Closures, & Decorators 6 hour

Anonymous functions using lambdas-variable length arguments - filter and map functions specifying a lambda as a predicate-infinite sequences using generator functions- the yield keyword in generator functions- closures - use of local and nonlocal variables in closures-modify pre-existing code using decorators-validity checks on input arguments.

Module -5: Creating classes, handling errors, & Importing modules 6 hour

classes in Python- __init__() method- try and except blocks -the finally block - import modules --reference a custom module

I. Learning Resources:

i. Text Books:

1. Guido van Rossum, Learning Python: Crash Course Tutorial, The Python developmentteam publishers, 2020. [Unit-1,2,3]
2. Bharti Motwani, “Data Analytics using Python”, paperback edition, Wiley PublishingLtd, 2020. [Unit-4]
3. James R. Parker, “Game Development Using Python”, 2nd edition, Mercury Learningand Information publishers, 2021. [Unit-5]

ii. Reference Books:

1. David M.Baezly , “Python Essential Reference”, Addison-Wesley Professional; 5thedition, 2021.
2. John Shovic, Alan Simpson, “Python for dummies”,John Wiley & Sons, 2020.

iii. Online References:

i. Programming for Everybody (Getting Started with Python), Accessed on 02, April 2021[Online] Available: https://www.coursera.org/learn/python

ii.https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013843672362 5 4105644524_shared/overview

COURSE CODE	COURSE TITLE	Total Hours
10218CA947	Data Structures and Algorithms using Python - Part 1	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester2023-2024

C. Branch: B.Tech-CSE

D. Course Handling Faculty: Dr. P.J.Beslin Pajila

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Implement modular algorithms to find solution for computational problem with time and space complexities using suitable data structure.
- Solve structured problem using array and linked list in list concepts
- Develop modular algorithms to find solution for computational problems with linear Data structures using Stack concepts
- Develop modular algorithms to find solution for computational problems with linear Data structures using Queue concepts
- Solve unstructured problem using tree algorithm. Implement an appropriate algorithm using graph ADT for an application.

G. Preamble:

The Course introduce fundamentals of Data Structures. Discuss frequently used linear data structures like Stack, Queue, List etc. Discuss the commonly performed operations on linear data structures like insert, update, delete etc. Provide insights on non - linear data structures.

F.Course Contents

Module–1: Introduction to Data Structures **6 Hour**

Definition and Importance of Data Structures-What is a data structure?- Types of Data Structures- Arrays: Definition and properties,-Advantages and disadvantages-Operations: insertion, deletion, traversal, searching, and sorting

Module–2: List **6 Hour**

List using Array-add operation-Insert operation-Delete Operation-An Analysis-Memory Usage-Introduction-List using Linked List-Introduction-Creation-Display Operation-Algorithm-Add Operation-Algorithm-Search Operation--Insert Operation- Algorithm-Delete

Operation-Algorithm- List using Array vs Linked list

Module–3: Stack **6 Hour**

Stack-Introduction-Push Operation-Algorithm-Pop Operation-Algorithm-Application Areas.

Module–4: Queue **6 Hour**

Queue- Enqueue Operation- Algorithm- Dequeue Operation- Algorithm

Module–5: Non-Linear Data Structures **6 Hour**

Non-Linear Data Structures - Introduction-Graph-Tree

G. Learning Resources

i. Text Book:

1. Bradley N. Miller, David L. Ranum ,"Problem Solving with Algorithms and Data Structures using Python", Franklin, Beedle & Associates,3rd Edition,ISBN-13: 978-1590282571
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser Publisher: Wiley,"Data Structures and Algorithms in Python", Wiley, 2nd Edition

ii. Reference Book

1. Benjamin Baka, "Python Data Structures and Algorithms", Packt Publishing, 978-786467355

iii. Online Resources

1. https://www.edx.org/learn/python/the-university-of-michigan-python-data-structures
2. https://www.coursera.org/specializations/data-structures-algorithms.

Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)
Avadi, Chennai-600062, Tamil Nadu, India

4th MEETING of BOARD of STUDIES

Minutes

for

B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning) Programme

[CBCS]

On

10.07.2024

B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning)

School of Computing

4th MEETING of BOARD of STUDIES
For
B.Tech Computer Science and Engineering (Artificial Intelligence & Machine Learning)

Date: 10.07.2024
Time : 10.00 am
Venue: 33023

Index

Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)
Avadi, Chennai-600062, Tamil Nadu, India

B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning)

School of Computing

4th MEETING of BOARD of STUDIES
For
B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning)

Date: 10.07.2024
Time : 10.00 am
Venue: 33023

AGENDA

Item No	Agenda
A. Opening	
1.	Confirmation of 3rd BoS meeting minutes held on 05.01.2024 (Annexure-I)
2.	To review the Action Taken Report on the minutes of the 3rd meeting of the Board of Studies (Annexure-II)
B. Items to be considered	
3.	To discuss and approve the new courses and course contents to be offered under Program Core category for the B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning) programme under the regulation VTR UGE 2021 with effect from Summer Semester 2024-2025. (Annexure-III)
4.	To discuss and approve the new course and course contents to be offered under Program Elective category for the B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning) programme under the regulation VTR UGE 2021 with effect from Summer Semester 2024-2025. (Annexure-IV)
5.	To discuss and approve the courses and course contents to be offered under Open Elective category for the other School programme under the regulation VTR UGE 2021 with effect from Summer Semester 2024-2025.(Annexure-V)
C. **Items to be ratified**	
6.	To ratify the value added courses offered in Winter Semester 2023 -24 for B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning) under the regulation VTR UGE 2021. (Annexure-VI)
7.	Any other cognate item

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(Deemed to be University Estd. u/s 3 of UGC Act, 1956)
Avadi, Chennai-600062, Tamil Nadu, India

School of Computing
3rd Meeting of Board of Studies
For
B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning)

Members Present: **Date:10.07.2024**

Sl.No	Name and Designation	Nominee	Signature
1	Dr. S. P. Chockkalingam, Professor and Dean.	Chairperson	
2	Dr. S. R. Sudarshan Iyengar	Associate Professor and Head, CSE, IIT, Ropar, Punjab	
3	Dr. Manoj B Chandak	Dean Academics and Professor, Department of CSE, Shri Ramdeobaba College of Engineering and Management, Nagpur	
4	Mr Dharbaneshwer	Senior Data Scientist, Wallmart, Chennai, Tamil Nadu	
5	Mr. Muthukumar	Project Manager, Infosys, Chennai, Tamil Nadu	
6	Mr.Sai Srinivas Vara Prasad Korlam Alumni	Network Consulting Engineer, Cisco Systems India, Bengaluru	
7	Dr. S. Lalitha Associate Professor & Head Department of CSE(AI & ML), Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Associate Professor Nominee	
8	Dr.M. Kavitha Professor, Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Professor Nominee	
9	Dr.N.R.Rajalakshmi Professor & Head Department of AI & ML	Professor Nominee	

	Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology		
10	Dr.S.Sridevi Professor, Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Professor Nominee	
11	Dr.V.Dhilip Kumar Professor & Head Department of AI & DS Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Professor Nominee	
12	Dr.M.S.Murali Dhar Associate Professor & Head Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Associate Professor Nominee	
13	Dr.R. Parthasarathy Associate Professor & Head Department of CSD Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Associate Professor Nominee	
14	Dr.R.Thangaselvi Assistant Professor, Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Associate Professor Nominee	
15	Dr.K.Prema Assistant Professor, Department of CSE, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Assistant Professor Nominee	

Invited Members

S.No	Name	Designation
1	Dr.J.Visumathi	Professor and Head, Department of IT, Vel Tech
2	Dr.T.Kujani	Assistant Professor Senior Grade, CSE, Vel Tech

The Chair expressed his happiness in welcoming all the members for the 4th meeting of BOS and thanked them for sparing their valuable time.

03-BoS-01	Confirmation of 3rd BoS meeting minutes held on 05.01.2024
Action taken	Chairman BoS presented the confirmation of 3rd BoS meeting minutes held on 05.01.2024 in the new programme B.Tech Computer Science and Engineering (Artificial Intelligence & Machine Learning) under the regulation VTR UGE 2021. (Annexure-I)
03-BoS-02	To review the Action Taken Report on the minutes of the 3rd meeting of the Board of Studies.
Action Taken	Chairman BoS presented the action taken report on the 3rd BoS meeting minutes held on 05.01.2024 in the new programme B.Tech Computer Science and Engineering (Artificial Intelligence & Machine Learning) under the regulation VTR UGE 2021. (Annexure-II)
03-BoS-03	To discuss and approve the new courses and course contents to be offered under Program Core category for the B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning) programme under the regulation VTR UGE 2021 with effect from Summer Semester 2024-2025. (Annexure-III)
Discussion	Chairman BoS presented the curriculum structure of B.Tech CSE(Artificial Intelligence & Machine Learning) under the regulation VTR UGE 2021. The domain specific courses like Artificial Intelligence Techniques, Machine Learning Techniques and Big Data Analytics were presented to the members. BoS members advised to move Optimization Techniques course from Program Elective to Program Core. Dr. S. R. Sudarshan Iyengar suggested to include The Nature of Computation book for FLAT.
Resolution	The members approved the courses and course contents of Program Core courses to be offered in the programme B.Tech Computer Science and Engineering (Artificial Intelligence & Machine Learning) under the regulation VTR UGE 2021 with effect from 2023-2024. The changes given by the BoS members will be incorporated in the forthcoming curriculum Revision. Course Structure and Course details are shown in (Annexure-III)
03-BoS-04	To discuss and approve the new course and course contents to be offered under Program Elective category for the B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning) programme under the regulation VTR UGE 2021 with effect from Summer Semester 2024-2025. (Annexure-IV)
Discussion	Chairman BoS presented the Program Elective Course to be offered in Summer 2024-2025. Experts suggested to include PowerBI and Sports Analytics task in the lab experiment of Data Visualization Course.
Resolution	The members approved the course and course contents of Program Elective course to be offered in the programme B.Tech Computer Science and Engineering (Artificial Intelligence & Machine Learning) under the regulation VTR UGE 2021 with effect from 2023-2024. Course Structure and Course details are shown in (Annexure-IV)

03-BoS-05	To discuss and approve the courses and course contents to be offered under Open Elective category for the other School programme under the regulation VTR UGE 2021 with effect from Summer Semester 2024-2025.(Annexure-V)
Discussion	Chairman BoS presented the Open Elective Course like Responsible & Safe AI Systems, Artificial Intelligence search methods for problem solving, Introduction to Machine learning and Deep Learning were presented to the members.
Resolution	**The members approved the Open Elective Courses and course contents offered during Summer semester 2024-2025.** (Annexure-V)
03-BoS-06	To ratify the value added courses offered in Winter Semester 2023 -24 for B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning) under the regulation VTR UGE 2021. (Annexure-VI)
Resolution	**The members ratified the value added course offered during Winter Semester 2023-2024.** (Annexure-VI)
03-BoS-07	**Any other Cognate Item**
	Member suggested to add creation of Python libraries in the laboratory task and also advised to include Devops and Agile concepts in the Web and Mobile Application Development course.
Resolution	The Chairman informed next BoS meeting may be scheduled in the month of December 2024

ANNEXURE-I

1. Confirmation of 3rd BoS meeting minutes held on 05.01.2024

7/1/24, 2:11 PM Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology Mail - 3rd BoS Meeting Minutes of B.Tech - CSE ...

Vel Tech

HOD CSE(Artificial Intelligence and Machine Learning) Vel Tech, Chennai <hodcseaiml@veltech.edu.in>

3rd BoS Meeting Minutes of B.Tech - CSE (Artificial Intelligence and Machine Learning) - Reg.

1 message

HOD CSE(Artificial Intelligence and Machine Learning) Vel Tech, Chennai <hodcseaiml@veltech.edu.in> Mon, Jul 1, 2024 at 2:09 PM
To: "masila@iiitdm.ac.in" <masila@iiitdm.ac.in>, "chandravadhana.kumaran@atos.net" <chandravadhana.kumaran@atos.net>, Saravanan Krish <saravanan.krishnann@gmail.com>, RV Chandrashekhar <rvcshekhar@gmail.com>

Dear Sir / Madam

Herewith I am attaching the 3rd BoS Meeting Minutes of B.Tech - CSE (Artificial Intelligence and Machine Learning) for your reference.

Thanks,

With kind regards
Dr S Lalitha B.Tech(IT), M.E(CSE), Ph.D.,
HoD & Associate Professor-CSE(AIML)
Vel Tech Rangarajan Dr Sagunthala R & D Institute
of Science and Technology **e:** hodcseaiml@veltech.edu.in
Contact:9790509487 **w:** www.veltech.edu.in

Vel Tech
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3rd-BoS-Minutes-B.Tech-CSE-AI-ML.pdf
1205K

ANNEXURE-II

To review the Action Taken Report on the minutes of the 3rd meeting of the Board of Studies held on 05.01.2024

Item No	Item	Decision taken	Action Taken
ITEMS FOR DISCUSSION AND APPROVAL			
03-BoS-3	To discuss and approve the courses and course contents of Program Core courses to be offered in the programme B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning) under the regulation VTR UGE 2021 with effect from 2023-2024.	The proposed courses and course contents under Program Core category to be offered were discussed and approved by the members	The approved courses were offered during Winter 2023-2024.
03-BoS-4	To discuss and approve the Value-added courses to be offered in the programme B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning) under the regulation VTR UGE 2021 during Winter Semester 2023-2024. (Annexure-IV)	The proposed value added courses and its course contents to be offered were discussed and approved by the members	The approved value added course were offered during Winter 2023-2024.
03-BoS-5	To ratify the value added courses offered in Summer Semester 2023 - 24 for B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning) under the regulation VTR UGE 2021 with effect from 2023-2024. (Annexure-V)	The ratified value added courses and its course contents to be offered were discussed and approved by the members	The ratified value added course were offered during Summer 2023-2024.

ANNEXURE-III

To discuss and approve the new courses and course contents to be offered under Program Core category for the B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning) programme under the regulation VTR UGE 2021 with effect from 2023-2024.

Program Core (58 Credits)

L-Lecture T-Tutorial P-Practical C-Credits

S.No	Course Code	Course Name	L	T	P	C
		Theory Courses				
1	10211CA101	Data Structures	3	0	0	3
2	10211CA103	Operating Systems	3	0	0	3
3	10211CA129	Modern Computer Architecture	3	0	0	3
4	10211CA130	Fundamentals of Computer Networks	3	0	0	3
5	10211CA106	Formal Languages and Automata Theory	3	0	0	3
6	10211CA107	Compiler Design	3	0	0	3
7	10211CA109	Microprocessors	2	0	0	2
		Integrated Courses				
8	10211CA202	Design and Analysis of Algorithms	3	0	2	4
9	10211CA204	Programming Using Java	3	0	2	4
10	10211CA207	Database Management Systems	3	0	2	4
11	10211CA208	Software Engineering	2	0	2	3
12	10211CA210	Big Data Analytics	3	0	2	4
13	10211CA211	Artificial Intelligence Techniques	3	0	2	4
14	10211CA212	Web and Mobile Application Development	3	0	2	4
15	10211CA223	Machine Learning Techniques	3	0	2	4
		Laboratory Courses				
16	10211CA301	Data Structures Laboratory	0	0	2	1

17	10211CA304	Operating Systems Laboratory	0	0	2	1
18	10211CA305	Microprocessors Laboratory	0	0	2	1
19	10211CA306	Competitive Coding-I	0	0	2	1
20	10211CA307	Competitive Coding-II	0	0	2	1
21	10211CA312	Fundamentals of Computer Networks Laboratory	0	0	2	1
22	10211CA313	Problem Solving Techniques	0	0	2	1
		Total Credits				**58**

Tutorial hour is not considered for credit calculation of the course

COURSECODE	COURSETITLE	L	T	P	C
10211CA106	Formal Languages And Automata Theory	3	0	0	3

A.Preamble

This course deals with the concepts of automata theory, formal languages, grammar, computability and decidability. Students learn concrete implementations, manipulations of discrete structures and their use in design and analysis of non-trivial problems for a given computational task. This course can be applied in Compilers, Artificial Intelligence, Robotics and Natural Language Processing.

B.Prerequisite Course

10210MA110- Discrete Mathematical Structures

C.Course Objectives

Learners are exposed to

- Understand overview of theoretical foundations of computer science from the perspective of formal languages.
- Illustrate various automata to solve problems in computing.
- Familiarize Regular grammars, context free grammar, recursive and recursively enumerable languages.

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K –Level
CO1	Design the finite automata to recognize the regular languages.	K3
CO2	Construct regular expression for regular grammar and its equivalence with finite automata.	K3
CO3	Develop push down automata and context-free grammar representations for context-free languages.	K3
CO4	Model Turing Machines for accepting recursively enumerable languages and its capabilities.	K3
CO5	Apply the notions of decidability and undecidability to examine complex problems.	K3

Knowledge Level (Based on revised Bloom's Taxonomy)
K1-RememberK2-UnderstandK3-ApplyK4-AnalyzeK5-EvaluateK6-Create

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		3									
CO2	3	3	3		3									
CO3	3	3	2	1	3									
CO4	3	3	3	3	3									
CO5	3	3	2	2										

High-3;Medium-2;Low-1

F.CourseContents

Unit 1 Formal Languages And Finite Automata L-10 Hours

Introduction to automata and automata theory, Basic concepts of formal Languages, Finite Automata – DFA, NFA, Epsilon NFA, Equivalence of DFA, NFA and Epsilon NFA, Minimization of Automata, FA with output.
Case Studies: Implementation of Spell checkers, Text search, Text editors, Simulation of FA using JFLAP.

Unit 2 Regular Languages And Expressions L-8 Hours

Regular Grammar, Regular Expressions, Converting Regular Expression to Epsilon NFA, Equivalence of regular expressions and NFA with Epsilon moves, Converting DFA to Regular Expressions, Pumping Lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular sets.
Case Studies: Pattern for Mobile numbers with country code, email address

Unit3Context Free Languages And Push Down Automata L-10 Hours

Context-Free Languages and Grammar, Derivation trees, Ambiguity, Simplification of CFG, Chomsky Normal Form, Greibach Normal Forms, Deterministic Push Down Automata, Non-Deterministic Pushdown Automata (NPDA), Equivalence of acceptance by final state and empty stack in PDA, Equivalence between NPDA and CFG, Closure properties of CFLs, Pumping Lemma for CFLs.
Case Studies: Tower of Hanoi, Evaluating Arithmetic expression, Transaction Process System.

Unit4Turing Machine L- 9 Hours

Context-sensitive Grammar, Turing Machine (TM) – Basics and formal definition, Instantaneous Description, TMs as language acceptors, TMs as Transducers, Designing Turing Machines, Variants of TMs, Checking of Symbols, Encoding a Turing Machine and Universal Turing Machine.
Case Study: Lambda Calculus

Unit5 Recursive And Recursively Enumerable Languages L- 8 Hours

Recursive Functions, Recursive languages and Recursively Enumerable Languages, Properties of Recursively Enumerable Languages and Recursive Languages, Decidability and Halting Problem,

Reduction, P and NP, NP- completeness, Post Correspondence Problem, Rice Theorem and Chomsky Hierarchy. Case Studies: Knapsack Problem, SAT Problem using Turing machine.

Total:45 Hours(L)

G.Learning Resources

i.Text Books:

1. John E Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, "Introduction to Automata Theory, Languages, and Computation", 3/e, Pearson Education, 2013. [Unit 1– 3]
2. John C. Martin, "Introduction to Languages and the theory of computation", 4/e, TMH, 2011 [Unit 4, 5]

ii.Reference Books:

1. Michael Sipser, "Introduction to the Theory of Computation", 3rd edition, Cengage Publishers, 2013.
2. Peter Linz, "An Introduction o Formal Language and Automata",5th edition, Cathleen Sether Publishers, 2012.
3. S.P.Eugene Xavier, "Theory of Automata, Formal Languages and Computation", New Age International Publishers,2005.

iii.Online References:

1. "Theory Of Computation" Sep. 09, 2016. Accessed on: Feb. 16, 2021, [Online]. Available: https://nptel.ac.in/courses/106/104/106104148/
2. "Automata Theory", Accessed on: Apr. 21, 2021, [Online]. Available: https://www.edx.org/course/automata-theory
3. "Lambda Expressions" [Online] Accessed on: Apr. 28, 2021, https://www.udemy.com/course/java-8-functional-programming-with-lambda-expression/

COURSE CODE	COURSE TITLE	L	T	P	C
10212CA210	Big Data Analytics	3	0	2	4

A. Preamble

The key objective of this course is to make the students to be familiar with the concepts of data warehouses, modelling and design of data warehouse. This course includes the most significant technologies used for manipulating, storing, and analyzing big data. In addition, the basic tools of data warehouse and big data analytics will be explored. These tools make the students to understand the strategies involved in data warehouse design and Big Data Platform.

B. Prerequisite Course

10211CA207 -Database Management Systems

C.Course Objectives

Learners are exposed to

- Understand the principles of data warehousing, multidimensional data model.
- Familiar with the data warehouse architecture and OLAP tools.
- Impart the architectural concepts of big data file management system.
- Explore PIG and HIVE tools to develop applications in Big data analytics.
- Implement best practices for Big Data Optimization.

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Build and process the data warehouse model for given application	K3
CO2	Design Job Execution procedures in Map Reduce and Apache Spark Paradigm	K3
CO3	Design memory efficient solutions for Big Data Applications	K3
CO4	Build Big Data Solutions for social media network applications	K3
CO5	Apply cloud and optimization techniques to develop the solutions for real time scenarios	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of COs with Program outcomes and Program Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3	3										3
CO2		2	2	2	3									3
CO3	2		3		3	2							2	2
CO4	2	3		3	3	3							3	3
CO5	2	2		3		3							3	3

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1Data Warehousing and Business Analysis L-9 Hours

Introduction to Data warehousing – Evolution of Decision Support systems – Modeling a Data Warehouse – Granularity in the Data Warehouse - Data Warehousing Components, Building a Data Warehouse, Warehouse Database- Extract, Transform and Load: ETL Overview, ETL Requirements and Steps, Data Transformation, Data Loading, ETL Tools. –. Reporting and Query tools and Applications –Online Analytical Processing (OLAP) – Need – Multidimensional Data Model.

Unit 2 Big Data Processing L-9 Hours

Introduction to Big Data, Big Data Analytics, Evolution of Big data – Best Practices for Big data Analytics – Big data characteristics- Understanding Big Data Storage – A General Overview of High-Performance Architecture – HDFS – Map Reduce Programming Model-Understanding the basics of MapReduce, Loading data into HDFS, Introduction-Apache Spark, Features, Components, Resilient Distributed Datasets, Data Sharing using Spark RDD, Spark Programming.

Unit 3 Big Data Storage System L-9 Hours

Apache Camel- Introduction, Overview, features, camel context, architecture, message queues. Apache Ignite-Memory Architecture, Memory Pages, Lifecycle, In-Memory Data Grid, Caching Support, Streaming Support. Cassandra-Architecture, Data Model, Referenced Api, Cqlsh, Keyspace Operations, Table Operations, Batch, CURD Operations. Apache Kafka-Fundamentals, Cluster Architecture, Work Flow, Basic Operations, Producer and Consumer Example.

Unit 4 Big data Visualization and Prediction L-9 Hours

Graph Analytics for Big Data: Graph Analytics - The Graph Model - Representation as Triples-Graphs and Network Organization - Choosing Graph Analytics - Graph Analytics Use Cases – Graph- Analytics Algorithms and Solution Approaches - Technical Complexity of Analyzing Graphs- Features of a Graph Analytics Platform.

Unit 5 Big Data Cloud Concepts and Optimization **L-9Hours**

Big data Cloud Computing-Features, Cloud Deployment Models, Cloud Delivery Models, Cloud for Big Data, Real time Analytics Platform (RTAP) applications – Using Graph Analytics for Big Data: Graph Analytics, Big Data Optimization- Smooth Convex Optimization-Projection-free methods, Accelerated gradient descent methods, Non smooth Convex Optimization-Smoothing techniques, Mirror-Prox method, Sparsity learning, Large-scale kernel machines.

Total: 45 Hours

G. Laboratory Experiments **Total: 30 Hours**

Part- 1

Task 1: Design a multi-dimensional data model schema namely Star, Snowflake and Fact Constellations for a Categorical data using SQL Server Management Studio (SSMS).
(Perform the above for Banking, Healthcare, Manufacturing, Sales and Automobile)
Tools: SQL Server Management Studio (SSMS), Microsoft Azure SQL Pool

Task 2: To configure, monitor, and administer a Data warehouse and perform basic Query operations on the DW.
Tools: SQL Server Management Studio (SSMS), Microsoft Azure SQL Pool

Task 3: Perform Data Cube Operations (OLAP Operations) using SQL Queries
Rollup
Rolldown
Slicing
Dicing
Database: MySQL

Task 4: Implement matrix multiplication with Map Reduce.
Tools: LINUX

Task 5: Write a Spark application to perform word count in the input file.
Tools: APACHE SPARK

Task 6: Implement CURD operations on Casandra
Tools: Casandra

Task 7: Implementing Producer and Consumer problem in kafca.
Tools: kafca

Task 8: i.Implement basis commands in HIVE.

ii.Use Hive to create, alter, and drop databases, tables, views, functions, and indexes **Tools: HIVE, LINUX**

Task 9: Write Pig Latin scripts sort, group, join, project, and filter the data
Tools: Pig, LINUX

Task 10 i.Construct the Pig Latin Scripts to find character Count
ii.Construct the Pig Latin Scripts to find a max temp for each and every year.
Tools: Pig, LINUX

Task 11: Collect any Social Media Data from a Twitter to a Local File with the Topic 'covid 19'. Download and Set Up MongoDB Server and a Client Mongo shell.
Tools: MongoDB, Python: Scipy

Task 12: Retrieve Analytic Information given below from MongoDB created in task 9:
i.For each "place_type", Find total favorite_count
ii. For each "country_code", find total "retweet_count"
iii.Find out top 10 most frequent topic words of the entire tweet message texts of your collection after lemmatization/stemming and removing all the Stop Words.
Tools: MongoDB, Python: Scipy

Total: 75 Hours

Part – 2

Use Cases:

Use case 1:

Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together.

Write a single Spark application that:

a. Transposes the original Amazon food dataset, obtaining a PairRDD of the type: user-id – list of the product-ids reviewed by user-id
b. Counts the frequencies of all the pairs of products reviewed together;
c. Writes on the output folder all the pairs of products that appear more than once and their frequencies.
d. The pairs of products must be sorted by frequency.

Use case 2:

Construct MapReduce program to perform data analysis on weather dataset.
Dataset is available at:https://www.kaggle.com/datasets/zaraavagyan/weathercsv

Use case 3: Apache Hive for Rea in real-world applications

It is often the case that data has to be retrieved in real-time from the source. The processing is done as soon as the data is inputted. For example, Google maps processes traffic data in real-time. As soon as it receives information from the source, the data is output onto its application. Develop the Real-time data processing using Apache Hive for analysing the Google Map data.

Use case 4: Build a data Pipeline based on Messaging using PySpark and Hive

Implement a data pipeline that ingests raw data from a source and moves this data to a destination where it can be stored or processed further for analysis. The pipeline should also able to filter or clean the data for various purposes. Then create a Hive external on top of HDFS which will allow the cleaned, processed data to be deployed.

i.Textbooks:

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012. [Unit 1]

2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015 [Unit 2-5].

ii.Reference books:

1. W.H. Inmon, “Building the Data Warehouse”, John Wiley & Sons, Inc, 4th Edition, 2005-(Online Publication: 2014).
2. Capriolo, E., Wampler, D., & Rutherglen, J., “Programming Hive”, O’Reilly Media, Inc.”,2012

iii.Online resources:

1. “Data Warehouse Design: Modern Principles and Methodologies”, Accessed on Oct 27, 2022 [online].
   Available: https://cdn.ttgtmedia.com/searchDataManagement/downloads/Data_Warehouse_Design.pdf
2. “Big data Analytics”, Accessed on Apr. 5, 2022 [online].
   Available: https://www.analyticsvidhya.com/learning-paths-data-science-business-analytics-business-intelligence-big-data/learning-path-data-science-python/
3. “Apache Spark Tutorial”, Accessed on Oct 28, 2022 [online].
   Available: https://www.tutorialspoint.com/apache_spark/apache_spark_deployment.htm
4. “Apache Camel Tutorial”, Accessed on Oct 28, 2022 [online].
   Available: https://www.tutorialspoint.com/apache_camel/apache_camel_quick_guide.htm

COURSE CODE	COURSE TITLE	L	T	P	C
10211CA212	Web And Mobile Application Development	3	0	2	4

A.Preamble

This course provides basic concepts about HTML5, CSS3, Bootstrap Framework and java script technologies to create the interactive client-side design of web applications. This course also teaches the server-side programming using Node JS, PHP and MVC frontend design for web applications using Angular. The conversion of web application to mobile apps can be performed using Angular Finally, the creation and deployment of micro services using Seneca and Dockers will be discussed.

B.Pre-requisite Course

10211CA204- Programming Using Java

C.Course Objectives:

Learners are exposed to,

- Create the interactive and responsive web application.
- Build the efficient server-side applications.
- Develop the single page MVC application.
- Create and deploy the micro services.

D.Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos	Course Outcomes	K - Level
CO1	Design web applications using Hypertext Mark-up Language and Cascading style sheets through bootstrap.	K3
CO2	Build the interactive and dynamic web page using Java Script Technology.	K3
CO3	Implement the server-side business logic to handle client request using NodeJS and PHP.	K3
CO4	Make use of MVC framework for integrating the window controls and its corresponding actions through event handlers.	K3
CO5	Transform the function as Micro service components to enhance the Reusability concept.	K3
	Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create	

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2	3		3	1	1							
CO2		3	3	1	2	1	1							
CO3		3	2		3	2	2							
CO4		3	3		3	2	2							
CO5		3	3		3	2	2							

High- 3; Medium-2; Low-1

F.Course Contents

Unit1:Front end design using HTML5, CSS3 and BOOTSTRAP Framework L-9 Hours

Introduction to HTML5: Basic Elements, Form elements, Media elements, HTML5 Graphics (Canvas, SVG), **CCS3**: selector string, Box Model, Text properties, CSS3D Transformation, CSS Animation, **Bootstrap Framework:** BS grid basics, Tables, images, alerts, form elements- Bootstrap Grids- Bootstrap Themes.
Casestudy: online blog creation.

Unit2: Dynamic webpage design using Java Script and jQuery L-9 Hours

Java Script: data types and variables- operators- control Statements- Functions- Objects- Build in Objects- DOM- Java Script Event Handling- Form Handling and validations- **AJAX & JQuery:** Introduction to AJAX.jQuery: Introduction- jQuery Selectors- jQuery Animations- Effects- Event Handling- jQuery DOM Traversing- JSON- jQuery AJAX.
Casestudy: web scraping and automation

Unit3: Server-side programming using PHP and Node JS. L-9 Hours

PHP: introduction-Variables- Program control- Built-in Functions-Connecting to Database using MySQLi - cookies-sessions-Regular Expression; **Node JS:** Introduction-Architecture-Features of Node JS- Installation and setup-Creating web servers with HTTP (Request & Response)-Event Handling-Get and Post Implementations-Database connectivity.
casestudy:online Book Store.

Unit4: Single Web Page Design using Angular L-9 Hours

TypeScript:Introduction to TypeScript - variables – Data types - Enum - Array - Tuples -Functions – OOP concepts - interfaces - generics - modules - namespaces - decorators. **Angular:** Install angular@cli - Components - Modules - Templates - Interpolation - Property Bindings - Expressions. Case study: Todo list

Unit5: Creating Forms and Mobile app Conversions **L-9 Hours**

Event Bindings and Statements - Services - Dependency Injection - Routing and Navigation pages - Template based Form - Reactive Forms - Validating - Pipes - Sorting and Filtering -Decorator - HTTP Client - Data storage - Observables & RxJS. Converting Web App to Mobile App Development - Install Capacitor Package - Configuration Setup - Native ios and Android packages - Build and Deploy the application.

Case study:Chat Bot

Total : 45 Hours

G.Laboratory Experiments

Part – 1

Task 1	Develop a simple college web site including all the department information using HTML5 and CSS3.
Task 2	Create home page, sign up and login page for clinic management service using Bootstrap Framework.
Task 3	Validate the Registration, user login, user profile and payment by credit card pages using JavaScript.
Task 4	Parse the web page to get the required information using JQuery and DOM Traversing.
Task 5	Create a simple HTTP web server using Node.js to generate a dynamic response
Task 6	Create a three-tier application using Node.js and MySQL data base.
Task 7	Create an Reactive form for User Registration using Angular for Online Exam portal.
Task 8	Improve any Angular (+Node JS) application by adding Error Handling concepts.
Task 9	Develop web application to implement routing and navigation in Angular.
Task 10	Build the Web application and convert it into Mobile app.

Part-2

Use Cases:

Use Cases1:Bike Rental System

This system is named as **Bike on Rent Management System**. This system is designed to help the customers to take bikes or two-wheelers on rent. When we go on any trip outside the town or country we want to be free of time so instead of going through metros and taxis we prefer to have our own vehicle for rent. Using this system vehicle owner can register as sellers and customers who want to take bikes on rent can register them as renters and can take any bike on rent. Address of the both are required as the customer can only take bike by going to the address provided and the vehicle owners can know the address that a customer is verified or not. The customer also has to upload some proofs to take the bike on rent. Proofs like license, pan card and identity card are compulsory so that no one could run taking the bike. Any customer whose proofs are not uploaded and are not valid will not be allowed to take any bike on rent. This has one admin account who verifies the registering user and two types of the user account. One for bike sellers and one for customers who take the bike on rent. This system has only one admin

account and cannot have more than one admin account. There will be simple chat room needs to be added to make instant interactions between customer and admin. Admin can verify and register the user who is registering. If the admin does not verify, the user cannot register.
Tools: HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, JQuery

Use Cases2: Clinic Management Service

This system is named as Clinic management service. This system is made to keep the records about the patients, doctors and other staff members working at a clinic or hospital receptionist. One can login into the clinic management service using the email id or the user id and password. After signing in into this system there are the options to add new patients, new doctors and other new staff members like nurses and ward boys etc. This system is designed to easily maintain the data of the patients specifically. Daily many new patients visit the clinic so adding the new patient's details and keeping the records using it is very easy. There is also an option to add and delete doctors and other staff member's details. New and unique ids are given to everyone who gets registered over this system. There are also the options to check the patient's disease and course the patient is going through. Fees paid by any customer or patient can be saved on it and it is easy to calculate daily that the money is collected. Doctors and another staff member like nurses, ward boys, janitor and maid leaves can be deducted from their salary and rest of the salary can be paid easily using this clinic management service. It is easy to calculate money and handle account on monthly basis also. This system also has an option to use the backup that means if we are backing up the database it can never be lost. So, overall, this clinic management service is a solution to all the problems that we face in a clinic or hospital.
Tools: HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, Java Script

Use Cases3: E-commerce service

Online shopping is a process in which people (specifically customers) are being provided with the option of purchasing goods and services directly from the seller, all in real-time environment. Online shopping is an application of the internet as electronic commerce (Like Amazon). From the business perspective, customers usually find the products more attractive, on websites, as they get all the details available there. People in large number are doing online shopping today, and it is not only because it is convenient as one can shop from home, but also because there are ample amount of varieties available, with high competition of prices, and also it is easy to navigate for searching regarding any particular item. For sellers, their products have access to World Wide market, which also increases the number of customers and enhances the customer relationships. Also the web stores are a means for the small scale companies to launch their products at global level. The main objective behind this project is to develop a web oriented application which can provide an online shopping feature to the users. In other words, the project aimed at creating a virtual shop environment for users, in some handy form, which will be available to them through internet. This system has been designed keeping in mind all the aspects such as loading the data, complexity and maintaining the security of user credentials.
Here in this system, complexity refers to the total number of features being provided to users, and their smooth arrangement and functioning required. Following are some of the key features of our system, which distinguishes it from others:

- Display of all the available categories for shopping on the home page.
- Display all the sub-categories on the home page; those are associated with any particular item.
- Admin has the authority to add new particulars to the items list whenever needed.
- Permission to administrator to remove items, anytime.
- Allows the admin to modify the price of each item, whenever required or felt like.
- Admin has the authority to update the description of each item.
- Permission to the admin to view information about each customer who checkouts the items list.

Tools: HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, Java Script

Use Cases4: College management service

This application college management system based on Internet that aims to all the levels of management providing information within an organization. This system can be used as an information management system for the college. For a given student/staff (Technical / Non-technical) the Administrator creates login id & password, using these student/ staff (Technical / Non-technical) can access the system to either upload or download some information from the database. Not only will this added user also get to know about the events and extra curriculum activities which will hold into the college campus.

The main menu will contain six parts which are as follow:

- Student Login
- Teacher login
- Deposit Fee
- Ask Queries Forum
- About Us
- Contact Us

Now, we can see that nearly everything is very much possible to perform with a single click, so this application will help you to computerize the system of college management so that student and other staff members can access the system online.

These are some key features of the system which is as follow:

- ✓ To reduce the headache of maintaining the record of students and teachers related documents.
- ✓ To reduce the cumbersome job of maintaining several documents like
- ✓ It will eliminate the delays in the generation of results and free updating of the students; this system will help in maintaining the records of absent students.
- ✓ Searching will become more efficient and fast in comparison of manual searching.
- ✓ It will also provide assurance that each employee of the college marked their attendance timely.
- ✓ Overall it will reduce the cost and time of the college head in taking care of the college.

Tools: HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, Java Script

Use Cases 5: E-Payment

In all E-commerce and other online services, payment activity is the most important section and this section mostly having the common procedures. If we make the payment service as the micro service component any web application full stack developer can easily integrate with his project instead of redesigning which is extra burden to developer. So, create the component for the Payment activity with the following operations:

- ✓ Getting card details
- ✓ Pin verification
- ✓ Encryption of card details
- ✓ Crediting and debiting the money on respective accounts.
- ✓ Payment Acknowledgement.
- ✓ Invoice Generation.

Convert this application to Mobile app

Tools: Node.js, Angular

Total : 30 Hours
Total: 75 Hours

H. Learning Resources

i. Text Books:

1. Ben Frain "Responsive Web Design with HTML5 and CSS: Develop future-proof responsive websites using the latest HTML5 and CSS techniques", Packt Publishing Limited, 3rd Edition, 2020.[Unit 1]
2. Mary Delamater, Murach's "JavaScript and jQuery", (4th Edition) Paperback – Illustrated, Mike Murach & Associates Inc, August 26, 2020.[Unit 2]
3. David Herron "Node.js Web Development: Server-side web development made easy with Node 14 using practical examples", Packt Publishing Limited,5th Edition, 2020. [Unit 3]
4. Yakov Fain "Angular Development with TypeScript", Manning Publications, 2nd Edition, December 2018. [Unit 4].

ii. Reference Books

1. AzatMardan, "Practical Node.js: Building Real-World Scalable Web Apps", 1st Edition.2018.

iii. Online Resources

1. "Angular the complete guide(2021 Edition)", Accessed on: May. 6, 2021 [Online], Available: https://www.udemy.com/course/the-complete-guide-to angular-2/
2. "Server-side Development with NodeJS, Express and Mongo DB", Accessed on: May. 06, 2021 [Online], Available: https://www.coursera.org/learn/server-side-nodejs
3. "Node.js Micro services for beginners", Accessed on: May. 06, 2021 [Online], Available: https://www.udemy.com/course/nodejs-microservices-for-beginners/

COURSE CODE	COURSE TITLE	L	T	P	C
10211CA223	Machine Learning Techniques	3	0	2	4

A.Preamble

This course introduces students to new and actively evolving interdisciplinary field of modern data analysis. The interplay between known data and unknown ones give rise to complex pattern structures and machine learning methods that are the focus of the study. In the course we will consider methods of Machine Learning and Data Mining Learning. It also includes dimensionality reduction techniques which help to deal with huge datasets.

B.Prerequisite Course

10210MA103- Probability, Statistics and Queuing theory

C.Course Objectives

Students are exposed to

1. Apply the concepts of supervised and unsupervised learning algorithms for real time applications
2. Executing decision tree algorithm and probabilistic models to overcome the problem of over fitting
3. Analyse and suggest appropriate machine learning approaches for various types of problems
4. Demonstrate the aspects of computational biology

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Examine the basic concepts of data mining and machine learning concepts	K3
CO2	Design and evaluate the dimensionality reduction algorithms using real world datasets.	K3
CO3	Apply various algorithms of Classification and Association.	K3
CO4	Demonstrate experiments to evaluate and compare different unsupervised learning algorithms	K3
CO5	Use the concept of neural networks for learning linear and non-linear activation functions	K3

Knowledge Level (Based on revised Bloom's Taxonomy)
K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2							1	1				
CO2	3	3	3	2	2				1	1			2	2
CO3	3	3	3	2	2				1	1			2	2
CO4	3	3	3	2	2				1	1			2	2
CO5	3	2	2	2	2	1	1		1	1			2	2

3-High; 2-Medium; 1-Low

F.Course Contents

Unit1 Introduction to Data Mining and Machine Learning L-9Hours

Introduction to Data mining and Knowledge Discovery – Data – Data Mining Functionalities – Steps in Data Mining Process, Architecture of Typical Data Mining systems - Interesting Pattern - Classification of Data Mining Systems – Machine Learning -Types of machine learning– Model selection and generalization- Evaluation Metric- Perspectives and Issues in Machine Learning – Concept Learning Task – Applications of Data Mining and Machine Learning

Unit 2 Dimensionality reduction L-9 Hours

Data Pre-processing- Needs Pre-processing the Data- Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation- Dimensionality Reduction – Feature Extraction- Variable Selection- Variable ranking- Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Cross Validation – Resampling methods

Unit3 Association and Classification L-9 Hours

Association Rule Mining - Mining Multilevel Association Rules - Mining Multidimensional Association Rule - Constraint Based Association Mining – Decision Tree Induction - Bayesian Classification – Support Vector Machines – Linear Regression - Logistic Regression - Decision Trees – Univariate Tree – Multivariate Tree – Regression Trees – ID3 - Random forest - Probability and Learning – Gaussian Mixture Models – Nearest Neighbor Methods

Unit4 Clustering Techniques L-9 Hours

Cluster Analysis - Types of Clustering methods – Partitioning Clustering - K-means, K- Medoid, K Mode- Density-Based Clustering - DBSCAN Algorithm - Distribution Model Based Clustering - Maximum likelihood Estimation – Expectation - Maximization Algorithm - Hierarchical Clustering - Agglomerative Hierarchical algorithm - Fuzzy Clustering - Fuzzy C-means algorithm Agglomerative and Divisive Clustering – BRICH - ROCK- Chameleon

Unit 5 Neural Networks **L-9 Hours**

ANN - Simple Perceptron - Gate implementation - Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Optimization - Hyper parameter tuning.

Total:45 Hours

G.Laboratory Experiments

Part – 1

Task 1	Apply and demonstrate the FIND-S algorithm for finding the most specific Hypothesis based on a given set of training data samples. **Tools: Google co-lab, Python, Scikit learn, Anaconda navigator**
Task 2	Implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples. **Tools: Google co-lab, Python, Scikit learn, Anaconda navigator**
Task 3	Apply LDA algorithm to select the appropriate data from the given data set. Use XG boost algorithm for classification. **Tools: Google co-lab, Python, Scikit learn, Anaconda navigator**
Task 4	Build a classification model that can effectively analyze and extract features from an image. Apply PCA algorithm to find the appropriate feature. **Tools: Google co-lab, Python, Scikit learn, Anaconda navigator**
Task 5	Write a program to demonstrate the working of the decision tree based on ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. **Tools: Weka, Python, Scikit learn, Anaconda navigator**
Task 6	Write a program to implement the Gaussian mixture model. Compute the accuracy of the classifier, considering few test data sets. **Tools: Rapid Miner, Python, Scikit learn, Anaconda navigator**
Task 7	Apply unsupervised learning to implement K – means clustering to perform cluster analysis, find the optimal number of clusters, identify appropriate features and interpret results. **Tools: Weka, Python, Scikit learn, Anaconda navigator**

Task 8	Apply unsupervised learning to implement Hierarchical clustering to perform cluster analysis, find the optimal number of clusters, identify appropriate features and interpret results. **Tools: Google co-lab, Python, Scikit learn, Anaconda navigator**
Task 9	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. **Tools: Google co-lab, Python, Scikit learn, Anaconda navigator**
Task 10	Apply back propagation neural network on image data. The idea is to build a Artificial Neural Network model that can effectively analyze and extract features from an image. **Tools: Google co-lab, Python, Scikit learn, Anaconda navigator**
Task 11	Assuming a set of documents that need to be classified, use the Radial basis function Classifier model to perform this task. Calculate the classification rate, accuracy, precision, and recall for your data set. **Tools: Google co-lab, Python, Scikit learn, Anaconda navigator**
Task 12	Write a program to implement artificial neural network with back propagation. **Tools: Google co-lab, Python, Scikit learn, Anaconda navigator**
Task 13	Create a perceptron with appropriate number of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights. **Tools: Google co-lab, Python, Scikit learn, Anaconda navigator**

Part-2

Use Cases:

Use Case 1: Medical Data Diagnosis

Use Case 2: Text Classification

Use Case 3: Biometrics pattern analysis

Use Case 4: Climatic prediction

Use Case 5: Credit Card Fraud Detection

Total : 30 Hours
Total : 75 Hours

G.Learning Resources

i.Text Books:

1. Ethem Alpaydin,, “Introduction to Machine Learning”, 4th edition, MIT Press, 2020 (Unit 1 to 4)
2. Christopher M Bishob, “Pattern Recognition and Machine Learning”, Springer-Verlag New York Inc, 2018
3. Tom Mitchell, “Machine Learning: A Guide to Current Research”, Kluwer academic publisher, 2019.

ii.Reference books:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An Introduction", Second Edition, MIT Press, 2019.(Unit 5)

2. Oliver Theobald,“ Machine Learning for Absolute Beginners", Scatterplot Press, third edtition, 2020
3. Beattie, Guy, “Machine Learning: Start with Machine Learning with all new tips tricks2020.Understand how machine learning can help”, 2020

iii.Online References:

1.Machine Learning, accessed online April 20, 2021 [online].Available: https://www.coursera.org/learn/machine-learning
2.Machine Learning by Georgia Tech, accessed online April 20, 2021[online], Available: https://www.udacity.com/course/machine-learning--ud2

ANNEXURE-IV

To discuss and approve the new course and course contents of Program Elective courses to be offered in the programme B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning) under the regulation VTR UGE 2021 with effect from 2023-2024.

Program Electives (18 Credits)

L-Lecture T-Tutorial P-Practical C-Credits

S. No	Course Code	Course Name	L	T	P	C
		Artificial Intelligence and Machine Learning Core				
1	10212CA110	Optimization Techniques	3	1	0	3
2	10212CA113	Reinforcement Learning*	3	0	0	3
3	10212CA121	High Performance Computing	3	0	0	3
4	10212CA214	Data Visualization	3	0	2	4
5	10212CA215	Deep Learning*	3	1	2	4
6	10212CA216	Natural Language Processing*	2	0	2	3
7	10212CA224	Computer Vision *	3	0	2	4
8	10212CA228	Blockchain Technology *	2	0	2	3
9	10212CA229	IoT and Cloud Computing*	3	0	2	4
		Honors				
		Artificial Intelligence				
10	10212CA206	Human Computer Interaction*	2	0	2	3
11		Speech Recognition*	3	0	0	3
12		Intelligent Agents*	3	0	2	4
13	10212CA223	Artificial Intelligence for Health Care8	3	0	2	4
		Machine Learning				
14	10212CA233	Social Media Analytics*	3	0	2	4
15	10212CA234	Time Series and Forecasting*	3	0	2	4

Tutorial hour is not considered for credit calculation of the course

COURSE CODE	COURSE TITLE	L	T	P	C
10212CA214	Data Visualization	3	0	2	4

A. Preamble

Data visualization is the visual and interactive exploration and graphic representation of data of any type. This course covers data visualization concepts, practices, and tools particularly for analyzing and presenting business data. Students will evaluate, design, and develop effective visualizations and dashboards, using various development tools.

B. Prerequisite Course

10211CA207-Database Management System

C. Course Objectives:

Learners are exposed to

- Understand the foundations of good design and apply it toward data visualizations.
- Clean and process data for improving visualizations.
- Create interactive graphs, charts and maps
- Gain best practices for telling stories with data, using interactive databases to create Visualizations.

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos	Course Outcomes	K - Level
CO1	Explain the visualization process and identify the type of data	K2
CO2	Apply various visualization techniques for Exploratory Data Analysis	K3
CO3	Explore visualization techniques Trees, Graphs, Networks, Text and documents	K3
CO4	Utilize various visualization techniques for spatial and Geospatial data	K3
CO5	Make use of different visualization tools for various applications	K3
	Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create	

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2		1					1			3	3
CO2	3	3	3	3	2					1	2		3	3
CO3	3	3	3	3	2					1	2		3	3
CO4	3	3	3	3	2					1	2		3	3
CO5	3	3	3	3	2	3				1	3		3	3

High- 3; Medium-2; Low-1

F. Course Contents

Unit 1 Introduction to Visualization **L-9 Hours**

Vision and Color Perception: Human Perception and Information Processing - Model of perceptual processing - Perception in visualization - Metrics - Visualization Process. Concepts and theories of data visualization: Gestalt principles, Information overloads – Gibson‘s Affordance theory - Costs and Benefits of visualization – Data abstraction and Data types – Dataset – Visualization Foundation.

Unit 2 Visualization for EDA **L-9 Hours**

Univariate analysis: Categorical Data- Bar chart – Pie Chart - Continuous data – Scatterplot-Line Plot-Strip Plot – Swarm Plot – Histogram – Density Plot – Rug Plot. Bivariate analysis: Categorical vs. Categorical: Stacked Bar Chart - Grouped Bar chart – Segmented Bar Chart - Mosaic Plots - Continuous vs. Continuous: Scatterplot Fit Lines - Categorical vs. Continuous : Bar Chart (Summary statistics) - Grouped Kernel Density Plots - Box Plots- Violin Plots - Ridgeline Plots- Beeswarm Plots. Multivariate Analysis: Point-Based Techniques - Line-Based Techniques - Region-Based Techniques - Combinations of Techniques.

Unit 3 Visualization for Trees, Graphs, Networks and Text **L-9 Hours**

Displaying Hierarchical Structures - Displaying Arbitrary Graphs/Networks - Issues. Levels of Text Representations - The Vector Space Model - Single Document Visualizations - Document Collection Visualizations - Extended Text Visualizations - Designing Effective Visualizations - Steps in Designing Visualizations - Problems - Comparing and Evaluating Visualization Techniques.

Unit 4 Visualization for Spatial and Geospatial **L-9 Hours**

Visualization Techniques for Spatial Data - One-Dimensional Data - Two-Dimensional Data -Three-Dimensional Data - Dynamic Data. Visualization Techniques for Geospatial Data - Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data - Visualization of Area Data - Issues in Geospatial Data Visualization.

Unit 5 Visualization for Time Oriented Data **L-9 Hours**

Characteristics of Time Oriented Data - Relating Data and Time - Visualizing Time-Oriented Data - Visualization Techniques to Analyze Outcomes of Feature Selection - Classification – Clustering – Regression - Model Selection

Total: 45 Hours

G. Laboratory Experiments

Part-2

Task 1: Exploration of Data Visualization Tools like Tableau, Python libraries, D3.js

- Connecting Dataset
- Preparation of data

Exploratory Data Analysis

Task 2: To visualize and perform Univariate analysis using continuous and categorical data
Categorical Data - Bar chart, Pie Chart Continuous data – Scatterplot, Line Plot, Strip Plot, Swarm Plot, Histogram, Density Plot, Rug Plot.
Tools : Tableau , Python

Task 3: To visualize and perform Bivariate analysis using continuous and categorical data
Categorical vs. Categorical: Stacked Bar Chart, Grouped Bar chart, Segmented Bar Chart, Mosaic Plots - Continuous vs. Continuous: Scatterplot Fit Lines Categorical vs. Continuous : Bar Chart (Summary statistics), Grouped Kernel Density Plots, Box Plots, Violin Plots, Ridgeline Plots, Beeswarm Plots.
Tools : Tableau , Python

Task 4: To visualize and perform Multivariate analysis using Multiple variables involving Multiple measures
Scatterplot Matrix, Parallel Coordinates, Line Graph, Stacked Bar Chart,
Tools : Tableau ,Python

Task 5: To design and perform visualization for Trees

- TreeMap, Sun Burst Display

Tools : Tableau, python, D3.js

Task 6: To design and perform visualization for Graphs and Networks

- Force based Layout

Tools : Tableau, python, D3.js

Task 7: To generate insight using Text Netwok Analysis and Visualization
Tools : Wordle, Tag Cloud, WordTree, InfraNodus

Task 8: To analyze and visualize Spatial and Geospatial data
Geographical Map, Map Projections
Tools : Tableau, python, D3.js, GIS

Task 9: To analyze and visualize Time Oriented Data
Analysis to identify systemic patterns in the data that help to form trends, cycles or seasonal

variances and to forecast the data. - Line Graph, Trend Lines, Area Chart
Tools : Tableau, python

Part-2

1. Performance of sales representatives
2. Performance of different company departments over year
3. Company Sales Branches Comparison
4. Call Time Analysis
5. Earthquake and Geospatial Data Analysis
6. Top10 startup Investment Analysis
7. Health Care analysis for patient care and reducing costs
8. Create an interactive dashboard, to convey the data that had been collected over the financial year.
9. Creating a Dashboard using COVID-19 data

Total: 30 Hours (P)
Total: 75 Hours

H. LearningResources

i. Text Books:

1. Matthew Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization Foundations, Techniques, and Applications", 2nd Edition, A K Peters Ltd.Natick, Massachusetts, 2015.

ii. Reference Books

1. Donabel Santos, "Tableau 10 Business Intelligence Cookbook", Packt Publishing, 1786465639, 9781786465634, 2016.

iii. Online Resource

1. "Data Science for beginner", Accessed on April.11.2021 [Online]. Available: https://bookdown.org/BaktiSiregar/data-science-for-beginners/Visualization.html
2. "Exploratory data analysis and Data visualization", Accessed on April.11.2021 [Online]. Available: https://www.creative-wisdom.com/teaching/WBI/EDA.shtml.
3. "Visualization of Multivariate Data", Accessed on April.11.2021 [Online].https://people.stat.sc.edu/hansont/stat730/MultivariateDataVisualization.pdf

ANNEXURE-V

To discuss and approve the courses and course contents of Open Elective courses to be offered in the regulation VTR UGE 2021 with effect from summer 2024-2025.

S.No.	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1	10213CA401	Responsible & Safe AI Systems	NPTEL	12 Weeks	3
2	10213CA402	Artificial Intelligence search methods for problem solving	NPTEL	12 Weeks	3
3	10213CA403	Introduction to Machine learning	NPTEL	12 Weeks	3
4	10213CA404	Deep Learning	NPTEL	12 Weeks	3

COURSE CODE	COURSE TITLE	W	H	C
10213CA401	**Responsible & Safe AI Systems**	**12**	**-**	**3**

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week1&2:

AI Capabilities Improvement in last 5-10 years

- Imminent risks from AI Models: Toxicity, bias, goal misspecification, adversarial example set.
- Long-term risks from AI Models: Misuse, Misgeneralization, Rogue AGI
- Principles of RAI - Transparency; Accountability; Safety, Robustness and Reliability; Privacy and Security; Fairness and non-discrimination; Human-Centred Values;
- Inclusive and Sustainable development, Interpretability
- Recap of Deep Learning Techniques, Language/Vision Models
- AI Risks for Gen models, Adversarial Attacks – Vision, NLP, Superhuman Go agents

Week3&4:

ML Poisoning Attacks like Trojans

- Implications for current and future AI safety
- Explainability
- Imminent and Long-term potential for transparency techniques
- Mechanistic Interpretability
- Representation Engineering, model editing and probing
- Critiques of Transparency for AI Safety

Week5&6:

Privacy & Fairness in AI

Week7&8:

Metrics and Tools for RAI - measuring bias/fairness, adversarial testing, explanations (Lime/SHAP/GradCam), audit mechanisms

- Regulation landscape - DPDP act (India), GDPR (EU), EU AI act, US presidential declaration, Ethical approvals, informed consent, participatory design, future of work, Indian context
- What is AGI? When could it be achieved?
- Instrumental Convergence: Power Seeking, Deception etc.

Week9&10:

- RAI in Legal domain
- RAI in Health care domain
- RAI in Education domain
- A few other domains
- Policy issues in RAI

Week11&12:

- Couple of panel discussion with industry practitioners, academic, government (possibly), and others.
- Fireside chat with eminent personalities
- Recorded Paper reading discussion

Course Provider :	NPTEL	
Professor :	1. Prof. Ponnurangam Kumaraguru	2.Prof. Balaraman Ravindran, 3.Prof. Arun Rajkumar
University :	IIT Hyderabad	IIT Madras

Total: 30 hours

COURSE CODE	COURSE TITLE	W	H	C
10213CA402	Artificial Intelligence Search Methods for Problem Solving	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 0 : Introduction: History, Can Machines think?, Turing Test, Winograd Schema Challenge, Language and Thought, Wheels & Gears

Week 1 : Introduction: Philosophy, Mind, Reasoning, Computation, Dartmouth Conference, The Chess Saga, Epiphenomena

Week 2 : State Space Search: Depth First Search, Breadth First Search, Depth First Iterative Deepening

Week 3 : Heuristic Search: Best First Search, Hill Climbing, Solution Space, TSP, Escaping Local Optima, Stochastic Local Search

Week 4 : Population Based Methods: Genetic Algorithms, SAT, TSP, emergent Systems, Ant Colony Optimization

Week 5 : Finding Optimal Paths: Branch & Bound, A*, Admissibility of A*, Informed Heuristic Functions

Week 6 : Space Saving Versions of A*: Weighted A*, IDA*, RBFS, Monotone Condition, Sequence Alignment, DCFS, SMGS, Beam Stack Search

Week 7 : Game Playing: Game Theory, Board Games and Game Trees, Algorithm Minimax, AlphaBeta and SSS*

Week 8 : Automated Planning: Domain Independent Planning, Blocks World, Forward &Backward Search, Goal Stack Planning, Plan Space Planning

Week 9 : Problem Decomposition: Means Ends Analysis, Algorithm Graph plan, Algorithm AO*

Week 10 : Rule Based Expert Systems: Production Systems, Inference Engine, Match-Resolve-Execute, ReteNet

Week 11 : Deduction as Search: Logic, Soundness, Completeness, First Order Logic, Forward Chaining, Backward Chaining.

Week 12 : Constraint Processing: CSPs, Consistency Based Diagnosis, Algorithm Backtracking, Arc Consistency, Algorithm Forward Checking

Course Provider:	NPTEL
Professor:	Prof. Deepak Khemani
University:	IIT Madras

Total: 30 hours

COURSE CODE	COURSE TITLE	W	H	C
10213CA403	Introduction to Machine learning	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Contents:

Week 0: Probability Theory, Linear Algebra, Convex Optimization - (Recap)

Week 1: Introduction: Statistical Decision Theory - Regression, Classification, Bias Variance

Week 2: Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Partial Least squares

Week 3: Linear Classification, Logistic Regression, Linear Discriminant Analysis

Week 4: Perceptron, Support Vector Machines

Week 5: Neural Networks - Introduction, Early Models, Perceptron Learning, Backpropagation, Initialization, Training & Validation, Parameter Estimation - MLE, MAP, Bayesian Estimation

Week 6: Decision Trees, Regression Trees, Stopping Criterion & Pruning loss functions, Categorical Attributes, Multiway Splits, Missing Values, Decision Trees - Instability Evaluation Measures

Week 7: Bootstrapping & Cross Validation, Class Evaluation Measures, ROC curve, MDL, Ensemble Methods - Bagging, Committee Machines and Stacking, Boosting

Week 8: Gradient Boosting, Random Forests, Multi-class Classification, Naive Bayes, Bayesian Networks

Week 9: Undirected Graphical Models, HMM, Variable Elimination, Belief Propagation

Week 10: Partitional Clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density-based Clustering

Week 11: Gaussian Mixture Models, Expectation Maximization

Week 12: Learning Theory, Introduction to Reinforcement Learning, Optional videos (RL framework, TD learning, Solution Methods, Applications)

Course Provider	**:**	NPTEL
Professor	**:**	Prof. Balaraman Ravindran
University	**:**	IIT Madras

Total: 30 hours

COURSE CODE	COURSE TITLE	W	H	C
10213CA404	Deep Learning	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1 : (Partial) History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm

Week 2 : Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feed forward Neural Networks, Representation Power of Feed forward Neural Networks

Week 3 : Feed Forward Neural Networks, Back propagation

Week 4 : Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Eigenvalues and eigenvectors, Eigenvalue Decomposition, Basis

Week 5 : Principal Component Analysis and its interpretations, Singular Value Decomposition

Week 6 : Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Contractive auto encoders

Week 7 : Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout

Week 8 : Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization

Week 9 : Learning Vectorial Representations Of Words

Week 10: Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Back propagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks

Week 11: Recurrent Neural Networks, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs

Week 12: Encoder Decoder Models, Attention Mechanism, Attention over images

Course Provider :	NPTEL
Professor:	Prof. Sudarshan Iyengar
University:	IIT Ropar

Total: 30 hours

ANNEXURE-VI

To ratify the value added courses offered in Winter Semester 2023 -24 for B.Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning) under the regulation VTR UGE 2021 with effect from 2023-2024.

L-Lecture T-Tutorial P-Practical C-Credits

S. No	Course Code	Course Name	L	T	P	C
1	10218CA947	Data Structures and Algorithms using Python - Part 1	3	0	0	0
2	10218CA936	Bash Shell Scripting Administration	3	0	0	0
3	10218CA941	Java Programming Fundamentals	3	0	0	0

Tutorial hour is not considered for credit calculation of the hours

COURSECODE	COURSETITLE	Total Hours
10218CA947	Data Structures and Algorithms using Python - Part 1	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester2023-2024

C. Branch: B.Tech-CSE(AIML)

D. Course Handling Faculty: Dr. P.J.Beslin Pajila

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Implement modular algorithms to find solution for computational problem with time and space complexities using suitable data structure.
- Solve structured problem using array and linked list in list concepts
- Develop modular algorithms to find solution for computational problems with linear Data structures using Stack concepts
- Develop modular algorithms to find solution for computational problems with linear Data structures using Queue concepts
- Solve unstructured problem using tree algorithm. Implement an appropriate algorithm using graph ADT for an application.

G. Preamble:

The Course introduce fundamentals of Data Structures. Discuss frequently used linear data structures like Stack, Queue, List etc. Discuss the commonly performed operations on linear data structures like insert, update, delete etc. Provide insights on non - linear data structures.

F.CourseContents

Module–1: Introduction to Data Structures **6 Hour**

Definition and Importance of Data Structures-What is a data structure?- Types of Data Structures- Arrays: Definition and properties,-Advantages and disadvantages-Operations: insertion, deletion, traversal, searching, and sorting

Module–2: List **6 Hour**

List using Array-add operation-Insert operation-Delete Operation-An Analysis-Memory Usage-Introduction-List using Linked List-Introduction-Creation-Display Operation-Algorithm-Add Operation-Algorithm-Search Operation--Insert Operation- Algorithm-Delete Operation-Algorithm- List using Array vs Linked list

Module–3: Stack **6 Hour**

Stack-Introduction-Push Operation-Algorithm-Pop Operation-Algorithm-Application Areas.

Module–4: Queue **6 Hour**

Queue- Enqueue Operation- Algorithm- Dequeue Operation- Algorithm

Module–5: Non-Linear Data Structures **6 Hour**

Non-Linear Data Structures - Introduction-Graph-Tree

G. Learning Resources

i. Text Book:

1. Bradley N. Miller, David L. Ranum ,“Problem Solving with Algorithms and Data Structures using Python", Franklin, Beedle & Associates,3rd Edition,ISBN-13: 978-1590282571
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser Publisher: Wiley,"Data Structures and Algorithms in Python", Wiley, 2nd Edition

ii. Reference Book

1. Benjamin Baka, "Python Data Structures and Algorithms", Packt Publishing, 978-786467355

iii. Online Resources

1. https://www.edx.org/learn/python/the-university-of-michigan-python-data-structures
2. https://www.coursera.org/specializations/data-structures-algorithms.

COURSE CODE	COURSE TITLE	Total Hours
10218CA936	Bash Shell Scripting Administration	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester 2023-2024

C. Branch: B.Tech.,CSE(AIML)

D. Course Handling Faculty: Dr. R Rajesh

E. Duration of the Course: 27.12.23to27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Familiarity with command-line interface and basic commands
- Ability to work with files, test conditions, and patterns.
- Ability to configure access levels and system environment variables.
- Using regular expressions and substring operations effectively.
- Understanding input types and the pipe operator for command chaining.

G. Preamble:

This comprehensive course delves into Bash Shell scripting, providing participants with practical knowledge and skills to automate tasks, manipulate data, and optimize workflows. Starting from the basics of Bash Shell, participants progress through advanced topics, such as regular expressions and file processing commands. With real-world examples and hands-on exercises, participants gain proficiency in using Bash Shell scripting for various tasks.

F.CourseContents

Module–1: Introduction to Bash Shell **5 Hour**

Definition and Importance of Data Structures-What is a data structure?- Types of Data Structures- Arrays: Definition and properties,-Advantages and disadvantages-Operations: insertion, deletion, traversal, searching, and sorting

Module–2: Getting Started **5 Hour**

File Text Size, Test Numbers, Checking Conditions, Multiple Digit Pattern, Checking If File Exists, Test File Exists, Script Output

Module–3: Shell Environment **5 Hour**

Introduction to Shell Environment, Command Program, Access Level Configuration, Booting Level Configuration, Booting Level Configuration Continue, System Admin Level Configuration, Networking Level Configuration, System Environment, User Configuration Files, Shell Special Variables. Array Declaration, Variable Declaration, Variable Declaration and Assignment

Module–4: Usage with String Manipulations **5 Hour**

String Manipulation and Internal Commands, Topic Structure, Regular Expressions, Square Bracket Round Bracket, Dot Character, Substring Length, Substring Removal.

Module–5: Commands-External and Internal **5 Hour**

Quick Revision on String Manipulation, Types of shell commands-External and Internal, Types of User Input, Pipe Operator. Lecture Introduction, Awk Introduction, Syntax and Dataset Familiarity, AWK for Column, Columns Extraction, Skipping the Header Row, Awk for Pattern Matching, Awk for Pattern Matching Continue, Dynamic Redirection of File Output, AWK Keyword, Status Variable, AWK for Grouping, What is Array, Statement Output, Total Female Population, Total Male Population, Percentage of Population, Peplinski Population

Module–6: Reading **5 Hour**

Internal Command, Reading from Single Variable, Reading from Array, Reading From File Introduction to Stacks Data Structure, Introduction to Stacks Data Structure Continue, Set Command Internal Command Set, Internal Command Unset, Intro to External Commands, External Command Cat External Command WC, Character Mode, Numerical Mode, Numerical Mode Continue, Searching Patterns in Multiple Files, Single File, Count Pattern Occurrence, Suppress Filename Headers Etc., Changing Ownership, Filter by Owner Before Change, External Command ENV, External Command CP, External Command MV, External Command Date, External Command ln, External Command ln Continue, Dataset Explanation for File Processing Commands, External Command-Essa-Jump to Line, Search for Pattern, External Command-Tail, External Command-Sort, External Command-Unit, External Command-PS, External Command Find, External Command Conclude

G. Learning Resources

i. Online Resources

Search Results Page | Infosys Springboard (onwingspan.com)

COURSE CODE	COURSETITLE	Total Hours
10218CA914	Java Programming Fundamentals	30

A. Course Category: Value Added Course

B. Offered Semester: Winter Semester2023-2024

C. Branch: B.Tech-CSE(AIML)

D. Course Handling Faculty: Ms. M. Sumithra

E. Duration of the Course: 27.12.23 to 27.04.24

F. Course Outcome:

The Students will be able to proficiently:

- Create Java programs using the fundamental programming constructs
- Implement and design a class based on attributes and behaviors of objects
- Develop Java code that demonstrates the working of different keywords in Java
- Explain and implement different Object-Oriented concepts in Java
- Develop Java code that uses the appropriate access modifiers, package declarations, import statements
- Identify, apply and understand the working of the most common APIs used in Java
- Explains about Exception Handling, Collections Framework and, Generics.

G. Preamble:

Java Programming Fundamentals is designed to introduce the fundamentals of Java programming and its object-oriented features. It will help out the learners to understand various keywords available in Java and Java's architecture. Also, this course will help learners to know the working of Java APIs through hands on approach

F.CourseContents

Module–1: **6 Hour**

About Java Programming Fundamentals, Introduction and Features of Java, Java Architecture, Java Development Kit

Module–2: List **6 Hour**

Data Types, Keywords and Identifiers, Operators, Type Casting, Widening and Narrowing, Conditional Statements, Control Flow and Looping, Arrays: Introduction to Arrays, Enhanced for loop

Module–3: Stack **6 Hour**

Object Oriented Concepts using Java, Class and Object, Constructors, this Keyword, Inheritance, Polymorphism, super Keyword

Module–4: Queue **6 Hour**

Final Keyword, static Modifier, Variable Arguments, Enumerated Data Types, Abstract class Interface Package Access Modifiers Java Libraries.

Module–5: Non-Linear Data Structures **6 Hour**

Exceptions, Generics, The Collections Framework, Date/Time APIs.

G. Learning Resources

i. Online Resources

"Infosys Spring Board ", Available:
https://infyspringboard.onwingspan.com/web/en/page/home

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Accredited by NAAC with the HIGHEST GRADE A++

SCHOOL OF ELECTRICAL & COMMUNICATION

MINUTES OF MEETING

41st BOARD OF STUDIES

on

29.06.2024

Venue: ECE Conference Hall

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

School of Electrical and Communication

Department of Electronics and Communication Engineering

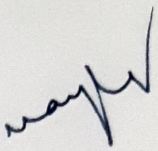
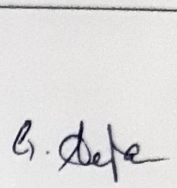
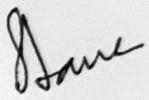
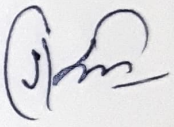
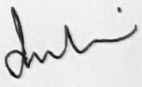
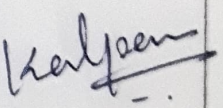
Chapter Name : 41st BoS Meeting

Date/Time of Meeting : 29.06.2024 /10.00 am – 12.00 pm

Location of Meeting : ECE Conference Hall

Members of Board of Studies

Serial Number	Name of the member	Designation	Signature
1	**Dr.A.Selwin Mich Priyadharson** **Professor and Head,** Department of Electronics and Communication Engineering, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Chairman, Board of Studies	
	External Experts		
2	**Dr.N.B. Balamurugan** **Professor,** Department of Electronics and Communication Engineering, Thiagarajar College of Engineering, Madurai.	Academic Expert	29/6/24
3	**Ms. Penilop** **Scientist E,** DSP Division, Sameer Centre for Electromagnetics, Chennai.	Industry Expert	Penilop B 29/6/2024
4	**Dr.G. Ramya,** **Assistant Professor,** Department of Electronics and Communication Engineering, SRM Institute of Science and Technology, Chennai.	Alumni Representative	ABSENT

Internal Experts			
5	**Dr. J.L. Mazher Iqbal** **Professor,** Department of Electronics and Communication Engineering, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Internal Member	
6	**Dr. G. Aloy Anuja Mary** **Professor,** Department of Electronics and Communication Engineering, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Internal Member	
7	**Dr. S. Jana** **Professor** Department of Electronics and Communication Engineering, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Internal Member	
8	**Dr. Harikrishna Paik** **Professor,** Department of Electronics and Communication Engineering, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Internal Member	
9	**Dr. E.D. Kanmani Ruby** **Professor,** Department of Electronics and Communication Engineering, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Internal Member	
10	**Dr.P. Kalpana Devi** **Associate Professor,** Department of Electronics and Communication Engineering, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Internal Member	
11	**Mrs.K.J. Subha** **Assistant Professor,** Department of Electronics and Communication Engineering, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Internal Member	ABSENT

12	**Gongal Reddy V Kishore Reddy** **Student (2020 - 2021), VTU18330** Department of Electronics and Communication Engineering, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology	Student Representative	ABSENT

BoS Chairman

Dr.A. Selwin Mich Priyadharson
Head of the Department
Electronics & Communication Engineering

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

23/5/24

Dr. Valarmathi. R.S
Dean - School of Electrical & Communication

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

AGENDA – 41st BOARD OF STUDIES MEETING

Agenda No.	Agenda
	Item for Confirmation
1	To confirm the minutes of meeting of the 40th Board of Studies held on 12.01.2024.
	Items for Discussion
2	Syllabus discussion for the specialization programme 'IoT' to be offered in the AY 2024-2025 under VTR UGE 2021.
3	Syllabus discussion for the minor degree courses (Semiconductor Technologies, 5G and Beyond) to be offered in the AY 2024-2025 under VTR UGE 2021.
4	Syllabus discussion for the PG elective courses to be offered in the AY 2024-2025 under VTR PGE 2023.
5	Reduction of credit hours to 45 for tutorial courses under program core category of VTR UGE 2021 as approved in 41st ACM Meeting held on 11 Mar 2023.
6	Ratification of Ph.D. course 'Speech Signal Processing and Coding'.
7	List of one credit courses to be offered during summer semester of AY 2024-2025 for VTR UGE 2021.
8	List of MOOC courses to be offered as program elective and open elective courses under VTR UGE 2021.
	Items for Reporting
9	Supporting document maintained for slow learner and advanced learner activity.
10	Student performance and placement details during the AY 2023-2024.
11	Student and Faculty achievements in NPTEL course during April 2024.
12	Industrial Visits underwent by the students during the AY 2023-2024.
13	Any other Points

The 41st BoS meeting started with a warm welcome by the chairman of the BoS. The board chairman appraised the external BoS members about their contributions and suggestions to the curriculum and syllabus for the past two years. The tenure for both the internal and external BoS members are expiring with this meeting and a new panel will be formed with vice chancellor's approval for the next two years.

Agenda #1: To confirm the minutes of meeting of the 40th Board of Studies held on 12.01.2024.

Discussion #1 The BoS chairman briefed the action taken for the agenda points discussed in 40th Board of Studies meeting held on 12.01.2024. The points are given below:

Agenda No.	Agenda– 40th BoS Meeting
	Item for Confirmation
1	To confirm the minutes of meeting of the 39th Board of Studies held on 27.05.2023.
	Items for Reporting
2	Ratification of open elective course 'FPGA Architecture and Applications' in VTR UGE 2021.
3	Courses offered under Industry and Higher Learning (IHL) category during summer semester of AY 2023- 24 in VTR UGE 2021.
4	Policy for identifying the slow & advanced learners and activities in VTR UGE 2021
5	Student performance during winter semester of AY 2022- 23 and placement details of B.Tech. ECE.
	Items for Discussion
6	New programme elective courses proposed in VTR UGE 2021 regulation.
7	Courses offered under Industry and Higher Learning (IHL) category during winter semester of AY 2023- 24 in VTR UGE 2021.
8	NPTEL courses to be offered as programme elective and open elective courses in VTR UGE 2021 regulation.
9	List of courses offered under B.Tech. ECE with specialization in IoT.
10	M.Tech. Regulation VTR PGE 2023 curriculum and syllabi.
11	New course proposed under Ph.D. course work with syllabus.
12	Any other points

S.No	Agenda	Suggestions by Members	Action Taken
1	Ratification of open elective course 'FPGA Architecture and Applications' in VTR UGE 2021.	• To avoid using the word 'Introduction' in titles of units 1-3. • Members also suggested to remove the topics 'case study' and 'power on reset' from unit 4.	• Suggested corrections were incorporated in the syllabus.

2	Courses offered under Industry and Higher Learning (IHL) category during summer semester of AY 2023- 24 in VTR UGE 2021 based on stake holders' feedback.	• Proposed list of courses was recommended by the members	• Inclusion of 10 new courses in the IHL category.
3	Policy for identifying the slow & advanced learners and activities in VTR UGE 2021.	• Faculty to motivate the advanced learners to take up additional NPTEL course according to their preference.	• Faculty are enrolled as NPTEL mentor and students were motivated to register under them as per their choice.
4	Student performance during winter semester of AY 2022-23 and placement details of 2020-2024 batch of students.	• To reduce and simplify the contents of II-year courses so as to improve the results.	• 10% of the content is reduced from the tutorial courses.
5	Discussion of new programme elective courses proposed in VTR UGE 2021 regulation.	• To add application topics in some of the units where applicable in '10212EC175 - Fundamentals of Quantum Computing'. • Members insisted to add suitable verb to all the experiments in the course '10212EC233- VLSI Chip Design'	• Suggested corrections were incorporated in the syllabus.
6	Discussion on courses offered under Industry and Higher Learning (IHL) category during winter semester of AY 2023- 24 in VTR UGE 2021.	• 11 new courses proposed under Industry and Higher Learning (IHL) category during winter semester of AY 2023- 24 is hereby recommended by the members of BoS.	• The courses were offered to the students during winter semester of AY 2023- 24.
7	Discussion on NPTEL courses to be offered as programme elective and open elective courses in VTR UGE 2021 regulation.	• 11 NPTEL courses to be offered as programme elective and open elective courses in VTR UGE 2021 regulation is hereby recommended by the members of BoS.	• The courses were offered to the students during winter semester of AY 2023- 24.
8	Discussion on list of courses offered under B.Tech. ECE with specialization in IoT	• The list of courses offered under B.Tech. ECE with specialization in IoT is recommended by the members of BoS.	• Syllabus is prepared and is to be discussed in 41st BoS.
9	Discussion of M.Tech. Regulation VTR PGE 2023 curriculum and syllabi	• Suggestions were given by the BoS members to avoid using two statements for one 'CO' and to remove the term 'introduction' in unit titles. • It is suggested to rephrase the	• Suggested corrections were incorporated in the syllabus.

		experiment titles with 'design and simulation'. • In open elective course 'Electric Vehicle Technology' suggestions were given to remove the term 'controllers' in unit 4 title and to add a topic on 'Green Energy'.	
10	Discussion on the new course proposed under Ph.D. course work with syllabus	• To include text books of recent year under learning resources • To include online resources.	• Suggested corrections were incorporated in the syllabus.
11	Discussion on list of courses offered under Minor degree in Semiconductor Technologies, 5G and Beyond for VTR UGE 2021	• The proposed list of courses is recommended by the members of BoS.	• The syllabus is prepared and is to be discussed in 41st BoS.
12	Any other points	• To maintain the list of ECE students undergoing minor in other departments	• The list is maintained by the respective mentors

All the members reviewed the action taken for the points discussed above and suggested to move on to next agenda.

Action #1: Resolved, that the action taken for the points discussed in the 40th Board of Studies are hereby recommended for approval by the members of BoS and shall be finalized.

Agenda #2: Syllabus discussion for the specialization programme 'IoT' to be offered in the AY 2024-2025 under VTR UGE 2021.

Sl. No.	Course Code	Course Title	L	T	P	C
Specialization Electives						
Internet of Things						
1.	10212EC176	Industry 4.0 and IIoT	3	0	0	3
2.	10212EC177	IoT Security	3	0	0	3
3.	10212EC178	Artificial Intelligence and Machine Learning	3	0	0	3
4.	10212EC179	Flexible and Wearable Sensors	3	0	0	3
5.	10212EC180	Automotive Sensors and In-Vehicle Networking	3	0	0	3
6.	10212EC234	IoT System Design and Development	2	0	2	3

Discussion #2: The domain in-charge presented the syllabus for the specialization programme 'IoT' to be offered in the AY 2024-2025 under VTR UGE 2021. The BoS members suggested the following:

- General remark to include 6 CO's if possible as the institute is following CDIO framework
- Industry 4.0 and IIoT [10212EC176] - to maintain atleast one CO with 'K3' knowledge level and to reduce the content of 'unit 5'.
- IoT Security[10212EC177] – The topic 'ML for threat detection' in unit 4 shall be removed.
- Artificial Intelligence and Machine Learning[10212EC178] – Overall the content coverage must be simplified. To remove unit 5 and to have either Artificial Intelligence or Machine Learning in the syllabus. In addition, real time application topics to be added with every unit.
- Flexible Electronics and Wearable Sensors[10212EC179] - Overall course content coverage must be simplified, especially unit 3.
- Automotive Sensors and In-Vehicle Networking [10212EC180]- Year of publication must be mentioned in the text book.
- IoT System Design and Development [10212EC234] – To replace the verb 'write' with 'simulate'

Action #2: Resolved, that the suggestions were incorporated in the syllabus and is hereby recommended for approval by the members of BoS.

Agenda #3: Syllabus discussion for the minor degree courses (Semiconductor Technologies, 5G and Beyond) to be offered in the AY 2024-2025 under VTR UGE 2021.

Sl. No.	Course Code	Minor Electives	L	T	P	C
5G and Beyond						
1.	10212EC181	Wireless Communication	3	0	0	3
2.	10212EC182	5G Technology	3	0	0	3
3.	10212EC183	5G New Radio Access Technology	3	0	0	3
4.	10212EC184	Millimeter Wave Technology	3	0	0	3
5.	10212EC185	5G Networks	3	0	0	3
6.	10212EC186	MIMO Wireless Communication	3	0	0	3
7.	10212EC187	5G Security	3	0	0	3
8.	10212EC188	6G Mobile Networks	3	0	0	3
Semiconductor Technologies						
1.	10212EC189	Semiconductor Materials and Devices	3	0	0	3
2.	10212EC190	Semiconductor Process Technology	3	0	0	3
3.	10212EC191	VLSI and Post CMOS Electronics	3	0	0	3
4.	10212EC192	Semiconductor Packaging	3	0	0	3
5.	10212EC193	VLSI Testing and Verification	3	0	0	3
6.	10212EC194	Quantum Technologies for VLSI	3	0	0	3
7.	10212EC195	Semiconductor Optoelectronics and Photovoltaics	3	0	0	3
8.	10212EC235	FPGA based System Design	1	0	4	3

Discussion #3: The domain in-charges presented the syllabus for the minor degree courses (Semiconductor Technologies, 5G and Beyond) to be offered in the AY 2024-2025 under VTR UGE 2021. The BoS members suggested to offer specialization degree under VLSI domain in accordance with CDAC and suggested to reduce the overall syllabus content of both the minor degree syllabus and in addition highlighted the following:

5G and Beyond

- Overall the content must be reduced for all the courses.
- Wireless Communication[10212EC181] – to add 'introduction of MIMO systems' in unit 4.
- To refer MIT open courses content for preparation of syllabus.

Semiconductor Technologies

- Semiconductor Materials and Devices [10212EC189] - to maintain atleast one CO with 'K3' knowledge level and to remove 'dynamic equilibrium' from unit 1, add application topics with every unit, change unit 3 title as 'PN Junction Diode' and to remove topics related to special diodes, also to remove topic 'fermi energy' from unit 5.
- Semiconductor Process Technology [10212EC190] – Overall the content coverage must be simplified.
- VLSI and Post CMOS Electronics [10212EC191] – Overall the content coverage must be simplified.
- Semiconductor Packaging [10212EC192], VLSI Testing and Verification[10212EC193], Quantum Technologies for VLSI[10212EC194], Semiconductor Optoelectronics and Photovoltaics[10212EC195] - Overall the content coverage must be simplified.
- FPGA based System Design[10212EC235] – to add simple experiments such as simulation of logic gates.

Action #3: Resolved, that the suggestions were incorporated in the syllabus and is hereby recommended for approval by the members of BoS.

Agenda #4: Syllabus discussion for the PG elective courses to be offered in the AY 2024-2025 under VTR PGE 2023.

Discussion #4: The PG coordinator presented the syllabus for the PG elective courses to be offered in the AY 2024-2025 under VTR PGE 2023. The BoS members suggested the following:

- Advanced Mathematics for Embedded Systems [20231EC105] - to remove the word 'Advanced' from the title.
- It is recommended to have the knowledge levels for the course outcomes at K3 level and atleast one CO must be in K4 level (Analyse).
- Depth of syllabus coverage must be extended and new topics to be added in all subjects.
- Alternate course for cloud computing shall be provided if possible.

Action #4: Resolved, that the suggestions were incorporated in the syllabus and is hereby recommended for approval by the members of BoS.

Agenda #5: Reduction of credit hours to 45 for tutorial courses under program core category of VTR UGE 2021 as approved in 41st ACM Meeting held on 11 Mar 2023.

Discussion #5: The domain-in charges presented the syllabus of tutorial courses from 60 hours to 45 hours under program core category of VTR UGE 2021 as approved in 41st ACM Meeting held on 11 Mar 2023.

- Analog Electronics [10211EC102] – Already studied topics such as diode shall be avoided in Unit 1.
- Control Systems [10211EC105] – Important topics are removed such as 'Nyquist criterion and transfer model'. These topics shall be retained.
- Signals and Systems [10211EC106] – Discrete Fourier series in unit 5 shall be retained
- Electromagnetics and Transmission Lines[10211EC107] – The topic 'Electromagnetic Potential' in unit 1 shall be retained.
- Discrete Time Signal Processing [10211EC111] – Remove application of 'FFT algorithm in Linear filtering' of unit 1.

Though not under tutorial, the following course 'Linear Integrated Circuits' was discussed based on the feedback from course handling faculty members:

- Linear Integrated Circuits [10211EC104]– Sub-topics such as 'Widlar or Wilson' must be included in unit 1, also to remove the word 'PLL' in all places. In Unit 5, 'V to F' and 'F to V' converters, 'video amplifier' shall be removed and the order of the filters along with the type as either 'butterworth or chebyshev' must be specified.

Action #5: Resolved, that the suggestions were incorporated in the syllabus and is hereby approved by the members of BoS.

Agenda #6: Ratification of Ph.D. course syllabus 'Speech Signal Processing and Coding'.

Discussion #6: The BoS chair reported the ratification in course syllabus of Ph.D. course 'Speech Signal Processing and Coding [40211EC131]'. The members suggested to include K4 levels in course outcome.

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Action #6: Resolved, that the Ph.D. course 'Speech Signal Processing and Coding' for ratification is hereby recommended for approval by the members of BoS.

Agenda #7: List of one credit courses to be offered during summer semester of AY 2024-2025 for VTR UGE 2021.

Discussion #7: The BoS chair discussed the list of one credit courses to be offered during summer semester of AY 2024-2025 under VTR UGE 2021 based on the stake

holders feedback obtained during winter semester of AY 2023-2024. The one credit courses are offered by the department of Industry and International relations. The list of courses is given below:

Industry Higher Learning (IHL) - International Relations (Summer AY 2024-25)

S.No.	COURSE TITLE
1	Data Analytics
2	Digital Forensics and Incident Response
3	Machine Learning
4	Next Generation of Wireless Networks
5	Security and privacy in 6G Networks
6	Innovative design thinking
7	Ethical hacking and pen testing

Industry Higher Learning (IHL) - Industry Relations (AY 2024-25))

S.No.	COURSE TITLE
1	RISC V based SOC on FPGA
2	Virtual Instrumentation for Industrial Measurement Practice
3	Application of Digital Twin in Aerospace Field
4	Introduction to Digital Forensics Tools
5	Augmented & Virtual Reality for Gaming Industry
6	3D ICs
7	Generative AI
8	Penetration testing in cyber security
9	Next generation internet
10	Humanoid Robots

Action #7: Resolved, that the inclusion of courses is hereby recommended for approval by the members of BoS.

Agenda #8: List of MOOC courses to be offered as program elective and open elective courses under VTR UGE 2021.

Discussion #8: The BoS chair discussed the list of NPTEL courses to be offered as program elective and open elective courses under VTR UGE 2021 during summer semester of AY 2024-2025.

S.No	Course Code	Course Title	Duration	Credits	Category
PROGRAMME ELECTIVE					
1	10212EC414	Cyber Security and Privacy	12	3	PE
2	10212EC415	Modern Digital Communication Techniques	12	3	PE
3	10212EC416	Operating System Fundamentals	12	3	PE
4	10212EC417	Responsible & Safe AI systems	12	3	PE
5	10212EC418	VLSI Design Flow: RTL to GDS	12	3	PE
OPEN ELECTIVE					
1	10213EC404	Introduction to Photonics	12	3	OE
2	10213EC405	A Basic Course on Electric and Magnetic Circuits	12	3	OE
3	10213EC406	Introduction to Semiconductor Devices	12	3	OE
4	10213EC407	Optimization Theory and Algorithms	12	3	OE
5	10213EC408	Microelectronics: Devices to Circuits	12	3	OE

Action #8: Resolved, that the inclusion of new courses offered under Independent Learning (MOOC) category during summer semester of AY 2024- 25 for the following courses are hereby recommended for approval by the members of BoS.

Agenda #9: Supporting document maintained for slow learner and advanced learner activity.

Discussion #9: The BoS chair reported the supporting document maintained for slow learner and advanced learner activity. The members suggested to give home assignments and counselling to improve students' performance.

Action #9: Resolved, that the above suggestions shall be carried out in the forthcoming semesters as recommended by the external BoS members.

Agenda #10: Student performance and placement details during the AY 2023-2024.

Discussion #10: The BoS chairman reported the student performance and placement details during the AY 2023-2024. The members appreciated the institute and faculty members for maintaining good percentage of results. They insisted to maintain and present the student record of those interested in higher studies during next BoS meeting.

Action #10: Resolved, that the suggestions given by the external members will be incorporated in maintaining placement and student performance data.

Agenda #11: Student and faculty achievements in NPTEL course during April 2024.

Discussion #11: The BoS chair presented the student and faculty achievements in NPTEL course during April 2024. The BoS members appreciated the efforts and achievements of both the students and faculty members.

Action #11: Resolved, that more participation of students and faculty in registering NPTEL course during November 2024 will be encouraged.

Agenda #12: Industrial Visits underwent by the students during the AY 2023-2024

Discussion #12: The BoS chair presented the Industrial Visits underwent by the students during the AY 2023-2024. The BoS members appreciated the initiatives taken by the department in arranging Industrial Visits in good companies.

Action #12: Resolved, more industrial collaboration will be initiated during the forthcoming academic year.

Agenda #13: Any other points: Dissolution of present BoS members and proposal for new panel members.

Discussion #13: The BoS chair expressed his gratitude to the present members for their valuable insights in the curriculum and academic activities and formally dissolved the team.

Action #13: Resolved, that the new team of experts will be formed and submitted to the Vice Chancellor for approval.

The meeting ended with a formal thanks by the chair of BoS. The suggestions given by the external BoS members are incorporated and ratified. Further it is submitted for approval in ACM.

S. Salivahanan

Prof. S. Salivahanan
Vice Chancellor

Vel Tech
Rangarajan Dr. Sagunthala

20/12/24

Dr. Valarmathi R S
Dean - School

Vel
Rangarajan
R&D Institute of

BoS Chairman

Dr.A. Selwin Mich Priyadharson
Head of the Department
Electronics & Communication Engineering

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology

Annexures

Sl. No.	Course Code	Course Title	L	T	P	C
Specialization Electives						
Internet of Things						
1.	10212EC176	Industry 4.0 and IIoT	3	0	0	3
2.	10212EC177	IoT Security	3	0	0	3
3.	10212EC178	Artificial Intelligence and Machine Learning	3	0	0	3
4.	10212EC179	Flexible and Wearable Sensors	3	0	0	3
5.	10212EC180	Automotive Sensors and In-Vehicle Networking	3	0	0	3
6.	10212EC234	IoT System Design and Development	2	0	2	3
Sl. No.	**Course Code**	**Minor Electives**	**L**	**T**	**P**	**C**
5G and Beyond						
1.	10212EC181	Wireless Communication	3	0	0	3
2.	10212EC182	5G Technology	3	0	0	3
3.	10212EC183	5G New Radio	3	0	0	3
4.	10212EC184	Millimeter Wave Technology	3	0	0	3
5.	10212EC185	5G Networks	3	0	0	3
6.	10212EC186	MIMO Wireless Communication	3	0	0	3
7.	10212EC187	5G Security	3	0	0	3
8.	10212EC188	6G Mobile Networks	3	0	0	3
Semiconductor Technologies						
1.	10212EC189	Semiconductor Materials and Devices	3	0	0	3
2.	10212EC190	Semiconductor Process Technology	3	0	0	3
3.	10212EC191	VLSI and Post CMOS Electronics	3	0	0	3
4.	10212EC192	Semiconductor Packaging	3	0	0	3
5.	10212EC193	VLSI Testing and Verification	3	0	0	3
6.	10212EC194	Quantum Technologies for VLSI	3	0	0	3
7.	10212EC195	Semiconductor Optoelectronics and Photovoltaics	3	0	0	3
8.	10212EC235	FPGA based System Design	1	0	4	3

P.G. Courses

Sl. No.	Course Code	Course Title	L	T	P	C
M. Tech						
Program Core						
1.	20231EC105	Modern Mathematics for Embedded Systems	4	0	0	4
Program Electives						
2.	20232EC101	Embedded Systems Security	3	0	0	3
3.	20232EC103	Intelligent Control and Automation	3	0	0	3
4.	20232EC109	Industrial Internet of Things	3	0	0	3
5.	20232EC110	Embedded Real Time System with FPGA	3	0	0	3
6.	20232EC113	In Vehicle Networking	3	0	0	3

Course Code	Course Title	L	T	P	C
10212EC176	INDUSTRY 4.0 AND IIOT	3	0	0	3

a) Course Category

Specialization Elective

b) Preamble

Smart factories are equipped with advanced sensors, embedded software and robotics that collect and analyze data and allow for better decision making. This Course will provide knowledge on the industry 4.0 design requirements, data analysis and applications of Internet of Things (IoT) in industries.

c) Prerequisite

Nil

d) Related Courses

Internet of Things

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Summarize the evolution of Industry 4.0 and design requirements of Industrial IoT (IIoT).	K2
CO2	Illustrate the functions of Industrial processes, business models, off-site on-site technologies	K2
CO3	Develop data acquisition system using instrumentation amplifier and mapping of IIOT analytics	K3
CO4	Interpret the plant safety and security features and benefits of inventory management system	K2
CO5	Outline the applications and challenges of IIoT.	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	L	L	-	-	-	-	-	_	L	-	L	M	L
CO2	H	L	L	-	-	-	-	-	L	L	-	L	M	L
CO3	H	M	M	L	L	-	-	-	L	L	-	L	M	L
CO4	H	M	M	M	-	-	L	L	L	L	-	L	M	L
CO5	H	M	M	L	-	-	-	-	L	L	M	L	M	L

g) Course Content

UNIT I OVERVIEW OF INDUSTRY 4.0 9

Evolution of Industry 4.0-Environmental impacts of industrial revolution- Industrial Internet-Design requirements - Drivers of Industry 4.0 - sustainability assessment of Industries - Smart business perspective - cyber security - Cyber Physical System - impacts of Industry 4.0.

UNIT II BUSINESS MODELS AND REFERENCE ARCHITECTURE 9

Industrial process: Features, industrial plant- Business models: Categorization, Opportunities - reference architecture: categorization, Industrial Internet Reference Architecture (IIRA) framework - Off-site Technologies: Cloud Computing and Fog Computing for IIoT - On-site Technologies: Augmented Reality and Virtual Reality.

UNIT III INDUSTRIAL DATA ACQUISITION AND IIoT ANALYTICS 9

Industrial data acquisition: designing data acquisition using instrumentation amplifier-components of distributed control system, PLC basic programming, SCADA - IIoT analytics - necessity, categorization, usefulness, challenges, mapping of analytics with the architecture, deployment analytics.

UNIT IV INVENTORY MANAGEMENT, PLANT SAFETY AND SECURITY 9

Inventory management: types, benefits, quality control - Plant safety and security: IIoT applications for undertaking safety measures in plant, Software security, Network security, mobile device security.

UNIT V APPLICATIONS AND CHALLENGES 9

Health monitoring- IoT smart city - smart irrigation - UAVs in industries - manufacturing industry - automotive industry - mining industry - inventory management and quality control - challenges in Industrial IoT.

Total: 45 Hrs

h) Learning Resources

Text Books

1. S. Misra, C. Roy, A. Mukherjee, “Introduction to Industrial Internet of Things and Industry 4.0”, CRC Press, 2020.
2. R. Anandan, Suseendran Gopalakrishnan, S. Pal, N. Zaman, “Industrial Internet of Things (IIoT): Intelligent Analytics for Predictive Maintenance”, Wiley-Scrivener, 2022.

Reference Books

1. G.Veneri Antonio, “Hands-on Industrial Internet of Things”, Packt Publication, 2018
2. Gilchrist, Alasdair, “Industry 4.0 The Industrial Internet of Things”, Apress, 2017.
3. Zaigham Mahmood, “The Internet of Things in the Industrial Sector: Security and Device connectivity, smart environments and Industry 4.0”, Springer, 2019.

Online Resources

1. Introduction to Industry 4.0 and Industrial Internet of Things - Course (nptel.ac.in) : https://onlinecourses.nptel.ac.in/noc20_cs69/preview
2. Introduction to internet of things: https://onlinecourses.nptel.ac.in/noc21_cs63/preview

Course Code	Course Title	L	T	P	C
10212EC177	**IOT SECURITY**	**3**	**0**	**0**	**3**

a) Course Category

Specialization Elective

b) Preamble

This course focuses on the principles and practices of securing Internet of Things (IoT) systems. It covers the security challenges, vulnerabilities, and threats in the IoT environment. The content provides in-depth knowledge to learn about various security mechanisms, protocols, and techniques to protect IoT devices, networks, and data. The training ingredients should enable the practical skills in implementing and evaluating IoT security solutions.

c) Prerequisite

Nil

d) Related Courses

Data Communication Network, Network Security.

e) Course Outcome

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Explain the importance of security and privacy in IoT ecosystems.	K2
CO2	Outline the principles of device security, provisioning, and hardware-based security mechanisms.	K2
CO3	Infer the knowledge of data security principles and cloud storage.	K2
CO4	Summarize comprehensive threat intelligence and vulnerability assessments in IoT systems.	K3
CO5	Utilize the various privacy considerations and applications of IoT systems.	K3

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	L	L	-	-	L	-	-	L	L	-	L	-	L
CO2	H	L	L	-	-	L	-	-	L	L	-	L	-	L
CO3	H	H	L	-	M	L	-	-	L	L	-	M	-	L
CO4	H	L	L	L	M	L	-	-	L	L	-	M	-	L
CO5	H	H	L	-	-	L	-	-	L	L	-	L	-	L

g) Course Content

UNIT I FUNDAMENTALS OF IOT SECURITY **9**

Introduction to IoT, security concern: confidentiality, authentication, data integrity, cyber threats and their detection, threat mitigation, malware resistance - device manipulation, risk management - device, communication, cloud level security for IoT ecosystem.

UNIT II DEVICE AND NETWORK SECURITY **9**

Device security, secure bootstrapping and provisioning, hardware-based security, network security, intrusion detection and prevention systems, network architectures and network design, network segmentation and isolation.

UNIT III DATA AND CLOUD SECURITY **9**

Data security, data encryption and integrity, privacy-preserving techniques for IoT, secure data storage and transmission - cloud security - secure cloud storage and processing, identity and access management in the cloud, security challenges and best practices in cloud-based IoT deployments.

UNIT IV INTELLIGENT IOT SECURITY MECHANISMS **9**

Threat detection, trust mechanisms and key management, privacy preserving data aggregation, anonymization and pseudonymization, security monitoring techniques, threat intelligence and vulnerability assessment.

UNIT V EMERGING TRENDS IN IOT SECURITY **9**

Blockchain technology: Smart Contracts for IoT, ethical hacking and penetration testing - heterogeneous intelligent transportation systems: autonomous vehicle security - fog platforms: secure data aggregation and processing for IoT applications.

Total : 45 Hrs

h) Learning Resources

Text books

1. Shandilya, Shishir K., Chun, Soon Ae, Weippl, Edgar, "Internet of Things Security: Fundamentals, Techniques", River Publishers, 2018.
2. Brian Russell, Drew Van Duren, "Practical Internet of Things Security", Packt Publishing, 2016.
3. Alasdair Gilchrist, "IoT Security Issues", De Gruyter, 2017.

Reference Books

1. Aditya Gupta, "The IoT Hacker's Handbook: A Practical Guide to Hacking the Internet of Things", APress, 2019.
2. Fei Hu, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations", CRC Press, 2016.
3. Brian Russell , Drew Van Duren, "Practical Internet of Things Security", Second Edition, Packt Publishing, 2018.
4. S. Velliangiri, Sathish A. P. Kumar, P. Karthikeyan, "Internet of Things: Integration and Security Challenges", CRC press, 2020.
5. Maciej Kranz, "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry", Wiley, 2016.

Online resources

1. Introduction to Internet of Things, https://onlinecourses.nptel.ac.in/noc19_cs65/preview, Dr. Sudip Misra, NPTEL Course.
2. A Simple Explanation of the Internet of Things, https://www.forbes.com/sites/jacobmorgan/2014/05/13/simple-explanation-internet-things-that-anyone-can-understand/, Forbes.
3. Secure all the (Internet of) Things, https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT, TechTarget.
4. Internet of things security is relevant to business, https://www.computerweekly.com/news/2240220811/Internet-of-things-security-is-relevant-to-business-says-researcher, ComputerWeekly.
5. The Internet of Things Brings Far-Reaching Security, https://www.cio.com/article/250268/mobile-security-the-internet-of-things-brings-far-reaching-security-threats.html, CIO.

Course Code	Course Title	L	T	P	C
10212EC178	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	3	0	0	3

a) Course Category

Specialization Elective

b) Preamble

The objective of the course is to introduce the basics of Artificial Intelligence (AI) and expert systems to impart the knowledge of predictions. This course aims to explore artificial intelligence and Machine Learning (ML) tools and develop the various existing applications.
.

c) Prerequisite

Nil

d) Related Courses

Nil

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Summarize the different search strategies in artificial intelligence.	K2
CO2	Outline the knowledge representation issues and rules for artificial intelligence.	K2
CO3	Explain the fundamentals of machine learning and its types.	K2
CO4	Interpret the neural network and genetic algorithms principles.	K2
CO5	Experiment with various machine learning applications.	K3

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	L	L	L	L	-	-	-	L	L	-	-	L	M
CO2	H	M	M	L	L	-	-	-	L	L	-	-	L	M
CO3	H	M	M	L	L	-	-	-	L	L	-	-	L	M
CO4	H	M	M	M	L	-	-	-	L	L	-	-	L	M
CO5	H	M	M	M	L	-	-	-	L	L	-	-	L	M

g) Course Content

UNIT I FUNDAMENTALS OF AI 9

Evolution of AI- agents and environments- concept of rationality- nature of environments- structure of agents: problem solving agents, search algorithms, uninformed search strategies.

UNIT II KNOWLEDGE REPRESENTATION 9

Knowledge representation issues - predicate logic-logic programming- semantic nets- frames and inheritance - constraint propagation - representing knowledge using rules: rule-based deduction system.

UNIT III FUNDAMENTALS OF MACHINE LEARNING 9

Types of machine learning: Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning- hypothesis spaces- inductive bias- generalization- bias variance trade-off.

UNIT IV NEURAL NETWORKS 9

Neural network representation: perceptron, feed forward, multilayer networks and back propagation, radial basis function network, recurrent neural networks, convolutional neural network.

UNIT V MACHINE LEARNING APPLICATIONS 9

Recommendation systems: weather prediction system, ML use cases in e-commerce, automated machine learning, diagnosis and disease identification, drug discovery, autonomous vehicle technology.

Total: 45 Hrs

h) Learning Resources

Text Books

1. Deepak Khemani,"Artificial Intelligence", Tata Mc Graw Hill Education, 2013.
2. Bratko, Prolog "Programming for Artificial Intelligence", Fourth edition, Addison Wesley Educational Publishers, 2011.
3. Christopher Bishop, "Pattern Recognition and Machine Learning", Tata Mc Graw Hill Education, 2007.
4. Indranath Chatterjee, "Machine learning and its application", Benthom books, 2021.

Reference Books

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third edition, 2009.
2. M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc., First edition, 2008.
3. Ethem Alpaydin, "Introduction to Machine Learning", Third edition, MIT Press, 2014.
4. Jason Bell, "Machine Learning-Hands on for Developers and Technical Professionals", First edition, Wiley, 2014.

Online Resources

1. An introduction to artificial intelligence-(NPTEL): https://onlinecourses.nptel.ac.in/noc22_cs56/preview
2. Machine Learning-(NPTEL): https://onlinecourses.nptel.ac.in/noc22_cs24/preview
3. Artificial intelligence lecture series: https://www.youtube.com/watch?v=kmeaG_BQZ7M&list=PLrjkTql3jnm_yol-ZK1QqPSn5YSg0NF9r

Course Code	Course Title	L	T	P	C
10212EC179	FLEXIBLE AND WEARABLE SENSORS	3	0	0	3

a) Course Category

Specialization Elective

b) Preamble

This course aims to impart the significance of these innovative technologies, providing a brief overview of wearable technology and exploring its profound impact on social life.

c) Prerequisite

Nil

d) Related Courses

IoT Security, Internet of Things

e) Course Outcome

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Explain the processing steps involved in the fabrication of flexible electronic circuits.	K2
CO2	Discuss the fabrication techniques of thin film transistor.	K2
CO3	Compare various types of wearable haptics, bio and chemical sensors.	K2
CO4	Interpret the parameters obtained from various body-worn sensors.	K2
CO5	Identify the low power circuits for implementing wearable biopotential sensor systems.	K3

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	L	L	-	-	-	-	-	_	L	-	L	-	-
CO2	H	-	L	-	-	-	-	-	L	L	-	L	-	-
CO3	H	M	M	L	L	-	-	-	L	-	-	L	L	M
CO4	H	M	M	M	-	-	L	L	L	-	-	L	L	M
CO5	H	M	L	L	-	-	-	-	L	-	M	L	M	L

g) Course Content

UNIT I FUNDAMENTALS OF FLEXIBLE ELECTRONICS TECHNOLOGY 9

Materials for flexible electronics: Nanowire and nanoparticle synthesis, transition metal oxides, amorphous thin films, polymeric semiconductors - structure and property relationships of thin-film deposition - processing methods for flexible devices: CVD, PECVD, PVD, etching, photolithography - low-temperature process integration.

UNIT II THIN FILM TRANSISTORS 8

Materials and technologies- review of semiconductors employed in flexible electronics - thin film transistors based on amorphous indium gallium zinc oxide- plastic electronics for smart textiles.

UNIT III WORLD OF WEARABLE(WOW) AND HAPTICS 10

Emergence of wearable computing and wearable electronics- attributes- Types of wearable sensors: invasive, non-invasive- intelligent clothing, healthcare, military, environment monitoring- wearable haptic devices: benefits, categories and tactile display- Wearable Bio and chemical sensors: system design, challenges in chemical biochemical sensing- application areas.

UNIT IV WEARABLE INERTIAL SENSORS AND APPLICATIONS 9

Parameters and practical considerations for wearable inertial sensor applications in clinical practice- Measurement of energy expenditure by body-worn devices- design considerations.

UNIT V BIOPOTENTIAL SIGNALS CHARACTERISTICS 9

Electrode-body interface and electrode noise- Measurement of energy expenditure by body-worn devices-design considerations - Low power analog/digital integrated circuit design techniques for wearable bio potential sensors- architectural design for low power bio potential acquisition- practical considerations.

Total: 45 Hrs

h) Learning Resources

Text Books

1. Edward Sazonov and Michael R. Neuman, “Wearable Sensors Fundamentals, Implementation and Applications”, Elsevier Inc., 2014.
2. William S. Wong, Alberto Salleo, “Flexible Electronics: Materials and Applications", Springer, First edition, New York, 2011.

Reference Books

1. Aime Lay-Ekuakille and Subhas Chandra Mukhopadhyay, “Wearable and Autonomous Biomedical Devices and Systems for Smart Environment”, Springer, 2010.
2. Toshiyo Tamura and Wenxi Chen, “Seamless Healthcare Monitoring”, Springer, 2018.
3. Guozhen Shen, Zhiyong Fan, “Flexible Electronics: From Materials to Devices”, First edition, World Scientific Publishing Co, Singapore, 2015.

Online resources

1. IoT sensors for every application: https://www.youtube.com/watch?v=r9mZ42xmWfE
2. IoT sensors types used in industries - Finoit Technologies: https://www.youtube.com/watch?v=a_rhr4jtZtY

Course Code	Course Title	L	T	P	C
10212EC180	AUTOMOTIVE SENSORS AND IN-VEHICLE NETWORKING	3	0	0	3

a) Course Category

Specialization Elective

b) Preamble

The integration of advanced sensors in automotive systems is crucial for enhancing vehicle body management, passenger convenience, safety, and security. This course aims to familiarize in various automotive sensor technologies and their applications, as well as the communication standards and protocols that support these systems.

c) Prerequisite

Nil

d) Related Courses

Nil

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Explain the automotive sensors requirements and the integration in different automotive systems.	K2
CO2	Classify the various powertrain sensors for chassis management in vehicles.	K2
CO3	Outline the various sensors for vehicle body management, convenience and security systems.	K2
CO4	Discuss the various systems such as ABS, ESP, TCS for understanding vehicle dynamics and stability.	K2
CO5	Make use of the in-vehicle communication trends and automotive standards.	K3

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	L	L	L	L	-	-	-	L	L	-	-	L	L
CO2	H	M	M	L	L	-	-	-	L	L	-	-	L	M
CO3	H	M	M	L	L	-	-	-	L	L	-	-	L	M
CO4	H	M	M	M	L	-	-	-	L	L	-	-	L	M
CO5	H	M	M	M	L	-	-	-	L	L	-	-	L	M

g) Course Content

UNIT I FUNDAMENTALS OF AUTOMOTIVE SYSTEMS 8

Introduction to the modern advancements and essential role of electronics in automobiles - possibilities and challenges in the automotive industry - enabling technologies and industry trends - application areas of electronics in the automobiles.

UNIT II POWERTRAIN SENSORS FOR CHASSIS MANAGEMENT 10

Powertrain sensors: Lambda (λ), exhaust temperature, nitrogen oxides, particulate matter, fuel quality, level, torque, speed, mass flow, manifold pressure wheel speed /direction, steering position (multiturn), acceleration (inertia measurement), brake pneumatic pressure, electronic stability.

UNIT III AUTOMOTIVE SENSOR FOR VEHICLE CONVENIENCE AND SECURITY SYSTEMS 9

Gas sensors (CO_2), temperature/humidity sensor, air bag sensor, tire pressure monitoring systems, anti-lock braking system, traction control, accelerators and tilt sensors for sensing skidding and anti-collision, anti-collision techniques using ultrasonic doppler sensors.

UNIT IV AUTOMOTIVE PASSENGER CONVENIENCE SYSTEMS 9

Distributed front air bag sensing systems, single-point sensing systems, side-impact sensing, and future occupant protection systems - electromechanical seat, seat belt height, steering wheel, mirror adjustments, central locking systems, tire pressure control systems, electromechanical window drives.

UNIT V MODERN TRENDS AND TECHNICAL SOLUTIONS 9

In-vehicle communication standards of Controller Area Network (CAN) and Local Interconnect Network (LIN) - telematics solutions, embedded connectivity - endorsing dependability in drive-by- wire systems: Terminology and concepts - Wire by-wire, FLEXRAY, future of in - vehicle communication.

Total: 45 Hrs

h) Learning Resources

Text Books

1. Automotive Electrics, "Automotive Electronics: Systems & Components", Fifth edition, BOSCH, 2014.
2. Automotive sensors handbook, BOSCH , Eighth edition, 2011.

Reference Books

1. John Turner, "Automotive Sensors", Momentum Press, First edition, New York, 2010.
2. Jiri Marek, Hans-Peter Trah, Yasutoshi Suzuki, Iwao Yokomori, "Sensors for Automotive Technology", Wiley, Fourth edition, New York, 2010.
3. Ernest O. Doebelin, "Measurement Systems – Application and Design", McGraw-Hill, Sixth edition, New Delhi, 2017.

Online Resources

1. Vehicle Networking and Communication Protocols: https://www.youtube.com/watch?v=PyxjlWnb6BA
2. CAN Bus- Serial Communication: https://www.youtube.com/watch?v=JZSCzRT9TTo

Course Code	Course Title	L	T	P	C
10212EC234	IOT SYSTEM DESIGN AND DEVELOPMENT	2	0	2	3

a) Course Category

Specialisation Elective

b) Preamble

This course provides hands-on experience in designing, developing, and deploying Internet of Things (IoT) systems using microcontrollers. It provides fundamental principles of IoT, working with various sensors and actuators, and implement communication protocols to create robust IoT solutions.

c) Prerequisite

Nil

d) Related Courses

Internet of Things

e) Course Outcome

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Summarize different types of microcontrollers.	K2
CO2	Outline interfacing sensors and actuators with microcontrollers.	K2
CO3	Explain the various communication protocols for IoT connectivity.	K2
CO4	Discuss the power utilization and management process.	K2
CO5	Demonstrate the programming microcontrollers for IoT applications.	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	L	-	-	-	-	-	-	L	L	-	-	-	M
CO2	H	M	M	L	-	-	-	-	L	L	-	-	-	M
CO3	H	M	M	L	L	-	-	-	L	L	-	-	L	M
CO4	H	M	M	M	L	-	-	-	L	L	-	-	M	M
CO5	H	M	M	M	-	-	-	-	L	L	-	-	M	M

g) Course Content

UNIT I MICROCONTROLLERS FOR IoT **6**

Selecting the right microcontroller for IoT projects - Overview of popular microcontrollers (Arduino, ESP8266/ESP32, STM32).

UNIT II SENSORS AND ACTUATORS **6**

Types of sensors and actuators - Interfacing sensors and actuators with microcontrollers.

UNIT III COMMUNICATION PROTOCOLS **6**

Overview of IoT communication protocols: HTTP, MQTT, CoAP- implementing Wi-Fi and bluetooth connectivity.

UNIT IV POWER MANAGEMENT **6**

Power requirements for IoT devices - Battery management and optimization - Energy harvesting techniques.

UNIT V APPLICATIONS OF IOT **6**

Industrial IoT (IIoT) in manufacturing - IoT in healthcare – IoT in smart home.

Total: 30 Hrs

Lab Experiments

S. No.	Practical Exercises	Course Outcome
1	Simulate the program to blink LEDs and read digital inputs.	**CO1**
2	Simulate the program to read sensor data and display it on a serial monitor or LCD.	**CO1**
3	Develop a web interface or mobile application to manage a LED or relay.	**CO2**
4	Design and implement a smart lighting system using motion sensors.	**CO2**
5	Develop a system to manage multiple appliances using a smartphone app.	**CO3**
6	Develop a system to monitor air quality parameters like CO2 and PM2.5.	**CO3**
7	Simulate the program for reading RFID tags and controlling access to a virtual system.	**CO4**
8	Simulate the program for measuring power consumption and visualizing data on a virtual platform.	**CO4**
9	Design and implement an irrigation facility based on soil moisture levels.	**CO5**
10	Simulate the program to interface temperature and humidity sensors.	**CO5**

Total: 30 Hrs

h) Learning Resources

Text Books

1. Jeremy Blum, “Exploring Arduino: Tools and Techniques for Engineering Wizardry", John Wiley & Sons, Inc, 2013.
2. Tero Karvinen, Kimmo Karvinen, Ville Valtokari, “Make: Sensors A Hands-On Primer for Monitoring the Real World with Arduino and Raspberry Pi”, Make Community, LLC, 2014.
3. Robert Faludi, “Building Wireless Sensor Networks With ZigBee, XBee, Arduino, and Processing”, O'Reilly Media, 2010.

Reference Books

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-On Approach", internetofthingsbook.com, 2014.
2. Elecia White, “Making Embedded Systems: Design Patterns for Great Software”, O'Reilly Media, 2020.
3. Michael Barr and Anthony Massa, “Programming Embedded Systems: With C and GNU Development Tools”, O'Reilly Media, 2022.

Online Resources

1. MIT Open Course Ware -Embedded Systems: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6- Embedded Systems - Introduction to Embedded Systems Design/
2. C programming for Embedded applications: https://www.linkedin.com/learning/learning-embedded-systems-programming
3. Introduction to embedded systems software and development environment: https://www.coursera.org/learn/embedded-software-development

Course Code	Course Title	L	T	P	C
10212EC181	WIRELESS COMMUNICATION	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course introduces the basic principles of wireless communication systems in general, and cellular systems in particular. It summarizes various radio wave propagation models, multiple access techniques, types and applications.

c) Prerequisite

Nil

d) Related Courses

5G Technology, 5G Networks

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Outline the evolution, concepts and techniques to improve the capacity of cellular system.	K2
CO2	Summarize the radio wave propagation models and parameters of mobile multipath channels.	K2
CO3	Compare the contention free and contention based multiple access techniques.	K2
CO4	Infer the various wireless standards used around the world.	K2
CO5	Interpret the various types and applications of wireless communication.	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	M	L	L	-	-	-	-	L	L	-	L	-	-
CO2	H	M	L	L	-	-	-	-	L	L	-	L	-	-
CO3	H	M	L	L	-	-	-	-	L	L	-	L	-	-
CO4	H	L	L	L	-	-	-	-	L	L	-	L	-	-
CO5	M	L	L	L	-	-	-	-	L	L	-	L	-	-

g) Course Content

UNIT I FUNDAMENTALS OF CELLULAR SYSTEM 9

Evolution of mobile radio communication – Cellular system: hexagonal geometry cell and concept of frequency reuse, channel assignment strategies, distance to frequency reuse ratio, channel and co-channel interference, handoff strategies – umbrella cell concept.

UNIT II RADIO WAVE PROPAGATION MODELS 9

Block diagram of wireless communication – large scale path loss – path loss models: free space and two-ray models – small scale fading- flat fading – frequency selective fading – fading due to doppler spread – fast fading – slow fading.

UNIT III MULTIPLE ACCESS TECHNIQUES 9

Contention-free multiple access schemes: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Space Division Multiple Access (SDMA) – contention-based multiple access schemes: ALOHA and Carrier Sense Multiple Access (CSMA).

UNIT IV WIRELESS STANDARDS 9

Global System for Mobile Communication (GSM) – Interim Standard 95 (IS-95) – General Packet Radio Service (GPRS) – Universal Mobile Telecommunications System (UMTS) – Wireless Local Area Network (WLAN).

UNIT V APPLICATIONS OF WIRELESS COMMUNICATION 9

Bluetooth – ZigBee – Wi – Fi- Long Term Evolution (LTE) – Overview of Internet of Things (IoT) – smart grids – health care – smart cities – smart agriculture.

Total: 45 Hrs

h) Learning Resources

Text books

1. T. S. Rappaport, “Wireless Communications”, Second Edition, Prentice Hall, 2013.
2. Andrea Goldsmith, “Wireless Communications”, First Edition, Cambridge University Press, 2005.

Reference books

1. Kamilo Feher, “Wireless digital communication”, Prentice-Hall, 2017.
2. V. K. Garg, “Wireless Communications and Networking”, Morgan Kaufmann, 2007.

Online resources

1. Introduction to Wireless and Cellular Communications (NPTEL)
   https://onlinecourses.nptel.ac.in/noc21_ee66/preview
2. Fundamentals of wireless communication (youtube.com)
   https://www.youtube.com/watch?v=8J3KOp6PR58
3. Wireless Communication (NPTEL)
   https://www.youtube.com/watch?v=SFIRXrvvXBQ
4. Wireless Communication (NPTEL)
   https://www.youtube.com/playlist?list=PLlQim6boihdgIdnLeVe34070cu899Le0c

Course Code	Course Title	L	T	P	C
10212EC182	5G TECHNOLOGY	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course provides the overview of 5G technology with advanced architecture like Multiple Input Multiple Output (MIMO) and Orthogonal Frequency Division Multiplexing (OFDM). This course also explains Non-Orthogonal Multiple Access (NOMA) concepts, making revolution on communication with transformative applications.

c) Prerequisite

Nil

d) Related Courses

Wireless Communication

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Explain the landscape requirements and 5G network architecture.	K2
CO2	Summarize the radio resources and radio access deployment technologies.	K2
CO3	Outline the channel modeling, estimation and beam-forming for MIMO.	K2
CO4	Compare NOMA with different types and its radio access technique.	K2
CO5	Interpret the various applications of 5G technologies.	K2

f) Correlation of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	L	L	-	-	-	-	-	L	L	-	L	-	-
CO2	H	L	L	-	-	-	-	-	L	L	-	L	-	-
CO3	H	L	L	-	-	-	-	-	L	L	-	L	-	-
CO4	H	L	L	-	-	-	-	-	L	L	-	L	-	-
CO5	H	L	L	L	-	-	-	-	L	L	-	L	-	-

g) Course Content

UNIT I FUNDAMENTALS OF 5G ARCHITECTURE 9

5G spectrum landscape and requirements – spectrum access modes and sharing scenario – 5G spectrum technologies – 5G services and performance metrics – 5G network architecture.

UNIT II RADIO-ACCESS TECHNOLOGIES 9

Radio resource and interference management – traffic offloading scenarios for networks – access design principles for multi-user communications: radio access for dense deployments, OFDM numerology for small-cell deployments, small-cell sub-frame structure.

UNIT III MIMO TECHNOLOGY 9

MIMO challenges: channel modeling, channel estimation and beam-forming – types of transceivers, merits and demerits – massive MIMO (Sub 6 GHz).

UNIT IV NON-ORTHOGONAL MULTIPLE ACCESS 9

NOMA types: Power domain NOMA, code domain NOMA, cooperative NOMA and hybrid NOMA –difference between orthogonal multiple accesses and NOMA.

UNIT V APPLICATIONS OF 5G 9

Robotic surgery – driverless car – industry-specific networks – home networks – space-air-ground networks – tactile internet – augmented reality and virtual reality.

Total: 45 Hrs

h) Learning Resources

Text books

1. Aditya k Jagannathan, "Principles of Modern Wireless communication systems", McGraw Hill Education, 1st Edition, 2016.
2. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock, "Millimeter Wave Wireless Communication", Prentice Hall, 1st Edition, 2014.

Reference books

1. R. Vannithamby and S. Talwar, "Towards 5G: Applications, Requirements and Candidate Technologies", John Willey & Sons, West Sussex, 2017.
2. Manish, M., Devendra, G., Pattanayak, P., Ha, N., "5G and Beyond Wireless Systems PHYLayer Perspective", Series in Wireless Technology Springer, 2021.
3. T. S. Rappaport, R. W. Heath Jr., R. C. Daniels, and J. M. Murdock, "Millimeter Wave Wireless Communication", Pearson Education, 2015.
4. M. Vaezi, Z. Ding, and H. V. Poor, "Multiple Access techniques for 5G Wireless Networks and Beyond", Springer Nature, Switzerland, 2019.

Online resources

1. Requirements and operating scenarios of 5G (NPTEL)
   https://www.youtube.com/watch?v=khsqASfv2T4
2. Overview of 5G Technology (NPTEL)
   https://www.youtube.com/watch?v=aYJncUscfmk
3. MIMO Communication Systems (NPTEL)
   https://www.youtube.com/watch?v=TfHvr0N51ZE
4. MIMO Channel Characteristics (NPTEL)
   https://www.youtube.com/watch?v=Dxj7JikI6zQ
5. Optical Wireless Communications for Beyond 5G Networks and IoT (NPTEL)
   https://www.youtube.com/watch?v=tDgaxz-z6jM

Course Code	Course Title	L	T	P	C
10212EC183	5G NEW RADIO ACCESS TECHNOLOGY	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course provides an overview of 5G New Radio (NR) access technology, interface, waveforms, channel models, multi antenna transmission techniques covering wide range of technology options and protocols.

c) Prerequisite

Nil

d) Related Courses

Wireless Communication

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Outline the characteristics, requirements, architecture and functionalities of 5G new radio.	K2
CO2	Interpret interface and protocol structure in new radio.	K2
CO3	Explain waveform design and channel models for 5G networks.	K2
CO4	Summarize various multi antenna uplink and downlink transmission techniques.	K2
CO5	Infer the concepts of 5G new radio in real time scenario.	K2

f) Correlation of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	-	-	-	-	-	-	L	L	-	L	-	-
CO2	H	L	L	-	-	-	-	-	L	L	-	L	-	-
CO3	H	M	M	-	-	-	-	-	L	L	-	L	-	-
CO4	H	M	M	-	-	-	-	-	L	L	-	L	-	-
CO5	H	M	M	-	-	-	-	-	L	L	-	L	-	-

g) Course Content

UNIT I FUNDAMENTALS OF 5G NEW RADIO 9

5G characteristics and requirements – NR frame numerology – NR carrier aggregation – RAN architectures – 5G core network functions and services.

UNIT II NEW RADIO INTERFACE 9

High-frequency operation and spectrum flexibility, scheduling and data transmission, quality-of-service handling – radio protocol architecture: user-plane protocols, control-plane protocols.

UNIT III WAVEFORMS AND CHANNEL MODELS 9

5G radio access technologies: design principles – multi-carrier with filtering – radio access for dense deployments, V2X communication – METIS channel models.

UNIT IV MULTI-ANTENNA TRANSMISSION IN 5G NR 9

Uplink and downlink multi-antenna precoding – codebook-based transmission – non-codebook-based precoding – beam management.

UNIT V APPLICATIONS OF 5G NEW RADIO 9

Autonomous vehicles: smart traffic regulation – health sector – physical location tracking of life-saving equipment – smart cities: secure and controlled internet access for residents – industry.

Total: 45 Hrs

h) Learning Resources

Text books

1. Afif Osseiran, Jose.F. Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.
2. Erik Dahlman, Stefan Parkvall, Johan Sköld, "5G NR: The Next Generation Wireless Access Technology", Elsevier, 2nd Edition, 2020.

Reference books

1. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies, CRC Press, 1st Edition, 2019.
2. Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, "5G Mobile Communications", Springer, 2017.
3. Jonathan Rodriguez, "Fundamentals 5G Mobile Networks", John Wiley & Sons, 1st Edition, 2015.
4. Long Zhao, Hui Zhao, Kan Zheng, Wei Xiang, "Massive MIMO in 5G Networks: Selected Applications", Springer, 1st Edition, 2018.
5. Robert W. Heath Jr., Angel Lozano, "Foundations of MIMO Communication", Cambridge University Press, 1st Edition, 2019.

Online resources

1. 5G New Radio service and architecture (Coursera)
   https://www.coursera.org/learn/5g-network-fundamentals
2. Overview of 5G Mobile Networks (NPTEL)
   https://www.youtube.com/watch?v=Ztai5bS2d-k
3. Non-orthogonal multiple access (NPTEL)
   https://www.youtube.com/watch?v=aIjrJfkrZ6U
4. 5G NR (New Radio) Technical Training-A Deep Dive (NPTEL)
   https://www.udemy.com/course/5g-nr-new-radio-training-5g-ran-split-rat-beamforming-massive-mimo

Course Code	Course Title	L	T	P	C
10212EC184	MILLIMETER WAVE TECHNOLOGY	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course will provide the overview of millimeter (mm) wave characteristics, models, devices, circuits, Multiple Input Multiple Output (MIMO) systems and applications of mm wave technology.

c) Prerequisite

Nil

d) Related Courses

Wireless Communication

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Outline the characteristics, challenges of channel models and its effects.	K2
CO2	Explain the devices and components used in mm wave.	K2
CO3	Summarize various modulation techniques applied in communication systems.	K2
CO4	Infer the different diversity techniques in MIMO systems.	K2
CO5	Interpret the scenario relating to the applications of mm wave.	K2

f) Correlation of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	L	L	-	-	-	-	-	L	L	-	L	-	-
CO2	H	L	L	-	-	-	-	-	L	L	-	L	-	-
CO3	H	L	L	-	-	-	-	-	L	L	-	L	-	-
CO4	H	L	L	-	-	-	-	-	L	L	-	L	-	-
CO5	H	L	L	L	-	-	-	-	L	L	-	L	-	-

g) Course Content

UNIT I CHARACTERISTICS AND MODEL 9

Millimeter wave characteristics - millimeter wave wireless - implementation challenges, design considerations, radio wave propagation for mm wave - outdoor and indoor channel models.

UNIT II DEVICES AND CIRCUITS 9

Millimeter wave generation and amplification: peniotrons, ubitrons, gyrotrons – free electron lasers – HEMT-models for mm wave transistors.

UNIT III COMMUNICATION SYSTEM 9

Modulations for millimeter wave communications: ON-OFF Keying, phase shift keying, frequency shift keying, quadrature amplitude modulation, orthogonal frequency-division multiplexing.

UNIT IV MIMO SYSTEM 9

Massive MIMO communications – spatial diversity of antenna arrays – multiple antennas – multiple transceivers – spatial, temporal and frequency diversity.

UNIT V APPLICATIONS OF MM WAVE TECHNOLOGY 9

Device to Device communications over 5G systems – mm wave for 5G mobiles and gyrotron technologies – optical technique of millimeter wave generation.

Total: 45 Hrs

h) Learning Resources

Text books

1. K.C. Huang, Z. Wang, “Millimeter Wave Communication Systems”, Wiley-IEEE Press, March 2011.
2. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock, “Millimeter Wave Wireless Communication”, Pearson Education, 2015.

Reference books

1. Xiang, W; Zheng, K; Shen, X.S; “5G Mobile Communications”, Springer, 2016.
2. Awadhesh Kumar Shukla, “Advances in Millimeter Wave Technology”, DRDO Monographs, 2019.

Online resources

1. Introduction to Millimeter-Wave Technology (NPTEL)
   https://youtu.be/DZdFXvZ5SOM?si=NjzlOOaeUwl47DKP
2. Millimeter Wave Active Devices (NPTEL)
   https://youtu.be/dIWsLh-MjOQ?si=RAonRJcdwt_XIVQN
3. Millimeter Wave (mmWave) Communication (NPTEL)
   https://youtu.be/Rt09KWCEUGg?si=6BHX1GXwxBZHyPnq
4. Hybrid beamforming (mmWave) (NPTEL)
   https://youtu.be/x1F5zft6Qtk?si=wBume81HM5MoDKwP

Course Code	Course Title	L	T	P	C
10212EC185	5G NETWORKS	3	0	0	3

a) Course Category

Program Elective

b) Preamble

The advent of 5G networks marks a major advancement in wireless communication, offering unprecedented speed, capacity, and latency improvements. This fifth generation of mobile networks is set to transform sectors like healthcare, transportation, and entertainment.

c) Prerequisite

Nil

d) Related Courses

5G Technology, 6G Mobile Networks.

e) Course Outcomes

On the successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Outline the features, architecture and components of 5G networks.	K2
CO2	Illustrate the 5G network infrastructure and its role in smart cities development.	K2
CO3	Explain the influence of 5G on connected and autonomous transportation system.	K2
CO4	Interpret smart manufacturing and predictive maintenance over industry 4.0.	K2
CO5	Infer the security, privacy issues and future trends in 5G network services and its applications.	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	L	-	-	-	-	-	-	L	L	-	L	-	-
CO2	H	L	L	-	-	-	-	-	L	L	-	L	-	-
CO3	H	L	L	L	-	-	-	-	L	L	-	L	-	-
CO4	H	L	L	L	-	-	-	-	L	L	-	L	-	-
CO5	H	L	L	L	-	-	-	-	L	L	L	L	-	-

g) Course Content

UNIT I FUNDAMENTALS OF 5G **9**

Evolution of wireless communication evolution – Key features of 5G networks: speed, latency, capacity, and reliability – 5G architecture and components: small cells, macro cells, and beamforming – spectrum and frequency bands for 5G.

UNIT II 5G NETWORK INFRASTRUCTURE **9**

Mobility Massive MIMO (Multiple Input Multiple Output)-Network slicing and virtualization – Edge computing and its relevance to 5G – Role of 5G in smart city development – Applications in traffic management and autonomous vehicles – 5G-enabled infrastructure monitoring and maintenance.

UNIT III 5G IN TRANSPORTATION SYSTEM **9**

Impact of 5G on connected and autonomous vehicles – Vehicle-to-everything (V2X) communication – 5G applications in railways and public transportation – Safety and security considerations.

UNIT IV 5G IN MANUFACTURING AND INDUSTRY 4.0 **9**

Manufacturing and Industry 4.0: Overview of Industry 4.0 and smart manufacturing – Role in industrial automation and robotics – 5G-enabled predictive maintenance and IoT – Case studies of 5G in manufacturing.

UNIT V CHALLENGES AND FUTURE TRENDS **9**

Security and privacy issues in 5G networks – Regulatory and standardization aspects – Future trends in 5G and beyond (6G, etc.) – 5G applications in real-time data collection and analysis.

Total: 45 Hrs

h) Learning Resources

Text books

1. Rodriguez, Jonathan, "Fundamentals of 5G mobile networks", John Wiley & Sons, 2015.
2. Dahlman, Erik, Stefan Parkvall, and Johan Skold, "5G NR: The next generation wireless access technology", Academic Press, 2020.

Reference books

1. Saro Velrajan, "An Introduction to 5G Wireless Networks: Technology, Concepts and Use-Cases", Notion Press, 1st Edition, 2020.
2. Long Zhao, Hui Zhao, Kan Zheng, Wei Xiang, "Massive MIMO in 5G Networks: Selected Applications", Springer, 1st Edition, 2018.
3. Robert W. Heath Jr., Angel Lozano, "Foundations of MIMO Communication", Cambridge University Press, 1st Edition, 2019.
4. R. Vannithamby and S. Talwar, "Towards 5G: Applications, Requirements and Candidate Technologies", John Willey & Sons, 1st Edition, 2017.

Online resources

1. 5G for everyone (Coursera)
   https://www.coursera.org/learn/5g-training
2. Optical Wireless Communications for beyond 5G Networks and IoT (NPTEL)
   http://acl.digimat.in/nptel/courses/video/108106190/L01.html
3. Linux Foundation X: Business Considerations for 5G with Edge, IoT, and AI (EDX)
   https://www.edx.org/learn/5g
4. 5G for Absolute Beginners (UDEMY)
   https://www.udemy.com/course/5g-for-absolute-beginners/

Course Code	Course Title	L	T	P	C
10212EC186	MIMO WIRELESS COMMUNICATION	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course covers the fundamentals of Multiple Input Multiple Output (MIMO) based wireless communication systems. MIMO is an essential part of modern wireless communication systems. MIMO brings to the domain of wireless communications, spectral efficiency and reliability gains. MIMO is one of the enabler of 5G communication systems.

c) Prerequisite

Nil

d) Related Courses

Wireless Communication

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Outline the diversity schemes involved in MIMO with advantages, channel models and power allocation.	K2
CO2	Illustrate the capacity of deterministic and random MIMO and fading channels.	K2
CO3	Explain the various space time coding techniques and its performance.	K2
CO4	Interpret various algorithms used to detect the received signal in MIMO systems.	K2
CO5	Infer the advances in MIMO communication systems.	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	M	L	-	-	-	-	-	L	L	-	L	-	-
CO2	H	L	L	-	-	-	-	-	L	L	-	L	-	-
CO3	H	L	L	-	-	-	-	-	L	L	-	L	-	-
CO4	H	L	L	-	-	-	-	-	L	L	-	L	-	-
CO5	H	L	L	-	-	-	-	-	L	L	-	L	-	-

g) Course Content

UNIT I FUNDAMENTALS OF MIMO CHANNEL MODELS 9

Diversity – multiplexing trade-off, transmit diversity schemes of MIMO systems, fading channel models: uncorrelated – fully correlated – separately correlated – keyhole MIMO fading models, parallel decomposition of MIMO channel.

UNIT II MIMO AND FADING CHANNEL MODELS 9

Capacity for deterministic and random MIMO channels – capacity of independent identically distributed channels – capacity of separately correlated rayleigh fading MIMO channels.

UNIT III SPACE-TIME CODES 9

Code design criteria – alamouti space-time codes – SER analysis of alamouti space-time code over fading channels – space-time block codes – space-time trellis codes – performance analysis of space-time codes.

UNIT IV MIMO DETECTION TECHNIQUES 9

Maximum likelihood – zero forcing-minimum mean square error-zero forcing equalization with successive interference cancellation – minimum mean square error successive interference cancellation.

UNIT V ADVANCES IN MIMO 9

Spatial modulation – MIMO based cooperative communication and cognitive radio – multiuser MIMO-MIMO systems for 5G wireless – MIMO applications in RADAR and satellite communication.

Total: 45 Hrs

h**) Learning Resources**

Text books

1. Tolga M.Duman and Ali Ghrayeb, "Coding for MIMO Communication Systems", John Wiley & Sons Ltd.,2007.
2. Ezio Biglieri, Robert Calderbank and Anthony Constantinides. "MIMO Wireless Communications" Cambridge University Press, 2007.
3. R. S. Kshetrimayum, "Fundamentals of MIMO Wireless Communications*"*, Cambridge University Press, 2017.

Reference books

1. B. Kumbhani and R. S. Kshetrimayum, "MIMO Wireless Communications over Generalized Fading Channels*",* CRC Press, 2017.
2. T. L. Marze a, E. G. Larsson, H. Yang and H. Q. Ngo, "Fundamentals of Massive MIMO*"*, Cambridge University Press, 2016.

Online resources

1. Fundamentals of MIMO Wireless Communication (NPTEL)
   http://nptel.ac.in/courses/117105132
2. MIMO channel model (NPTEL)
   https://onlinecourses.nptel.ac.in/noc22_ee65/preview
3. Foundations of Advanced Wireless Communication (Coursera)
   https://www.coursera.org/learn/foundations-of-advanced-wireless-communication
4. Multiple Antenna Communications (NPTEL)
   https://www.classcentral.com/course/swayam-fundamentals-of-mimo-wirelesscommunication-6702

Course Code	Course Title	L	T	P	C
10212EC187	5G SECURITY	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course deals with the underlying principles of 5G network security. It aims to introduce students in implementing secure network communication.

c) Prerequisite

Nil

d) Related Courses

Wireless Communication

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Outline the fundamental concepts of cyber security and techniques.	K2
CO2	Illustrate the various security protocols and standards.	K2
CO3	Infer the various challenges in 5G security.	K2
CO4	Interpret the threat detection and mitigation in 5G networks.	K2
CO5	Summarize the 5G security applications in various emerging technologies.	K2

f) Correlation of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	L	L	-	-	-	-	-	L	L	-	-	-	-
CO2	M	L	L	-	-	-	-	-	L	L	-	L	-	-
CO3	M	L	L	L	-	-	-	-	L	L	-	L	-	-
CO4	M	L	L	-	-	-	-	-	L	L	-	L	-	-
CO5	M	L	L	-	-	-	-	-	L	L	-	L	-	-

g) Course Content

UNIT I FUNDAMENTALS OF CYBERSECURITY 9

Basic concepts in cybersecurity: confidentiality, integrity, availability, threats, vulnerabilities, and risks – cryptography – symmetric and asymmetric encryption – key management – network security – firewalls – VPN – IDS/IPS.

UNIT II SECURITY PROTOCOLS AND STANDARDS 9

3GPP security specifications – authentication and key agreement (aka) – secure access to the network, network slicing security – isolation of network slices – security considerations for network slicing – transport layer security – secure communication channels – use of TLS in 5G.

UNIT III 5G SECURITY CHALLENGES 9

Threat landscape – potential attack vectors in 5G – impact of 5G on traditional security models – privacy concerns – data privacy issues in 5G networks – regulatory requirements – GDPR-CCPA.

UNIT IV THREAT DETECTION AND MITIGATION IN 5G NETWORKS 9

Intrusion detection systems (IDS) – types of IDS – IDS in 5G networks – anomaly detection techniques for detecting anomalies – machine learning approaches in anomaly detection-incident response – steps in incident response – tools and techniques for incident management.

UNIT V SECURITY IN 5G APPLICATIONS 9

IoT security – security challenges in IoT within 5G – best practices for securing IoT devices. mobile edge computing (MEC) security – security challenges and solutions for securing MEC environments – cloud security – integrating 5G with cloud services – security considerations for cloud-based 5G applications.

Total: 45 Hrs

h) Learning Resources

Text books

1. Madhusanka Liyanage, Ijaz Ahmad, Ahmed Bux Abro, "A Comprehensive Guide to 5G Security", First Edition, John Wiley & Sons Ltd, 2018.
2. Bhunia Swarup, "Hardware Security –A Hands on Approach, Morgan Kaufmann", First edition, 2018.

Reference books

1. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies", CRC Press, 1st Edition, 2019.
2. Erik Dahlman, Stefan Parkvall, Johan Skold, "5G NR: The Next Generation Wireless Access Technology", First Edition, Elsevier, 2016.
3. Afif Osseiran, Jose F. Monserrat, Patrick Marsch, 5G Mobile and Wireless Communications Technology, Second Edition, Cambridge University Press, 2011.
4. Jonathan Rodriguez , "Fundamentals of 5G Mobile Networks", First Edition, Wiley, 2010.

Online resources

1. Evolution of Air Interface Towards 5G (NPTEL)
   https://nptel.ac.in/courses/108105134
2. Cryptography and Network Security (NPTEL)
   https://onlinecourses.nptel.ac.in/noc22_cs90/preview
3. 5G Wireless Standard Design (NPTEL)
   https://onlinecourses.nptel.ac.in/noc24_ee152/preview
4. Optical Wireless Communications for Beyond 5G Networks and IoT (NPTEL)
   https://onlinecourses.nptel.ac.in/noc24_ee59/preview
5. Basics of Software Defined Radios and Practical Applications (NPTEL)
   https://onlinecourses.nptel.ac.in/noc24_ee79/preview

Course Code	Course Title	L	T	P	C
10212EC188	6G MOBILE NETWORKS	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course addresses the fundamentals of 6G mobile networks and provides an overview of emerging 6G wireless communication techniques, exposes physical layer, transport layer, Cloudnet and applications of 6G wireless networks.

c) Prerequisite

Nil

d) Related Courses

5G Networks, 5G Technology

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Summarize the use cases, requirements, performance metrics and enabling technologies.	K2
CO2	Illustrate the physical layer and architecture for artificial intelligence / machine learning in 6G physical layer.	K2
CO3	Outline the transport layer and machine type communications in 6G wireless networks.	K2
CO4	Infer the concepts of intelligent networks and 6G network architecture.	K2
CO5	Interpret the applications of 6G in super-smart society, autonomous systems and healthcare.	K2

f) Correlation of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	-	-	-	-	-	-	-	L	L	-	L	-	-
CO2	M	L	L	-	-	-	-	-	L	L	-	L	-	-
CO3	M	L	L	-	-	-	-	-	L	L	-	L	-	-
CO4	M	L	L	-	-	-	-	-	L	L	-	L	-	-
CO5	M	L	L	L	-	-	-	-	L	L	-	L	-	-

g) Course Content

UNIT I FUNDAMENTALS OF 6G **9**

Need for 6G – requirements and metrics: requirements and KPI targets of 6G – performance metrics – 6G use cases – 6G enabling technologies: novel wireless paradigms and frequencies above 100 GHz – multi-dimensional network architectures.

UNIT II PHYSICAL LAYER **9**

Role of PHY layer in 6G – 6G PHY at terahertz (THz) band – artificial intelligence / machine learning in 6G PHY: hardware architectures for AI in radio – security issues at 6G PHY – physical layer design challenges in reconfigurable intelligent surface aided 6G (Qualitative Treatment only).

UNIT III TRANSPORT LAYER AND MACHINE TYPE COMMUNICATIONS **9**

Mobility challenges in TCP – achieving TBPS bitrate in TCP – other challenges in TCP – machine type communications in 6G: MTC applications and devices – medium access and network architecture for 6G MTC.

UNIT IV CLOUDNET **9**

6G CloudNet:5G and beyond networks – trends towards intelligent-based optimized networks – potential technology transformation for 6G: artificial intelligence exploitation – new spectrum band exploitation – network architectures and technologies.

UNIT V APPLICATIONS OF 6G **9**

Super-smart society – extended reality – connected robotics and autonomous systems – wireless brain-computer interactions – haptic communication – smart healthcare and biomedical communication.

Total: 45 Hrs

h) Learning Resources

Text books

1. Yulei Wu, Sukhdeep Singh, Tarik Taleb, Abhishek Roy, Harpreet S. Dhillon, Madhan Raj Kanaarathinam, Aloknath De, "6G Mobile Wireless Networks", Springer, 2021.
2. Jonathan Rodriguez, Christos Verikoukis, John S. Vardakas and Nikos Passas, "Enabling 6G Mobile Networks", Springer, 2022.
3. M. Vaezi, Z. Ding, and H. V. Poor, "Multiple Access techniques for 5G Wireless Networks and Beyond", Springer Nature, Switzerland, 2019.

Reference books

1. Manish, M., Devendra, G., Pattanayak, P., Ha, N., "5G and Beyond Wireless Systems PHY Layer Perspective", Springer Series in Wireless Technology, 2021
2. T. S. Rappaport, R. W. Heath Jr., R. C. Daniels, and J. M. Murdock,, "Millimeter Wave Wireless Communication", Pearson Education, 2015.

Online resources

1. 6G Introduction (YouTube)
   https://www.youtube.com/watch?v=MXNt9jbC1U&list=PLBC3G7CyizTpfoJB2qotyokOgS8X5DjdO&index=1
2. 6G Use Cases & Applications (YouTube)
   https://www.youtube.com/watch?v=ejHA-WaUI28&t=25
3. 6G Requirements (YouTube)
   https://www.youtube.com/watch?v=9bBteffPeAg&list=PLBC3G7CyizTpfoJB2qotyokOgS8X5DjdO&index=6
4. 6G Technologies (YouTube)
   https://www.youtube.com/watch?v=7OtrHXVLmvg&list=PLBC3G7CyizTpfoJB2qotyokOgS8X5DjdO&index=8

Course Code	Course Title	L	T	P	C
10212EC189	SEMICONDUCTOR MATERIALS AND DEVICES	3	0	0	3

a) Course Category

Program Elective

b) Preamble

Semiconductor materials and devices form the foundation of modern electronics to develop faster and more powerful technology. This course will provide an understanding of semiconductor structures, basic devices, and their characterization.

c) Prerequisite

Nil

d) Related Courses

Semiconductor process technology

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Illustrate the structure of the semiconductor materials.	K2
CO2	Interpret the significant emission of electron in semiconductor materials.	K2
CO3	Outline the basics of energy bands and dopants used in semiconductor materials.	K2
CO4	Summarize the characteristics and applications of the PN diode.	K2
CO5	Explain the primary operation, configuration, and applications of transistors.	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	L	L	L	-	-	-	-	L	L	-	-	-	-
CO2	H	L	L	L	-	L	L	-	L	L	-	-	-	-
CO3	H	L	L	L	-	L	L	-	L	L	-	-	-	-
CO4	H	L	L	L	-	L	L	-	L	L	-	L	-	-
CO5	H	M	M	M	-	M	M	-	L	L	-	M	-	-

g) Course Content

UNIT I SEMICONDUCTOR STRUCTURE 9

Electronics – Atomic structure – Structure of elements –Energy of an electron – Valence electrons – Free electrons - Voltage source – Constant voltage source – Constant current source – Theorem and its equivalent circuit: Thevenin, Norton.

UNIT II ELECTRON EMISSION 9

Electron emission – Types of electron emission – Thermionic emission – Thermionic emitter – Commonly used thermionic emitters – Cathode construction – Field emission – Secondary emission – Photo electric emission.

UNIT III SEMICONDUCTOR PHYSICS 9

Semiconductor - Bonds in semiconductor - Crystals – Commonly used semiconductor – Energy band description of semiconductors – Effect of temperature on semiconductors – Hole current- Intrinsic and extrinsic semiconductor: types and properties.

UNIT IV PN JUNCTION DIODE 9

PN diode - Forward and reverse bias – I-V characteristics: diode equation, breakdown voltage, diode equivalent circuit – Applications: clipper, clamper, half wave, full wave, bride rectifier - Zener diode - Forward and reverse bias – I-V characteristics - Zener diode as voltage regulator.

UNIT V BIPOLAR JUNCTION TRANSISTOR 9

Construction of transistor – Biasing – Operation of NPN and PNP: voltage and current relations - Transistor connections: CB, CE and CC configurations, input, output characteristics, current gain and its relation – Comparison and applications - Transistor as an amplifier.

Total: 45 Hrs

h) Learning Resources

Text Books

1. V K Mehta, Rohit Mehta, “Principles of Electronics”, Twelfth edition, S.Chand &Co., 2022.
2. S. Salivahanan, N. Suresh Kumar, A. Vallavaraj, “Electronic Devices & Circuits”, Third edition, Tata McGraw-Hill, 2012.

Reference Books

1. Adrian Kitai, “Fundamentals of Semiconductor Materials and Devices”, John Wiley & Sons Inc., New York, 2023.
2. Simon Sze, Ming-Kwei Lee, “Semiconductor Physics and Devices”, Third edition, John Wiley & Sons Inc., New York, 2021.
3. Parasuraman Swaminathan, “Semiconductor materials, devices and fabrication”, Wiley & Sons Inc., New York, 2017.

Online Resources

1. Semiconductor materials: https://fab.cba.mit.edu/classes/862.22/notes/semiconductor_materials_devices.pdf.
2. YouTube Semiconductor fundamentals: https://www.youtube.com/watch?v=_FMK-LqHloU&ab_channel=edX.
3. Introduction to semiconductor devices- Course (nptel.ac.in).

Course Code	Course Title	L	T	P	C
10212EC190	SEMICONDUCTOR PROCESS TECHNOLOGY	3	0	0	3

a) Course Category

Program Elective

b) Preamble

Semiconductor process technology forms the bedrock of modern electronics, underpinning the production of microchips that power our digital world. It encompasses a sophisticated array of techniques and methodologies designed to fabricate semiconductor devices, such as transistors and integrated circuits, with ever-increasing precision and efficiency.

c) Prerequisite

Nil

d) Related Courses

Semiconductor materials and devices

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Illustrate the flow of CMOS fabrication, characterization and evaluation.	K2
CO2	Extend the diffusion mechanisms and evaluation of diffused layers.	K2
CO3	Outline the ion implementation process and various deposition methods.	K2
CO4	Summarize different epitaxial growth techniques Silicon oxidation technologies in VLSI.	K2
CO5	Explain the various pattern transfer techniques and etching techniques.	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	M	M	L	-	-	-	-	-	M	-	M	-	-
CO2	H	M	M	M	-	-	-	-	-	L	-	M	-	-
CO3	H	M	M	L	-	-	-	-	L	L	-	M	-	-
CO4	H	M	M	L	-	-	-	-	L	M	-	M	-	-
CO5	H	M	M	L	-	-	-	-	L	M	-	M	-	-

g) Course Content

UNIT I FUNDAMENTALS OF SEMICONDUCTOR FABRICATION 9

Semiconductor process technology: Semiconductor technologies and trends, Basic fabrication steps - Characterization and evaluation of crystals - wafer preparation - wafer shaping and wet chemical etching techniques.

UNIT II DIFFUSION 9

Basic Diffusion process: Diffusion equation and profiles - Evaluation of diffused layers, Extrinsic diffusion: concentration dependent diffusivity - Lateral diffusion.

UNIT III ION IMPLANTATION AND DEPOSITION 9

Ion implantation: Implantation damage and annealing - Implantation processes: multiple implantation and Masking - Deposition requirements and techniques: physical and chemical vapor deposition.

UNIT IV EPITAXIAL GROWTH AND OXIDATION 9

Epitaxial growth techniques: vapor deposition - Defects in epitaxial growth - Dielectric deposition: Silicon dioxide - Polysilicon deposition - Thermal oxidation process: Kinetics of growth - thin oxide growth.

UNIT V PHOTOLITHOGRAPHY AND ETCHING 9

Introduction to optical lithography: exposure tools – masks - photo resist - pattern transfer - Lithographic methods: e-beam lithography, dry and wet etching - Plasma etching - Reactive plasma etching techniques and equipment - applications.

Total: 45 Hrs

h) Learning Resources

Text Books

1. Peter Van Zant, "Microchip Fabrication: A Practical Guide to Semiconductor Processing", Tata McGraw- Hill Professional, Sixth edition, 2014.
2. Nandita Das Gupta and Amitava Das Gupta, “Semiconductor Devices modelling and Technology”, PHI, 2013.
3. S.K. Gandhi, “VLSI Fabrication Principles”, John Wiley Inc, Second edition, 1994.

Reference Books

1. S.M. Sze, “VLSI Technology”, Second Edition, Tata McGraw Hill, 2017
2. Marc J. Madou, “Fundamentals of Microfabrication and Nanotechnology” - Volume II, CRC Press, Third edition, 2011.
3. Yoshio Nishi and Robert Doering, “Handbook of Semiconductor Manufacturing Technology”, CRC Press, Second edition, 2007.
4. Gary. S. May and S. M. Sze, “Fundamentals of semiconductor fabrication”, John Wiley, First edition, 2003.
5. Richard Jaeger, “Introduction to Microelectronic Fabrication”, Prentice Hall, Second Edition, 2001.

Online Resources

1. Introduction to Semiconductor Process – Course (coursera.org)
2. Semiconductor Devices and circuits – Course (nptel.ac.in)

Course Code	Course Title	L	T	P	C
10212EC191	VLSI AND POST CMOS ELECTRONICS	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course entails on the fundamental principles of fabricating post CMOS VLSI devices and circuits. It also encompasses a diverse range of emerging technologies and material designed to overcome the limitations of conventional CMOS.

c) Prerequisite

Nil

d) Related Courses

Nil

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Explain the operation and characteristics of CMOS circuits.	K2
CO2	Outline the tradeoffs in VLSI circuit.	K2
CO3	Interpret the electronic materials and devices beyond CMOS	K2
CO4	Summarize the potential and challenges of post CMOS architectures.	K2
CO5	Illustrate the mathematical models for post CMOS devices.	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	L	L	L	-	-	-	-	L	L	-	L	-	-
CO2	H	L	L	L	-	-	-	-	L	L	-	L	-	-
CO3	H	M	M	L	-	-	-	-	L	L	-	L	-	-
CO4	H	M	M	L	-	-	-	-	L	L	-	L	-	-
CO5	H	M	M	L	-	-	-	-	L	L	-	L	-	-

g) Course Content

UNIT I CMOS VLSI CIRCUITS 9

MOS transistor theory- Long channel I-V characteristics – C-V characteristics – Non ideal I-V effects – DC characteristics: static CMOS invertor, beta ratio effects, noise margin, pass transistor – Circuit pitfalls.

UNIT II CMOS TRADEOFF 9

Delay: timing optimization, transient response – RC delay model – Logical effort on path- Power: dynamic and static – Interconnect modelling: skin effect, temperature dependence - Scaling.

UNIT III POST CMOS ELECTRONICS MATERIAL 9

Carbon nano tube field effect transistors (CNTFETs): material view, properties and limitations - Grapheme and other 2D materials, spintronics: fundamental phenomenon, materials - spintronic devices - magnetic tunnel junctions - Ferroelectric FETs (FeFETs).

UNIT IV POST CMOS ELECTRONICS- ARCHITECTURES 9

FinFETs and Gate all around FETs (GAAFETs): operation, fabrication techniques and challenges, advantages over planar transistors, Tunnel FETs (TFETs): operating principles, band-to-band tunneling mechanism - Design and fabrication challenges - Applications in low power electronics.

UNIT V MODELLING OF POST-CMOS ELECTRONICS 9

Importance of modeling in device design and optimization - Analytical models: FinFETs, GAAFETs, TFETs, negative capacitance FETs, memristors, resistive RAM - Numerical simulation techniques.

Total: 45 Hrs

h) Learning Resources

Text Books

1. N.H.E.Weste and D. Harris, “CMOS VLSI Design: A Circuits and Systems Perspective”, Fourth edition, Pearson, 2022.
2. Jacob Baker, “CMOS: Circuit Design, Layout, and Simulation”, Fourth Edition, Wiley-IEEE Press, 2019.

Reference Books

1. 1 M. Lundstrom and J. Guo “Nanoelectronics: Device Physics, Modeling, and Simulation", Springer, 2005.
2. Dhiman, Rohit; Chandel, Rajeevan, “VLSI and Post-CMOS Electronics”, Institution of Engineering and Technology, 2019.
3. Saha, Samar K., “FinFET Devices for VLSI Circuits and Systems”, CRC press, 2020.

Online Resources

1. Siemens EDA Tools exploration: https://eda.sw.siemens.com/en-US/modelsim-student-edition.
2. YouTube Introduction to beyond CMOS: https://www.youtube.com/watch?v=YFQO_cZiGPY
3. Introduction to CMOS circuits: https://nptel.ac.in/courses/117101105

Course Code	Course Title	L	T	P	C
10212EC194	QUANTUM TECHNOLOGIES FOR VLSI	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course will provide the ideas of quantum technologies into VLSI. The course also describes cutting-edge quantum algorithms and discusses the relative merits of competing quantum techniques in VLSI.

c) Prerequisite

Nil

d) Related Courses

Nil

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Outline the irreversible logic design and its representation	K2
CO2	Interpret the basic quantum computing functions for logic implementation.	K2
CO3	Infer the performance metrics of quantum gates.	K2
CO4	Illustrate the performance metrics of quantum circuits	K2
CO5	Relate the concepts of quantum mechanics in to VLSI	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	L	M	L	-	-	-	-	L	L	-	L	-	-
CO2	H	M	M	L	-	-	-	-	L	L	-	L	-	-
CO3	H	M	M	L	-	-	-	-	L	L	-	L	-	-
CO4	H	M	L	M	-	-	-	-	L	L	-	M	-	-
CO5	H	M	M	L	-	-	-	-	L	M	-	L	-	-

g) Course Content

UNIT I IRREVERSIBLE LOGIC DESIGN 9

Overview of MOSFET- CMOS - Design of basic and universal logic gates, pass transistor, AOI gates, transmission gate, dynamic gates - Stick diagram: NAND, NOR - Static and dynamic power dissipation.

UNIT II FUNDAMENTALS OF QUANTUM COMPUTING 9

Basics of quantum computing – Principles of quantum mechanics in VLSI – need for quantum computing– Relationship between reversible and quantum logic – Qubits and operators: entanglement and superposition.

UNIT III QUANTUM GATES 9

Introduction to Quantum Gates: Single Qubit Gates, Quantum Not Gate, Reversible gates: Pauli-X, Y and Z, Hadamard, Phase Gate - Multiple Qubit Gates: controlled gate, controlled Not, swap - Ancilla inputs- Garbage outputs.

UNIT IV QUANTUM CIRCUITS 9

Quantum circuits: quantum teleportation, measurement and interference, quantum dots, quantum wells, general unitary transformations, dirac formalism, superposition of states, quantum circuit composition - Quantum cost.

UNIT V INTEGRATING QUANTUM MECHANICS INTO VLSI 9

Computational problems - Comparison with classical computing: quantum decoherence, error correction, Fault Tolerance - Classical computation - Efficiency: area, power, delay, depth, complexity.

Total: 45 Hrs

h) Learning Resources

Text Books

1. Hafiz Md.Hasan Babu, "Quantum Computing: A Pathway to quantum logic design", IOP Publishing, 2020.
2. Chris Bernhardt, "Quantum Computing for Everyone", The MIT Press, 2019.

Reference Books

1. John Gribbin, "Computing with Quantum Cats: From Colossus to Qubits", 2021.
2. Niel H.E. Weste, David Harris, Ayan Banerjee, "CMOS VLSI Design- A Circuits and Systems Perspective", Third Edition, 2013.
3. Benenti G., Casati G. and Strini G., "Principles of Quantum Computation and Information", Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific, 2004.

Online Resources

1. Mermin's lecture notes http://people.ccmr.cornell.edu/~mermin/qcomp/ CS483.html
2. Michael Nielsen, "Neural Networks and Deep Learning", Determination Press, 2015. http://neuralnetworksanddeeplearning.com/
3. VLSI Physical Design: Course (nptel.ac.in).
4. Introduction to Quantum Computing: Course (nptel.ac.in).
5. Introduction to Quantum Computing: Quantum Algorithms and Qiskit - Course (nptel.ac.in).

Course Code	Course Title	L	T	P	C
10212EC193	VLSI TESTING AND VERIFICATION	3	0	0	3

a) Course Category

Program Elective

b) Preamble

The course includes design and architectures for testability techniques in digital systems with improved fault coverage. It also provides knowledge on approaches for introducing Built-In Self-Test (BIST) into logic circuits, memories and embedded cores.

c) Pre requisite

Nil

d) Related Courses

Semiconductor materials and devices

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Summarize the significance of testing to observe the faults in digital circuits.	K2
CO2	Infer the various fault modeling techniques to locate a fault in the circuit.	K2
CO3	Interpret a suitable test pattern generation to perform verification of the digital circuits.	K2
CO4	Outline the different types of design for testability approaches for testing circuits under test.	K2
CO5	Illustrate the various types of architectures utilized for BIST and Memory BIST(MBIST).	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	M	M	L	-	-	-	-	L	L	-	L	-	-
CO2	H	M	M	L	-	-	-	-	L	L	-	L	-	-
CO3	H	M	M	L	-	-	-	-	L	L	-	L	-	-
CO4	H	M	M	L	-	-	-	-	L	L	-	L	-	-
CO5	H	M	M	L	-	-	-	-	L	L	-	L	-	-

g) Course Content

UNIT I FUNDAMENTALS OF TEST AND DESIGN 9

Need for testing - testing during VLSI lifecycle - challenges in testing - types of simulation: compiled code and event driven - VLSI testing equipment and economics - observability and controllability - fault coverage.

UNIT II FAULT MODELLING 9

Logic fault models: stuck-at-fault, transition fault, open and short faults - single versus multiple fault model - fault detection and redundancy- fault equivalence and fault location.

UNIT III TEST GENERATION 9

Automated Test Pattern Generation (ATPG) for combinational circuits: D algorithm, Path-Oriented Decision Making (PODEM) - ATPG for sequential circuits: time frame expansion and multiple clocks.

UNIT IV DESIGN FOR TESTABILITY 9

Testability trade-offs - ad hoc design for testability - scan cell design - scan architectures - scan design flow - board level and system level DFT approaches -boundary scan standards.

UNIT V BUILT-IN SELF-TEST (BIST) 9

BIST test pattern generation - BIST architectures: LSSD On-Chip Self-Test (LOCST), Built-In Logic Block Observer (BILBO)- Memory BIST: RAM BIST compiler.

Total: 45 Hrs

h) Learning Resources

Text Books

1. Laung-Terng Wang, Cheng-Wen Wu, and Xiaoqing Wen, "VLSI Test Principles and Architectures: Design for Testability", Morgan Kaufmann Publishers, 2021.
2. Miron Abramovici, Melvin A. Breur, Arthur D. Friedman, "Digital Systems Testing and Testable Design", Jaico Publishing House, Second Edition, 2006.

Reference Books

1. M. L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital Memory and Mixed Signal VLSI Circuits", Springer, 2013.
2. Neil H.E. Weste and David Money Harris, "A Circuits and Systems Perspective", Pearson Education, Fourth Edition, 2011.
3. Vaibbhav Taraate, "ASIC Design and Synthesis", Springer, First Edition, 2021.

Online Resources

1. VLSI Design Verification and Test: Course (nptel.ac.in)
2. Digital VLSI Testing: Course (nptel.ac.in)

Course Code	Course Title	L	T	P	C
10212EC192	SEMICONDUCTOR PACKAGING	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course provides the fundamental and advanced concepts in the field of electronics packaging. It also describes the testing and reliability of packaging and provides the knowledge on recent electronic packaging technologies.

c) Prerequisite

Nil

d) Related Courses

Advanced Semiconductor Devices

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Explain the basic principles of electronic packaging.	K2
CO2	Outline the selection of material and issues in electrical connection.	K2
CO3	Illustrate the chip level packaging and their significance.	K2
CO4	Extend the knowledge in packaging technology and thermal design.	K2
CO5	Infer the various packaging electrical issues and testing process.	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	H	H	-	-	-	-	-	L	M	-	M	-	-
CO2	H	M	M	M	-	-	-	-	-	L	-	M	-	-
CO3	H	M	M	-	-	-	-	-	L	L	-	M	-	-
CO4	H	M	-	H	-	-	-	-	L	M	-	M	-	-
CO5	H	M	-	L	-	-	-	-	-	M	-	M	-	-

g) Course Content

UNIT I FUNDAMENTALS OF ELECTRONIC SYSTEMS PACKAGING 9

Introduction - Functions of electronic packaging, packaging hierarchy, IC packaging: MEMS packaging, consumer electronics packaging, medical electronics packaging - Trends and challenges, driving forces on packaging technology.

UNIT II MICRO ELECTRONIC PACKAGING 9

Materials for microelectronic packaging - substrates - encapsulants – interconnects – Packaging issues- Packaging material properties: ceramics, polymers, and metals in packaging, material for high density interconnect substrates.

UNIT III CHIP LEVEL PACKAGING 9

IC assembly: purpose, requirements, technologies, flip chip - Wafer level packaging: reliability, burn – in and test - Single chip packaging: functions, materials processes – Multi-chip packaging: types, design, comparison, trends - System-In-Package (SIP) - Passives.

UNIT IV PACKAGING TECHNOLOGY AND THERMAL DESIGN 9

Printed wiring boards technology - Surface mount technology - Thermal mismatch in packages - thermal design consideration in system packaging - electrical modeling of a through silicon via - power distribution - return path discontinuities and thermal management.

UNIT V ELECTRICAL ISSUES AND TESTING 9

Enhance the reliability and performance: packaging material issues - Electrical design: Packaging roadmaps – Failures - Electrical issue: signal distribution, power distribution, electromagnetic interference and RF issues - Electrical testing: system level electrical testing, interconnection tests, active circuit testing, design for testability

Total: 45 Hrs

h) Learning Resources

Text Books

1. Rao R. Tummala, “Fundamentals of Device and Systems Packaging: Technologies and Applications”, Second Edition by McGraw Hill, 2020.
2. John H.Lau, “Semiconductor Advanced Packaging”, Springer, 2021.

Reference Books

1. S.A. Srinivasa Moorthy, “Introduction to Electronic Packaging-Unconventional Guide to Product Design”, NotionPress, 2020.
2. Andrea Chen and Randy Hsiao-Yu Lo, “Semiconductor Packaging”, CRC Press Taylor & Francis Group, 2012.
3. Ali Jamnia, “Practical Guide to the Packaging of Electronics: Thermal and Mechanical Design and Analysis”, Third Edition, CRC press, 2016.

Online Resources

1. Electronic Packaging and Manufacturing - Course (nptel.ac.in)
2. An Introduction to Electronics Systems Packaging - Course (nptel.ac.in)

Course Code	Course Title	L	T	P	C
10212EC195	SEMICONDUCTOR OPTOELECTRONICS AND PHOTOVOLTAICS	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course provides the fundamental and advanced concepts in the field of optoelectronics and semiconductor devices. It also describes the applications of semiconductor lasers, optoelectronic sources, detectors, and photovoltaic cells.

c) Prerequisite

Nil

d) Related Courses

Nil

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Illustrate the semiconductor materials, LED structure and characteristics.	K2
CO2	Explain the semiconductor laser dynamics, emission, population inversion, and resonators.	K2
CO3	Interpret the various optoelectronic detectors and advanced detectors.	K2
CO4	Outline the principles and characteristics of solar cells.	K2
CO5	Compare the performance of various semiconductor based solar cells.	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	M	M	L	-	-	-	-	-	L	-	L	-	-
CO2	H	M	M	M	-	-	-	-	-	L	-	L	-	-
CO3	H	M	M	L	-	-	-	-	L	L	-	L	-	-
CO4	H	M	M	L	-	-	-	-	L	L	-	M	-	-
CO5	H	M	M	L	-	-	-	-	L	M	-	M	-	-

g) Course Content

UNIT I SEMICONDUCTOR MATERIALS AND LED MECHANISM 9

Semiconductor materials for optoelectronic devices - radiative and non-radiative recombination mechanisms - Light Emitting Diodes (LEDs): light emitting materials, device structure, spectral characteristics and applications.

UNIT II LASER DYNAMICS 9

Spontaneous and stimulated emission - absorption and amplification of light in a medium - population inversion and threshold condition for a laser - semiconductor laser: structure, materials, device characteristics.

UNIT III OPTO ELECTRONIC DETECTORS 9

Materials for optical detectors - photocurrent generation in PN diodes - photo detectors: PIN photo detector - avalanche photo detector - quantum well inter sub-band detector - chemiluminescence.

UNIT IV PHOTOVOLTAIC CELLS 9

Energy consumption and solar energy - photovoltaic effect and its application - development of solar cells - characteristics of solar cells: photocurrent and quantum efficiency - application of solar cells.

UNIT V SEMICONDUCTOR MATERIALS FOR PHOTOVOLTAIC CELLS 9

Solar cell structure - inherent limits of thin-film photovoltaics - semiconductor materials for solar cells: $Cu_2ZnSn(S,Se)$ related materials -solar cell characterization.

Total : 45 Hrs

h) Learning Resources

Text Books

1. Pallab Bhattacharya, “Semiconductor Optoelectronic Devices”, PHI, Second Edition, 2017.
2. Niloy K Dutta , Xiang Zhang, “ Opto electronic detectors”, World Scientific Publishing”, 2018.

Reference Books

1. P. Bhattacharya, “Semiconductor Optoelectronic Devices”, Prentice Hall of India, 2017.
2. S. M. Sze, “Semiconductor devices: physics and technology”, Wiley, Third Edition, 2016.
3. M. Parans Paranthaman , Winnie Wong-Ng, “Semiconductor Materials for Solar Photovoltaic Cells”, Springer Nature, 2015.

Online Resources

1. Semiconductor Optoelectronics: physics and technology of semiconductor optoelectronic devices- Course (nptel.ac.in)
2. Solar Photovoltaics Fundamentals, Technology and Applications- Course (nptel.ac.in)

Course Code	Course Title	L	T	P	C
10212EC235	FPGA BASED SYSTEM DESIGN	1	0	4	3

a) Course Category

Program Elective

b) Preamble

Recent advances in VLSI technology have led to the emergence of a new class of computer architectures that exploit application-level parallelism. These reconfigurable computers can be rapidly customized at the hardware level to execute specific computations. In this course, students will explore the latest developments in reconfigurable computing from both hardware and software perspectives.

c) Prerequisite

Nil

d) Related Courses

Nil

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Dave's Taxonomy)
CO1	Build an FPGA system for combinational and sequential circuits using HDL.	S1
CO2	Apply FPGA tools to synthesize and implement digital based design using HDL.	S2
CO3	Demonstrate and implement the real time interfacing using FPGAs.	S3

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	M	H	M	H	-	-	-	-	L	-	M	-	-
CO2	M	L	H	M	H	L	L	-	-	L	-	M	-	-
CO3	M	L	H	M	H	L	L	-	L	L	-	M	-	-

g) Course Content

Theory **15 Hrs**

Field Programmable Gate Arrays- Logic blocks, routing architecture, Design flow technology- Altera MAX 5000 and 7000 - Spartan II and Virtex II FPGAs and Cyclone FPGAs - overview of verilog HDL, basic concepts of hardware description languages: structural, dataflow and behavioral styles - Delay modeling - Control statements - FSM modeling of hardware description.

List of experiments

S. No.	CO Mapping	Practical Exercises (60 Hours)	Skill Level
1.	CO1	Introduction to lab using Xilinx FPGA - Vivado synthesis tool.	S1
2.	CO1	Demonstration of design, synthesis and implementation of digital block on FPGA.	S1
3.	CO1	Simulate a HDL code to describe the functions of a full adder using three modeling styles.	S1
4.	CO1	Simulate a verilog program for multiplexer and de-multiplexer.	S1
5.	CO1	Simulate a verilog program for encoder and decoder using any type of modeling.	S1
6.	CO1	Simulate a verilog code for 8-bit ALU using any type of modeling.	S2
7.	CO2	Simulation of counters and shift registers.	S2
8.	CO2	Simulation of finite state machine for sequence detector using Xilinx FPGA.	S2
9.	CO2	Simulation of asynchronous counter using digital logic ICs.	S2
10.	CO2	Simulation of comparator using digital logic ICs.	S2

11.	CO2	Design and implementation of digital clock using Xilinx FPGA.	S3
12.	CO3	Design and implementation of an LCD interface in FPGA.	S3
13.	CO3	Design and implementation of seven segment display interface using Xilinx FPGA.	S3

Total: 75 Hrs

h) Learning Resources

Text Books

1. Simon, "Programming FPGA's : Getting started with Verilog", McGraw – Hill Education, 2016.
2. Stephen Brown, "Fundamentals of Digital logic with Verilog Design", McGraw – Hill Education, 2017.
3. S. Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Prentice Hall NJ, USA, 2003.

Reference Books

1. Nikoloas Voros Et Al. "Applied Reconfigurable Computing: Architectures, Tools and Applications", Springer, 2018.
2. Wayne Wolf, "FPGA- Based System Design", Pearson education, LPE First Indian Reprint, 2005.
3. Farzad Nekoogar and Faranak Nekoogar, "From ASICs to SOCs: A Practical Approach", Prentice Hall PTR, 2003.

Online Resources

1. Verilog notes: https://www.asic-world.com/
2. Reconfigurable computing Candidate talk: https://youtu.be/5_H_j72Ftq8http://www.verilog.com/
3. Digital Design with Verilog: Course (nptel.ac.in).

Course Code	Course Title	L	T	P	C
20231EC105	MODERN MATHEMATICS FOR EMBEDDED SYSTEMS	4	0	0	4

a) Course Category

Program Core

b) Preamble

The following course provides a comprehensive understanding of several critical areas in mathematical and operational research methodologies. The course focusing on a distinct aspect of the field, aiming to equip students with both theoretical knowledge and practical problem-solving skills. The course develops a strong foundation in graph theory, queuing theory, optimization techniques, and probability distributions in reliability analysis.

c) Prerequisite

Nil

d) Related Courses

Nil

e) Course Outcome

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Solve problems related to graph isomorphism and other complex graph theoretic issues.	K3
CO2	Model real-world scenarios using linear programming to optimize resources and improve decision-making processes	K3
CO3	Identify the general characteristics of time-to-failure distributions and their impact on system reliability.	K3
CO4	Construct mathematical representations of queuing systems with finite and infinite capacities.	K3
CO5	Build statistical models for Completely Randomized Designs (CRD) and Randomized Block Designs (RBD).	K3

f) Correlation of COs with POs and PSOs

	PO1	PO2	PO3	PSO1	PSO2
CO1	H	L	M	L	L
CO2	H	L	M	L	L
CO3	H	L	M	L	-
CO4	H	L	L	L	-
CO5	H	L	L	L	L

g) Course Content

UNIT I GRAPH THEORY 12

Introduction to paths, trees, vector spaces - Matrix coloring and directed graphs - some basic algorithms - Shortest path algorithms - Depth-first search on a graph – Isomorphism - Other graphs - Theoretic algorithms - Performance of graph theoretic algorithms - Graph theoretic computer languages

UNIT II OPTIMIZATION TECHNIQUE 12

Linear Programming - Model Formulation - Graphical solution - Simplex Method - Transportation Problem – Assignment Problem.

UNIT III PROBABILITY DISTRIBUTIONS IN RELIABILITY ANALYSIS 12

Introduction - State Variable - Time-to-Failure - General Characteristics of Time-to-Failure Distributions - Survivor Function - Failure Rate Function - Conditional Survivor Function - Mean Time-to-Failure - Additional Probability Metrics - Mean Residual Lifetime - Mixture of Time-to-Failure Distributions – Some Time-to-Failure Distributions - The Exponential Distribution - The Gamma Distribution - The Weibull Distribution - The Normal Distribution.

UNIT IV QUEUEING THEORY 12

Single and multiple servers - Markovian queuing models - Finite and infinite capacity queues - Finite source model - Queuing applications.

UNIT V ANALYSIS OF VARIANCE 12

Some General Principles - Completely Randomized Designs - Randomized-Block Designs - Multiple Comparisons - Analysis of Covariance.

Total: 60 Hrs

h) Learning Resources

Reference books

1. Narsingh ,Deo, “Graph theory with applications to engineering and computer science” Prentice Hall India Learning Private Limited; New edition, 1979.
2. Harary F, “Graph Thoery”, Narosa publishing House, 2001.
3. Hamdy A. Taha, “Operations Research An Introduction Tenth Edition”, Global Edition, Pearson edition limited, 2017.
4. Sharma J K, “Operations Research theory and applications” Sixth Edition, Trinity Press, New Delhi 2016
5. Marvin Rausand, Anne Barros, Arnljot Hoyland, “System Reliability Theory Models, Statistical Methods, and Applications”, Third edition , John Wiley & Sons, Inc. 2021.
6. Kishor S. Trivedi, “Probability and Statistics with Reliability, Queuing, and Computer Science Applications” Second edition, John Wiley & Sons, Inc. 2016
7. Richard A. Johnson, “Miller & Freund’s Probability and statistics For Engineers” Ninth edition, Pearson Education, Boston, 2017.
8. Narayanan S., Manigavachagom Pillay T. K., Ramanaiah G., “Advanced Mathematics For Engineering Students”, Volume III S Viswanathan Pvt Ltd, 2000.
9. Montgomery D.C., Runger G.C., Hubele N. F. “Engineering Statistics”, John Wiley and Sons, Inc.USA, 2011.

Course Code	Course Title	L	T	P	C
20232EC101	EMBEDDED SYSTEMS SECURITY	3	0	0	3

a) Course Category

Program Elective

b) Preamble

The embedded systems security course provides a solid overview of the basic principles in cryptography and data security, with particular emphasis on this application in embedded systems. The course deals with both the theoretical and real time challenges of various security features in embedded systems, ensuring that students will be well prepared to address those in practice.

c) Prerequisite

Nil

d) Related Courses

Embedded Systems

e) Course Outcome

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Identify various computer and network security concepts, including OSI security architecture, security attacks, and security services and mechanisms.	K3
CO2	Solve encryption strategies utilizing the Data Encryption Standard (DES) and Advanced Encryption Standard (AES).	K3
CO3	Build comprehensive knowledge of core embedded OS security requirements.	K3
CO4	Compare and contrast different cryptographic practices and protocols for embedded devices.	K4
CO5	Utilize SSL and other security protocols effectively to secure wireless embedded systems.	K3

f) Correlation of COs with POs and PSOs

	PO1	PO2	PO3	PSO1	PSO2
CO1	H	H	M	L	-
CO2	H	M	L	L	L
CO3	H	L	M	L	L
CO4	H	L	M	M	-
CO5	H	L	L	L	-

g) Course Content

UNIT I FUNDAMENTALS OF SECURITY PRINCIPLES 9

Computer and network security concepts: Overview, OSI security architecture, Security attacks, Services and mechanisms - fundamentals of security design principles, Attack surfaces and attack trees, model for network security.

UNIT II CLASSICAL SYMMETRIC CIPHERS 9

Classical encryption techniques: Symmetric cipher model, Substitution and transposition techniques - Block ciphers and DES: Traditional block cipher structure, Data Encryption Standard (DES), DES Example and strength - Advanced Encryption Standard (AES): AES Structure and transformation functions, AES key expansion.

UNIT III EMBEDDED THREAT MANAGEMENT 9

Embedded security trends, Security policies and threats - System software considerations: Role of operating system, Microkernel vs. Monolithic kernel - Core embedded OS security requirements, Access control and capabilities, Hypervisors and system virtualization, I/O virtualization, Remote management, Assuring Integrity of the Trusted Computing Base (TCB).

UNIT IV EMBEDDED CRYPTOGRAPHY AND DATA SECURITY 9

Cryptographic methods & Data Protection in embedded systems - Advanced cryptography for embedded systems - Data protection techniques in embedded systems - Embedded system cryptography and security protocols - Cryptographic practices and protocols for embedded devices, Embedded system data security - Secure data handling in embedded systems - Embedded cryptographic applications, Data security and cryptographic solutions for embedded systems.

UNIT V SECURITY PROTOCOLS AND STRATEGIES 9

Network communications protocols and built-in security - Security protocols and algorithms: Secured Socket Layer (SSL), Embedded security in wireless - Application-layer and Client/Server protocols, Choosing and optimizing cryptographic algorithms for resource-constrained systems - Hardware-based security.

Total: 45 Hrs

h) Learning Resources

Text books

1. William Stallings, “Cryptography and Network Security: Principles and Practice”, 7th Edition, Pearson Education Limited, 2017.
2. David Kleidermacher and Mike Kleidermacher, “Embedded Systems Security: Practical Methods for Safe and Secure Software and Systems Development”, Newnes (an imprint of Elsevier), 2012.
3. Timothy Stapko, “Practical Embedded Security: Building Secure Resource-Constrained Systems”, Newnes (an imprint of Elsevier), 2008.

Reference books

1. Christof Paar, Jan Pelzl, “Introduction to Cryptography”, Springer, 2010.
2. Ingrid Verbauwhede (Ed.), “Secure Integrated Circuits and Systems”, Springer, 2010.
3. Stefan Mangard, Elisabeth Oswald, Thomas Popp, “Power Analysis Attacks”, Springer, 2007.
4. Debdeep Mukhopadhyay, Rajat Subhra Chakraborty, “Hardware Security: Design, Threats, and Safeguards”, CRC Press, 2015. ISBN: 9781439895832.
5. Marc Joye, Michael Tunstall, “Fault Analysis in Cryptography”, Springer, 2012.

Online resources

1. NPTEL Course-Hardware Security: https://onlinecourses.nptel.ac.in/noc22_cs48/preview
2. COURSERA- Internet of Things Security: https://www.coursera.org/learn/iot-security
3. EDX-https://www.edx.org/learn/embedded-systems/the-university-of-texas-at-austin-embedded systems-shape-the-world-microcontroller-input-output
4. EDX-https://www.edx.org/learn/embedded-systems/arm-education-embedded-systems-essentials-with-arm-getting-started

Course Code	Course Title	L	T	P	C
20232EC103	INTELLIGENT CONTROL AND AUTOMATION	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course aims to equip students with foundational knowledge and advanced techniques for intelligent control systems used in automation. By combining concepts from Artificial Neural Networks (ANN), Fuzzy Logic (FL), Genetic Algorithms (GA), and recent industrial automation methods, students will learn to design and optimize intelligent control systems for various applications.

c) Prerequisite

Nil

d) Related Courses

Advance Machine Learning and Artificial Intelligence.

e) Course Outcome

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Utilize adaptive neuro-controllers integrating both ANN and fuzzy logic principles.	K3
CO2	Solve optimization problems by utilizing a combination of Genetic Algorithms and other search techniques.	K3
CO3	Build different combinations of ANN, fuzzy logic, and optimization methods to achieve superior control performance.	K3
CO4	Identify and apply concepts of industrial automation, including PLC and SCADA systems.	K3
CO5	Choose appropriate intelligent control strategies for different industrial automation applications.	K3

f) Correlation of COs with POs and PSOs

	PO1	PO2	PO3	PSO1	PSO2
CO1	M	L	M	L	-
CO2	M	L	M	L	M
CO3	M	L	M	M	-
CO4	H	M	L	M	L
CO5	H	M	L	M	L

g) Course Content

UNIT I ARTIFICIAL NEURAL NETWORK AND FUZZY LOGIC 9

Learning with ANNs, Single-layer and multi-layer perceptron - Back Propagation Algorithm, ANNs for identification and control - Adaptive neuro controller - Fuzzy Logic Control: Fuzzy sets, fuzzy logic, fuzzy logic controller design - Fuzzy modelling and identification, Adaptive fuzzy control design.

UNIT II GENETIC ALGORITHM 9

Basic concept of Genetic Algorithms and detailed algorithmic steps - Hybrid Genetic Algorithms, Solution for typical control problems using Genetic Algorithms - Other search techniques: Tabu Search, Ant-colony Search, Particle Swarm Optimization.

UNIT III COMBINED ANN, FUZZY LOGIC, AND OPTIMIZATION METHODS 9

Fuzzification and rule base using ANN - Neuro-fuzzy systems - Adaptive Neuro-Fuzzy Inference System (ANFIS) - Optimization of membership functions and rule base using Genetic Algorithms and Particle Swarm Optimization.

UNIT IV INDUSTRIAL AUTOMATION 9

Automation components: Discrete switches, analog sensors, relays, actuators, and automation tools - Automation in production systems: Principles and strategies, basic elements of an automated system, advanced automation functions - Industrial automation: Computer vision, PLC, SCADA.

UNIT V INTELLIGENT CONTROLLERS FOR INDUSTRIAL AUTOMATION APPLICATION 9

Applications of intelligent controllers in industrial monitoring, optimization, and control, Automation of smart appliances, Automation concepts for electric vehicles, intelligent controllers and automation for power systems.

Total: 45 Hrs

h) Learning Resources

Text books

1. Ronald L. Krutz, “Industrial Automation and Control System Security Principles”, Wiley, 2020.
2. Eyal Wirsansky, “Hands-On Genetic Algorithms with Python”, Paperback, 2020.
3. Dan W. Patterson, “Artificial Neural Networks and Machine Learning”, Prentice Hall, 2017.
4. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley, 4th Edition, 2016.
5. David E. Goldberg, “Genetic Algorithms in Search, Optimization, and Machine Learning”, Pearson Education, 2009.

Reference books

1. Chanchal Dey and Sunit Kumar Sen, “Industrial Automation Technologies”, 1st Edition, CRC Press, 2022.
2. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress, Kindle Edition, 2016.
3. Frank D. Petruzella, “Programmable Logic Controllers”, McGraw Hill, New York, 2016.
4. Lawrence (Larry) M, Thompson and Tim Shaw, “Industrial Data Communications”, ISA Press, 5th Edition, 2015.
5. Stuart A. Boyer, “SCADA: Supervisory Control and Data Acquisition Systems”, ISA Press, 2010.

Online resources

1. Artificial Neural Networks and Deep Learning: https://www.deeplearningbook.org/
2. Genetic Algorithms Overview: https://in.mathworks.com/help/gads/what-is-the-genetic-algorithm.html
3. Introduction to Genetic Algorithms - MIT Open Course Ware: https://www.youtube.com/watch?v=kHyNqSnzP8Y
4. Introduction to Industrial Automation: https://www.surecontrols.com/what-is-industrial-automation/
5. PLC Programming and SCADA Systems: https://www.plcacademy.com/
6. IoT and Industry 4.0: https://www.epicor.com/en/blog/what-is-industry-4-0/
7. Automation of Smart Appliances: https://www.sciencedirect.com/science/article/abs/pii/S0957417414004343
8. Automation for Electric Vehicles: https://ieeexplore.ieee.org/document/9247271

Course Code	Course Title	L	T	P	C
20232EC109	INDUSTRIAL INTERNET OF THINGS	3	0	0	3

a) Course Category

Program Elective

b) Preamble

The course on Industrial Internet of Things (IIoT) is designed to provide students with an in depth understanding of how IoT technologies are revolutionizing industrial sectors. By integrating IIoT into industrial processes, industries can achieve greater efficiency, improved productivity, and enhanced safety. This course is structured to focus on different aspects of IIoT, from fundamental concepts to real-world applications

c) Prerequisite

Nil

d) Related Courses

Nil

e) Course Outcomes

On successful completion of the course, student will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Build a foundational understanding of the role of the IoT and IIoT in modern industries.	K3
CO2	Identify the roles of microcontrollers and embedded PCs in the deployment of IIoT solutions.	K3
CO3	Construct data analytics and predictive maintenance models utilizing IIoT technology to enhance operational efficiency.	K3
CO4	Infer the cyber physical systems of AR/VR, AI and Bigdata.	K2
CO5	Identify key challenges and opportunities in implementing IIoT solutions across different industries.	K3

f) Correlation of COs with POs and PSOs

	PO1	PO2	PO3	PSO1	PSO2
CO1	H	L	-	L	L
CO2	H	L	-	L	L
CO3	H	L	-	L	L
CO4	H	L	M	M	L
CO5	M	L	M	M	L

g) Course Content

UNIT I FUNDAMENTALS OF IIoT **9**

Various Industrial Revolutions - Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry - Industry 4.0 revolutions - Support System for Industry 4.0 - Smart Factories.

UNIT II SYSTEMS FOR IIoT AND REFERENCE ARCHITECTURE **9**

Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform - Microcontrollers and Embedded PC roles in IIoT - Wireless Sensor nodes and Protocols: Bluetooth, WiFi, and LoRa Protocols, IoT Hub systems - Industrial Internet Architecture Framework – Functional Viewpoint – Operational Domain, Information Domain, Application Domain, Business Domain.

UNIT III IIoT DATA MONITORING AND CONTROL INTERNET SYSTEMS **9**

IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology. Introduction-Proximity Network Protocols – WSN Edge Node – Legacy Industrial Protocols - Industrial Ethernet – Industrial Gateways

UNIT IV MIDDLEWARE TRANSPORT PROTOCOL AND CYBER PHYSICAL SYSTEMS **9**

TCP/IP, UDP, RTP, CoAP –Middleware Software patterns –Software Design patterns – Application Programming Interface (API) – CAN Protocol-Web Services – Middleware IIoT – Securing the IIoT- Identity Access Management - Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis.

UNIT V APPLICATIONS OF INDUSTRIAL IOT 9

Healthcare, Power Plants, Inventory Management and Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management, Real life examples of IIoT in Manufacturing Sector, Case studies: IIoT application development with Embedded PC based development boards.

. **Total : 45 Hrs**

h) Learning Resources

Text books

1. Alasdair Gilchrist "Industry 4.0: The Industrial Internet of Things" Apress Publications, 2017.
2. Bartodziej, Christoph Jan "The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics" Springer Publications, 2017.

Reference books

1. Dr. Ovidiu Vermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers, 2013.
2. Rajkamal "Embedded System: Architecture, Programming and Design", Tata MCGraw Hill 3rd Edition, 2017.

Online resources

1. Introduction to Industry 4.0 and Industrial Internet of Things - Course (nptel.ac.in) - Introduction to Industry 4.0 and Industrial Internet of Things - Course (nptel.ac.in) Prof. Sudip Misra
2. Introduction: Sensing and Actuation - Lecture 01: Introduction: Sensing and Actuation (youtube.com) (IIT Kharagpur).
3. IoT Based Smart Electricity Energy Meter using ESP32 & Blynk Application - IoT Based Smart Electricity Energy Meter using ESP32 & Blynk Application (youtube.com)

Course Code	Course Title	L	T	P	C
20232EC110	EMBEDDED REAL TIME SYSTEM WITH FPGA	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course aims to introduce the fundamentals of real-time system design using Field-Programmable Gate Arrays (FPGAs), theoretical concepts and practical techniques for developing real-time applications with FPGA.

c) Prerequisite

Nil

d) Related Courses

Nil

e) Course Outcomes

On successful completion of the course, student will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Choose appropriate design methodologies and tools based on project requirements and constraints.	K3
CO2	Build modular and cohesive systems that adhere to design quality standards.	K3
CO3	Organize strategies for identifying and managing dependencies in parallelized designs.	K3
CO4	Infer the FPGA-based hardware accelerators for real-time applications.	K2
CO5	Build advanced Fieldbus networks for efficient and reliable low-speed communication in real-time applications.	K3

f) Correlation of COs with POs and PSOs

	PO1	PO2	PO3	PSO1	PSO2
CO1	H	L	-	M	-
CO2	H	L	L	-	L
CO3	H	L	-	M	-
CO4	H	L	L	-	M
CO5	M	L	L	M	-

g) Course Content

UNIT I FUNDAMENTALS OF EMBEDDED SYSTEM DESIGN 9

Overview of embedded system- Design challenges: design life cycle, measures of success, cost- FPGA tool chain- Target FPGA - function generators, storage elements, special purpose function blocks – Xilinx Virtex 5- Creating and generating custom IP.

UNIT II SYSTEMS DESIGN 9

Cellular system, Hexa Principles of system design: design quality, modules and interfaces, cohesion and coupling, designing for reuse- Hardware design – Software design – Partitioning: analytical solution to partitioning, practical issues.

UNIT III SPATIAL DESIGN 9

Principles of parallelism: granularity, degree of parallelism, spatial organizations- Identifying parallelism: ordering, dependence, uniform dependence vectors- Spatial parallelism with platform FPGA: hardware cores and designs – Debugging.

UNIT IV PERFORMANCE OF REAL TIME SYSTEMS 9

Balancing bandwidth technique: Kahn process network, synchronous and asynchronous design – FPGA bandwidth technique: on-chip and off-chip memory, streaming instrument data and its practical issues – Scalable designs: scalable constraints and its solutions.

UNIT V FUTURE VISION ON REAL TIME SYSTEMS 9

Real time hardware: Heterogeneous soft multi-cores, architectural issues with individual soft core, advanced fieldbus networks and simpler distributed nodes - Low speed communication: Generating the hardware base system, testing the design.

Total: 45 Hrs

h) Learning Resources

Text books

1. Ron Sass, Andrew G. Schmidt, "Embedded Systems Design with Platform FPGAs Principles and Practices", Elsevier, 2017.
2. Phillip A. Laplante, Seppo J. Ovaska, "Real-Time Systems Design and Analysis: Tools for the Practitioner", 4th Edition Wiley, 2012.

Reference books

1. Juan José Rodriguez Andina, Eduardo de la Torre Arnanz, "FPGAs: Fundamentals, Advanced Features, and Applications in Industrial Electronics", CRC Publisher, 1st Edition September 2020.
2. Peter Athanas, Dionisios Pnevmatikatos, "Embedded Systems Design with FPGAs", Springer-Verlag New York Inc., 2012.

Online resources

1. Introduction to Real Time Embedded Systems Part I - Course (nptel.ac.in) - https://nptel.ac.in/courses/108105057 Prof. Rajib Mall, Prof. Amit Patra, Prof. A. Routray
2. Embedded Systems Design Course (nptel.ac.in) - https://onlinecourses.nptel.ac.in/noc22_cs46/preview By Prof. Anupam Basu, IIT Kharagpur .

Course Code	Course Title	L	T	P	C
20232EC113	IN VEHICLE NETWORKING	3	0	0	3

a) Course Category

Program Elective

b) Preamble

This course introduces the networking concept of embedded devices in vehicles. It explains interconnection methods and protocols for embedded systems in the vehicles, leads to connected and autonomous vehicles.

c) Prerequisite

Nil

d) Related Courses

Automotive Embedded System, Embedded Communication Protocol

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Apply knowledge of data communication networks to understand the fundamentals and importance of automotive communication protocols.	K3
CO2	Construct models of the CAN Data Link Layer to validate principles of data exchange, including arbitration, data frames, and remote frames.	K3
CO3	Identify key components of LIN node configuration and identification processes to ensure proper network setup.	K3
CO4	Outline the Medial Oriented System Transport (MOST) protocol and FlexRay used in automotive for multimedia and fault tolerant applications.	K2
CO5	Choose an appropriate communication technologies for vehicular environments, including Intelligent Transport System (ITS) and Wireless Access Vehicle Environments (WAVE).	K3

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	H	L	L	L	-
CO2	H	M	M	L	L
CO3	H	M	L	L	-
CO4	H	M	M	L	L
CO5	H	M	L	L	L

g) Course Content

UNIT I FUNDAMENTALS OF DATA NETWORKS AND PROTOCOLS 9

Basics of data communication networks and automotive communication protocols: Networks - Need for networks - Types of networks - Need for standards - TCP/IP model – Topologies - Error detection and correction mechanisms - Encoding schemes - Serial/parallel transmission – Bits - Baud and bandwidth - Synchronous and asynchronous - Need and benefits of IVN - Classes of IVN protocols.

UNIT II CONTROLLER AREA NETWORK (CAN) PROTOCOL 9

Overview of CAN - CAN Applications - SAE J1939 Protocol - Main characteristics of CAN - CAN in OSI Reference Model - CAN Data Link Layer - Principles of data exchange in CAN - Arbitration- Data Frame - Remote Frame - Error detection and management in CAN - CAN physical Layer- Bit encoding - Bit timing and synchronization - Relationship between data rate and bus length - Single wire and twin wire media - CAN repeaters - Medium to medium gateway - Protocol handlers.

UNIT III LOCAL INTERCONNECT NETWORK (LIN) PROTOCOL 9

Introduction to LIN - LIN consortium - LIN specification - LIN features - Technical overview - Work flow concept - LIN operation - LIN frame format - Scheduling table - Network management of LIN cluster - LIN Transport Layer - LIN node configuration and identification - LIN diagnostics - LIN physical layer - Comparison with other IVN protocols.

UNIT IV DIAGNOSTICS PROTOCOLS FOR VEHICLES 9

Process of Automotive Fault Diagnostics - Fault Codes - Vehicle Systems (open loop and closed loop) - On and Off Board Diagnostics – OBDI – OBDII - Engine Analyzers - Steps taken to diagnose a fault - Diagnostics Protocol KWP2000 - MOST overview, data rates, data types, topology - Flex Ray introduction –network topology – ECU sand bus interfaces - application areas.

UNIT V APPLICATIONS AND TECHNOLOGIES 9

Global Positioning Systems (GPS) - Inertial Navigation Systems (INS) - Vehicle Location and Navigation – Bluetooth – UWB – RFID - Intelligent Transportation Systems (ITS) and Wireless Access in Vehicular Environments (WAVE) - Vehicular Ad Hoc Networks (VANETs) – Communications Air interface Long and Medium range (CALM) - Real time management and planning of CRDI vehicle operation

Total: 45 Hrs

h) Learning Resources

Text books

1. Dominique Paret, "Multiplexed Networks for Embedded Systems CAN, LIN, FlexRay, Safe by Wire", 1st edition, Wiley, United States, 2014.
2. Chung Ming Huang, YuhShyan Chen, "Telematics Communication Technologies and Vehicular Networks: Wireless Architectures and Application", 1st edition, Information Science Reference, United States, 2010.

Reference books

1. Ronald K Jurgen, "Distributed Automotive Embedded Systems", 4th Edition, SAE International, United States, 2010.
2. Richard Zurawski, "Industrial Communication Technology Handbook", 2nd Edition, CRC press, United States, 2015.
3. Konrad Reif, "Automotive Mechatronics: Automotive Networking, Driving Stability Systems Electronics", 2nd Edition, Springer, United States, 2015.

Online resources

1. Networks and Systems: https://nptel.ac.in/courses/117106116
2. UART to Local Interconnect Network (LIN bus): https://www.udemy.com/course/automotive-networks-foundation-classes/
3. Controller Area Network (CAN bus): https://www.udemy.com/topic/controller-area-network-can-bus/
4. Secure Vehicle and Industrial Networking: https://www.online.colostate.edu/courses/SYSE/SYSE549.dot
5. Introduction to Automotive Cyber security and Vehicle Networks: https://www.careers360.com/courses-certifications/skill-lync-introduction-automotive-cybersecurity-and-vehicle-networks-course

M.Tech Embedded Systems and Technologies

MOOC NPTEL based Courses Offered in Summer 2024-2025 for VTRPGE23 Regulation

S.No	NPTEL COURSE CODE	COURSE TITLE	DURATION	REGISTRATION END DATE	CREDITS	CATEGORY
Open Elective						
1	20233EC401	Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software	12	August 16,2024	3	OE
2	20233EC402	Introduction to Industry 4.0 and Industrial Internet of Things	12	July 29,2024	3	OE

COURSE CODE	COURSE TITLE	L	T	P	C
10211EC101	CIRCUIT THEORY	2	1	0	3

a) Course Category :

Program Core

b) Preamble :

The course deals with the analysis of circuits through Graph theory, Network theorems, Fundamentals of AC circuit analysis, concepts of resonance, transients through differential equations and two port networks.

c) Prerequisite :

Nil

d) Related Courses :

Electromagnetics and Transmission Lines

e) Course Outcomes:

On successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Infer the basics of circuit analysis and graph theory	K2
CO2	Interpret circuits using network theorems	K2
CO3	Solve the problems on RL, RC and RLC DC transient circuits	K3
CO4	Discuss the characteristics of AC steady state analysis and power analysis.	K2
CO5	Illustrate the parameters of the two port networks and the concepts of resonance	K2

f) Correlation of COs with POs and PSOs:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	H	L	-	-	L	L	-	-	M	H	L	L	-
CO2	H	H	L	-	-	L	L	-	-	M	H	L	L	L
CO3	M	M	L	-	-	-	M	-	-	M	M	L	L	L
CO4	H	H	L	-	-	-	-	-	-	M	M	L	L	L
CO5	M	M	L	-	-	M	-	-	-	M	M	L	L	L

g) Course Content:

UNIT I BASICS OF CIRCUIT ANALYSIS & GRAPH THEORY 9

Review of KCL, KVL, Node and Mesh Analysis; Analysis using dependent current sources and voltage source, Resistors in series and parallel – Voltage and Current division rule, Graph Theory: Incidence- Duality & Dual networks

UNIT II NETWORK THEOREMS 9

Source Transformation – Superposition Theorem – Thevenin's Theorem – Norton's Theorem– Maximum Power Transfer Theorem – Reciprocity Theorem

UNIT III DC TRANSIENT ANALYSIS 9

RL and RC Circuits: Source free circuit – Properties of Exponential Response and Step functions – Natural and Forced Response Driven RL and RC circuits – RLC Circuits: Source free damped and under damped parallel RLC circuit – Critical Damping – Source free series RLC–Complete Response and lossless Circuits.

UNIT IV AC STEADY STATE AND POWER ANALYSIS 9

Analysis of AC steady state circuits: Characteristics, Forced Response to Sinusoidal functions, Phasor Relationship to passive components – Impedance and admittance – Application of Network Theorems – Power Analysis: Instantaneous – Average and RMS- Power, Power factor and Energy.

UNIT V TWO PORT NETWORKS AND RESONANCE CIRCUITS 9

Two port Networks – Impedance Parameter – Admittance Parameter – Transmission parameter, Hybrid Parameters and their inter relationship – Series and parallel resonance: frequency response, Quality factor and Bandwidth

Total: 45 Hrs

h) Learning Recourses:

Text Books

1. W.H. Hayt and I. E. Kemmerley, "Engineering Circuits Analysis", McGraw Hill Education 8th edition, 2014.
2. Franklin F Kuo, "Network Analysis and Synthesis", Wiley Toppan, 2nd edition, 1966.
3. M. E. Van Valkenburg, "Network Analysis", 3rd edition, PHI, 2014.
4. S. Salivahanan, "Circuit Theory – Analysis and Synthesis", First Impression, Pearson, 2020.

Reference Books

1. Joseph A. Edminister, "Electric Circuits", Schaum's outline series, McGraw-Hill 1987
2. A. Sudhakar, Shyammohan S. Palli, "Circuits and Networks", Tata McGraw-Hill, 4th edition, 2015
3. Smarajit Ghosh, "Network Theory Analysis & Synthesis", PHI learning, 1st Ed, 2005
4. Chakrabarti A, "Circuits Theory Analysis and Synthesis", Dhanpath Rai & Sons, New Delhi, 2018.
5. P. M. Chandrashekharaiah, "Electric Circuits and Network Analysis", CBS Publishers & Distributors Pvt. Ltd, 2018
6. T. Nageswara Rao, "Electric Circuits", A.R. Publications, 1999

Online Resources

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/lecture-notes.
2. https://nptel.ac.in/courses/108/102/108102042.
3. https://www.daenotes.com/search/node?keys=circuit%20Analysis.

Course Code	Course Title	L	T	P	C
10211EC102	ANALOG ELECTRONICS	2	1	0	3

a) Course Category

Program Core

b) Preamble

This course provides the basic and design knowledge about electronic circuit analysis using BJT and MOSFET which involves feedback, oscillator, high frequency amplifiers and its applications

c) Prerequisite

Nil

d) Related Courses

Linear Integrated Circuits, Communication Systems.

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Explain the operation of basic semiconductor and its devices.	K2
CO2	Compare the performance of different biasing types used for transistor operation.	K2
CO3	Apply the ' h' parameters and small signal model for different transistor configuration	K3
CO4	Interpret the effect of feedback, feedback amplifier and oscillators	K2
CO5	Illustrate the various types of tuned and power amplifiers.	K2

f) Correlation of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	H	M	L	-	L	-	-	-	-	-	-	L	L	-
CO2	M	M	L	-	L	-	-	-	L	-	-	-	-	-
CO3	M	H	L	M	L	-	-	-	-	-	-	-	L	-
CO4	M	M	L	-	M	L	-	L	M	L	L	-	L	-
CO5	M	M	L	-	H	-	-	-	L	M	M	L	L	-

g) Course Content

UNIT I SEMICONDUCTOR DEVICES 9

Overview of semiconductor, PN Diode : Varactor diode, LED, PIN diode and Laser diode-Working principle and application of Zener diode - Rectifiers-Clipper and clamper-Basic principle and working of SCR, UJT.

UNIT II DC BIASING OF TRANSISTOR 9

Introduction–Working principle of BJT-Transistor characteristics-CB, CE, CC -Thermal runaway, DC Biasing-BJT: Fixed -Emitter-Stabilized-Voltage-Divider - Compensation techniques.

UNIT III TRANSISTOR AMPLIFIER 9

Two port system approach, The Hybrid Equivalent model, Approximate Hybrid equivalent circuit, Hybrid Π model: CE, CC and CB configurations

UNIT IV FEEDBACK AMPLIFIER AND OSCILLATORS 9

Basic concept of Feedback, Feedback connection types, Input and output impedance of feedback configurations - characteristics of negative feedback, Oscillators**:** Principles of sinusoidal oscillator - RC oscillators: phase shift, Wien bridge - LC oscillators: Hartley, Colpitts, crystal oscillator.

UNIT V TUNED AND POWER AMPLIFIERS 9

Tuned amplifier: single tuned, double tuned and stagger tuned amplifier - Power amplifiers: Transformer coupled Class A power amplifier, Class B amplifier operation, Transformer coupled Push-pull circuits, Complimentary symmetry circuits, Class C power amplifier.

Total : 45 Hrs

h) Learning Resources

Text Books

1. Boylestead &Neshelsky, “Electronic Devices & Circuits” , Pearson Education / PHI Ltd, 11th edition, 2010.
2. S.Salivahanan, N.Suresh Kumar and A.Vallavaraj, “Electronic Devices and Circuits”, McGraw-Hill, 5th edition, 2022.
3. David .A. Bell, “Electric Circuits And Electronic Devices Oxford University Press”, 5th Edition, 2010.

Reference Books

1. Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw-Hill, 2007.
2. Bapat K N, “Electronic Devices & Circuits”, McGraw Hill, 1992.
3. Halkias .C.,” Integrated Electronics” ,2nd Edition, Tata McGraw-Hill, 2001
4. Sedra and Smith, “Microelectronic circuits”, Oxford University Press, 5th ed.
5. Donald L.Schilling and Charles Belove, “Electronic Circuits”, Tata McGraw Hill, 3rdEdition, 2003.
6. Dr. R. S. Sedha, “A Textbook of Electronic Circuits” , S. Chand, 2014.

Online Resources

1. Analog Electronics Course (nptel.com)

Course Code	Course Title	L	T	P	C
10211EC104	Linear Integrated Circuits	3	0	0	3

a) Course Category

Program Core

b) Preamble

Linear Integrated Circuits introduces the basic building blocks of the Integrated circuits along with fundamental concepts of electronic circuits like operational amplifiers, rectifiers and timers and acquire the knowledge in the analysis and design IC based circuits.

c) Prerequisite

NIL

d) Related Courses

VLSI Design, Circuit Theory

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Describe the characteristics of operational amplifiers.	K2
CO2	Illustrate the various linear and non-linear applications of Op-Amp	K2
CO3	Manipulate different waveform generator circuits using op-amp and Timer IC555	K2
CO4	Construct ADC and DAC using operational amplifiers., and analyze Active filters using op-amp	K3
CO5	Explain the operation of PLL and special function Op-Amp ICs	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	L	L	L	-	-	-	-	-	L	-	L	-	-
CO2	H	M	L	L	L	-	L	-	-	-	-	L	-	-
CO3	H	M	M	-	L	L	-	-	M	-	-	-	L	-
CO4	H	M	M	-	L	L	L	-	-	L	L	M	-	-
CO5	H	M	M	M	L	L	L	L	M	M	L	-	L	-

g) Course Content

UNIT I CHARACTERISTICS OF OP-AMP 9

Integrated Circuits- Classification of ICs - Op Amp: Ideal Characteristics Internal Circuit-Differential Amplifier-Open loop and Closed loop configuration-DC Characteristics and AC Characteristics - Current Source: Widlar source, Frequency Compensation

UNIT II LINEAR AND NON-LINEAR OP-AMP CIRCUITS 9

Linear: Inverting and Non-inverting voltage amplifiers, summing, scaling and averaging amplifiers, Subtractor, voltage follower, Instrumentation amplifiers, V to I and I to V converters, Non Linear: Differentiators, Integrators, Clippers, Clampers & Active Limiters, Log and Antilog Amplifiers, Precision Rectifiers

UNIT III WAVEFORM GENERATORS 9

Comparator, Regenerative comparator, sine wave generators, Astable multivibrator and Monostable multivibrator, triangle wave generators, saw tooth wave function generator – 555 Timer: Functional Diagram, Monostable and Astable operation,

UNIT IV D/A & A/D CONVERTERS AND ACTIVE FILTERS 9

D/A conversion: D/A conversion techniques, weighted resistor DAC and R-2R Ladder DAC – A/D conversion: A/D conversion techniques, Flash type ADC, Monolithic ADC and Ramp type ADC, Active Filters Design First order: LPF -Butterworth Filter, HPF and BPF

UNIT V PLL AND SPECIAL FUNCTION ICs 9

PLL: Phase detector/comparator, VCO, Applications: Frequency Multiplication / Division, Frequency Synthesizer – XR-2206 Function Generators, IC 723 general purpose regulator, Audio Power amplifier

Total: 45 Hrs

h) Learning Resources

Text Books

1. D. Roy Choudhry and Shail B. Jain, "Linear Integrated Circuits"- (4/e), New Age International Pvt. Ltd, 2011.
2. R. Gayakwad, “Op-amps and Linear Integrated Circuits”, (4/e), PHID.
3. S.Salivahanan & V S Kanchana Bhaaskaran, “Linear Integrated Circuits”, 2nd Edition, Tata McGraw Hill, New Delhi.

Reference Books

1. S. Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, (3/e) TMH, 2003.
2. R. F. Coughlin & F. F. Driscoll, “Operational Amplifiers and Linear Integrated circuits”, PHI, 1996.
3. D. A. Bell, “Solid State pulse circuits”, (4/e), PHI.
4. Milman Gravel, “Micro- electronics”, McGraw Hill, 1991.

Online Resources

1. https://www.tutorialspoint.com/linear_integrated_circuits_applications/index.htm
2. https://www.circuitstoday.com/category/integrated-circuits
3. https://onlinecourses.nptel.ac.in/noc20_ee13/preview

Course Code	Course Title	L	T	P	C
10211EC105	CONTROL SYSTEMS	2	1	0	3

a) Course Category

Program Core

b) Preamble

This course aims to provide a basic knowledge about control system, its significance, transfer function, open and closed loop systems, mathematical model of electrical and mechanical systems, time domain and frequency domain analysis of I order and II order systems and their specifications, stability analysis in time and frequency domain, design of compensators viz., lag and lead compensators, characteristics and significance of P, PI and PID controllers and State Space analysis.

c) Prerequisite

Signals and Systems

d) Related Courses

Linear Integrated Circuits, Analog Communication Systems

e) Course Outcomes

On successful completion of this course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Choose the concepts of control system components and derive the mathematical model of electrical and mechanical systems.	K3
CO2	Determine the Time response of I order and IIorder systems for various test signals and examine the system stability using time domain approach.	K3
CO3	Sketch the Frequency response of I order andII order systems and examine the system stability using frequency response plots.	K3
CO4	Develop controllers and compensators forControl System analysis using Frequencydomain approach.	K3
CO5	Apply the concept of State-Space for ControlSystem Analysis.	K3

f) Correlation of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	L	L	-	-	L	-	-	L	-	L	-	-
CO2	M	L	-	-	M	-	-	-	M	L	-	L	-	-
CO3	M	L	-	-	M	-	-	-	M	L	-	L	-	-
CO4	L	L	-	M	-	L	L	L	-	-	L	L	L	-
CO5	M	M	L	L	M	-	-	-	M	L	-	M	M	-

g) Course Content

UNIT I CONTROL SYSTEM COMPONENTS AND REPRESENTATIONS 9

Basic components of control system – open loop and closed loop systems: differential equation - transfer function, modeling of electric systems, translational and rotational mechanical systems - block diagram reduction techniques - signal flow graph

UNIT II TIME DOMAIN AND STABILITY ANALYSIS 9

Standard test signals – Transient and Steady state response of first order systems and second order systems –Stability; Concept and definition, characteristic equation, location of poles - Routh Hurwitz criterion: relative stability - Root locus Technique: construction and properties

UNIT III FREQUENCY DOMAIN AND STABILITY ANALYSIS 9

Frequency domain Specification - Gain Margin, Phase Margin; Bode plot, Polar plot – Stability analysis using frequency response methods; Correlation between time domain and frequency domain specification

UNIT IV COMPENSATORS AND CONTROLLERS 9

Realization of basic compensators- series, parallel and series - parallel compensation - Lead and Lag networks – Design of Lead and Lag compensator using Bode plot – Introduction to P, PI, PD and PID Controllers

UNIT V CONTROL SYSTEM ANALYSIS USING STATE SPACE 9

State variable representation – Canonical Realization - Conversion of state variable models to transfer functions - Conversion of transfer functions to state variable models - state transition Matrix - Concepts of Controllability and Observability.

Total : 45 Hrs

h) Learning Resources

Text Books

1. Norman S. Nise, Control System Engineering, 2019, 8th Edition, John Wiley & Sons
2. M.Gopal, ―Control System – Principles and Design‖, Tata McGrawHill, 4th Edition, 2012.

Reference Books

1. Modern Control Systems by Richard C. Dorf and Robert H. Bishop, 14th Edition, Pearson, 2021.
2. Ogata, K., "Modern Control Engineering", Prentice Hall of India Ltd., 5th Edition, New Delhi, 2022.
3. S. K. Bhattacharya, Control System Engineering, 3rd Edition, Pearson,2013.

Course Code	Course Title	L	T	P	C
10211EC106	SIGNALS AND SYSTEMS	2	1	0	3

a) Course Category

Program Core

b) Preamble

The signals existing in the real world are analog in nature and hence processing of this signal in continuous mode or discrete mode becomes essential in engineering applications. This course provides the knowledge on continuous and discrete time signals and systems and its analysis.

c) Prerequisite

Fourier series and Transform Techniques

d) Related Courses

Discrete Time Signal Processing

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Identify the types of continuous time and discrete time signals,systems and their properties	K2
CO2	Apply Fourier Transform, Laplace transform and its properties forthe analysis of continuous time signals.	K3
CO3	Use Fourier and Laplace transforms to examine the continuous timesystems and realize it.	K3
CO4	Construct the discrete time signals using DTFT, Z transform and theirproperties.	K3
CO5	Make use of DTFT and Z transform to examine the discrete timesystems with realization.	K3

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	H	L	L	M	-	-	-	L	L	-	L	L	M
CO2	H	H	L	L	M	-	-	-	L	L	-	L	L	M
CO3	H	H	L	L	M	-	-	-	L	L	-	L	L	M
CO4	H	H	L	L	M	-	-	-	L	L	-	L	L	M
CO5	H	H	L	L	M	-	-	-	L	L	-	L	L	M

g) Course Content

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Introduction to signals - Classification of signals – Continuous time, Discrete Time, Elementary signals - Basic operations on signals - Analysis and synthesis of signals using Singularity function - Continuous and Discrete Time Systems – Classification, LTI system – Properties.

UNIT II CONTINUOUS TIME SIGNALS 9

Fourier analysis of continuous time signals: Review of Fourier series- Continuous Time Fourier transform - Properties of continuous time FT - Laplace Transform - Properties of Laplace Transform.

UNIT III CONTINUOUS TIME SYSTEMS 9

Convolution Integral - Frequency response of continuous time LTI systems using Fourier Transform and Laplace Transform - Realization of CT systems: direct forms, cascade and parallel, Application of CT Systems.

UNIT IV DISCRETE TIME SIGNALS 9

Sampling of Continuous Time signals and aliasing, Fourier analysis of discrete time signals: Discrete time Fourier series, Discrete Time Fourier transform - Properties of DTFT, Z Transform, Properties of Z Transform

UNIT V DISCRETE TIME SYSTEMS 9

Convolution sum, Frequency response of discrete time LTI systems using Discrete Time Fourier Transform and Z Transform, Realization of DT systems: direct forms, cascade, parallel - Applications of DT systems

Total: 45 Hrs

h) Learning Resources

Text Books

1. Allan V. Oppenheim et al, “Signals, Systems and Inference”, Pearson Education Global edition – 2022 (UNIT I-V)

Reference Books

1. S Salivahanan, “Signals and Systems”, McGraw-Hill International, 2018.
2. S.Haykin and B. VanVeen “Signals and Systems” Second edition Paper back - I, Wiley, 2021.
3. M. Mandal and A. Asif, “Continuous and Discrete Time Signals and Systems, Cambridge, 2007.
4. Michael J. Roberts, “Fundamentals of Signals and Systems”, book by Michael J. Roberts, McGraw-Hill Higher Education, 2008.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_ee28/preview (Signals and Systems)
2. https://archive.nptel.ac.in/courses/108/104/108104100/ (Principles of Signals and Systems)

COURSE CODE	COURSE TITLE	L	T	P	C
10211EC107	ELECTROMAGNETICS AND TRANSMISSION LINES	2	1	0	3

a) Course Category

Program Core

b) Preamble

This course provides the students with different coordinate systems and familiarizing with the different concepts of electrostatic, magnetostatic and time varying electromagnetic systems. It also exposes the students to the ideas of electromagnetic waves and structure of transmission lines and lines at high radio frequencies.

c) Prerequisite courses

Nil

d) Related Courses

Antenna Theory, Optical and Microwave Communication Systems

e) Course Outcomes

On successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Apply the concept and derivation of Electrostatic theorems and laws	K3
CO2	Describe the basic Magnetostatic theorems and laws and infer the magnetic properties of matter	K2
CO3	Interpret electromagnetic waves and its propagation in different medium and wave polarization	K2
CO4	Interpret the concepts of guided structures used in power distribution and communication	K2
CO5	Apply the concepts of impedance matching techniques using Smith chart	K3

f. Correlation of COs with POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	L	L	-	-	-	-	L	L	-	M	-	-
CO2	H	H	L	L	-	-	-	-	L	L	-	L	-	-
CO3	H	M	M	L	-	-	-	L	L	L	-	M	L	-
CO4	H	H	M	L	L	L	L	L	L	L	-	M	L	-
CO5	H	M	M	M	L	L	M	L	L	L	-	M	L	-

g) Course Content

UNIT I ELECTROSTATIC FIELDS 9

Review of scalar and vector field: Dot and Cross products, Cartesian, Cylindrical, Spherical coordinates systems, physical interpretation of gradient, divergence and curl - Gauss's law - Stoke's Theorem - Electric field due to point-charges - Electrostatic potential - Laplace and Poisson's equation in one-dimension - Electric flux density - Boundary conditions

UNIT II STEADY MAGNETIC FIELDS 9

Lorentz Law of force, magnetic field intensity (H) - Biot-Savart's Law - Ampere's Law - Magnetic field intensity due to straight conductors, infinite sheet of current, at the centre of the toroid, along the axis of the circular loop and solenoid -Magnetic flux density (B) – Magnetic moment- Boundary conditions – Magnetic Scalar and vector potential - Magnetic force - Inductance

UNIT III MAXWELLS EQUATIONS AND PLANE WAVE 9

Continuity equation - Displacement current - Maxwell's equation - Boundary conditions – Plane wave equation in conducting and non-conducting media, Phase velocity, Group velocity, Depth of penetration, Conductors and dielectrics, Impedance of conducting medium, Brewster Angle, Poynting vectors and Poynting theorem.

UNIT IV TRANSMISSION LINE 9

Cascaded T sections: Line parameters - Transmission Line Equation – infinite line- Waveform distortion – distortionless line- Reflection Line – Input and Transfer Impedance - Open and Short Circuited Lines - Reflection Factor and Reflection Loss

UNIT V LINE AT HIGH FREQUENCIES 9

Dissipation less line: Voltage and Current - Input impedance - Open and short-circuited lines - Power and impedance measurements- Standing Waves– Impedance Matching in High Frequency Lines using Smith Chart.

Total: 45 Hrs

h) Learning Resources

Text Books

1. W.H Hayt. and J.A. Buck: "Engineering Electromagnetics", McGraw Hill Publications, 6th Ed, 2017
2. M.N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", 6th ed., Oxford (Asian Edition), 2015
3. J.D.Ryder "Networks, Lines and Fields", PHI, 2nd Ed, 1978
4. E C Jordan and K G Balmain, "Electromagnetic Waves and Radiating Systems", PHI, 2nd Ed,2015

Reference Books

1. J.F.D Kraus,Keith. R.Carver "Electromagnetics", 5th edition, McGraw Hill,2010
2. M.N.O.Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", 6th ed., Oxford (Asian Edition), 2015
3. N. Narayana Rao,"Elements of Engineering Electromagnetics", Pearson, 6th Ed, 2006

Online Resources

1. https://onlinecourses.nptel.ac.in/noc20_ee59/preview
2. http://simons.berkeley.edu/talks/peter-richtarik-2013-10-23
3. Introduction to Convex Optimization in Machine Learning

Course Code	Course Title	L	T	P	C
10211EC108	COMMUNICATION SYSTEMS	2	1	0	3

a) Course Category
Program Core

b) Preamble
This course provides an introduction about all types of analog, digital modulation and demodulation techniques with its applications. This course also provides the information about the baseband and passband transmission schemes, enabling the student to determine errors.

c) Prerequisite
Analog Electronics

d) Related Courses
Cellular Mobile Communication, Satellite Communication

e) Course Outcomes
On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Interpret the behavior of amplitude modulation and detection schemes and explain transmitter and receiver characteristics.	K2
CO2	Explain the various features of angle modulation and demodulation techniques and compare their performances	K2
CO3	Illustrate the influence of noise over communication systems through random process and noise theory	K2
CO4	Apply the concept of sampling and various wave form coding schemes.	K3
CO5	Identify the baseband transmission techniques and modulation schemes in pass band transmission.	K3

f) Correlation of COs, POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	H	L	H	L	-	-	L	L	-	-	-	-	-
CO2	M	H	L	H	L	-	-	L	L	-	-	-	-	-
CO3	M	L	L	L	-	M	-	L	L	-	L	M	M	-
CO4	H	H	H	H	H	-	-	L	L	L	L	H	H	-
CO5	H	L	L	L	M	-	-	L	L	L	L	-	L	-

g) Course Content

UNIT I AMPLITUDE MODULATION 9

Modulation - Need for Modulation - Frequency Spectrum and Bandwidth, Principles of Amplitude Modulation: AM Envelope - Modulation Index, AM Modulator and Demodulator: DSBSC- SSBSC- VSB, AM Transmitter, AM Receiver: Superheterodyne Receiver.

UNIT II ANGLE MODULATION 9

Angle Modulation - Phase and Frequency Modulation, Narrow Band FM and Wideband FM, FM Modulator: Generation of FM by Parameter Variation Method - Armstrong's Indirect Method, FM Demodulator: Frequency Discriminator - Foster Seeley Discriminator - Balanced Slope Detector- PLL Detector.

UNIT III RANDOM PROCESS AND NOISE THEORY 9

Random Variables, Random Process: Stationary Process-Ergodic Process-Gaussion Process, Transmission of Random Process Through Linear Systems, Noise: Shot Noise - Thermal and White Noise - Narrow Band Noise - Noise Equivalent Bandwidth - - Noise Figure, Capture and Threshold Effect, Noise in AM.

UNIT IV SAMPLING PROCESS AND WAVE FORM CODING 9

Basic elements of a digital communication system, Sampling Theorem - Sampling and signal recovery, PAM-PWM-PPM, Quantization Process: Quantization Noise and Error, Modulation: PCM-DM-ADM-DPCM

UNIT V BASE BAND AND PASS BAND TRANSMISSION 9

Matched filter –Intersymbol Interference- Correlative coding -Adaptive Equalization-Eye patterns, Digital modulation schemes: Generation-Detection-BW of ASK, FSK, PSK, QPSK, QAM.

Total : 45 Hrs

h) Learning Resources

Text Books

1. Simon Haykins, "Communication Systems", John Wiley, 4th Edition, 2000.
2. Herbert Taub, Donald L Schilling, and Goutam soha "Principles of Communication Systems", 4th Edition, Tata McGraw Hill, 2014.
3. John G. Proakis, "Digital Communication" McGraw Hill 3rd Edition, 1995.

Reference Books

1. Taub & Schilling, "Principles of Digital Communication",28th reprint, Tata McGraw-Hill, 2003
2. R. P Singh and S.D. Sapre "Communication Systems-Analog and Digital", 2nd Edition, Tata McGraw Hill, 2007.
3. John G. Proakis, Masoud Salehi "Fundamentals of Communication Systems" Pearson Education, 2006.
4. Bruce Carlson, "Communication Systems" 5th Edition, Tata Mc Graw Hill. 2010
5. Sam K. Shanmugam, "Analog& Digital Communication" John Wiley, 2006
6. Wayne Tomasi "Electronic Communication Systems", 5th Edition, Pearson education in south Asia print 2011.

Online Resources

1. http://www.sp4comm.org/docs/chapter12.pdf
2. http://www.talkingelectronics.com/Download%20eBooks/Principles%20of%20electronics/CH-16.pdf
3. https://www.youtube.com/watch?v=QEubAxBfqKU
4. https://youtu.be/kVQ7mr2TU2U
5. https://youtu.be/uf-X7zuFo5A
6. http://www.csun.edu/~skatz/katzpage/sdr_project/sdr/FM_and_PM.pdf

Course Code	Course Title	L	T	P	C
10211EC110	DATA COMMUNICATION NETWORKS	3	0	0	3

a) Course Category

Program Elective

b) Preamble

The purpose of this course is to provide the knowledge of fundamental concepts of networking, protocols, architectures and applications.

c) Prerequisite

Nil

d) Related Courses

Network Security, Network Management, High Performance Communication Networks

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Interpret the fundamental concepts of data communication networks and its architecture model.	K2
CO2	Summarize the various functions of data link layer and LAN architecture.	K2
CO3	Apply the knowledge of different types of switching androuting protocols	K2
CO4	Outline the concepts of end to end process and application protocols	K2
CO5	Infer the Queuing model and advance switchingconcepts.	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	M	-	-	L	-	-	L	L	L	-	L	-	-
CO2	H	M	-	-	L	-	-	-	L	L	-	L	-	-
CO3	H	M	L	L	L	-	-	-	L	L	-	L	-	-
CO4	H	M	-	-	L	-	-	L	L	L	-	L	-	-
CO5	H	M	L	-	-	-	-	-	L	L	-	L	-	-

g) Course Content

UNIT I INTRODUCTION TO DATA COMMUNICATION AND NETWORKING DEVICE 9

Evolution of data Networks-Network fundamentals: Data rate, Channel capacity, modes of communication-Network Topologies- Categories of Networks- ISO/OSI Reference Model -TCP/IP Model-Networking and Inter Networking Devices: Repeaters, Hubs, Bridges, Switches, Routers, Gateways.

UNIT II DATA LINK LAYER & LOCAL AREA NETWORK 9

Logical Link Control –Types of error: single bit error- Burst error-Error Detection Techniques: CRC - checksum-Error Correction Technique: Hamming code –Flow control protocol: ARQ protocols-Medium Access Control: Random Access Protocols.

UNIT III SWITCHING & ROUTING TECHNOLOGIES 9

Circuit switching-packet switching-message switching-Internetworking- IP Addressing: IPv4 - Subnetting: classful-CIDR-IPv6-Routing: Distance Vector - Link State Routing Protocols.

UNIT IV END-END PROTOCOLS 9

Process-process delivery: Basics of Port addressing and Sockets- TCP, UDP and SCTP-TCP congestion control- Application protocols: WWW, HTTP, SMTP, FTP.

UNIT V QUEUING MODELS & ADVANCED SWITCHING 9

Markov chain theory - Queuing model basics and L - M/M/1 and its variants - M/G/1, G/M/1-applications of queuing model, -Introduction to Software Defined Networking.

Total: 45 Hrs

h) Learning Resources

Text books

1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", 5thEdition, Pearson Publications, 2012.
2. Behrouz A. Forouzan, "Data Communication and Networking", 2nd Edition, McGraw-Hill, 2003.

Reference books

1. William Stallings, "Data and Computer Communication", Prentice Hall of India. Eighth edition.
2. Andrew S. Tanenbaum, "Computer Networks", Prentice Hall.

Course Code	Course Title	L	T	P	C
10211EC111	DISCRETE TIME SIGNAL PROCESSING	2	1	0	3

a) Course Category

Program Core

b) Preamble

Discrete Time Signal Processing provides an introduction to the basic concepts of signal processing to acquire knowledge on systems using various transformation techniques. It also invokes students to realize the different filter structures and to develop algorithms for signal processing.

c) Prerequisite

Signals and Systems

d) Related Courses

Advanced Digital Signal Processing, Digital Image and Video Processing

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Demonstrate the use of DFT and its properties for linear filtering applications.	K3
CO2	Use suitable transformation technique to design Digital IIR filters.	K3
CO3	Apply windowing and sampling techniques to design FIR filter.	K3
CO4	Illustrate the finite word length effects in filters.	K3
CO5	Explain Multirate Signal Processing and the architecture, addressing modes of TMS320C67XX processor	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	H	H	M	L	M	-	-	-	L	L	-	L	L	L
CO2	H	H	M	M	M	-	-	-	L	L	-	L	M	M
CO3	H	H	M	M	M	-	-	-	L	L	-	L	M	M
CO4	H	H	M	M	L	-	-	-	L	L	-	L	L	L
CO5	M	M	M	M	L	-	-	-	L	L	-	L	L	L

g) Course Content

UNIT I DISCRETE FOURIER TRANSFORMS 9

DFT and its properties - Circular Convolution Methods – Linear filtering: Overlap add and overlap save methods - FFT algorithms: Radix-2 FFT algorithms, Decimation in Time, Decimation in Frequency algorithms.

UNIT II IIR FILTER DESIGN 9

Analog filter design: Butterworth and Chebyshev filter – Discrete time IIR filter from analog filter: IIR filter design by using Approximation of derivatives, Impulse Invariance, Bilinear transformation – Filter design (LPF, HPF) using frequency translation.

UNIT III FIR FILTER DESIGN 9

Linear phase FIR filter - Filter design using windowing techniques (Rectangular Window, Hamming Window and Hanning Window) – Frequency sampling techniques – Structures of FIR: Direct form, Cascade, Linear Phase structures.

UNIT IV FINITE WORDLENGTH EFFECTS 9

Fixed point and Floating point arithmetic - Quantization- Truncation and Rounding errors - Quantization noise- Coefficient quantization error – Product quantization error – Overflow error – Limit cycle oscillations– Scaling.

UNIT V MULTIRATE SIGNAL PROCESSING, DSP PROCESSORS AND APPLICATIONS 9

Decimation–Interpolation–Sampling rate conversion by a rational factor - DSP processor: Harvard architecture, Pipelining, MAC unit, TMS320C67XX processor Architecture, Addressing modes - Application – Sub band coding – Musical Sound processing.

Total: 45 Hrs

h) Learning Resources

Text Books

1. John G. Proakis & Dimitris G. Manolakis, "Digital Signal Processing– Principles, Algorithms & Applications", 5th edition, Pearson Education/Prentice Hall, 2021.

Reference Books

1. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, "Digital Signal Processing", Tata Mc GrawHill Publication, 4th edition 2019.
2. Emmanuel C. Ifeachor, & Barrie. W. Jervis, "Digital Signal Processing-A Practical Approach", 2nd edition, Pearson Education/ Prentice Hall, 2002.
3. Sanjit K. Mitra, "Digital Signal Processing–A Computer Based Approach", Tata McGraw Hill, 2011.
4. A.V.Oppenheim, R.W.Schaferand J.R.Buck, "Discrete-Time Signal Processing", 3rd edition, Pearson, 2021.

Online Resources

1. TMS320C67x/C67x+ DSP CPU and Instruction Set Reference Guide (Rev. A)
2. Study Materials | Digital Signal Processing | Supplemental Resources | MIT OpenCourseWare Digital Signal Processing | Supplemental Resources
3. https://www.youtube.com/watch?v=_HATc2zAhcY Introduction to convolution operation
4. https://www.youtube.com/watch?v=r18Gi8lSkfM Fourier Transform, Fourier Series and Frequency Spectrum
5. https://www.tutorialspoint.com/digital_signal_processing/dsp_discrete_fourier_transform_introduction.htm

Course Code	Course Title	L	T	P	C
10211EC112	WIRELESS COMMUNICATION	2	1	0	3

a) Course Category

Program Core

b) Preamble

This course addresses the fundamental concepts of wireless communication and provides an overview of modulation and multipath mitigation techniques. It covers multiple access techniques, multi user systems and various wireless communication standards.

c) Prerequisite

Communication Systems

d) Related Courses

MIMO Wireless Communication, Cellular Mobile Communication

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Interpret a wireless channel and evolve design a cellular system based on resource availability	K2
CO2	Identify suitable modulation schemes for the wireless channel and systems.	K3
CO3	Discuss different types of equalization and diversity techniques to improve the quality of wireless communication	K2
CO4	Compare multiple access techniques in wireless communication	K2
CO5	Demonstrate the various types of wireless networks and standards	K2

f) Correlation of COs, POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	M	M	M	L	-	-	-	-	-	L	-	M	-	-
CO2	H	M	M	M	L	-	-	-	-	L	L	L	M	-
CO3	L	L	L	M	L	-	-	-	-	L	L	M	M	-
CO4	M	L	L	M	L	-	-	-	-	L	L	M	M	-
CO5	L	L	M	L	H	-	M	-	-	M	L	H	-	M

g) Course Content

UNIT I CELLULAR CONCEPTS AND MOBILE RADIO PROPAGATION 9

Overview of wireless communication– Cellular concept: Frequency reuse, Hand off, System capacity – Radio Propagation: Large scale path loss, Reflection, Diffraction, Scattering- Small scale fading – Multipath channel parameters : Doppler shift, Doppler spread – Types of fading: Flat fading, Frequency selective fading, Fast fading and Slow fading.

UNIT II MODULATION TECHNIQUES 9

Overview of digital modulation – Linear modulation: Principles of Offset QPSK– Constant envelope modulation: Minimum Shift Keying, Gaussian Minimum Shift Keying, – Spread spectrum modulation techniques: DS-SS, FH-SS

UNIT III MULTIPATH MITIGATION TECHNIQUES 9

Equalization : Adaptive equalization , Linear and Non-Linear equalization – Zero Forcing, and Minimum Mean Square Error Algorithms – Micro and Macro diversity – Diversity combining techniques –Transmit diversity – Rake receiver.

UNIT IV MULTI USER SYSTEMS 9

Multiuser channels : Uplink and downlink – Multiple Access : FDMA, TDMA, CDMA, SDMA, Hybrid techniques –Power control – Uplink/downlink channel capacity – MIMO multiuser systems.

UNIT V WIRELESS COMMUNICATION STANDARDS 9

Evolution – 3G Overview: WCDMA/UMTS, 3GPP Network structure – 4G features and challenges – IMS , LTE system over view and physical channels, WiMax/IEEE802.16– Advanced broad band wireless access : UWB, AWS – 5G wireless system : Architecture and 5G deployment.

Total : 45 Hrs

h) Learning Resources

Text Books

1. Rappaport. T.S., “Wireless communications”, Pearson Education, 2nd Edition, 2010.
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2007.
3. Andreas F.Molisch, “Wireless Communications”, John Wiley , 2006.
4. Ajay R. Mishra, “Cellular technologies for emerging markets:2G, 3G and beyond” John Wiley, 2010
5. Simon Haykin & Michael Moher, “Modern Wireless Communications”, Pearson Education, 2007.

Reference Books

1. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers, 2007.
2. Kaveth Pahlavan,. K. Prashanth Krishnamurthy, "Principles of Wireless Networks", Prentice Hall of India, 2006.
3. Clint Smith. P.E., and Daniel Collins, “3G Wireless Networks”, 2nd Edition, Tata McGraw Hill, 2007.
4. William Stallings, "Wireless Communications and networks" Pearson / Prentice Hall of India, 2nd Ed., 2007

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_ee66/preview
2. http://www.sp4comm.org/docs/chapter12.pdf
3. https://onlinecourses.nptel.ac.in/noc23_ee75/preview
4. https://nptel.ac.in/courses/117104099
5. https://nptel.ac.in/courses/108105134

Course Code	Course Title	L	T	P	C
10211EC113	ANTENNA THEORY	2	1	0	3

a) Course Category

Program Core

b) Preamble

This course provides the basic concepts of waveguides and antenna fundamentals. It also discusses about the antenna arrays, special antennas and radio propagation in guided systems.

c) Prerequisite

Electromagnetics and Transmission lines

d) Related Courses

Optical & Microwave Communication Systems, RF and Microwave Integrated Circuits

e) Course Outcomes

On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Apply the propagation characteristics of guided waves between parallel planes, rectangular waveguide and circular waveguide.	K3
CO2	Explain the basic antenna parameters and various techniques involved in parameter measurements.	K2
CO3	Explain the design and operation of various types of antenna arrays.	K2
CO4	Apply the antenna characteristics to design various types of linear and planar antennas.	K3
CO5	Explain the knowledge of the structure of atmosphere, types of communication and propagation methods.	K2

f) Correlation of COs with POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	M	L	L	L	-	-	-	M	L	-	L	L	-
CO2	H	M	L	L	L	-	-	-	M	L	-	L	L	-
CO3	H	M	L	L	-	-	-	-	M	L	-	M	L	-
CO4	H	M	M	L	L	L	L	-	M	L	-	L	-	-
CO5	H	M	M	L	L	L	L	L	M	L	-	L	-	-

g) Course Content

UNIT I WAVE GUIDES 9

General Wave behaviours along uniform Guiding structures - Transverse Electromagnetic waves - Transverse Magnetic waves - Transverse Electric waves - TM and TE waves between parallel planes - TM and TE waves in rectangular wave guides - TM and TE waves in Circular wave guides

UNIT II ANTENNA FUNDAMENTALS 9

Basic antenna parameters: gain, directivity, beam solid angle, beam width and effective aperture calculations - Effective height - wave polarization - antenna temperature - radiation resistance - radiation efficiency - antenna field zones - principles of reciprocity - Duality of antennas - Concept of retarded potential - Field, directivity and radiation resistance of an infinitesimal dipole - half wave dipole - Measurement of radiation pattern – gain

UNIT III ANTENNA ARRAYS 9

Two element Array - N-Element Linear Array: Uniform Amplitude and Spacing, Non-Uniform Amplitude and Spacing, Directivity- Principle of pattern multiplication - Grating lobes - Planar Array: Broadside, End fire & Binomial arrays, Dolph Chebyshev arrays

UNIT IV SPECIAL ANTENNAS 9

Principles of Horn - Parabolic dish antenna - Casse grain antenna - Travelling wave antenna - Principle and applications of V and rhombic antenna - Principle of Log periodic antenna array and Helical antenna - Rectangular Patch antenna - Antennas for mobile base station and handset - Phased Array antenna

UNIT V RADIO WAVE PROPAGATION 9

Radio wave propagation – Modes- structure of atmosphere- sky wave propagation- effect of earth‘s magnetic field- Ionospheric abnormalities and absorption- space wave propagation-LOS Distance - Field strength of space wave - duct propagation - VHF and UHF Mobile radio propagation - tropospheric scatter propagation

Total : 45 Hrs

h) Learning Resources

Text Books

1. E.C. Jordan and K.G.Balmain "Electro Magnetic Waves and Radiating System, Pearson Education, 2nd Edition, 2015.
2. Warren L Stutzman and Gary A Thiele, "Antenna Theory and Design", John Wiley and Sons, 2nd Edition, 2009.

Reference Books

1. A. Balanis, "Antenna Theory: Analysis and Design", Wiley Publications. 3rd Edition, 2016.
2. John D Kraus, "Antennas for all Applications", 3rd Edition, McGraw Hill, 2005.
3. Collin R.E, "Antennas & Radio Wave Propagation", McGraw Hill. 1985.
4. Terman, "Electronics & Radio Engineering", 4/e, McGraw Hill.
5. Thomas A. Milligan, "Modern Antenna Design", Wiley, 2nd, Edition, 2005.
6. Constantine A.Balanis, P .Loannides, "Introduction to Smart Antennas",1organ & Claypool Publisher's series, 1st Edition, 2007.

Online Resources

1. http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Transmissiones % 20and%20E M%20Waves/TOC.html.
2. http://nptel.ac.in/courses/117101056.
3. www.antenna-theory.com.
4. http://www.dxzone.com/catalog/Antennas
5. http://www.engr.sjsu.edu/rkwok/EE172/Antenna_Fundamental.pdf.

Course Code	Course Title	L	T	P	C
10211EC115	OPTICAL AND MICROWAVE COMMUNICATION SYSTEMS	2	1	0	3

a) Course Category
Program Core

b) Preamble
This course deals with the fundamentals of optical fibers, sources, and detectors. Students will get familiarize with Microwave components and its Scattering parameters, Solid state devices, tubes and measurements.

c) Prerequisite
Antenna Theory

d) Related Courses
RF & Microwave Integrated circuits, Satellite Communication, Radar and Electronic Navigational system.

e) Course Outcomes
On successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Discuss the fundamentals of optical fibers and its different types of losses, dispersion	K2
CO2	Explain the concepts of optical light sources anddetectors for optical fiber communication	K2
CO3	Apply the properties of S parameters to study the characteristics of microwave components.	K3
CO4	Compare the working principle of different solid state-based devices.	K2
CO5	Demonstrate the working principle of Microwave tubes and Measurement techniques.	K2

f) Correlation of COs, POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	M	M	-	-	-	L	-	-	L	L	L	L	-
CO2	H	M	M	-	-	-	-	-	-	-	M	L	L	-
CO3	H	M	M	L	M	L	L	-	L	L	-	L	M	-
CO4	H	M	M	-	-	-	-	-	-	-	-	L	L	-
CO5	H	M	M	L	M	L	-	-	L	L	M	L	L	-

g) Course Content

UNIT I OPTICAL FIBER FUNDAMENTALS 9

Evolution of Optic Communications - Basic Optical Laws – Light Propagation in fiber - Fiber Types - Splicing Techniques and Connectors – Attenuation, Absorption, Scattering Losses, Bending Losses, Core and Cladding Losses – Dispersion: Group Delay, Material Dispersion, Waveguide Dispersion, Intermodal Dispersion.

UNIT II OPTICAL SOURCES, DETECTORS AND SYSTEMS 9

Intrinsic and extrinsic material-direct and indirect band gaps-LED structures-Surface emitting LED-Edge emitting LED-quantum efficiency and LED power - light source materials-modulation of LED- LASER diodes. Detectors: PIN photo detector, Avalanche photo diodes, Photo detector noise-noise sources.

UNIT III MICROWAVE COMPONENTS AND TWO PORT NETWORKS 9

Microwave frequencies - advantages and applications, scattering matrix formulation: Concept of N port scattering matrix representation - S parameters properties, Passive microwave devices: bends – corners – attenuators , S Matrix Calculations for 2 port Junction: E plane and H plane Tees - Magic Tee, Directional Coupler - Circulator and Isolator.

UNIT IV MICROWAVE SOLID STATE DEVICES 9

Transit time limitations in Microwave Bipolar Transistors, Power frequency limitations, Gunn effect: RWH theory - High-field domain and modes of operation -Avalanche transit time devices: IMPATT and TRAPATT diodes, parametric amplifiers

UNIT V MICROWAVE TUBES AND MEASUREMENTS 9

Microwave vacuum tube-based devices, Limitations of conventional tubes at microwave frequencies, Two cavity Klystron - velocity modulation – Reflex klystron - Traveling wave tube, Magnetron. Measurement of Power, Wavelength, Impedance,Attenuation, SWR.

Total: 45 Hrs

h) Learning Resources

Text Books

1. Gerd Keiser, "Optical Fiber Communication" McGraw -Hill International, 4th Edition. 2010.
2. John M. Senior, “Optical Fiber Communication”, Second Edition, Pearson Education, 2007
3. Annapurna Das and Sisir K Das, “Microwave Engineering”, Third edition Tata McGraw Hill Inc., 2009.
4. David M. Pozar, "Microwave Engineering", Third Edition, Wiley India.2012.

Reference Books

1. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.
2. Mathew M Radmanesh, “RF and Microwave Electronics”, Prentice Hall, 2000.
3. Samuel Y Liao, “Microwave Devices & Circuits” Third Edition Prentice Hall of India, 2006.
4. Thomas H Lee, “Planar Microwave Engineering: A Practical Guide to Theory, Measurements and Circuits”, Cambridge University Press, 2004.

Online Resources

1. https://en.wikipedia.org/wiki/Microwave_engineering
2. http://www.microwaveeng.com
3. Microwave and RF Information for Engineers | Microwave Calculators, Encyclopedia, Discussion Forum (microwaves101.com)
4. Optical Communications - Course (nptel.ac.in)
5. Microwave Engineering - Course (nptel.ac.in)

Course Code	Course Title	L	T	P	C
40211EC131	SPEECH SIGNAL PROCESSING AND CODING	3	0	0	3

a) Course Category

PhD coursework

b) Preamble:

The course provides the basics of digital speech processing, time domain model for speech signals, principles and applications of linear predictive coding analysis. The course also provides the knowledge of homomorphic speech processing, speech enhancement, speech coding and recognition techniques.

c) Prerequisite

Nil

d) Related Course:

Nil

e) Outcome:

On successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Explain the fundamental of digital speech processing and digital models for speech signals	K2
CO2	Choose the time domain models for speech signals	K3
CO3	Illustrate the principle and applications of Linear Predictive Coding analysis	K3
CO4	Use the concepts of homomorphic Speech Processing and speech enhancement	K3
CO5	Describe the speech coding and recognition techniques, speech verification and identification system	K2

f) Course Content

UNIT I FUNDAMENTALS OF SPEECH SIGNAL 9

Introduction: speech production and perception, information sources in speech, linguistic aspect of speech, acoustic and articulatory phonetics, nature of speech, models for speech analysis and perception. The Acoustic Theory of Speech Production- Uniform lossless tube model, effect of losses in vocal tract, effect of radiation at lips, digital models for speech signals.

UNIT II TRANSFORMS FOR SPEECH SIGNAL 9

Short - term processing: need, approach, time, frequency and time - frequency analysis; short - term Fourier transform (STFT): overview of Fourier representation, non - stationary signals, development of STFT, transform and filter - bank views of STFT, Window considerations, short time energy and average magnitude short time average zero crossing rate.

UNIT III SPEECH SIGNAL ANALYSIS 9

Linear Prediction (LP) analysis: Basis and development, Levinson - Durbin's method, normalized error, LP spectrum, LP cepstrum, LP residual, The Autocorrelation Method, The Covariance Method, Solution of LPC Equations: Cholesky Decomposition Solution for Covariance Method, Applications of LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

UNIT IV SPEECH ENHANCEMENT 9

Cesptrum analysis: Basis and development, delta, delta - delta and mel - cepstrum, homomorphic signal processing - real and complex cepstrum; phase unwrapping, sinusoidal analysis and synthesis of speech - Homomorphic Systems for Convolution, Pitch Detection, Formant Estimation, The Homomorphic Vocoder.

Speech Enhancement: Nature of interfering sounds, Speech enhancement techniques: Single Microphone Approach: spectral subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter, Multi microphone Approach

UNIT V SPEECH CODING AND RECOGNITION 9

Speech coding: Need and parameters, classification, waveform coders, speech - specific coders, GSM, CDMA and other mobile coders; Applications: Some applications like pitch extraction, spectral analysis and coding standard
Speaker Recognition: Recognition techniques, Features that distinguish speakers, Speaker Recognition Systems: Speaker Verification System, Speaker Identification System
.

Total: 45 Hrs

g) Learning resources

Text Books

1. Branko Kovacevic, Milan M. Milosavljevic, Mladen Veinovic, Milan Markovic, Robust, "Digital Processing of Speech Signals", Springer, 2017.
2. L.R. Rabiner and R.W. Schafer, "Digital Processing of Speech Signals" Pearson Education, New Delhi, India, 2004.

Reference Books

1. Human and Machine, D. O'Shaughnessy, "Speech Communications", Second Edition, University Press, 2005.
2. T. F. Quatieri, "Discrete time processing of speech signals", Pearson Education, 2005.
3. L. R. Rabiner, B. H. Jhuang and B. Yegnanarayana, "Fundamentals of speech recognition", Pearson Education, 2009.

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

SCHOOL OF ELECTRICAL & COMMUNICATION

MINUTES OF MEETING

32nd BOARD OF STUDIES

For

B.TECH./M.TECH. DEGREE PROGRAMME

ELECTRICAL AND ELECTRONICS ENGINEERING

DATE: 29/06/2024

TIME: 10:30 AM

VENUE: SIMULATION LAB, Room No.2213

MODE: HYBRID

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

32nd Board of Studies Meeting

Department: Electrical and Electronics Engineering
School: School of Electrical and Communication
Date of Meeting: 29-06-2024

S.No	Name of the Member	Responsibility	Signature
1	**Dr. S. Ramesh** Professor and Head Department of Electrical and Electronics Engineering Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology Chennai	Chairman, Board of Studies	29/6/24
	External Experts		
2	**Dr. S. Senthil Kumar** Professor Department of Electrical Engineering National Institute of Technology Trichy	Academic Expert	Online
3	**Mr. Kiran Krishna Dhandale** Technical Lead GE Renewables Chennai	Industry Expert	29/6/24
	Internal Experts		
4	**Dr. P. K. Dhal** Professor Dept of Electrical and Electronics Engineering Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology, Chennai	Member	29/6/24
5	**Dr. P. Chandrasekar** Professor Dept of Electrical and Electronics Engineering Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology Chennai	Member	29/6/24
6	**Dr. K. Karunanithi** Professor Dept of Electrical and Electronics Engineering Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology Chennai	Member	

7	**Dr. S. Sivakumar** Associate Professor Dept of Electrical and Electronics Engineering Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology Chennai	Member	29/6/24
8	**Dr. K. Vinoth** Associate Professor Dept of Electrical and Electronics Engineering Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology Chennai	Member	29/6/24
9	**Dr. K. Karthikumar** Associate Professor Dept of Electrical and Electronics Engineering Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology Chennai	Member	K. Karthikumar 29.6.2024
10	**Mrs. Priscilla Whitin** Assistant Professor Dept of Electrical and Electronics Engineering Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology Chennai	Member	Absent
11	**Dr. S. Vinoth John Prakash** Assistant Professor Dept of Electrical and Electronics Engineering Vel Tech RangarajanDr.Sagunthala R&D Institute of Science and Technology Chennai	Member	29/6/2024
12	**Mr. R. Sreedhar** Assistant Professor Dept of Electrical and Electronics Engineering Vel Tech RangarajanDr.Sagunthala R&D Institute of Science and Technology Chennai	Member	29/06/2024.
	Special Invitee		
13	**Mr. Shaik Abubakar Siddique,** **VTU 21057,** B.Tech. Batch 2020-2024, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology Chennai	Student Member	29/6/24

Dr. Ramesh
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Dr. Valarmathi. R.S
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SCHOOL OF ELECTRICAL & COMMUNICATION

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

32nd BOARD OF STUDIES MEETING

Date: 29-06-2024 Time: 10:30 A.M. Venue: Simulation Lab, Room No.2213

AGENDA

Items for confirmation

32.01 To confirm and approve the 31st Board of Studies meeting Minutes of Electrical and Electronics Engineering department held on 30th December 2023.

32.02 To record the leave of absence of members.

Items for discussion

32.03 Integrated program core and program elective syllabi for B.Tech. – EEE VTR UGE 2021 regulations.

32.04 'Applied Mathematics for Power Electronics' syllabus for M.Tech. – Power Electronics under VTU PGE 2023 regulations.

32.05 Industry/Higher Institute Learning (IHL) interaction course syllabus

32.06 Summer semester course list for the academic year (AY) 2024-25.

32.07 Value-added courses for the AY 2024-25.

32.08 Self-learning courses (NPTEL/SWAYAM) for AY 2024-25.

Items for ratification

32.09 Industry/Higher Learning Institute Interaction courses and Self-learning courses (Coursera) offered in Winter Semester AY 2023-24.

Items for reporting

32.10 Result analysis of summer semester AY 2023-24.

32.11 Interim feedback analysis of winter semester AY 2023-24.

32.12 Faculty and student's accomplishments for CY 2024.

32.13 Any other items: Course Code for B.Tech. EEE with Honors in Smart Grid Technologies.

The Chairman-Board of Studies welcomed all the members for the BoS meeting and thanks them for sparing their valuable time. The Chair introduced the External BoS members.

Items for Confirmation

AGENDA 32.01	**To confirm and approve the 31st Board of Studies meeting Minutes of Electrical and Electronics Engineering department held on 30th December 2023.**
DISCUSSION	The 31st Board of Studies meeting minutes is presented to the members and it is confirmed for approval.
AGENDA 32.02	**To record the leave of absence of members.**
DISCUSSION	The internal BoS member, Mrs. Priscilla Whitin, and the Alumni representative, Mr. Raja, have expressed their inability to attend the BoS meeting due to their personal commitments.

Items for Discussion and Approval

AGENDA 32.03	**Integrated program core and program elective syllabi for B.Tech. – EEE VTR UGE 2021 regulations.**
DISCUSSION	The feedback provided by various stakeholders has been discussed in the department advisory committee and the observations of feedback also presented to the members. Based on this feedback, the following program core courses and program elective courses are proposed as integrated courses. The detailed discussions on the syllabi are as follows: *(i) Discussion on "**10211EE202 - ELECTRICAL MACHINE DESIGN**":* Expert members have suggested to remove specific software name such as "ANSYS" in the experiments list and recommended to use relevant open-source software tools instead. They have also proposed to replace "output characteristics" with "electrical and mechanical characteristics" in the first experiment. Internal members have also agreed to the suggestions given by the expert members. *(ii) Discussion on **"10211EE203 - SWITCHGEAR AND PROTECTION"**:* Expert members have suggested to remove specific software name such as 'DIgSILENT' in the experiments list and recommended to use relevant open-source software tools instead. They have also recommended to include '*relay coordination study*' in Unit IV and advised to revise the course title as ***"Switchgear and Protection"***.

	*(iii) Discussion on **"10212EE204 - OBJECT ORIENTED PROGRAMMING USING JAVA"**:* The members appreciated and recommended the syllabus contents. *(iv) Discussion on **"10212EE129 – SMART GRID":*** The expert members have suggested to incorporate *'various distributed energy resources, utilities: EV and storage and smart substation automation'* in Unit III and *'cyber security'* in Unit IV contents. The internal members have accepted the experts' suggestions to revise the course contents accordingly.
ACTION	The syllabi for the proposed integrated courses to be offered under program core and program elective courses are revised as per the suggestions given by the experts and it is attached as **Annexure – I.**
AGENDA 32.04	**'Applied Mathematics for Power Electronics' syllabus for M.Tech. – Power Electronics under VTU PGE 2023 regulations.**
DISCUSSION	*Discussion on course **"20231EE110 - Applied Mathematics for Power Electronics"*** **The expert members** suggested to revise the syllabus contents by including Fourier Transform and Optimization techniques. The internal members also requested to include Fourier Transform in the proposed syllabus contents. The members have also requested to move one of the existing program core course, 20231EE103 – Modern Control Theory under Program Elective category with the course code 20232EE132.
ACTION	The syllabus for the course *"20231EE110 - Applied Mathematics for Power Electronics"* is revised as per the suggestions given by the members and is attached as **Annexure – II**.
AGENDA 32.05	**Industry/Higher Institute Learning (IHL) interaction course syllabus**
DISCUSSION	*Discussion on **"10212EE167 - POWER SYSTEM AUTOMATION"*** **The expert members** appreciated the syllabus contents of course given by Prof. N. Murugesan, CEO, Ohm Energy Services, Bengaluru. The members have recommended that the course can be offered as Program Elective course with 3 Credits.
ACTION	The proposed IHL syllabus is recommended as Program Elective and is attached in **Annexure - III**.
AGENDA 32.06	**Summer semester course list for the academic year (AY) 2024-25.**
DISCUSSION	The list of courses offered in summer semester of AY 2024-25 are presented for discussion. The expert members recommended the list of courses.

ACTION	The recommended list of courses is attached as **Annexure - IV**.
AGENDA 32.07	**Value-added courses (VAC) for the AY 2024-25.**
DISCUSSION	The list of VAC to be offered for B.Tech. – EEE programme are presented. The expert members have suggested to include modelling based VAC also.
ACTION	The expert members have approved the list of courses and the recommended VAC is attached in **Annexure - V**.
AGENDA 32.08	**Self-learning courses (NPTEL/SWAYAM) for AY 2024-25.**
DISCUSSION	The list of self-learning courses to be offered from NPTEL/SWAYAM for B.Tech. – EEE and M.Tech. - Power Electronics programmes are presented for recommendation.
ACTION	The expert members have approved the list of self-learning courses to be offered from NPTEL/SWAYAM and the list of recommended self-learning courses is attached in **Annexure - VI.**

Items for Ratification

AGENDA 32.09	**Industry/Higher Learning Institute Interaction course and Self-learning courses offered in Winter Semester AY 2023-24.**
DISCUSSION	The Industry/Higher Learning Institute Interaction course and Self-learning courses (Coursera) offered during the Winter Semester AY 2023-24 is presented and are ratified by the members.
ACTION	The expert members have ratified IHL and self-learning courses. The details are attached in **Annexure - VII.**

Items for Reporting

AGENDA 32.10	**Result analysis of summer semester AY 2023-24.**
DISCUSSION	The result analysis of summer semester AY 2023-24 is presented and discussed.
ACTION	The experts appreciated the academic performance of students. The details are attached in **Annexure - VIII**.
AGENDA 32.11	**Interim feedback analysis of winter semester AY 2023-24.**
DISCUSSION	The interim feedback analysis of winter semester AY 2023-24 for the B.Tech. courses are presented and discussed.
ACTION	The experts appreciated the faculty members for their Teaching-Learning interim feedback. The details are enclosed in **Annexure - IX**.
AGENDA 32.12	**Faculty and student's accomplishments for CY 2024.**
DISCUSSION	The accomplishments and recognitions of the Faculty and Students during CY 2024 are presented.

ACTION	The expert members appreciated the involvements of the Students and Faculty in academic and research activities. The details of Faculty and Students accomplishments and recognitions are given in **Annexure - X.**
AGENDA 32.13	**Any other items: Course Code for B.Tech. EEE with Honors in Smart Grid Technologies.**
DISCUSSION	The revised course codes for the list of courses to be offered for **"B.Tech. EEE with Honors in Smart Grid Technologies"** are presented.
ACTION	The expert members have given their recommendation for the revision. The revised course codes are given in **Annexure – XI**.

25/7/2024

CHAIRMAN – BoS

Dr. S. Ramesh
Head of the Department
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Vel Tech
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Prof. S. Salivahanan
Vice Chancellor
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….Meeting Snaps….

Annexures

Annexure I

Integrated Program Core and Program Elective syllabi for B.Tech. – EEE (VTR UGE 2021 regulations)

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SCHOOL OF ELECTRICAL & COMMUNICATION

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

Syllabi for B.Tech. – EEE (VTR UGE 2021 regulations) - Program Core and Program Elective

Course Details

Sl.No	Course Code	Course Name	Course Category	L	T	P	C
1	10211EE202	Electrical Machine Design	Program Core (Integrated)	**2**	**1**	**2**	**4**
2	10211EE203	Switchgear and Protection	Program Core (Integrated)	**2**	**0**	**2**	**3**
3	10212EE204	Object Oriented Programming using Java	Program Elective (Integrated)	**2**	**0**	**2**	**3**
4	10212EE129	Smart Grid	Program Elective	**3**	**0**	**0**	**3**

COURSE CODE:10211EE202	COURSE TITLE: ELECTRICAL MACHINE DESIGN	L	T	P	C
		2	1	2	4

COURSE CATEGORY: Program Core (Integrated)

PREAMBLE: This course provides an introduction to the design of various DC and AC Machines and gives a general idea to the computer aided design of electrical machines.

PREREQUISITE COURSES: DC Machines and Transformers, AC Machines

RELATED COURSES: DC Machines and Transformers, AC Machines

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Expose the students towards the design of various types of electrical machines
- Understand the basic design concept of armature and field winding of DC machine
- Understand of basic design and cooling system of electrical transformer
- Understand the design concept of induction machine
- Understand the design concept of synchronous machine

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Exhibit the study of MMF calculation of various types of electrical machines.	K2
CO2	Explain the design of armature and field systems for D.C machines.	K2
CO3	Demonstrate the design and cooling system of transformers.	K2
CO4	Construct the design of stator and rotor of induction machines.	K3
CO5	Choose appropriate design parameters of stator and rotor of synchronous machines.	K3

CORRELATION OF COs WITH POs AND PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	M	L	L						L		M	M
CO2	H	H	H	M	L						L		H	M
CO3	H	H	H	M	L						L		H	M
CO4	H	H	H	M	L						L		H	M
CO5	H	H	H	M	L						L		H	M

COURSE CONTENTS:

UNIT I	MMF CALCULATIONS FOR ROTATING ELECTRICAL MACHINES	9

Major considerations in electrical machine design – Design of magnetic circuits – MMF for air gap-MMF for teeth - Real and apparent flux densities–leakage flux

UNIT II	DESIGN OF D.C MACHINES	9
Output equation - Choice of poles - Design of field system - Design of armature - Design of commutator and brush		
UNIT III	**DESIGN OF TRANSFORMERS**	**9**
Output equation of single phase and three phase Transformer, Design of core, design of winding - Design of tank and cooling tubes		
UNIT IV	**DESIGN OF INDUCTION MACHINES**	**9**
Output equation - Choice of specific loadings – Design of stator–Design of squirrel cage rotor - Design of slip ring rotor		
UNIT V	**DESIGN OF SYNCHRONOUS MACHINES**	**9**
Output equations - Runaway speed - Short Circuit Ratio- Design of salient pole machine - Armature design - Estimation of air gap length - Design of damper winding - Design of field winding – Design of turbo alternator		

TOTAL (L): 45 PERIODS

List of Experiments **TOTAL (P): 30 PERIODS**

1. Design and simulation of DC machine to obtain the electrical and mechanical characteristics.
2. Design and calculation of core losses and copper losses for shell type transformer.
3. Design and fabrication of single phase step down transformer.
4. Design and calculation of magnetic loading for 3-phase induction motor.
5. Design and simulation of 3-phase induction motor to obtain torque-slip characteristics.
6. Design and simulation of PMSM to find torque-speed characteristics.
7. Design and simulation of synchronous generator to obtain output power characteristics.

TOTAL (L+P): 75 PERIODS

TEXT BOOKS:

1. Mittle V.M. and Mittl E.A, Design of Electrical Machines, standard publishers Distribution, Fourth edition, 1996.
2. Sawhney, A.K. A course in Electrical Machine Design, Dhanpat Rai & sons, 1993.

REFERENCE BOOKS:

1. Rai, H.M. Electrical Machine Design, Sathiya Prakashan Publications, Third edition, 1992.
2. Say M.G., The Performance & Design of Alternating current Machines Isaac Pitman & sons Ltd., London 1995.
3. Clayton, A.E., Performance & Design of Direct current Machines, English Language Book society & Sri Isaac Pitman & sons Ltd., London 1995

COURSE CODE: 10211EE203	COURSE TITLE: SWITCHGEAR AND PROTECTION	L	T	P	C
		2	0	2	3

COURSE CATEGORY: Program Core (Integrated)

PREAMBLE: The functioning of a power system depends significantly on efficient and reliable protection schemes. This course provides the fundamentals of power system protection and switchgear technology including relay & breaker principles, types, operations and applications.

PREREQUISITE COURSES: Circuit Analysis, DC Machines and Transformer

RELATED COURSES: Power System Analysis, Transmission and Distribution

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Understand the essential qualities of a reliable protective system and protection terminologies
- Explain the operating principles of various relays based upon technology and functional requirements
- Understand Protection of electrical power apparatus generation, transmission and distribution system
- Understand the arcing phenomena, arc quenching and breaking in circuit breakers
- Classify different circuit breaker principles and operation

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	List out essential qualities of a protective system and protection terminologies.	K2
CO2	Contrast operating principles of relays based on technology and functional requirements.	K2
CO3	Summarize protection schemes for generation, transmission and distribution system	K2
CO4	Compare different Circuit breaker principles and operation.	K2
CO5	Understand the basic concept of digital protection schemes.	K2

CORRELATION OF COs WITH POs AND PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	L											H	
CO2	H				L	L	L					L	H	L
CO3	H	L	L		L	L	L					L	H	L
CO4	H	L	L										H	
CO5	H					L	L					L	H	L

COURSE CONTENTS:		
UNIT I	**INTRODUCTION**	**4**
Basic terminology - essential qualities of a protective relay - The universal relay - torque equation, RX diagram - CT, PT & applications		
UNIT II	**ELECTROMAGNETIC RELAYS**	**7**
Electromagnetic relays–operating principles of relays-Over current relays –directional over current relays - distance relays,- differential relays - under frequency and negative sequence relays		
UNIT III	**CIRCUIT BREAKERS**	**7**
Arcing phenomena and arc quenching - circuit breaker rating– RRRV - Current Chopping and Capacitive current breaking-DC circuit breaking- Oil minimum circuit breakers - Air blast circuit breakers - Vacuum and SF6 circuit breakers		
UNIT IV	**PROTECTION OF POWER APPARATUS**	**6**
Generator protection - Transformer protection – Bus bar protection - Feeder protection - A.C. Motor protection and carrier current protection of transmission lines, Relay coordination study.		
UNIT V	**DIGITAL PROTECTION**	**6**
Introduction, Advantages of digital protection, Basic elements of digital protection, Operation of digital relay, Mathematical background to digital algorithms: Sinusoidal-wave based algorithm and Walsh function, Digital overcurrent protection		
		TOTAL (L): 30 PERIODS

List of Experiments **TOTAL (P): 30 PERIODS**

1. Time-current characteristics of electromechanical over current/earth fault relay.
2. Time-voltage characteristics of electromechanical under voltage relay.
3. Time-voltage characteristics of electromechanical over voltage relay.
4. Simulation of differential protection.
5. Simulation of distance protection.

TOTAL (L+P): 60 PERIODS

TEXT BOOKS:

1. Badri Ram and Viswakarma, D.N., “Power System Protection and Switch Gear”, Tata McGraw-Hill Publishing Company Ltd., 2001.
2. Bhavesh Bhalja, R. P. Maheshwari, N. G. Chothani, “Protection and Switchgear”, Oxford University Press, 2nd edition, New Delhi, India, 2018.

REFERENCE BOOKS:

1. B.Ravindranath and N.Chander, "Power Systems protection and switchgear", Wiley Eastern Ltd, 1977.
2. C.L.Wadhwa, "Electric power systems", New Age International (P) Ltd publishers, 1983.
3. Sunil S. Rao, "Switchgear and protection", Khanna publishers, New Delhi, 1986.
4. T.S.Madhava Rao, “Power System Protection Static Relays”, Second Edition, Tata McGraw Hill, 2004
5. https://onlinecourses.nptel.ac.in/noc21_ee110/preview

COURSE CODE: 10212EE204	COURSE TITLE: OBJECT ORIENTED PROGRAMMING USING JAVA	L	T	P	C
		2	0	2	3

COURSE CATEGORY: Program Elective (Integrated)

PREAMBLE: To understand and develop the Java programming language for solving real time problems.

PREREQUISITE COURSES: Problem Solving using C

RELATED COURSES: Data Structures and Algorithms

COURSE EDUCATIONAL OBJECTIVES :

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads and generics classes
- To design and build simple Graphical User Interfaces

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Solve basic problems using object-oriented programming concept with Java.	K2
CO2	Apply the concepts of inheritance and interface for implementation in real time applications.	K3
CO3	Examine Java applications using exceptions and strings.	K3
CO4	Summarize the use of Java applications to implement threads and generics classes.	K2
CO5	Illustrate the features of event driven programming.	K2

CORRELATION OF COs AND POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		L									
CO2	H	H	M	L	L							
CO3	H	H		L							L	M
CO4	H		M	M	L							L
CO5	H	M			L						L	L

COURSE CONTENTS :

UNIT I	INTRODUCTION TO OOPS AND JAVA FUNDAMENTALS	6

Java fundamentals: Java architecture – Language Basics – Characteristics of Java – Features of Java – Comments – Data types – Variables – Operators – Type conversion and

casting – Flow control statements – Arrays. OOPS: Classes and objects – Concepts of classes and objects – Creating classes – Methods – Constructors – Static variables and methods – This Keyword – Packages.		
UNIT II	**INHERITANCE AND INTERFACES**	**6**
Inheritance – Super classes – Sub classes – Protected members – Constructors in sub classes – Abstract classes and methods – Final methods and classes. Interfaces: defining an interface, implementing interface, differences between classes and interfaces and extending interfaces – Object cloning.		
UNIT III	**EXCEPTION HANDLING AND STRINGS**	**6**
String Class – String Buffer Class – Exception handling – Errors vs Exceptions – Exception hierarchy – Usage of try, catch, throw, throws and finally, re-throwing exceptions – Built-in exceptions – User defined exceptions.		
UNIT IV	**MULTITHREADING AND GENERIC PROGRAMMING**	**6**
Differences between multi-threading and multitasking, Thread life cycle, Creating threads, Synchronizing threads, Inter-thread communication, Daemon threads, Thread groups. Generic Programming: Generic classes – Generic methods – Bounded Types – Restrictions and Limitations.		
UNIT V	**EVENT DRIVEN PROGRAMMING**	**6**
Graphics programming – Frame – Components – Working with 2D shapes – Using colour, fonts, and images – Basics of event handling – Event handlers – Adapter classes – Actions – Mouse events – AWT event hierarchy – Introduction to Swing – Layout management – Swing Components – Text Fields, Text Areas – Buttons – Check Boxes – Radio Buttons – Lists- choices – Scrollbars – Windows – Menus – Dialog Boxes.		
		TOTAL (L): 30 PERIODS

LIST OF EXPERIMENTS **TOTAL (P): 30 PERIODS**

1. Develop a Java application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, and type of EB connection (i.e. domestic or commercial). Compute the bill amount using the following tariff. **[CO1]**
   a. If the type of the EB connection is domestic, calculate the amount to be paid as follows:
      - First 100 units - Rs. 1 per unit
      - 101-200 units - Rs. 2.50 per unit
      - 201 -500 units - Rs. 4 per unit
      - > 501 units - Rs. 6 per unit
   b. If the type of the EB connection is commercial, calculate the amount to be paid as follows:
      - First 100 units - Rs. 2 per unit
      - 101-200 units - Rs. 4.50 per unit
      - 201 -500 units - Rs. 6 per unit
      - > 501 units - Rs. 7 per unit
2. Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), using packages. **[CO1]**
3. Develop a java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant

Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary. **[CO2]**

4. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area (). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape. **[CO2]**
5. Develop a java program using String Class. **[CO3]**
6. Write a java program to implement Exception Handling mechanism. **[CO3]**
7. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer at every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, then the third thread will print the value of the cube of the number. **[CO4]**
8. Write a java program to find the maximum value from the given type of elements using a generic function. **[CO4]**
9. Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result. Handle any possible exceptions like divide by zero. **[CO5]**
10. Develop an Applet that receives an integer in one text field & compute it factorial value & returns it in another text filed when the button “Compute” is clicked. **[CO5]**

TEXTBOOKS:

1. Herbert Schildt — Java The complete referencell, 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary Cornell, — Core Java Volume – I Fundamentals, 9th Edition, Prentice Hall, 2013.

REFERENCE BOOKS:

1. Paul Deitel, Harvey Deitel — Java SE 8 for programmers, 3rd Edition, Pearson, 2015.
2. Timothy Budd — Understanding Object-oriented programming with Java, Updated Edition, Pearson Education, 2000.

ONLINE RESOURCES:

1. “Programming in Java”, Accessed on: Apr. 20, 2021 [Online], Available: https://nptel.ac.in/courses/106/105/106105191/
2. “Java Tutorial”, Accessed on: Apr. 20, 2021 [Online], Available: https://www.javatpoint.com/java-tutorial

COURSE CODE:10212EE129	COURSE TITLE: SMART GRID	L	T	P	C
		3	0	0	3

COURSE CATEGORY: Program Elective

PREAMBLE: To enable the students to understand the requirement of smart grid, acquire knowledge of architecture, automation, advanced metering Infrastructure, distributed generation and integration, demand management, energy storage, electric vehicle and cyber security etc.,

PREREQUISITE COURSES: Power System Analysis

COURSEEDUCATIONALOBJECTIVES:

The objectives of the course are to,

- Understand the requirements of smart grid, components and architecture of smart grid.
- Educate the importance of sensors, measurement and control methods
- Familiar about the renewable energy generation and integration.
- Understand the various aspects of communications, standards and security.
- Brief about the integration of renewable energy resources and future of smart grid

COURSEOUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand components of the Smart Grid and the impact of Renewable Energy	K2
CO2	Describe measurement methods, sensors, control and automation of smart grid	K2
CO3	Interpret the role of distributed generation resources and energy storage technologies	K2
CO4	Importance of communications, standards and security of smart grid	K2
CO5	Summarize the applications of smart grid	K2

CORRELATION OF COs WITH POs AND PSOs

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	M			M	L					L		M	
CO2	M	M			M	L					L		M	
CO3	M	M			M	L					L		M	
CO4	M	M			M	L					L		M	
CO5	M	M			M	L					L		M	

COURSE CONTENTS:		
UNIT I	**INTRODUCTION**	**9**
Overview, today's grid versus smart grid, rationale for smart grid, power system enhancement, communication and standards, environment and economics, shareholders roles and function, architecture, functions of components		
UNIT II	**SENSING, MEASUREMENT, CONTROL AND AUTOMATION**	**9**
Smart meters, protocols, AMI, demand side integration, substation automation, distribution management, micro grid and smart grid comparison, wide area monitoring systems, IEDs and SCADA, Phasor measurement units, GIS and Google mapping tools, Multi agent technology		
UNIT III	**DISTRIBUTED GENERATION AND STORAGE**	**9**
Introduction, photovoltaic systems, wind, hydro and tidal energy, geothermal energy systems, Biomass, Integration, energy storage technologies: batteries, flow batteries, fuel cell, hydrogen electrolyser, flywheels, super conducting magnetic energy storage systems, super capacitors, electric vehicles, case studies		
UNIT IV	**COMMUNICATIONS, STANDARDS AND SECURITY**	**9**
Architecture of communication system, wired and wireless communication, spectrum technologies, WiMAX, Satellite Communication. interoperability and interchangeability, standards of security and safety, priority areas for standardization: consumer energy efficiency, electric transportation, smart grid cyber security		
UNIT V	**APPLICATIONS**	**9**
Demand side management, load management, energy management and conservation, smart grid analytics, demonstrations: solar/wind power generation, battery management system, smart meters, ev charging systems, IoT applications, design and analysis of smart grid : case study		
		TOTAL:45 PERIODS

TEXTBOOKS:

1. James Momoh, "Smart Grid: Fundamentals of Design and Analysis", John Wiley & Sons Inc, IEEE press, 2012.
2. Janaka Ekanayake, "Smart Grid: Technology and Applications", John Wiley & Sons Inc, 2012.

REFERENCEBOOKS:

1. Takuro Sato, Smart Grid Standards Specifications, Requirements and Technologies, First Edition, John Wiley & Sons Singapore Pte. Ltd, 2015.
2. Stuart Borlase , Smart Grids - Advanced Technologies and Solutions , Second Edition, Taylor & Francis Group, CRC Press, 2018.
3. Salman K. Salman, Introduction to the Smart Grid Concepts, Technologies and Evolution, The Institution of Engineering and Technology, 2017.
4. Qi Huang, Shi Jing "Innovative Testing and Measurement Solutions for Smart Grid", John Wiley & Sons Inc, 2015.
5. https://archive.nptel.ac.in/courses/108/107/108107113/

Annexure II

‘Applied Mathematics for Power Electronics’ syllabus for M.Tech. – Power Electronics under VTU PGE 2023 regulations

COURSE CODE: 20231EE110	COURSE TITLE: APPLIED MATHEMATICS FOR POWER ELECTRONICS	L	T	P	C
		3	1	0	4

COURSE CATEGORY: Program Core

COURSE EDUCATIONAL OBJECTIVES

The objectives of the course are,

- To develop the ability to apply the concepts of matrix theory in Electrical Engineering problems.
- To familiarize the students in the field of differential equations to solve boundary value problems associated with engineering applications.
- To develop the ability among the students to solve problems using Laplace transform associated with engineering applications.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.
- To develop the ability among the students to solve problems using Fourier series associated with engineering applications.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO No.	Course Outcomes
CO1	Apply the concepts of matrix theory in Electrical Engineering problems.
CO2	Solve boundary value problems associated with engineering applications.
CO3	Solve problems using Laplace transform associated with engineering applications.
CO4	Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems
CO5	Solve problems using Fourier series and Fourier transform associated with engineering applications.

COURSE CONTENTS:

UNIT I COMPLEX VARIABLES 12

Review of complex variables, Conformal mapping & transformations, Function of complex variables, Pole and singularity, Integration with respect to complex argument, Residues and basic theorems on residues.

UNIT II NUMERICAL ANALYSIS 12

Introduction, Interpolation formulae, Difference equation, Roots of equations, Solution of simultaneous linear and non-linear equations, Solution techniques for ODE and PDE, Introduction to stability, Matrix Eigen value and Eigen vector problems.

UNIT III OPTIMIZATION TECHNIQUE 12

Calculus of several variables, Implicit function theorem, Nature of singular points, Necessary and sufficient conditions for optimization, Elements of calculus variation,

Constrained Optimization, Lagrange multipliers, Gradient method, Dynamic programming.

UNIT IV LINEAR ALGEBRA 12

Vector space, Linear dependence of vectors, basis, linear transformations, inner product space, rank and inverse of a matrix, solution of algebraic equations, consistency conditions, Eigen values and eigen vectors, Hermitian and Skew Hermitian matrices.

UNIT V FOURIER SERIES AND TRANSFORM 12

Fourier Trigonometric series: Periodic function as power signals - Convergence of series – Even and odd functions: Cosine and sine series - Non periodic function - Parseval's theorem and power spectrum, Fourier transform: Discrete Time Fourier transform, Methods of obtaining FFT, Window functions: Their Properties, Application of S-transform, Wavelet transform.

TOTAL: 60 PERIODS

REFERENCE BOOKS:

1. John B. Conway, Functions of one complex variable, Springer International. Second Edition,1995
2. James Ward Brown & Ruel V. Churchill, Complex variable and application., McGraw Hill International Edition, 2004
3. John H. Mathews, Numerical Methods for Mathematics , science and Engineering, PHI,1992
4. D.C. Sanyal and K. Das, A text Book of Numerical analysis, U.N. Dhar & Sons Pvt. Ltd. 2014
5. S.S.Rao,, Optimisation theory and application, Wiely Eastern limited,1997
6. Hoffman & Kunze. R, Linear Algebra, PHI,1971
7. A V Oppenheim, R W Schafer, Discrete Time Signal Processing, PHI, 1994.

Annexure III

Industry/Higher Institute Learning (IHL) Interaction course syllabus

COURSE CODE:	COURSE TITLE:	L	T	P	C
10212EE167	POWER SYSTEM AUTOMATION	3	0	0	3

COURSE CATEGORY: Program Elective

PREAMBLE: Electric power grid is a major critical Infrastructure. It is the driver of economy and sustenance for any country. Maintaining Power supply with highest availability with security is the mandate. Continuous monitoring of system-wide network and prompt action initiation is essential to see that the Grid does not get compromised. It requires smarter devices that can collect and communicate information. This course introduces a fundamental knowledge on automation technologies in power system**.**

PREREQUISITE COURSES: Power System Analysis

COURSEEDUCATIONALOBJECTIVES:

The objectives of the course are to,

- Learn the fundamentals of automation and the building blocks of automation system for power grid.
- To study different communication in power system automation and also to understand the importance in power systems.
- Understand the role of sub-station in the power network, component of sub-station automation, building sub-station automation (SA) systems.
- Understand the use of energy management systems (EMS) and wide-area measurement systems (WAMS) in distribution automation (DA) system.
- Understand the need for distribution automation, power system security requirements, systems, standards etc.

COURSEOUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamentals of power system automation.	K2
CO2	Understand different communication in power system automation.	K2
CO3	Understand power system automation architectures.	K2
CO4	Understand EMS and WAMs, their objectives and its importance in power systems.	K2
CO5	Understand substation and feeder automations.	K2

CORRELATION OF COs WITH POs AND PSOs

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	M			M	L					L		M	
CO2	M	M			M	L					L		M	
CO3	M	M			M	L					L		M	
CO4	M	M			M	L					L		M	
CO5	M	M			M	L					L		M	

COURSE CONTENTS:

UNIT I	**AUTOMATION FUNDAMENTALS**	**9**

History of automation systems, Supervisory control and data acquisition (SCADA) in power systems, SCADA control centre, Building blocks of SCADA systems: Remote terminal unit (RTU), Intelligent electronic devices (IEDs), Data concentrators and merging units, SCADA communication systems and Master station, Classification of SCADA systems.

UNIT II	**COMMUNICATION SYSTEM FOR AUTOMATION**	**9**

SCADA communication requirements, Smart grid communication infrastructure, SCADA communication topologies, SCADA data communication techniques, SCADA communication protocol architecture, Evolution of SCADA communication protocols, SCADA and smart grid protocols, Media for SCADA and smart grid communication.

UNIT III	**SUBSTATION AUTOMATION**	**9**

Need for substation automation, Conventional substations, Islands of automation, Smart devices for substation automation and integrated digital substation. Substation automation: Technical issues, new digital substation, Substation automation architectures, renewable versus existing substations, Substation automation application functions, Data analysis: Benefits of data warehousing.

UNIT IV	**ENERGY MANAGEMENT SYSTEMS (EMS) FOR CONTROL CENTRES**	**9**

Operating states of the power system and sources of grid vulnerability, Energy control centres, EMS framework, Data acquisition and communication, Generation operation and management, Transmission operations and management: Real time, Study-mode simulations, Post-event analysis and energy scheduling and accounting, Dispatcher training simulator, Smart transmission, EMS with WAMS, Future trends in EMS and DMS with WAMS.

UNIT V	**DISTRIBUTION AUTOMATION AND DISTRIBUTION MANAGEMENT (DA/DMS)SYSTEMS**	**9**

Introduction to distribution automation, Subsystems in a distribution control centre, DMS framework: Integration with subsystems, DMS application functions, Advanced real-time DMS applications, DMS coordination with other systems, Customer automation, functions, Social media usage for improved reliability and customer satisfaction, Future trends in DA and DMS.

TOTAL:45PERIODS

TEXTBOOKS:

1. Mini S. Thomas and John Douglas McDonald, “Power System SCADA and Smart Grids”, CRC Press, 2015.
2. Gilbert N. Sorebo and Michael C. Echols “Smart Grid Security - An End-to-End View of Security in the New Electrical Grid”, CRC Press, 2012.

REFERENCEBOOKS:

1. Ulf Häger, Christian Rehtanz and Nikolai Voropai, “Monitoring, Control and Protection of Interconnected Power Systems”, Springer, 2014
2. Eveliopadilla “Sub-Station automation – Systems design and implementation”, Wiley , 2016
3. Stuart A. Boyer “SCADA : supervisory control and data acquisition”, ISA, 2004
4. Robert Radvanovsky Jacob Brodsky “SCADA /Control Systems Security”, CRC Press , 2013

Annexure IV

Summer Semester course list for AY 2024-25

SCHOOL OF ELECTRICAL AND COMMUNICATION

ELECTRICAL AND ELECTRONICS ENGINEERING

List of Courses

Summer Semester AY 2024-25

S. No.	Course Category	Course Code	Course Name	Credits	Faculty Name	TTS No.
B.Tech. Electrical and Electronics Engineering						
1.	Program Core	10211EE101	Circuits Analysis	4	Dr.P.K.Dhal	351
2.		10211EE113	Electronic Circuits	3	Dr.Hari Charan Nannam	3529
3.		10211EE102	DC Machines and Transformers	3	Dr.K.Karunanithi	2736
4.		10211EE201	Electromagnetic Fields	3	Dr. S. Vinoth John Prakash	2026
5.		10211EE107	Transmission and Distribution	3	Dr.K.Karthikumar	3065
6.		10211EE112	Microprocessor and Microcontrollers	3	Dr.R.A.Priya	3550
7.		10211EE114	Linear Integrated Circuits	3	Dr.S.Sivakumar	1326
8.		10211EE110	Power System Operation and Control	3	Dr.S.Ramesh	2784
9.		10211EE203	Switchgear and Protection	3	Dr.K.Vinoth	2611
10.		10211EE301	Circuits and Devices Lab	1	Dr.S.Amosedinakaran Dr.S.Vinoth John Prakash	3517 2026
11.		10211EE302	DC Machines and Transformers Lab	1	Dr.K.Karunanithi Dr.P.Rajakumar	2736 3514
12.		10211EE304	Control and Instrumentation Lab	1	Dr.K.Karthikumar Dr.Hari Charan Nannam	3065 3529
13.		10211EE305	Microprocessor and Microcontrollers Lab	1	Dr.R.A.Priya Dr.S.Sivakumar	3550 1326
14.		10211EE308	Power System Simulation Lab	1	Dr.P.Chandrasekar Dr.S.Amosedinakaran	2085 3517

S. No.	Course Category	Course Code	Course Name	Credits	Faculty Name	TTS No.
15.		10211EE306	Analog and Digital Electronics Lab	1	Dr.K.Vinoth	2611
16.	Program Elective	10212EE124	Power Plant Engineering	3	Dr.P.Rajakumar	3514
17.		10212EE154	Renewable Energy Sources	3	Dr.S.Vinoth John Prakash	2026
18.		10212EE204	Object Oriented Programming using Java	3	Dr.S.Sivakumar	1326
19.		10212EE135	Special Electrical Machines	3	Dr.K.Vinoth	2611
20.		10212EE121	Power Quality Engineering	3	Dr.K.Karthikumar	3065
21.		10212EE129	Smart Grid	3	Dr.P.Chandrasekar	2085
22.	Open Elective	10213EE107	Power Supply Quality	3	Dr.S.Amosedinakaran	3517
23.		10213EE102	Biomedical Instrumentation	3	Dr.R.A.Priya	3550
24.		10213EE114	Renewable Energy Systems	3	Dr.Hari Charan Nannam	3529
25.		10213EE121	Electrical Machines	3	Mr.K.Barathi	2151
26.		10213EE130	Wind and Solar Power System	3	Dr.P.Rajakumar	3514
27.	Independent Learning	10214EE601	Minor Project-1	2	Dr.S.Sivakumar	1326
M.Tech. Power Electronics						
28.	Program Core	20231EE101	Analysis of Power Electronics Circuits	4	Dr.R.A.Priya	3550
29.		20231EE102	Switched Mode Power Conversion	4	Dr.P.Chandrasekar	2085
30.		20231EE104	Modelling and Analysis of Electrical Machines	4	Dr.K.Vinoth	2611
31.		20231EE109	Smart Grid	3	Dr.S.Vinoth John Prakash	2026
32.		20231EE301	Power Converters Lab	1	Dr.K.Karthikumar	3065
33.	Program Elective	20232EE125	Solar Energy Engineering	3	Dr.P.Rajakumar	3514
34.		20232EE109	Grid Converters for Renewable Energy Applications	3	Dr.Hari Charan Nannam	3529
35.	Independent Learning	20234EE705	Project Phase II	6	Dr.K.Karunanithi	2736

Annexure V

Value-Added Courses (VAC) for AY 2024-25

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List of VAC

AY 2024-25

S.No.	Course Name
1.	Python Programming for Data Science
2.	Data Science with Excel
3.	Fundamentals of Machine Learning
4.	Fundamentals of Deep Learning
5.	Web Application Development & Deployment Cloud
6.	Use Case Approach For Vulnerability Analysis & Penetration Testing
7.	ML Ops with Use Case Approach
8.	IoS Application Creation
9.	Exploratory Data Analysis & Visualization
10.	Application Development using AR/VR
11.	Analysis of Data using Data Science Concept
12.	Agile Methodology
13.	Real Time Applications using LabVIEW
14.	PCB Design and Fabrication Techniques
15.	Internet of Things (ESP 32 Board)
16.	Additive Manufacturing (3D Printing) Applications
17.	CNC Programming and Operations
18.	Advanced Welding Techniques

Annexure VI

List of Self Learning Courses (NPTEL/SWAYAM)

AY 2024-25

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List of Self Learning Courses (NPTEL/SWAYAM)

Summer Semester

AY 2024-25

S.No.	Course Code	Course Name
B.Tech. - Program Elective		
1.	10212EE418	A Basic Course on Electric and Magnetic Circuits
2.	10212EE419	Economic Operations and Control of Power Systems
3.	10212EE420	Electrical Distribution System Analysis
4.	10212EE421	Sustainable Power Generation Systems
5.	10212EE422	Digital electronic and System design
B.Tech. - Open Elective Category		
6.	10213EE401	Design of Photovoltaic Systems
7.	10213EE402	Physics of Renewable Energy Systems
8.	10213EE403	Smart Grid: Basics to Advanced Technologies
9.	10213EE404	Solar Energy Engineering and Technology
10.	10213EE405	Introduction to Electric and Hybrid Electric Vehicle
11.	10213EE406	Basic Electrical Circuits
M.Tech. - Program Elective		
12.	20232EE416	Power Electronics Applications in Power Systems
13.	20232EE417	Power Electronics with Wide Band Gap Devices
14.	20232EE418	Phase-Locked Loops
15.	20232EE419	Nonlinear Dynamical Systems and Control

Annexure VII

Ratification

Industry/Higher Learning Institute Interaction course and Self-learning courses

VTU/DINT/23-24/1057

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Office of International Relations

Adjunct / Visiting Professor Programme

Ref.No: VTU/23-24/IHL/ 64 **Date:** 18.03.2024

School: SoEC **Department:** EEE

Course Category: Industry/ Higher Institute Learning

Professor & Course Details

Name of the Professor	Dr. Lung-Jieh Yang	
Designation	Professor	
University & Country	Tamkang University & Taiwan	
Course Code	10215EE902	
Course Title	Sustainability and Offshore Wind Farm	
Tentative Course Duration	**From:** 04-04-2024	**To:** 06-04-2024
Total No. of	**Credits:** 1	**Hours:** 15
Course Content	Attached	
Mode of Delivery	ON Campus	

Coordinator – Intl. Relations

Dean– Intl. Relations

Dept Coordinator

HoD Dr. S. Ramesh
Head of the Department
Electrical and Electronics Engineering

Dean Saravanakathi. R.S
Dean - School of Electrical & Communication

Dean (Academics)

Prof. Dr.A.T. Ravichandran
Dean-Academics

Vice Chancellor

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DEPARTMENT OF EEE

WINTER SEMESTER AY 2023-2024

Industry / Higher Institute Learning Course - MARK SHEET

Course Code & Title: 10215EE902/ 1157EE915 & Sustainability and Offshore Wind Farm

Course Category: Industry / Higher Institute Learning **Max Marks:** 40

No. of Hours Taken: 15 **Date of Test:** 06/4/2024

S.No.	ID No.	NAME	BATCH	Exam Marks (20)	Quiz Marks (80)	Total Marks (100)	Result
1	VTU19090	BHAVAN B	2021-2025	72	10	**82**	**Pass**
2	VTU19723	S ADESH	2021-2025	76	10	**86**	**Pass**
3	VTU19765	ABHISHEK KUMAR	2021-2025	68	9	**77**	**Pass**
4	VTU20248	K GUHAN	2021-2025	76	11	**87**	**Pass**
5	VTU20418	MEKALA VENKATA KARTHIKEYA	2021-2025	72	10	**82**	**Pass**
6	VTU20715	NONGTHOMBAM ADITYA LUWANG	2021-2025	80	11	**91**	**Pass**
7	VTU20800	SANDEEP KUMAR	2021-2025	68	8	**76**	**Pass**
8	VTU20975	THOJI KAJIRI	2021-2025	68	11	**79**	**Pass**
9	VTU21057	SHAIK ABUBAKAR SIDDIQUE	2021-2025	76	10	**86**	**Pass**
10	VTU21285	MARATI JYOTHI PRAKASH	2021-2025	72	10	**82**	**Pass**
11	VTU21303	CHANDRA BHUSHAN	2021-2025	76	11	**87**	**Pass**
12	VTU21324	HARISH ZADE	2021-2025	72	10	**82**	**Pass**
13	VTU23976	PASAM VENKATA SUSANTH	2021-2025	72	11	**83**	**Pass**
14	VTU23992	DAGGU PRUDHVIRAJ	2021-2025	68	9	**77**	**Pass**

S.No.	ID No.	NAME	BATCH	Exam Marks (20)	Quiz Marks (80)	Total Marks (100)	Result
15	VTU24044	MOHAMMED ISMAIL AHMED	2021-2025	68	9	**77**	**Pass**
16	VTU24058	GUNDOJI KEERTHI	2021-2025	80	10	**90**	**Pass**
17	VTU24072	MAILAVARAPU SAI KIRAN	2021-2025	64	8	**72**	**Pass**
18	VTU24084	MULUMUDI HAREESH	2021-2025	72	9	**81**	**Pass**
19	VTU24088	THALLURI VENKATA KARTHIK	2021-2025	80	9	**89**	**Pass**
20	VTU24108	NAKKANADODDI UPENDRA	2021-2025	72	9	**81**	**Pass**
21	VTU24113	THAVIDABOINA GANESH	2021-2025	80	8	**88**	**Pass**
22	VTU24002	VELLANKI SHASHIDHARA CHARY	2021-2025	80	8	**88**	**Pass**
23	VTU21324	Y.SATYA SAI RAMA MANIKANTA	2021-2025	72	9	**81**	**Pass**
24	VTU16813	MD.SHAHZEB	2020-2024	68	10	**78**	**Pass**
25	VTU18299	P.NITHIN	2020-2024	64	10	**74**	**Pass**
26	VTU21619	BUDIDA VAMSI KRISHNA	2020-2024	72	10	**82**	**Pass**
27	VTU17574	L.DINESH KRISHNA	2020-2024	68	10	**78**	**Pass**
28	VTU21611	A.R.BHUVANESH	2021-2025	68	10	**78**	**Pass**
29	VTU21634	B.KARTHIK	2021-2025	68	10	**78**	**Pass**

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The following UG students have successfully completed the **Coursera** online courses (Jan - April 2024 Session) as per the VTR UGE 2015 under the course category mentioned herewith.

S.No.	VTU No.	NAME	Course Code and Name	Coursera Score %	Vel Tech Score	Grade	Credit
1	18038	Veera Reddy	1156EE490-Linear Circuits 1: DC Analysis	76.16	57	D	2
2	18180	Gadi Revanth Jashuva		83.16	62	C	2
3	17522	P.V.V.N.Satyanarayana		78.96	59	D	2
4	17028	Suman Tripathi		81.56	61	C	2
5	21634	Karthik		80	60	C	2
6	17574	Lanke Dinesh Krishna		80.36	60	C	2

Note:

NPTEL Pass Mark: 40

Vel Tech Pass Mark: 50

Vel Tech Score = Coursera Score x 0.75

Annexure VIII

Result Analysis for Summer Semester

AY 2023-24

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year- Result Analysis- 2023-24- Summer Semester

Course code	Course name	Faculty name	Total No. of students	Total No. of students appeared for exam	Total No. of students absent	Total No. of students pass	Total No. of students Re-appear	Pass %
10211EE101	Circuits Analysis (PC)	Dr.P.K.Dhal	55	54	1	40	14	74
10211EE113	Electronic Circuits (PC)	Dr.Hari Charan Nannam	56	54	2	49	5	91
10211EE102	DC Machines & Transformers (PC)	Dr.K.Karunanithi	20	20	0	19	1	95
10211EE201	Electromagnetic Fields (PC)	Dr.S.Amosedinakaran	55	54	1	50	4	93
10212EE124	Power Plant Engineering (PE)	Mr.P.Sathyanathan	25	25	0	25	0	100
10212EE154	Renewable Energy Sources (PE)	Dr.S.Vinoth John Prakash	29	29	0	27	2	93
10211EE301	Circuits & Devices Lab (PC)	Dr.P.K.Dhal/ Dr.M.S.Prabhu	55	54	1	54	0	100
10211EE302	DC Machines & Transformers Lab (PC)	Dr.K.Karunanithi/ Dr.P.Rajakumar	20	20	0	19	1	95

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SCHOOL OF ELECTRICAL AND COMMUNICATION

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year- Result Analysis- 2023-24- Summer Semester

Course code	Course name	Faculty name	Total No. of students	Total No. of students appeared for exam	Total No. of students absent	Total No. of students pass	Total No. of students Re-appear	Pass %
10211EE107	Transmission and Distribution (PC)	Dr.M.S.Prabhu	32	31	1	30	1	97
10211EE108	Power Electronics (PC)	Dr.Hari Charan Nannam	31	30	1	29	1	97
10211EE112	Microprocessor and Microcontrollers (PC)	Dr.R.A.Priya	32	31	1	31	0	100
10212EE135	Special Electrical Machines (PE)	Dr.K.Vinoth	24	22	2	20	2	91
10212EE121	Power Quality Engineering (PE)	Dr.P.Chandrasekar	23	22	1	18	4	82
10211EE307	Power Electronics Lab (PC)	Dr.Hari Charan / Dr.K.Vinoth	30	30	0	30	0	100
10211EE305	Microprocessor & Microcontrollers Lab (PC)	Dr.R.A.Priya/ Dr.S.Sivakumar	30	30	0	25	5	83
Common courses for II and III Year								
10212EE106	Computer Networks and Communication (PE-CS)	Dr.S.Amosedinakaran	35	34	1	32	2	94
10212EE102	Operating Systems (PE-CS)	Dr.S.Sivakumar	34	33	1	32	1	97

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SCHOOL OF ELECTRICAL AND COMMUNICATION

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year- Result Analysis- 2023-24- Summer Semester

Course code	Course name	Faculty name	Total No. of students	Total No. of students appeared for exam	Total No. of students absent	Total No. of students pass	Total No. of students Re-appear	Pass %
1151EE111	Power System Operation & Control (PC)	Dr.S.Ramesh	28	27	1	22	5	81
1151EE112	Electrical Machine Design (PC)	Dr.S.Sivakumar	28	27	1	24	3	89
1152EE132	Utilization of Electrical Energy (PE)	Dr.K.Karthikumar	6	6	0	5	1	83
1152EE112	Flexible AC Transmission Systems (PE)	Dr.M.S.Prabhu	4	4	0	4	0	100
1151EE309	Power System Simulation Lab (PC)	Dr.P.Chandrasekar	25	25	0	25	0	100

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SCHOOL OF ELECTRICAL AND COMMUNICATION

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Open elective/ Allied Elective- Result Analysis- 2023-24- Summer Semester

Course code	Course name	Faculty name	Total No. of students	Total No. of students appeared for exam	Total No. of students absent	Total No. of students pass	Total No. of students Re-appear	Pass %
10213EE114	Renewable Energy Systems (OE)	Dr.R.A.Priya	60	60	0	59	1	98
10213EE126	Wind Energy Technology (OE)	Dr.P.Rajakumar	57	55	2	51	4	93
10213EE109	Transducers and Sensors (OE)	Dr.P.K.Dhal	60	60	0	52	8	87
1153EE110	Power Supply Quality (AE)	Dr.K.Karthikumar	62	60	2	49	11	82

Annexure IX

Interim Feedback Report- Winter Semester

AY 2023-24

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R&D Institute of Science and Technology

SCHOOL OF ELECTRICAL AND COMMUNICATION

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Consolidated Interim Feedback Report - WINTER SEMESTER - 2023-2024

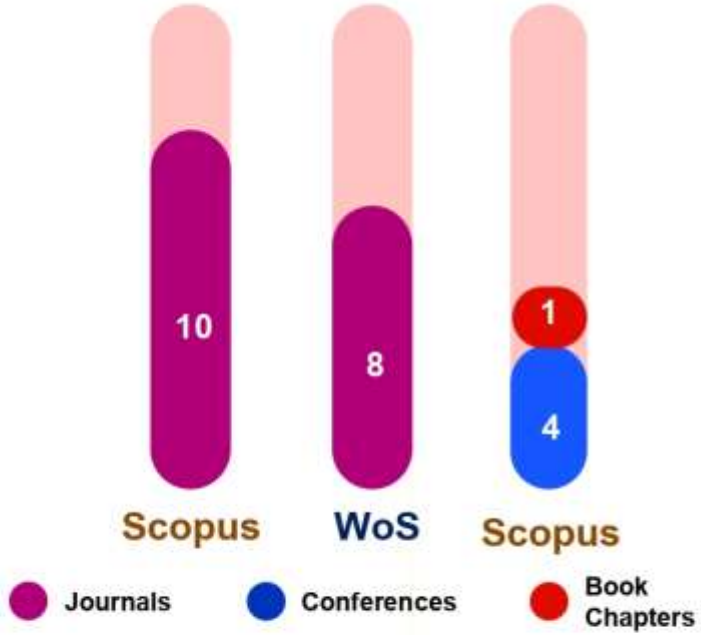
S.No	Name of the Faculty	Subject Code	Subject Title	Total Students	Total Students Participated	% of participants	Score												Average
							1	2	3	4	5	6	7	8	9	10	11	12	
1	Dr.S.Ramesh	1151EE111	Power System Operation Control	28	21	75	5	5	4.9	4.9	4.8	4.8	4.9	4.9	4.9	4.9	4.9	4.9	**4.9**
2	Dr.S. Siva Kumar	1151EE112	Electrical Machine Design	28	21	75	4.9	4.9	4.9	4.9	4.8	4.9	4.9	5.0	5.0	4.9	5.0	5.0	**4.9**
3	Dr. Chandrasekar. P	1151EE309	Power System Simulation Lab	28	21	75	4.8	4.9	4.8	4.9	4.9	4.9	4.9	5	5	5	5	4.9	**4.9**
4	Dr.K.Karthikumar	1152EE132	Utilization Of Electrical Energy	8	6	75	5.0	5.0	4.8	5.0	5.0	4.8	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**
5	Dr.Prabhu.M.S	10211EE107	Transmission and Distribution	32	30	94	4.7	4.7	4.8	4.7	4.6	4.8	4.8	4.8	4.8	4.8	4.8	4.8	**4.8**
6	Dr.Hari Charan Nannam	10211EE108	Power Electronics	31	29	94	4.9	4.9	4.8	4.9	4.7	4.8	4.8	4.8	4.8	4.8	4.8	4.8	**4.8**
7	Dr.Priya.R.A	10211EE112	Microprocessor and Microcontrollers	32	30	94	4.8	4.8	4.8	4.8	4.7	4.7	4.8	4.8	4.8	4.8	4.8	4.8	**4.8**
8	Dr.Priya.R.A	10211EE305	Microprocessor and Microcontrollers Laboratory	31	29	94	4.8	4.8	4.8	4.8	4.7	4.7	4.8	4.7	4.8	4.8	4.8	4.8	**4.8**
9	Dr.Hari Charan Nannam	10211EE307	Power Electronics Laboratory	31	29	94	4.8	4.8	4.8	4.8	4.7	4.8	4.8	4.8	4.8	4.8	4.8	4.8	**4.8**
10	Dr.S. Siva Kumar	10212EE102	Operating Systems	34	30	88	4.7	4.7	4.8	4.5	4.7	4.7	4.8	4.8	4.8	4.8	4.8	4.8	**4.7**
11	Dr.Amosedinakaran.S	10212EE105	Computer Networks and Communication	35	31	89	4.6	4.7	4.7	4.5	4.6	4.6	4.7	4.7	4.7	4.7	4.7	4.7	**4.7**
12	Dr.K.Vinoth	10215EE901	Wind Energy Technology for Electrical Engineers	17	17	100	4.8	4.6	4.8	4.6	4.8	4.8	4.7	4.8	4.8	4.8	4.8	4.7	**4.8**
13	Dr.Prabhu.M.S	1152EE112	Flexible Ac Transmission Systems	4	2	50	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**
14	Dr.Dhal P.K.	10211EE101	Circuits Analysis	61	50	82	4.6	4.6	4.6	4.5	4.6	4.6	4.5	4.6	4.6	4.6	4.6	4.6	**4.6**
15	Dr.K.Karunanithi	10211EE102	DC Machines and Transformers	26	21	81	4.6	4.6	4.6	4.4	4.5	4.5	4.6	4.7	4.6	4.5	4.6	4.5	**4.6**
16	Dr.Hari Charan Nannam	10211EE113	Electronic Circuits	60	49	82	4.8	4.8	4.8	4.7	4.7	4.8	4.7	4.7	4.7	4.8	4.7	4.7	**4.7**
17	Dr.Amosedinakaran.S	10211EE201	Electromagnetic Fields	61	50	82	4.6	4.5	4.7	4.5	4.6	4.6	4.5	4.5	4.7	4.6	4.6	4.5	**4.6**
18	Dr.Dhal P.K	10211EE301	Circuits and Devices Laboratory	60	49	82	4.7	4.6	4.7	4.6	4.6	4.6	4.6	4.6	4.7	4.6	4.6	4.6	**4.6**
19	Dr.K.Karunanithi	10211EE302	DC Machines and Transformers Laboratory	26	21	81	4.5	4.6	4.7	4.4	4.6	4.6	4.5	4.6	4.5	4.5	4.6	4.6	**4.6**
20	P Sathyanathan	10212EE124	Power Plant Engineering	30	24	80	4.6	4.8	4.6	4.6	4.5	4.6	4.6	4.6	4.7	4.5	4.6	4.7	**4.6**
21	Dr.S. Vinoth John Prakash	10212EE154	Renewable Energy Sources	34	27	79	4.5	4.6	4.6	4.6	4.6	4.7	4.6	4.6	4.7	4.6	4.6	4.6	**4.6**
22	Dr. Chandrasekar. P	10212EE121	Power Quality Engineering	24	22	92	4.7	4.7	4.8	4.7	4.7	4.6	4.7	4.8	4.6	4.7	4.7	4.7	**4.7**
23	Dr.K.Vinoth	10212EE135	Special Electrical Machines	24	22	92	4.6	4.6	4.6	4.7	4.6	4.6	4.6	4.5	4.6	4.6	4.6	4.6	**4.6**
24	Dr.K.Vinoth	10213EE131	Charging Station	1	1	100	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**
25	Dr.Prabhu.M.S	10213EE133	Electric Propulsion System and Control	1	1	100	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	**5.0**
26	Dr.Dhal P.K.	10213EE109	Transducers and Sensors	60	44	73	4.3	4.3	4.4	4.4	4.5	4.5	4.5	4.5	4.6	4.5	4.5	4.6	**4.5**
27	Dr.Priya.R.A	10213EE114	Renewable Energy Systems	60	37	62	4.7	4.6	4.5	4.5	4.5	4.6	4.6	4.6	4.5	4.5	4.6	4.6	**4.6**
28	Dr.Rajakumar.P	10213EE126	Wind Energy Technology	60	41	68	4.5	4.6	4.5	4.5	4.5	4.4	4.5	4.4	4.5	4.6	4.6	4.6	**4.5**
29	Dr.K.Karthikumar	1153EE110	Power Supply Quality	73	21	29	4.6	4.5	4.6	4.5	4.6	4.7	4.8	4.9	4.8	4.8	4.8	4.8	**4.7**
30	S Hema	10211BM103	Electric Circuit Theory	37	35	95	4.7	4.6	4.6	4.5	4.5	4.5	4.6	4.7	4.4	4.6	4.6	4.5	**4.6**
31	Dr.Amosedinakaran.S	10212EE105	Computer Networks and Communication	35	31	89	4.6	4.7	4.7	4.5	4.6	4.6	4.7	4.7	4.7	4.7	4.7	4.7	**4.7**
			Total	**1072**	**842**	**82**	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**

Annexure X

Faculty and Atudent’s Accomplishments - CY 2024

Faculty Awards & Achievements

Count – CY 2024 as on 31.5.24



12 Faculty members have published **23 articles/book chapters** in the peer – reviewed journals and conferences indexed by **Scopus and Web of Science (WoS)**

Count – CY 2024

Details

S. No.	Title	Inventor Name	Patent No. / Design No.	Date of Grant
1	Self Dependent Machine For Automotive Applications	Dr. P. Chandrasekar	494387	04/01/2024
2	Digital Cordless Drilling Machine	Dr. P. K. Dhal	404265-001	11/01/2024
3	An Intelligence Sensor Based Biodegradable Waste Collection Unit	Dr. P. K. Dhal	6338623	20/01/2024
4	A Device for an Electric Vehicle	Dr. S. Ramesh	517429	29/02/2024

Faculty Awards & Achievements

Rewards for Publications / Funded Projects / Consultancy / Patents to the faculty presented by Shri. Sudheer Kumar, Director of Capacity Building & Public Outreach Office (CBPO) at ISRO HQ, Bengaluru.

Faculty Awards & Achievements (Contd…)

Unnat Bharath Abhyan 2.0

Dr. N. K. Rayaguru
Associate Professor
TTS 2666

Grant Received: ₹ 50,000/-

Received a Grant of ₹ 50,000 through Unnat Bharath Abhyan 2.0 for Rural Energy Systems supported by IIT Delhi.

Dr. S. Sivakumar
Associate Professor
TTS 1326

Dr.S.Sivakumar, Associate Professor/EEE received **Best Paper Award** for his research paper presentation in the **International Conference of Embracing The Digital Horizon: Pioneering Commerce and Management Strategies for a Transformative Future (EDH 2024)** organized by **Loyala College of Arts & Science, Mettala, Tamilnadu on 13-14 March 2024.**

BEST PAPER AWARD

Diabetes Prediction Using Supervised and Unsupervised Machine Learning

By

SIVAKUMAR. S

Dept. of Electrical & Electronics Engineering, Vel Tech Rangarajan Dr. Sagunthala R and D Institute of Science and Technology, Avadi, Chennai, Tamilnadu, India.

Presented during the International Conference of Embracing The Digital Horizon : Pioneering Commerce and Management Strategies for a Transformative Future (EDH 2024)

Loyola College of Arts & Science, Mettara, Tamil Nadu, India, held on 13-14 March 2024.

Dr. D. Arul Pon Daniel
Convenor

Dr. Samuel Jeyaseelan SJ
Principal

Dr.P.Baburao
Assistant Professor
TTS 3545

Dr.P.Baburao, Asst. Professor/EEE has been recognized for being a **Reviewer** in the **International Conference on Automation & Computation organized by Department of Computer Science & Engineering, Graphic Era Hill University, Uttarakhand, India.**

Graphic Era

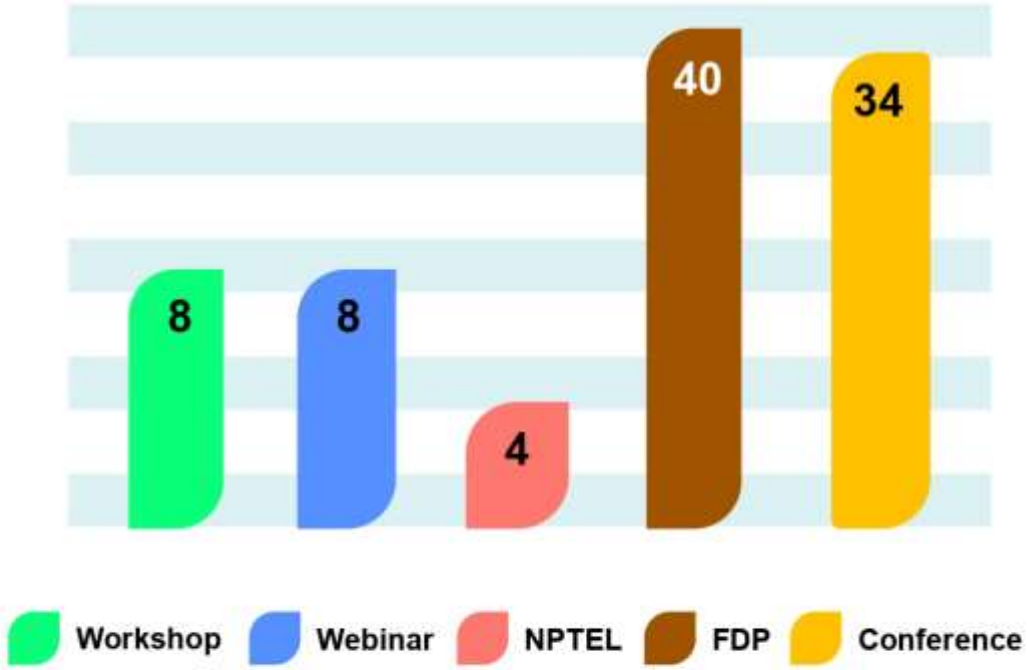
IEEE

AUTOMATION & COMPUTATION

Certificate of Recognition

Presented to

Capacity Building Program (AY 2023-24)



Students Achievements - Academics

QUALIFIED

Mr. Pranav Kumar Rowlo
(VTU17929)
B.Tech. Final Year,
(Batch 2020-2024)

GATE 2024

QUALIFIED

EE

GATE Score : 354

All India Rank : 7584

EC

GATE Score : 360

All India Rank : 7824

Successfully Qualified in **GATE 2024** with **Dual GATE Scores** in Electrical Engineering (EE) and Electronics and Communication Engineering (EC)

Students Achievements - Academics (Contd…)

Mr. Prasanth Kumar V and Mr. Shashak A,
II Year EEE students have won SECOND PRIZE ₹ 3,000 in Vel Tech Quiz Mania, January 2024 Edition

Students Achievements - Academics (Contd…)

Mr. K. Akhil

Mr. K. Akhil and Mr. Shaik Mansoor have successfully achieved student level credential for completing the **Data Analytics Essential course.**

Mr. Shaik Mansoor

Mr. K. Akhil has successfully completed the **iQ School of Academics: AWS Cloud Practitioner** certified by **iQuadra Information Services.**

Networking Academy

Certificate of Course Completion

K. Akhil

has successfully achieved student level credential for completing the Data Analytics Essentials course.

The student was able to proficiently

Networking Academy

Certificate of Course Completion

SHAIK MANSOOR,EEE(2022) Vel Tech, Chennai

has successfully achieved student level credential for completing the Data Analytics Essentials course.

The student was able to proficiently

iQuadra

Information Services

CERTIFICATE

OF ACHIEVEMENT

Proudly Presented to :

Kalavalapudi Akhil

Has successfully completed the iQ School of Academics AWS Cloud Practitioner

SRIHARI NANNURU

Head of Offshore Development center

Students Achievements- Patents

Published

Title	:	A Novel Dual Source Split Source Inverter for Single-Phase Applications
Inventors	:	Dr. Hari Charan Nannam, Muppidi Angel Babita (II Year PG student)
Patent No.	:	202341089376
Date of Filing	:	28/12/2023
Date of Publication	:	12/1/2024

Granted

Title	:	Wireless Charging Gadget for Electric Vehicles
Inventors	:	Ms. Kavitha N (II Year PG student) Dr. Chandrasekar P
Design No.	:	410485-001
Date of Grant	:	14/03/2024

Students Achievements - Extra-Curricular

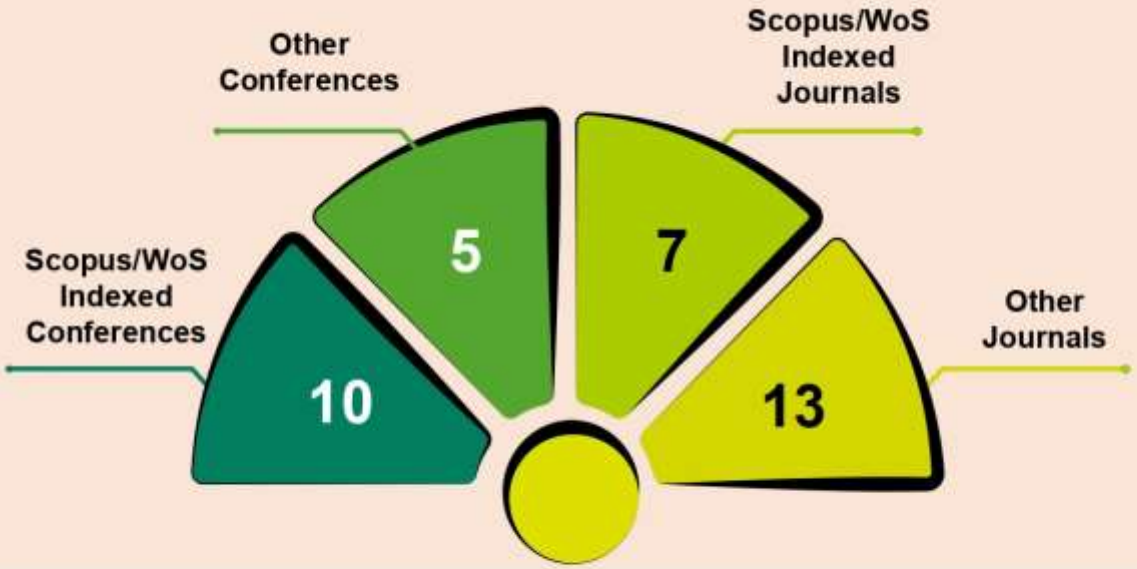
Mr. Surya, II Year EEE won **First Prize** in Tamil Nadu State Open Archery Championship 2024 organized by Thoothukudi District Archery Association and Focus Archery Academy on 25.02.2024

Students Participation

Student Achievements - Publications

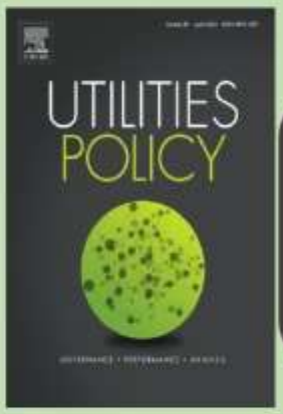
Count

Students have published their research findings in various national and international conferences and journal.



Highlight

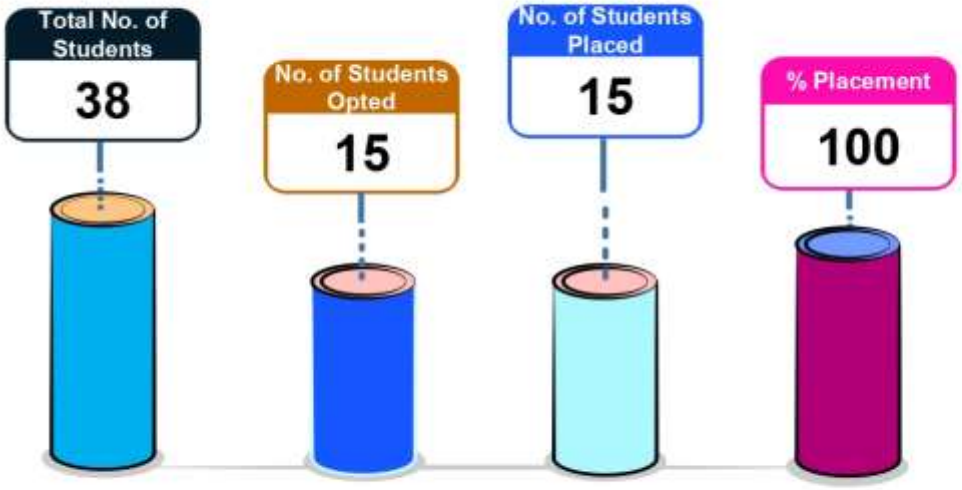
Mr. Pranav Kumar Rowlo (VTU17929), B.Tech. Final Year (Batch 2020-2024) published his research findings in a peer reviewed SCI journal "Utilities Policy (Elsevier)" with IF 4.



Research Article Title

Generation Expansion Planning considering environmental impact and sustainable development for an Indian state using the LEAP platform.

Placement and Graduation Ratio



Spectacular Achievement
100% Placement
5 Consecutive Years

Hitachi Energy | motherson | SPIC Nourishing growth | SETCOM | Mu Sigma | ZF

Graduation Ratio

Annexure XI

Course Codes for B.Tech. EEE with Honors in Smart Grid Technologies

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

SCHOOL OF ELECTRICAL AND COMMUNICATION
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech. EEE withHonors in Smart Grid Technologies

List of Courses (18 Credits)

S.No.	Course Code	Lecture Courses	L	T	P	C
1	20212EE101	Smart Grid	3	0	0	3
2	20212EE102	Energy Management and SCADA	3	0	0	3
3	20212EE103	Power System Restructuring	3	0	0	3
4	20212EE104	Distributed Generation and Micro Grid	3	0	0	3
5	20212EE105	IoT Applications in Smart Grid	3	0	0	3
6	20212EE106	AI for Smart Grid Systems	3	0	0	3

Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)
Avadi, Chennai-600062, Tamil Nadu, India

38th MEETING of BOARD of STUDIES

Minutes

for

B.Tech (Information Technology)

and

M.Tech (Information and Cyber Security)

[CBCS]

On

12.07.2024

Department of Information Technology

School of Computing

Department of Information Technology
School of Computing
38th MEETING of BOARD of STUDIES
for
B.Tech.(IT) & M.Tech.(ICS)

Date: 12.07.2024 – 11:00 AM

Venue: SoC Block

INDEX

Department of Information Technology
School of Computing
38th MEETING of BOARD of STUDIES
For
B.Tech.(IT) & M.Tech.(ICS)

Date: 12.07.2024 – 11:00 AM

Venue: SoC

AGENDA

Item No	Agenda
A.	**Opening**
1.	Confirmation of 37th BoS meeting minutes held on 03.01.2024. **(Annexure-I)**
2.	To review the Action Taken Report on the minutes of the 37th meeting of the Board of Studies **(Annexure-II)**
B.	**Items to be considered**
3	To discuss the **feedback on curriculum** of B.Tech IT & M.Tech ICS taken for the academic year 2023-2024. **(Annexure-III)**
4.	To discuss the existing **curriculum structure** of B.Tech IT under the Regulation VTR UGE 2021 for program core courses required for students to be implemented with effect from the academic year Summer 2024-2025**. (Annexure-IV)**
5.	To discuss and approve **course contents of few Program Electives** proposed in this BoS as per the list attached, to be offered in the programme B.Tech IT under the regulation VTR UGE 2021 with effect from Summer 2024-2025. (**Annexure-V)**
6.	To discuss and approve the **Program Elective courses in various domains under Industry Institute Interaction (III) Initiatives collaboration of ATOS in the existing** B**.Tech IT curriculum under the regulation VTR UGE 2021** to be implemented with effect from the academic year Summer 2024-2025 in view of employability skills. . (**Annexure – VI)**
7.	To discuss and approve the revision of **Cloud Computing Specialization in the existing** B**.Tech (IT) curriculum under the regulation VTR UGE 2021** to be implemented with effect from the academic year Summer 2024-2025 in view of employability and Skill. **(Annexure-VII)**
8.	To discuss and approve the courses to be offered in **Online MOOCs platforms under Open Elective Category** for B.Tech IT under regulation VTR UGE 2021 during the Summer 2024-2025. . (**Annexure – VIII)**
9.	To discuss and approve few Program Electives of **PG programme M.Tech Information and Cyber Security** under the regulation **VTR PGE 2023** keeping in view of AICTE and National Education Policy (NEP) 2020 and employability skills to be implemented with effect Summer 2024-2025. (**Annexure-IX)**
10	To discuss and approve the courses to be offered in **Online MOOCs platforms under Open Elective** during Summer 2024-2025 for PG programmes. . **(Annexure-X)**

Items to be Ratified

11. Ratification of Program Electives course contents in the existing B.Tech (IT) curriculum VTU UGE 2021. **under Industry Institute Interaction(III) Intiatives collaboration of ATOS in the existing** B**.Tech IT curriculum under the regulation VTR UGE 2021** in Winter 2023-2024 in view of employability skills. (**Annexure-XI)**

Sno	Course code	Course Name	L	T	P	C
1	10212IT270	Introduction to System Programming, zOS Commands and Panel on IBM Z	2	0	2	3

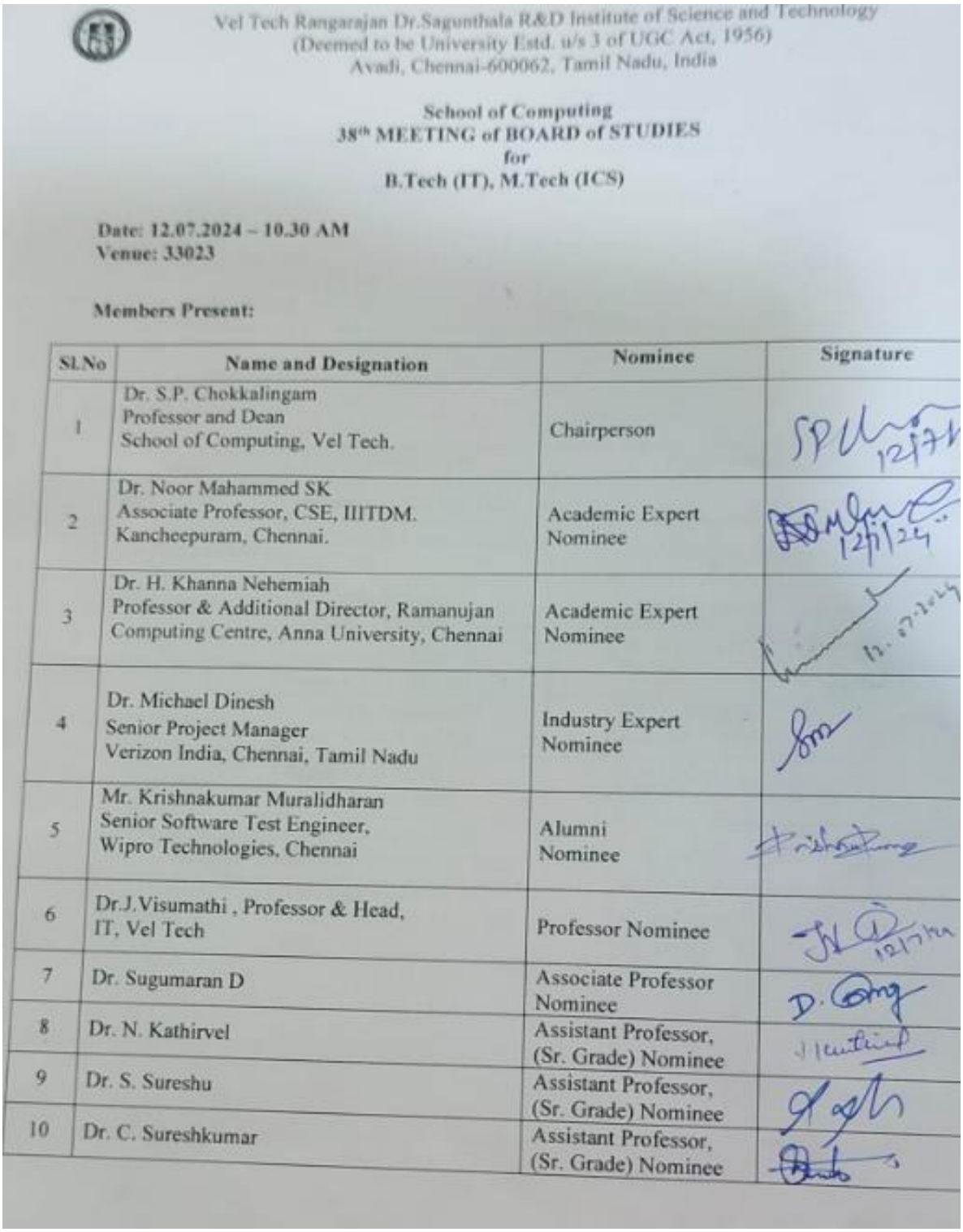
12. Ratification of courses offered by **Industry Experts for B.Tech IT for Skill enhancement and Employment opportunities** under Industry/Higher Institute Interaction Learning **(IHL)** Category during the **Winter Semester of academic year 2023-2024** for B.Tech IT curriculum R15 **(Annexure XII).**

Sno	Course code	Course Name	L	T	P	C
1	1157IT923	Computer Vision with Deep Learning	1	0	0	1
2	1157IT924	UI UX	1	0	0	1
3	1157IT924	Agile and Scrum	1	0	0	1

13. **Ratification of Value added Courses** offered for B.Tech. IT Winter Semester 2023-24 (**Annexure-XIII**).

Sno	Course code	Course Name	L	T	P	C
1	10218IT924	Web Development from Python to Php	2	0	0	0
2	10218IT925	Python Developer	2	0	0	0
3	10218IT926	Python Automation	2	0	0	0
4	10218IT927	Data Structures and Algorithms using Python	2	0	0	0
5	10218IT928	IoT Engineer	2	0	0	0
6	10218IT929	Linux Administration	2	0	0	0
7	10218IT930	Bash Shell Script administrator	2	0	0	0
8	10218IT931	Machine learning using Python	2	0	0	0
9	10218IT932	Adobe XD for web designer	2	0	0	0

14 Any other cognate item



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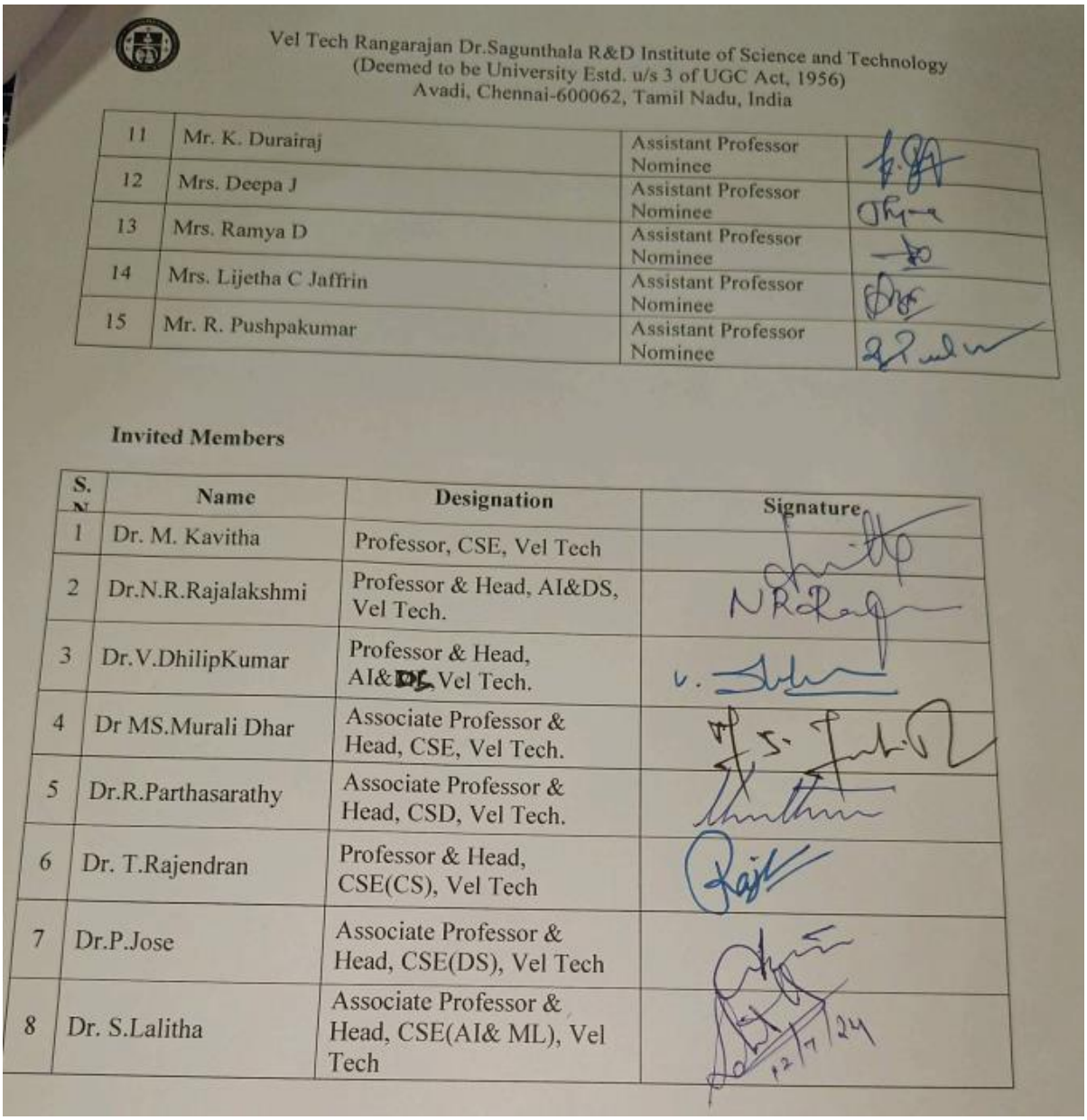
Avadi, Chennai-600062, Tamil Nadu, India

School of Computing
38th MEETING of BOARD of STUDIES
for
B.Tech (IT), M.Tech (ICS)

Date: 12.07.2024 – 10.30 AM
Venue: 33023

Members Present:

Sl.No	Name and Designation	Nominee	Signature
1	Dr. S.P. Chokkalingam Professor and Dean School of Computing, Vel Tech.	Chairperson	
2	Dr. Noor Mahammed SK Associate Professor, CSE, IIITDM. Kancheepuram, Chennai.	Academic Expert Nominee	
3	Dr. H. Khanna Nehemiah Professor & Additional Director, Ramanujan Computing Centre, Anna University, Chennai	Academic Expert Nominee	
4	Dr. Michael Dinesh Senior Project Manager Verizon India, Chennai, Tamil Nadu	Industry Expert Nominee	
5	Mr. Krishnakumar Muralidharan Senior Software Test Engineer, Wipro Technologies, Chennai	Alumni Nominee	
6	Dr.J.Visumathi , Professor & Head, IT, Vel Tech	Professor Nominee	
7	Dr. Sugumaran D	Associate Professor Nominee	
8	Dr. N. Kathirvel	Assistant Professor, (Sr. Grade) Nominee	
9	Dr. S. Sureshu	Assistant Professor, (Sr. Grade) Nominee	
10	Dr. C. Sureshkumar	Assistant Professor, (Sr. Grade) Nominee	



Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology
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11	Mr. K. Durairaj	Assistant Professor Nominee	
12	Mrs. Deepa J	Assistant Professor Nominee	
13	Mrs. Ramya D	Assistant Professor Nominee	
14	Mrs. Lijetha C Jaffrin	Assistant Professor Nominee	
15	Mr. R. Pushpakumar	Assistant Professor Nominee	

Invited Members

S. N	Name	Designation	Signature
1	Dr. M. Kavitha	Professor, CSE, Vel Tech	
2	Dr.N.R.Rajalakshmi	Professor & Head, AI&DS, Vel Tech.	
3	Dr.V.DhilipKumar	Professor & Head, AI&DS, Vel Tech.	
4	Dr MS.Murali Dhar	Associate Professor & Head, CSE, Vel Tech.	
5	Dr.R.Parthasarathy	Associate Professor & Head, CSD, Vel Tech.	
6	Dr. T.Rajendran	Professor & Head, CSE(CS), Vel Tech	
7	Dr.P.Jose	Associate Professor & Head, CSE(DS), Vel Tech	
8	Dr. S.Lalitha	Associate Professor & Head, CSE(AI& ML), Vel Tech	12/7/24

The Chair expressed his happiness in welcoming all the new members for the 36th meeting of BOS and thanked them for sparing their valuable time.

38-BoS-01	Confirmation of 37th BoS meeting minutes held on 03.01.2024. **(Annexure-I)**
Action Taken	The minutes of 37th BoS meeting minutes held on 3.01.2024 was circulated to members through e-mail, the members confirmed the minutes.(Annexure - I)
38-BoS-02	To review the Action Taken Report on the minutes of the 37th meeting of the Board of Studies **(Annexure-II)**
Resolution	The members reviewed the action taken report on the decisions of 37th BoS meeting minutes held on 03.01.2024 (Annexure - II)
	Items to be Considered
38-BoS-03	To discuss the **feedback on curriculum** of B.Tech IT & M.Tech ICS taken for the academic year 2023-2024. **(Annexure-III)**
Discussion	The members reviewed the feedback on curriculum of B.Tech IT taken for the academic year 2023-2024.
Resolution	The members reviewed the student feedback and alumini feedback for curriculum and suggested the value for stakeholder's feedback.
38-BoS-04	To discuss the existing **curriculum structure** of B.Tech IT under the Regulation VTR UGE 2021 for program core courses required for students to be implemented with effect from the academic year Summer 2024-2025**. (Annexure-IV)**
Discussion	The members discussed existing **curriculum structure** proposed in this BoS, to be offered in the programme B.Tech Information Technology under the regulation VTR UGE 2021
Resolution	The members approved the **Course Structure** proposed in this BoS, to be offered in the programme B.Tech Information Technology under the regulation VTR UGE 2021 and these will be offered with effect from Summer winter 2024-2025. Course structure and details are available in [Annexure - IV].
38-BoS-05	To discuss and approve **course contents of few Program Electives** proposed in this BoS as per the list attached, to be offered in the programme B.Tech IT under the regulation VTR UGE 2021 with effect from Summer 2024-2025. (**Annexure-V)**
Discussion	The members reviewed **changes in the few Program Elective** proposed in this BoS as per the list attached, to be offered in the programme B.Tech IT under the regulation VTR UGE 2021. Dr H. Khanna Nehemiah suggested to revisit the contents of Cryptography and Network Security. Experts recommended a slight modification in the course content and subsequently granted approval for the course. Course details are available in [Annexure -V].
Resolution	By considering the suggestion of the members, changes and these will be offered with effect from Summer 2024-2025.
38-BoS-06	To discuss and approve the **Program Elective courses in various domains under Industry Institute Interaction(III) Initiatives collaboration of ATOS in the existing** B**.Tech IT curriculum under the regulation VTR UGE 2021** to be implemented with effect from the

	academic year Summer 2024-2025 in view of employability skills. . (**Annexure – VI)**
Discussion	Experts reviewed the program elective courses and course contents of **Office 365 Administration.** All members appreciated the initiatives taken in collaborating with ATOS for offering courses as per the industry requirements for student's better skilling and placement opportunities.
Resolution	The members approved the new course and course contents of **Office 365 Administration in the existing** B**.Tech (IT) curriculum under the regulation VTR UGE 2021** to be implemented with effect from the academic year Summer 2024-2025.
38-BoS-07	To discuss and approve the revision of **Cloud Computing Specialization in the existing** B**.Tech (IT) curriculum under the regulation VTR UGE 2021** to be implemented with effect from the academic year Summer 2024-2025 in view of employability and Skill. **(Annexure-VII)**
Discussion	The members reviewed and recommended some new courses in the revision of **Cloud Computing Specialization in the existing** B**.Tech (IT) curriculum under the regulation VTR UGE 2021** to be implemented with effect from the academic year Summer 2024-2025 in view of employability and Skill. Dr Michael Dinesh suggested to include the course "Cloud Optimization" under this specialization and suggested to revisit the contents of the course "Cloud Security".
Resolution	Experts approved the new courses in **Cloud Computing Specialization in the existing** B**.Tech (IT) curriculum under the regulation VTR UGE 2021** to be implemented with effect from the academic year Summer 2024-2025 in view of employability and Skill.
38-BoS-08	To discuss and approve the courses to be offered in **Online MOOCs platforms under Open Elective Category** for B.Tech IT under regulation VTR UGE 2021 during the Summer 2024-2025. (**Annexure – VIII)**
Discussion	Experts reviewed the courses to be offered in Online MOOCs platforms under open Elective of B.Tech(IT) under regulation VTR UGE 2021
Resolution	The members approved the courses to be offered in Online MOOCs platforms under Open Elective Category (MOOCs) during the **Summer semester of academic year 2024-2025** for B.Tech(IT). Course details are available in [Annexure - VIII]
38-BoS-09	To discuss and approve few Program Electives of **PG programme M.Tech Information and Cyber Security** under the regulation **VTR PGE 2023** keeping in view of AICTE and National Education Policy (NEP) 2020 and employability skills to be implemented with effect Summer 2024-2025. (**Annexure-IX)**
Discussion	The members reviewed Program Electives of **PG programme M.Tech Information and Cyber Security** under the regulation **VTR PGE 2023**. Dr Noor Mohammed suggested to rearrange the contents of the course "Cybe Security Policy, Law and Ethics". Experts recommended a slight modification in the course content and subsequently granted approval for the course. Course details are available in [Annexure -IX].
Resolution	By considering the suggestion of the members, changes and these will be offered with effect from Summer 2024-2025.

<table>
<tr><td>38-BoS-10</td><td>To discuss and approve the courses to be offered in Online MOOCs platforms under Open Elective during Summer 2024-2025 for PG programmes. . (Annexure-X)</td></tr>
<tr><td>Discussion</td><td>Experts reviewed the list of courses to be offered in Online MOOCs platforms under Open Elective Category (MOOCs) during the Summer 2024-2025 for PG programmes.</td></tr>
<tr><td>Resolution</td><td>Experts approved the list of courses to be offered in Online MOOCs platforms under Open Elective Category (MOOCs) during the Summer 2024-2025 for PG programmes. Course details are available in [Annexure - X]</td></tr>
<tr><td></td><td>Items to be Ratified</td></tr>
<tr><td>38-BoS-11</td><td>Ratification of Program Electives course contents in the existing B.Tech (IT) curriculum VTU UGE 2021. under Industry Institute Interaction(III) Intiatives collaboration of ATOS in the existing B.Tech IT curriculum under the regulation VTR UGE 2021 in Winter 2023-2024 in view of employability skills. (Annexure-XI)
<table>
<tr><th>Sno</th><th>Course code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10212IT270</td><td>Introduction to System Programming, zOS Commands and Panel on IBM Z</td><td>2</td><td>0</td><td>2</td><td>3</td></tr>
</table></td></tr>
<tr><td>Resolution</td><td>The members ratified the course content “Introduction to System Programming, zOS Commands and Panel on IBM Z” in the existing B.Tech (IT) curriculum VTU UGE 2021 under Industry Institute Interaction(III) Intiatives collaboration of ATOS in the existing B.Tech IT curriculum under the regulation VTR UGE 2021 in Winter 2023-2024 (Annexure-XI)</td></tr>
<tr><td>38-BoS-12</td><td>Ratification of courses offered by Industry Experts for B.Tech IT for Skill enhancement and Employment opportunities under Industry/Higher Institute Interaction Learning (IHL) Category during the Winter Semester of academic year 2023-2024 for B.Tech IT curriculum R15 regulations (Annexure XII).
<table>
<tr><th>Sno</th><th>Course code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>1157IT923</td><td>Computer Vision with Deep Learning</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>2</td><td>1157IT924</td><td>UI UX</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>3</td><td>1157IT924</td><td>Agile and Scrum</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
</table></td></tr>
<tr><td>Resolution</td><td>The members ratified the courses offered by Industry Experts for B.Tech.(IT) for Skill enhancement and Employment opportunities under Industry/Higher Institute Interaction Learning Category during the Winter semester of academic year 2023-2024 for B.Tech.(IT). The list of courses offered and course contents are available in (Annexure-XII).</td></tr>
</table>

<table>
<tr><td>38-BoS-13</td><td>
Ratification of Value added Courses offered for B.Tech. IT Winter Semester 2023-24 (Annexure-XIII).
<table>
<tr><th>Sno</th><th>Course code</th><th>Course Name</th><th>L</th><th>T</th><th>P</th><th>C</th></tr>
<tr><td>1</td><td>10218IT924</td><td>Python Developer</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>2</td><td>10218IT925</td><td>Data Structures and Algorithms using Python</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>3</td><td>10218IT926</td><td>IoT Engineer</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>4</td><td>10218IT927</td><td>Bash Shell Script administrator</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>5</td><td>10218IT928</td><td>Machine learning using Python</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>6</td><td>10218IT929</td><td>Adobe XD for web designer</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>Resolution</td><td>The members ratified Value added Courses offered for B.Tech. IT in Winter Semester 2023-24. The list of courses offered and course contents are available in (Annexure-XIII)</td></tr>
<tr><td>38-BoS-14</td><td>Any other cognate item</td></tr>
<tr><td></td><td>The next BoS meeting will be conducted in December 2024</td></tr>
</table>

Annexure-I

Confirmation of 37th BoS meeting minutes held on 03.01.2024

7/10/24, 8:23 PM Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology Mail - IT-37th BoS Minutes Final

Vel Tech

HOD IT Vel Tech, Chennai <hodit@veltech.edu.in>

IT-37th BoS Minutes Final

HOD IT Vel Tech, Chennai <hodit@veltech.edu.in> Wed, Feb 14, 2024 at 3:48 PM
To: Dr V SRINIVASA RAO <deansoc@veltech.edu.in>
Bcc: "Dr. KHANNA NEHEMIAH H" <nehemiah@annauniv.edu>, Noor Mahammad <noor@iiitdm.ac.in>, Balaji.Sridharan@cognizant.com, Krishna Kumar <krishnakumar2925@gmail.com>

Good Morning Sir
Herewith I have attached the 37th BoS meeting minutes of B.Tech -Information Technology

--
Thanks & Regards,

Dr. J.Visumathi
HOD / IT
Mobile No. : 73388 03042
email id: hodit@veltechuniv.edu.in
website: www.veltechuniv.edu.in
Address :
Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology,
400 feet Outer Ring Road, Avadi,
Chennai - 6006 062, Tamil Nadu

2 attachments

IT- 37th BoS -Meeting Summary Report-12.02.2024.docx
42K

IT- 37th Bos Minutes.pdf
2820K

Annexure-II

To review the Action Taken Report on the minutes of the 37th meeting of the Board of Studies

Item No	Item	Decision taken	Action Taken
ITEMS FOR DISCUSSION AND APPROVAL			
37-BoS-3	Curriculum Feedback from Stake Holders	The members reviewed and approved the proposed Program Elective courses for implementation from Winter 2023-2024	The proposed courses will be offered with effect from Winter 2023-2024
37-BoS-4	Approval of changes in the existing **Course Structure** proposed in this BoS, to be offered in the programme B.Tech Information Technology under the regulation VTR UGE 2021	The members reviewed and approved the proposed course structure for implementation from Winter Semester Academic Year 2023 – 2024.	Proposed Courses were offered
37-BoS-5	Approval of **course contents of Program Elective** category in the existing B.Tech (IT) curriculum VTR UGE 2021	The members reviewed and approved the proposed courses under Program Elective category for implementation from Winter Semester Academic Year 2023 – 2024.	Proposed Courses will be offered with effect from winter 2023-2024
37-BoS-6	Approval of courses under industry **(ATOS) collaborated specialization Cloud Infrastructure Management** in the existing B.Tech (IT) curriculum under the regulation VTR UGE 2021	The members reviewed and approved the industry (ATOS) collaborated courses under Program Elective category for implementation from Academic Year winter Semester 2023-2024	The proposed course was offered with effect from the Academic Year Winter Semester 2023-2024,

37-BoS-7	Approval of courses to be offered in Online **MOOCs platforms under Open Elective Category** for B.Tech (IT) under regulation VTR UGE 2021 and **Independent Learning Category (MOOCs)** for B.Tech IT under regulation VTU R15	Experts reviewed the Open elective Courses offered under NPTEL platform	Students were allowed to undergo the courses under Open Elective Category in NPTEL platform with effect from the academic year Winter Semester 2023-2024
37-BoS-8	Approval of **Value added Courses - Winter semester 2023-2024**	The members reviewed and approved the list of value added courses	The proposed courses are offered with effect from the Winter Semester 2023-2024.
37-BoS-9	Introducction and Approval of **course structure and course contents** of Program Core and few Program Electives of **PG programmes M.Tech Information and Cyber Security** under the regulation **VTR PGE 2023**	The members reviewed and approved the new course structure and course contents of Program Core and few Program Electives of PG programmes M.Tech Information and Cyber Security under the new regulation VTR PGE 2023	The proposed course was offered with effect from the Academic Year 2023-2024
37-BoS-10	Approval of courses in Online MOOCs platforms **under Independent Learning Category (MOOCs)** for PG programmes. .	The members reviewed and approved the list of MOOCs courses for M.Tech ICS	Students were allowed to undergo the courses under Open Elective Category in NPTEL platform with effect from the academic year Winter Semester 2023-2024
37-BoS-11	Ratification of **new** Program Core courses offered in M.Tech Information and Cyber Security under the regulation VTR PGE 2023 implemented with effect from the academic year Summer 2023-2024	The members ratified the **new courses and course contents** of M.Tech ICS	The offered courses are ratified

37-BoS-12	Ratification of courses offered by Industry Experts for B.Tech(IT) for Skill enhancement and Employment opportunities under Industry/Higher Institute Interaction Learning (IHL) Category during the summer semester of academic year 2023-2024	The members ratified the courses offered by **IHL** for B.Tech(IT)	The offered course is ratified
37-BoS-1	Ratification of **Value added Courses** - Summer Semester 2023-2024.	The members ratified the value added courses offered during Summer Semester 2023-2024	The offered courses are ratified
37-BoS-14	Ratification of **new, revised Program Elective courses and course contents**-B.Tech programme VTUR15.	The members ratified the **new, revised courses and course contents**-B.Tech programme VTUR15.	The offered courses are ratified

Annexure – III

To discuss the stakeholders feedback on curriculum of B.Tech IT taken for the academic year 2023-2024

School of Computing
Department of Information Technology
Faculty Feedback on Curriculum 2023-2024

PROGRAM CORE

1. Curriculum can be more industrial/practical oriented.
2. Recommended to improve the course content in IoT and Cloud computing and Java programming.
3. Recommended to include more use cases in all the courses.
4. Suggested to add advanced concepts in courses like Data Structures and Database Management Systems.

PROGRAM ELECTIVE

1. Case studies can be included in major domain related courses.
2. Cryptography and Network Security can be included in the Program elective category.

INDEPENDENT LEARNING

1. Suggested to include Modern Computer Vision course.

School of Computing

Department of Information Technology

Action Taken: Academic Year 2023-2024 Curriculum Feedback

Based on the faculty feedback analysis few courses were introduced and some courses were revised in the curriculum as below:

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Network Technologies	Program Core	37 Bos- 03.01.2024
2	Advanced Database Management System	Program Core	37 Bos- 03.01.2024
3	Advanced Data Structures And Algorithms	Program Core	37 Bos- 03.01.2024
4	Advanced Operating Systems	Program Core	37 Bos- 03.01.2024
5	Artificial Intelligence	Program Core	37 Bos- 03.01.2024
6	Cryptography and Network Security	Program Core	37 Bos- 03.01.2024
7	Vulnerability Assessment and Penetration Testing	Program Core	37 Bos- 03.01.2024
8	Modern Computer Vision	Independent Learning	37 Bos- 03.01.2024

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R&D Institute of Science and Technology

School of Computing
Department of Information Technology
Faculty Feedback on Curriculum

Academic Year : 2023 - 2024
Programme Name : Information Technology
Email ID : jdeepa@veltech.edu.in
Faculty ID: TTS2665
Faculty Name: J. Deepa
Designation: Assistant Professor

1. Quality and relevance of the courses included into the curriculum

☐ Excellent ☑ Very good ☐ Good ☐ Satisfactory ☐ Poor

2. Curriculum covers depth and breadth of the courses

☑ Excellent ☐ Very good ☐ Good ☐ Satisfactory ☐ Poor

3. Courses in the curriculum as per the current trends and future predictions

☐ Excellent ☑ Very good ☐ Good ☐ Satisfactory ☐ Poor

4. Courses in the curriculum give more focus on design experience

☑ Excellent ☐ Very good ☐ Good ☐ Satisfactory ☐ Poor

5. Courses in the curriculum helps the student for the critical thinking/problem solving

☑ Excellent ☐ Very good ☐ Good ☐ Satisfactory ☐ Poor

6. Courses in the curriculum focus on interdisciplinary aspects

☑ Excellent ☐ Very good ☐ Good ☐ Satisfactory ☐ Poor

7. Observed updation of curriculum frequently

☑ Excellent ☐ Very good ☐ Good ☐ Satisfactory ☐ Poor

8. Present curriculum focus on employability and professional development

☐ Excellent ☑ Very good ☐ Good ☐ Satisfactory ☐ Poor

9. Rate the distribution of credits to the courses

☑ Excellent ☐ Very good ☐ Good ☐ Satisfactory ☐ Poor

10. Courses in the curriculum focuses on value education, leadership

☑ Excellent ☐ Very good ☐ Good ☐ Satisfactory ☐ Poor

Any other suggestions ..... Modern computing Virtual can be added as Independent learning .....

Signature of the Faculty

School of Computing
Department of Information Technology
Students Feedback on Curriculum 2023-2024

The primary stakeholders of the B. Tech Information Technology Programme are the students, making their input crucial. During the academic year 2023-2024, valuable suggestions were gathered through structured feedback from B. Tech IT students. Sixteen students provided their insights on the curriculum, and key recommendations are outlined below:

- Consider adding advanced technological courses to enhance the coding knowledge.
- Suggested to incorporate practical knowledge and real-time implementation through more use cases.
- Include industrial visits as part of the curriculum to provide students with firsthand experience and enhance their practical knowledge through exposure to real-world scenarios.
- Suggested to include hands-on training in essential subjects.
- Suggested to include programming challenges courses.
- Students expressed to provide supplementary content that extends beyond the prescribed curriculum.
- Suggested to incorporate courses directly related to industry demands.
- Suggested to add the usecase implementation for installation of windows OS and practical demo for hardware and software configurations.

The following questions are given to the students about feedback on curriculum and the response is mentioned in the below graph:

Q1 How do you rate the curriculum offered in relation to the Technological advancements?

Q2 How do you rate the syllabus in related to the needs of industry/society?

Q3 How do you rate the relevance of the courses for providing employability?

Q4 Did the course curriculum intellectually motivate you?

Q5 How much has your experience at this curriculum contributed to your job-related knowledge and skills?

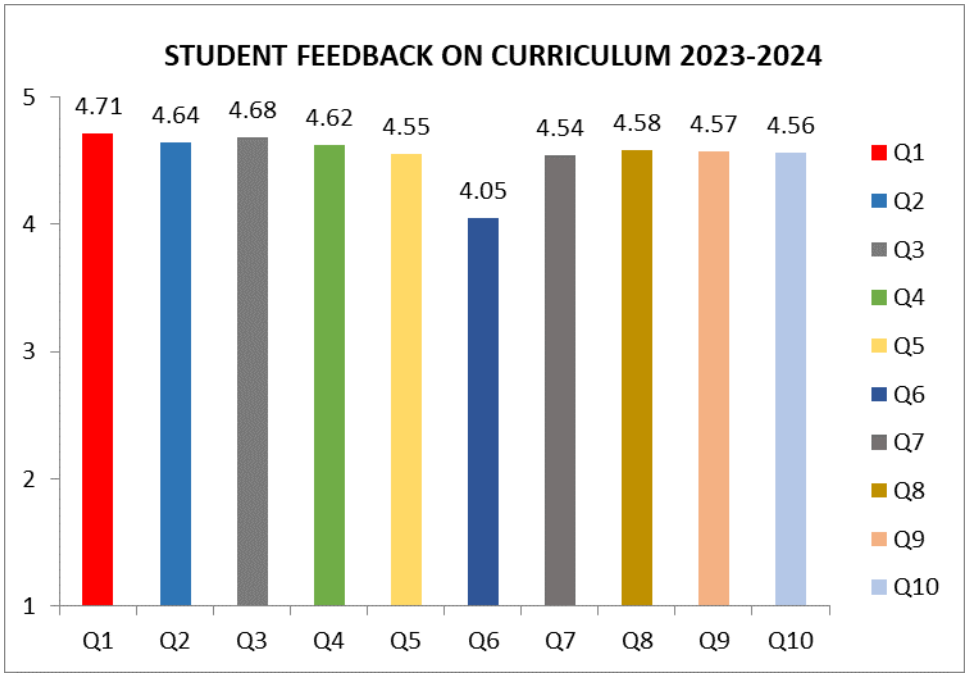
Q6 Was the course curriculum fulfilling your expectations?

Q7 Does the syllabus create any interest to pursue post-graduation/research in the particular subject?

Q8 Were reading material and references regarding curriculum / subject easily found?

Q9 How do you rate the objectives stated for each of the courses?

Q10 How do you rate the syllabus of the courses that you have studied in relation to the competencies expected out of the courses?



From the above feedback analysis, students have given less rating for Q6 (Was the course curriculum fulfilling your expectations?). Students are highly satisfied with Q1 (How much has your experience at this curriculum contributed to your job-related knowledge and skills?) and Q3 (How do you rate the relevance of the courses for providing employability?).

Action Taken: Academic Year 2023-2024 Curriculum Feedback

Based on the student feedback analysis few courses were introduced and some courses were revised in the curriculum under various category:

S.NO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Windows Server Administration Operating System	Program Elective	37 BOS- 03.01.2024
2	Office 365 Administration	Program Elective	37 BOS- 03.01.2024
3	Cryptography And Network Security	Program Core	37 BOS- 03.01.2024
4	Advanced Database Management System	Program Core	37 BOS- 03.01.2024
5	Advanced Data Structures And Algorithms	Program Core	37 BOS- 03.01.2024
6	Intrusion Detection And Prevention Systems	Program Elective	37 BOS- 03.01.2024
7	Wipro Talent Next Training Using .Net	Value Added	37 BOS- 03.01.2024

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R&D Institute of Science and Technology

School of Computing

Department of Information Technology

Student Feed Back on Curriculum

Academic Year	: 2023-2024
Programme Name	: B.Tech – Information Technology
Student Reg Number	: 21UIT0038
Student Name	: Nana Jagadeesh
Mobile Number	: 8367137198
Email Id	: vtu20683@veltech.edu.in

You are requested to give appropriate rating for the following points:
5- Strongly Agree 4- Agree 3- Neutral 2-Disagree 1- Strongly Disagree

S.No	Question	Rating
1	How do you rate the curriculum offered in relation to Technological advancements?	4
2	How do you rate the syllabus in related to the needs of industry/society?	5
3	How do you rate the relevance of the courses for providing employability?	4
4	Did the course curriculum intellectually motivate you?	5
5	Was the course curriculum fulfilling your expectations?	5
6	How much has your experience at this curriculum contributed to your job-related knowledge and skills?	4
7	Does the syllabus create any interest to pursue post-graduation / research in the particular subject?	4
8	Were reading material and references regarding curriculum/subject easily found?	3
9	How do you rate the objectives stated for each of the courses?	4
10	How do you rate syllabus of the courses that you have studied in relation to competencies expected out of the courses?	4

Any other suggestions for improvement

We need "DOTNET" for our future development in companies.

Date: 22/10/2023

N. Jagadeesh
Signature of the student

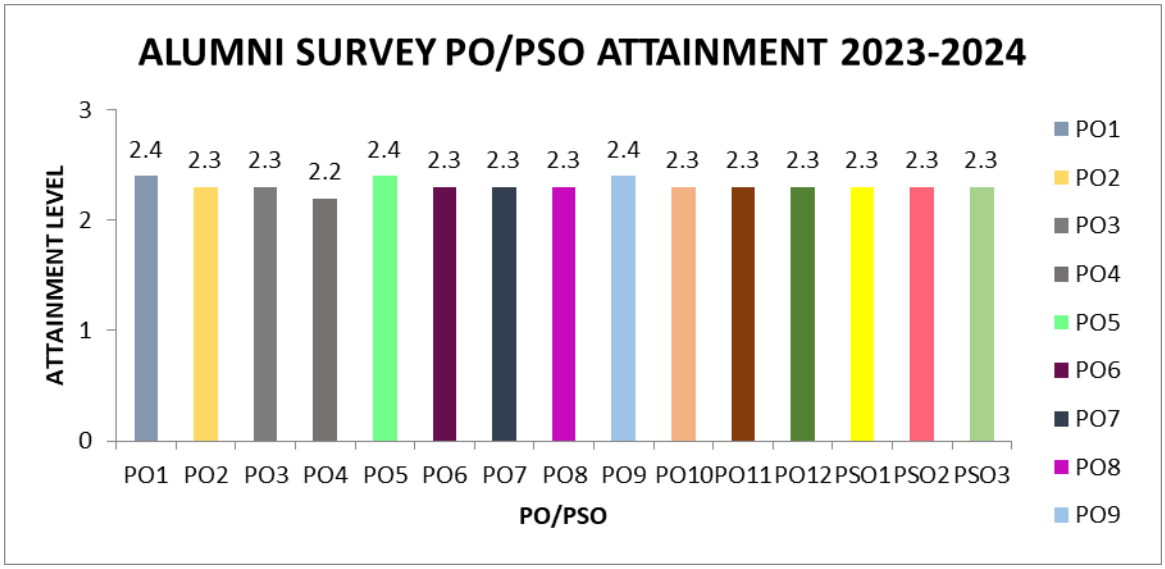
School of Computing
Department of Information Technology
Alumni Feedback on Curriculum 2023-24

Alumni are one of the stakeholders of B.Tech Information Technology programme. In the academic year 2023-2024, suggestions from the alumni are collected through structured feedback. Alumni shared their insights on the curriculum, and the primary suggestions they provided are listed as follows:

1. Advanced concepts can be added to the curriculum.
2. Industry collaborated courses can be offered in program elective
3. More practical hours can added to all subjects.
4. MOOC courses can be added based on recent technologies.
5. Project based learning can be given for the students for their better improvement.
6. Suggested to include Data privacy related courses.

PO / PSO ATTAINMENT- AY 2023-2024

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
2.4	2.3	2.3	2.2	2.4	2.3	2.3	2.3	2.4	2.3	2.3	2.3	2.3	2.3	2.3



ACTION TAKEN: ACADEMIC YEAR 2023-24 CURRICULUM FEEDBACK

Based on the alumni feedback analysis, few courses were introduced and some courses were revised in the curriculum under various category:

S.NO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Windows Server Administration Operating System	Program Elective	37 BOS- 03.01.2024
2	Office 365 Administration	Program Elective	37 BOS- 03.01.2024
3	Advanced Database Management System	Program Core	37 BOS- 03.01.2024
4	Advanced Data Structures And Algorithms	Program Core	37 BOS- 03.01.2024
5	Advanced Operating Systems	Program Core	37 BOS- 03.01.2024
6	Data Privacy And Security	Program Core	37 BOS- 03.01.2024
7	Intrusion Detection And Prevention Systems	Program Elective	37 BOS- 03.01.2024

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R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

School of Computing
Department of Information Technology
Alumni Survey

Academic Year : 2023-2024

Dear Alumni

The Department of Information Technology, requires feedback from you to measure whether the B- Tech (Information Technology) programme offered is sufficient in preparing the students to be a competent engineer for professional life after their graduation.

The objectives of the survey are:

(i) To improve the Curriculum and include the recent courses.

(ii) To measure the attainment of Program Outcomes (PO) and Program Specific Outcome(PSO) statements

We are grateful if you could spare some time to complete this survey.

Fill the following details and particulars for Alumni Survey

	a. Personal Information:	
1	Name	Jajoba Anuroop
2	Year of Graduation	2023
3	Roll No.	15674
4	Gender	M
5	Date of Birth	28/08/2002
6	e-mail ID, Contact No.	jajobaanurbop@gmail.com / 8501931101
7	Have you upgraded your education qualification? If yes, fill the below.	
	Degree/Specialization	B.Tech/Information Technology
	Year of Graduation	2023
	Institution	Veltech University
8	Are you pursuing any higher education? If yes If yes, fill the below	
	Degree/Specialization	MS/ Information Technology
	Year of Graduation	2025
	Institution	University of New Hampshire
9	Employment Details	
	Name of organization employed	
	Year of the appointment	
	Designation at the time of appointment	
	Current Designation	
	Total years of experience	
10	Are you Self employed? If yes, If yes, fill the below.	

1

	Name of organization owned					
	Establishment Year of your company					
	No. of Employees in the company					
	b. Curriculum Aspects:					
11	**To what extent is your current position related to your program of study?**					
	Kindly tick in the following boxes.	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓				
12	**How well do you think your undergraduate experience prepared you to**					
	Kindly tick in the following boxes.	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
	Be in your current position	✓				
	Pursue higher studies	✓				
	Be an effective leader	✓				
	Work effectively as a member of a team	✓				
13	**Have you received any Reward/Appreciation from employer? If yes, mention with reason**					
14	**Have you attended any outreach activities? If yes, mention the activities.**					
15	**If you want to improve your program of study or department, what would be your recommendations?**					
	More Real time practical knowledge					
16	PSO1: **Mathematical Concepts:** Equipped with the knowledge to infer the mathematical models for problem solving using data structures, design and analysis of algorithms.					
	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)	
		✓				
17	PSO2: **Software Development:** Exhibit proficiency to analyze, design and develop applications in various domains to provide solutions using innovative ideas					
	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)	
		✓				

2

18	PSO1: **Transferring Skills:** Demonstrate the ability to provide solutions for real world problems through Acquaintance and Hands-on training.				
	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓			
19	**Curriculum delivery to students is satisfied**				
	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
			✓		
20	**Allocations of the hours and credits to the courses are satisfied.**				
	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
			yes		
21	**Satisfied with the academic performance / ranking of our institution.**				
	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
			✓		
22	**Library and industry powered centre facilities for the courses are more than adequate in our Institution.**				
	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
			✓		
23	**Assessment pattern is satisfied for students to face university exam in confidence**				
	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
			✓		
24	**Electives offered in the syllabus are in relation to the technological advancements.**				
	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
			✓		
25	**Experiments in the lab courses are relation to the real life/time applications.**				
	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
			✓		
26	**To what extent did your experience as an undergraduate contribute to your knowledge, skills, and personal development in the following areas?**				
Careful reading: Comprehension and analysis of written texts within and across genres.	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓			
Critical thinking: Examination of ideas, evidence, and assumptions before accepting or formulating a conclusion.	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓			

Creative thinking: Developing or combining ideas, images, or expertise in innovative ways.	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓			
Information literacy: Locating, evaluating, and using information effectively and responsibly for a particular purpose.	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓			
Effective writing: Conveying accurate and compelling content in clear, expressive, and audience-appropriate prose.	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓			
Effective speaking: Conveying accurate and compelling content in clear, expressive, and audience-appropriate oral presentations.	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓			
Teamwork: Contributing to a team, facilitating the work of team members, and fostering a constructive team climate.	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓			
Problem solving: Designing, evaluating and implementing a strategy to answer questions or achieve a goal.	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓			
Civic engagement: Promoting the quality of life in a community, through both political and non-political processes	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓			
Intercultural knowledge and competence: Information, skills, and commitments that support effective and appropriate interactions in a variety of cultural contexts.	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓			
Ethical reasoning: Recognizing ethical issues, examining different ethical perspectives, and considering the ramifications of alternative actions.	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓			
Integrative thinking: The habit of connecting ideas and experiences, and the ability to transfer learning to novel situations.	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Satisfactory (1)
		✓			

Suggestions regarding Curriculum Improvement and List few courses that you wish to include in the B.Tech (Information Technology) programme which you think are important for building up a good career.

Big Data Analytics Course Can be included in Curriculum. Also Instead of Industry Collaborated Course for gaining Interview Skills.

Place: Chennai
Date: 03/11/2023

Signature: J Anuroop
Name and Designation
J Anuroop

School of Computing

Department of Information Technology

Industry Feedback on Curriculum 2023-2024

The Industry people are the most important stakeholders of B.Tech Information Technology Programme. Suggestions were collected in the form of feedback from them. Received 2 Industry feedback on curriculum and the major suggestions are listed below:

1. Curriculum can be more industrial/practical oriented.
2. Suggested to focus on office automation problems.
3. Courses must be improved based on current industry standard like ATOS courses.
4. Latest software delivery models like Agile, Scrum, Safe can be added to the existing syllabus
5. Improve training on programming languages like Python, Java and Dotnet.
6. Focus more on Hackathon programming practices and interdisciplinary aspects.
7. Suggested to include programming skill development courses in Value added category.

School of Computing

Department of Information Technology

Action Taken: Academic Year 2023-2024 Curriculum Feedback

Based on the Industry person feedback analysis few courses were introduced and some courses were introduced in the curriculum:

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Office 365 Administration	Program Elective	37th BOS, 3.1.2024
2	Windows Server Administration Operating Systems	Program Elective	37th BOS, 3.1.2024
3	Introduction to IBM z/OS and Mainframe Computers	Program Elective	37th BOS, 3.1.2024

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology

School of Computing
Department of Information Technology
Industrial Experts Feed Back on Curriculum

Date: 7/9/2023

Name : Sankaralingam T.
Designation : Technical leader
Industry : CISCO Systems

1. How do you rate the previous curriculum in alignment with the industry expectations?

Excellent / Good / Fair / Poor

2. What recommendations do you have for improving our curriculum for next regulation to meet the industrial expectation?

Include Adas Courses

3. Please recommend some content to enhance already existing syllabus

4. Please recommend some subject to include in the curriculum and syllabi

Subject name: Office 365 Administration
How the above subject helpful for students towards industry: Helpful for placements.
Subject name: Windows Server Administration OS
How the above subject helpful for students towards industry: Helpful for placement.

5. Are the Text books relevant and cover the contents of syllabus? Yes / No
If any correction needs please provide details
Subject Name:
Proposed Text Books :
1.
2.
3.

6. Are the Reference books relevant and cover the contents of syllabus? Yes / No
If any correction needs please provide details
Subject Name:
Proposed Text Books :
1.
2.
3.

7. List courses that can be added in elective subjects.

8. Any other suggestions.

1. Focus on office Automation problems.

Signature

School of Computing

Department of Information Technology

Employer Feedback on Curriculum 2023-2024

The employer are the most important stakeholders of B.Tech Information Technology Programme. Suggestions were collected in the form of feedback from the Employers. Received 3 employer's feedback on curriculum and the major suggestions are listed below:

1. Curriculum can be more industrial/practical oriented.
2. Suggested to include zero credit course in line with industry to impart skills.
3. Suggested to include courses to improve programming skills.
4. Recommended to train the students with basic subjects like Design and Analysis of algorithms, Data Structures, Database Management Systems and Java.
5. Suggested to include more lab integrated courses.

School of Computing

Department of Information Technology

Action Taken: Academic Year 2023-2024 Curriculum Feedback

Based on the Employer feedback analysis few courses were introduced and some courses were introduced in the curriculum:

SNO	COURSE NAME	CATEGORY	BOS REFERENCE
1	Code X	Value Added Category	37th BOS, 3.1.2024
2	Code Daksha	Value Added Category	37th BOS, 3.1.2024

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology

School of Computing
Department of Information Technology

Academic Experts Feed Back Form on Curriculum

Date: 3/1/24

Name : Dr NOOR Mahammad Sk
Designation : ASSOCIATE PROFESSOR
Organization : IIITDM Kancheepuram

1. How do you rate the previous curriculum quality?

   Excellent / Good / Fair

2. What recommendations do you have for improving our curriculum for next regulation?

   Institute is following good Approaches inline with Industry. Zero credit course is a Good Approach to Impart skills.

3. How is the pacing of the units? Does the scope and sequence for the unit have a natural flow? Yes / ~~No~~
   If any variations please give comments.
   Subject Name :
   Unit Number : We have provided during meeting.
   Variation :

4. Please provide comments on organization of units and contents.

   During meeting Discussed & Suggested.

5. Are the Text books relevant and cover the contents of syllabus. Yes / ~~No~~
   If any correction needs please provide details.
   Subject Name:
   Proposed Text Books : - NA -
   1.
   2.
   3.

6. Are the Reference books relevant and cover the contents of syllabus? Yes / No
   If any correction needs please provide details
   Subject Name:
   Proposed Text Books : - NA -
   1.
   2.
   3.

7. Give the list of courses that can be added in elective subjects.

   —

8. Any other suggestions.

   - NIL -

Signature

Annexure – IV

To discuss the **Course Structure** proposed in this BoS, to be offered in the programme B.Tech Information Technology unser the regulation VTR UGE 2021 keeping in view of National Education Policy (NEP) 2020, ACM IEEE, ACITE Model Curriculum, NASSCOM and Digital India Skills to be implemented with effect from the academic year Summer semester 2024-2025.

B.Tech - Information Technology
CURRICULUM
(CBCS)
Honors / Specialization
With effect from 2021-2022

Credits required for regular students in various course categories for B.Tech(IT)

The students shall earn 164 credits in various course categories given below for the award of degree of B.Tech (IT).

Course Category	Minimum Credits Required
Foundation Courses (FC)	56
Program Core (PC)	58
Program Elective (PE)	18
Open Elective (OE)	12
Independent Learning(IL)	14
Industry / Higher Institute Learning Interaction(IHL)	2
Professional Proficiency Courses (PPC)	4
TOTAL	**164**

Foundation Core (56 Credits)

Foundation courses enhance the knowledge, skills and attitude of UG engineering graduates of all programmes to the expected level. The foundation courses shall have the courses related to basic sciences and mathematics, basic engineering sciences and humanities and social sciences.

L-Lecture, T-Tutorial, P-Practical, C-credit

S.No	Course Code	Subject Title	Category	L	T	P	C
Lecture Courses							
1	10210MA101	Linear Algebra for Computing	BSC	3	1	0	4
2	10210MA102	Calculus & Ordinary Differential Equations	BSC	3	1	0	4
3	10210MA103	Probability, Statistics and Queuing Theory	BSC	3	1	0	4
4	10210PH101	Semiconductor Physics	BSC	3	0	0	3
5	10210CH101	Engineering Chemistry	BSC	3	0	0	3
6	10210CH104	Environmental Science and Sustainability	BSC	3	0	0	3
7	10210CS101	Problem Solving using C	ESC	3	0	0	3
8	10210CS102	Computational Thinking for Problem Solving	ESC	3	0	0	3
9	10210ME101	Design thinking	ESC	2	0	0	2
10	10210BM101	Biology for Engineers	ESC	2	0	0	2
11	10210ME103	Innovation & Entrepreneurship	ESC	2	0	0	2
12	10210ME102	Universal Human Values	HSC	3	0	0	3
13	10210ME104	Project Management & Finance	HSC	2	0	0	2
14	10210ME105	Engineers and Society	HSC	1	0	0	M
15	10210BL101	Constitution of India	HSC	1	0	0	M
Integrated Courses							
16	10210EN201	Professional Communication – I	HSC	1	0	2	2
17	10210EN202	Professional Communication – II	HSC	1	0	2	2
18	10210EE201	Basic Electrical, Electronics & Measurement Engineering	ESC	2	0	2	3

19	10210EE204	Introduction to Engineering	ESC	1	0	4	3
20	10210ME201	Engineering Graphics	ESC	1	0	4	3
Laboratory Courses							
21	10210PH301	Modern Physics Laboratory	BSC	0	0	2	1
22	10210CH302	Engineering Chemistry Laboratory	BSC	0	0	2	1
23	10210EE301	Engineering Products Lab	ESC	0	0	2	1
24	10210CS301	Problem Solving using C Lab	ESC	0	0	2	1
25	10210CS302	Computational Thinking laboratory	ESC	0	0	2	1
Total Credits							**56**

- BSC – Basic Science Courses, ESC – Engineering Science Courses, HSC – Humanities & Social Science Courses, M – Mandatory course

The Program Core Course Structure and course contents proposed

Program Core (58 Credits)

(2022-2023) Admitted batch onwards

L-Lecture, T-Tutorial, P-Practical, C-credit

S.No	Course Code	Course Name	L	T	P	C	Sem. No
		Theory Courses					
1	10211IT117	Data Structures and Algorithms	3	0	0	3	III
2	10211IT118	Modern Computer Architecture	3	0	0	3	III
3	10211IT119	Fundamentals of Computer Networks	3	0	0	3	III
4	10211IT120	Operating Systems Concepts	3	0	0	3	IV
5	10211IT121	Software Engineering	2	0	0	2	V
		Integrated Courses					
6	10211IT201	Database System Concepts	3	0	2	4	III

7	10211IT202	Introduction to Design and Analysis of Algorithms	3	0	2	4	IV
8	10211IT203	Programming using Python	2	0	2	3	IV
9	10211IT204	Artificial Intelligence Techniques	3	0	2	4	IV
10	10211IT205	Programming Using Java	3	0	2	4	V
11	10211IT206	Machine Learning Techniques	3	0	2	4	V
12	10211IT207	Big Data Analytics	3	0	2	4	V
13	10211IT208	Web and Mobile Application Development	3	0	2	4	VI
14	10211IT209	IoT and Cloud Computing	3	0	2	4	VI
15	10211IT210	Cyber Security	3	0	2	4	VI
		Laboratory Courses					
16	10211IT311	Data Structures and Algorithms Laboratory	0	0	2	1	III
17	10211IT312	Computer Networks Laboratory	0	0	2	1	III
18	10211IT313	Operating System Concepts Laboratory	0	0	2	1	IV
19	10211IT314	Competitive Coding-I	0	0	2	1	IV
20	10211IT315	Competitive Coding-II	0	0	2	1	V
		Total Credits				**58**	

B.Tech – INFORMATION TECHNOLOGY

CBCS CURRICULUM

Minimum credits required for Lateral Entry students in various course categories for B.Tech(IT) – VTR UGE 2021

The students shall earn 120 credits in various course categories given below for the award of degree of B.Tech (IT).

Program Structure

Course Category	Minimum Credits Required
Foundation Courses (FC)	22
Program Core (PC)	48
Program Elective (PE)	18
Open Elective (OE)	12
Independent Learning(IL)	14
Industry / Higher Institute Learning Interaction(IHL)	2
Professional Proficiency Courses (PPC)	4
TOTAL	**120**

B.Tech – INFORMATION TECHNOLOGY

CBCS CURRICULUM

VTR UGE 2021

Lateral Entry 2022-2023 Admitted Batch (2021-2022)

Foundation Core (22 Credits)

L-Lecture, T-Tutorial, P-Practical, C-credit

S.No	Course Code	Subject Title	Category	L	T	P	C
Lecture Courses							
1	10210MA103	Probability, Statistics and Queuing Theory	BSC	3	1	0	4
2	10210PH101	Semiconductor Physics	BSC	3	0	0	3
3	10210CS101	Problem Solving using C	ESC	3	0	0	3
4	10210ME101	Design thinking	ESC	2	0	0	2
5	10210ME103	Innovation & Entrepreneurship	ESC	2	0	0	2
6	10210ME102	Universal Human Values	HSC	3	0	0	3
7	10210ME104	Project Management & Finance	HSC	2	0	0	2
8	10210ME105	Engineers and Society	HSC	1	0	0	M
9	10210BL101	Constitution of India	HSC	1	0	0	M
Integrated Courses							
10	10210EN201	Professional Communication – I	HSC	1	0	2	2
Laboratory Courses							
11	10210CS301	Problem Solving using C Lab	ESC	0	0	2	1
Total Credits							**22**

B.Tech – INFORMATION TECHNOLOGY

CBCS CURRICULUM

VTR UGE 2021

Lateral Entry 2023-2024 Admitted Batch (2022-2023)

Foundation Core (22 Credits)

L-Lecture, T-Tutorial, P-Practical, C-credit

S.No	Course Code	Subject Title	Category	L	T	P	C
Lecture Courses							
1	10210CH104	Environmental Science and Sustainability	BSC	3	0	0	3
2	10210MA103	Probability, Statistics and Queuing Theory	BSC	3	1	0	4
3	10210ME101	Design thinking	ESC	2	0	0	2
4	10210BM101	Biology for Engineers	ESC	2	0	0	2
5	10210ME103	Innovation & Entrepreneurship	ESC	2	0	0	2
6	10210ME102	Universal Human Values	HSC	3	0	0	3
7	10210ME104	Project Management & Finance	HSC	2	0	0	2
8	10210ME105	Engineers and Society	HSC	1	0	0	M
9	10210BL101	Constitution of India	HSC	1	0	0	M
Integrated Courses							
10	10210EE204	Introduction to Engineering	ESC	1	0	4	3
Laboratory Courses							
11	10210EE301	Engineering Products Lab	ESC	0	0	2	1
Total Credits							**22**

Lateral Entry Admitted 2023-2024 Batch (2022-2023) onwards

Program Core (48 Credits)

S.No	Course Code	Course Name	L	T	P	C	Sem. No
		Theory Courses					
1	10211IT117	Data Structures and Algorithms	3	0	0	3	III
2	10211IT118	Modern Computer Architecture	3	0	0	3	III
3	10211IT119	Fundamentals of Computer Networks	3	0	0	3	III
		Integrated Courses					
4	10211IT201	Database System Concepts	3	0	2	4	III
5	10211IT202	Introduction to Design and Analysis of Algorithms	3	0	2	4	IV
6	10211IT203	Programming using Python	2	0	2	3	IV
7	10211IT204	Artificial Intelligence Techniques	3	0	2	4	IV
8	10211IT205	Programming Using Java	3	0	2	4	V
9	10211IT206	Machine Learning Techniques	3	0	2	4	V
10	10211IT207	Big Data Analytics	3	0	2	4	V
11	10211IT208	Web and Mobile Application Development	3	0	2	4	VI
12	10211IT209	IoT and Cloud Computing	3	0	2	4	VI
		Laboratory Courses					
13	10211IT311	Data Structures and Algorithms Laboratory	0	0	2	1	III
14	10211IT312	Computer Networks Laboratory	0	0	2	1	III
15	10211IT314	Competitive Coding-I	0	0	2	1	IV
16	10211IT315	Competitive Coding-II	0	0	2	1	V
		Total Credits				**48**	

Annexure-V

To discuss and approve **course contents of few Program Electives** are proposed in this BoS as per the list attached, to be offered in the programme B.Tech IT under the regulation VTR UGE 2021 with effect from Summer 2024-2025. (**Annexure-V)**

Program Electives (18 Credits)

Program Electives are the courses offered in the programme which covers depth and breadth. The students may register for appropriate electives offered in the programme based on their area of interest. One course under this category shall be taken from the list of approved MOOCs.

L-Lecture T-Tutorial P-Practical C-Credits

S. No	Course Code	Course Name	L	T	P	C
1	10212IT101	Cryptography and Network Security	3	0	0	3
2	10212IT102	Optimization Techniques	3	0	0	3
3	10212IT103	Information Coding Techniques*	3	0	0	3
4	10212IT104	High Performance Computing	3	0	0	3
5	10212IT105	Cognitive Computing*	3	0	0	3
6	10212IT106	Cryptocurrency and Blockchain Technologies*	3	0	0	3
7	10212IT107	Cyber Security Policy, Law & Ethics*	3	0	0	3
8	10212IT108	Robotic Process Automation	3	0	0	3
9	10212IT109	Reinforcement Learning	3	0	0	3
10	10212IT110	Software Testing and Automation*	3	0	0	3
11	10212IT111	Service Oriented Architecture*	3	0	0	3
12	10212IT112	UI and UX Design*	3	0	0	3
13	10212IT113	DevOps*	3	0	0	3
		Integrated Courses				
13	10212IT210	Data Visualization	3	0	2	4
14	10212IT211	Deep Learning	3	0	2	4
15	10212IT212	Natural Language Processing	3	0	2	4
16	10212IT213	Modelling for Data Science	3	0	2	4

17	10212IT214	Computer Graphics	3	0	2	4
18	10212IT215	Computer Vision	3	0	2	4
19	10212IT216	Web Security*	3	0	2	4
20	10212IT217	Virtual and Augmented Reality*	3	0	2	4
21	10212IT218	Internetworking With TCP/IP*	3	0	2	4
22	10212IT219	Ethical Hacking	3	0	2	4
23	10212IT220	Full Stack Web Development*	3	0	2	4

COURSE CODE	COURSE TITLE	L	T	P	C
10212IT101	Cryptography and Network Security	3	0	0	3

A. Preamble

The purpose of this course is to understand principles of encryption algorithms, conventional and public key cryptography. It also includes knowledge of authentication, hash functions and also application level of security mechanisms.

B.Prerequisite course

10211IT119 – Fundamentals of Computer Networks

C.Course Objectives:

Learners are exposed to:

- Understand the basics of cryptography, its techniques and principles
- Make use of mathematical concepts to apply the public key cryptography
- Utilize the authentication hash functions and digital signatures for security
- Organize various cryptographic standards to apply over security applications
- Identify the preventive security mechanisms for efficient security management

D.Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Understand the encryption and decryption techniques using block ciphers.	K2
CO2	Apply key exchange and management schemes using public key cryptography	K3
CO3	Demonstrate techniques to sign and verify messages using signature generation and verification algorithms.	K3
CO4	Implement cryptographic algorithm for various network security applications	K3
CO5	Illustrate the technologies to protect cyberspace against security threats	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											2		
CO2	3	2		3			2						3		
CO3	3	2		3			2						2		
CO4	2				1		2						3		
CO5	2	3		2	2										

High- 3; Medium-2; Low-1

F.Course contents

Unit 1 Introduction to Cryptography 9 Hours

OSI Security Architecture - Classical Encryption techniques – Cipher Principles – Data EncryptionStandard – Block Cipher Design Principles and Modes of Operation - Evaluation criteria for AES –AES Cipher – Triple DES – Placement of Encryption Function – Traffic Confidentiality-Case study on Barclays Bank

Unit 2 Public Key Cryptography 9 Hours

Number Theory concepts: Primes and Prime Factorization –Congruent modulo n, equivalent class modulo n, Integer modulo n, Multiplicative inverse, Relatively prime, Euler's theorem, Fermat's little theorem, Extended Euclidean Algorithm, Chinese Remainder Theorem. Confidentiality using Asymmetric Encryption – Public Key Cryptography and RSA- Key Management - Diffie-Hellman key Exchange – Elliptic Curve Architecture and Cryptography – Case study on Elan Financial Services

Unit 3 Authentication and Hash Function 9 Hours

Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm –Secure Hash Algorithm – RIPEMD – HMAC Digital Signatures – Authentication Protocols – Digital Signature Standard- Case study on Swedbank

Unit 4 Network Security Applications 9 Hours

Authentication Applications: Kerberos – X.509 Authentication Service – Electronic MailSecurity –PGP – S/MIME - IP Security- Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange, Authentication Header.

Unit 5 Security Management 9 Hours

Intrusion detection and Prevention System – password management – Viruses and related Threats – Virus Countermeasures- Worms Security Risks – Firewall Design Principles – Trusted Systems- Log Management. Case study on Biometric deployment for secure password management.

Total: 45 Hours

G.Learning Resources

i. Text Books:

1. William Stallings, ―Cryptography And Network Security – Principles and Practices, Prentice
2. Hall of India, Eighth Edition, 2020 [Unit 1-5].
3. David Kim and Michael G.Solomon, "Fundamentals of Information Systems Security", Jones and Bartlett Publishers, Third Edition, 2018 [Unit 1-5].

ii. References Books:

1. AtulKahate, ―Cryptography and Network Security, Tata McGraw-Hill, 2011.
2. Bruce Schneier, ―Applied Cryptography, John Wiley & Sons Inc, 2011.
3. Charles B. Pfleeger, Shari Lawrence Pfleeger, ―Security in Computing, Third Edition, Pearson Education, 2010.

iii. Online References

1. "Cryptography techniques", Accessed on: July 2022, [online]. Available: http://Cryptographywilliamstallings.com/Extras/Security-Notes/
2. "Authentication algorithms", Accessed on: July 2022 [online]. Available: http://www.cs.bilk.ent.edu.tr/~selcuk/teaching/cs519/
3. "Network security concepts", Accessed on: July 2022[online]. Available: http://freevideolectures.com/Course/3027/Cryptography–andNetwork-Security

Annexure- VI

To discuss and approve the **new Program Elective courses in various domains under Industry Institute Interaction(III) Intiatives collaboration of ATOS in the existing** B.**Tech IT curriculum under the regulation VTR UGE 2021** to be implemented with effect from the academic year Winter 2023-2024 in view of employability skills.

Specialization: 18 credits

Track: Artificial Intelligence and Machine Learning

S.No	Course Code	Course Name	L	T	P	C
1	10212IT101	Optimization Techniques	3	1	0	3
2	10212IT110	Reinforcement Learning	3	1	0	3
3	10212IT210	Data Visualization	3	0	2	4
4	10212IT211	Deep Learning	3	1	2	4
5	10212IT212	Natural Language Processing	3	0	2	4
6	10212IT215	Computer Vision	3	0	2	4

Track: Cloud Infrastructure Management

S.No	Course Code	Course Name	L	T	P	C
1	10212IT251	Virtualization Techniques	2	0	2	3
2	10212IT252	Windows Client Administration Operating System	2	0	2	3
3	10212IT253	Windows Server Administration Operating System	2	0	2	3
4	10212IT254	Cloud Fundamentals using Azure	2	0	2	3
5	10212IT255	Administering Microsoft Exchange Server*	2	0	2	3
6	10212IT256	Office 365 Administration	2	0	2	3

Track: Network and Server management

S.No	Course Code	Course Name	L	T	P	C
1	10212IT257	Data Center Hosting – Windows Operating System	2	0	2	3
2	10212IT258	Data Center Hosting – Unix Operating System*	2	0	2	3
3	10212IT259	Advanced Switching and Networking Techniques	2	0	2	3
4	10212IT260	Advanced Routing Techniques and Security	2	0	2	3
5	10212IT261	Juniper Networking Techniques*	2	0	2	3
6	10212IT262	Storage Management*	2	0	2	3

Track: Application Modernization Service Specialization

S.No	Course Code	Course Name	L	T	P	C
1	10212IT263	IIS Web Server Technologies	2	0	2	3
2	10212IT264	Application Server Technologies	2	0	2	3
3	10212IT265	Web Sphere Application Server.*	2	0	2	3
4	10212IT266	WebSphere MQ*	2	0	2	3
5	10212IT267	Middleware Technologies*	2	0	2	3
6	10212IT268	Database Administration Using MSSQL Server	2	0	2	3
7	10212IT269	Oracle Database Administration *	2	0	2	3

COURSE CODE	COURSE TITLE	L	T	P	C
10212IT256	Office 365 Administration	2	0	2	3

A.Preamble

This course focuses on the administration, configuration, troubleshooting and operations of the Microsoft Office 365 platform. It also make us to learn how to adjust user and subscription settings, configure Exchange mailboxes and groups, set up SharePoint sites, manage Microsoft Teams, and perform advanced configurations, such as multifactor authentication and PowerShell scripting.

B.Prerequisite Courses

- 10211IT119/10211IT108–Fundamentals of Computer Networks/ Computer Networks
- 10211IT120/ 10211IT108- Operating Systems Concepts/ Operating system

C.Course Objectives

Learners are exposed to

- Understand the basic concepts of Identity and Access Management,Zero Trust Security and user management.
- Learn how to develop and implement an effective security strategy.
- Equip students with the knowledge and skills needed to manage mobile devices and protect sensitive information in an organization.
- Equip students with the knowledge and skills needed to plan for and manage compliance requirements in Microsoft 365, including archiving and retention, content search and investigation, and data governance troubleshooting.

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Understand the fundamentals of Microsoft 365 and learn about Role Based AccessControl (RBAC)	K3
CO2	Analyze and identify gaps in current Microsoft 365 security posture using Secure Score.	K3
CO3	Compute Advanced Threat Analytics and learn to identify attacks using attack simulator in Microsoft 365.	K3
CO4	Manage and configure devices with MDM and domains for MDM.	K3
CO5	Create useful retention tags and retention policy.	K3

Knowledge Level (Based on revised Bloom's Taxonomy)
K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create

E.Correlation of Cos with Program Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												**2**	**2**	
CO2	2												**2**	**2**	
CO3	3	2	2										**2**	**2**	
CO4	3												**2**	**2**	
CO5	2	3	2										**2**	**2**	

High- 3; Medium-2; Low-1

F.Course Contents

UNIT I User and Group Protection L-6 Hours

User and Group Protection: Identity and Access Management Concepts-Zero Trust Security-User Accounts -Administrator Roles and Security Groups - Password Management in Microsoft 365-**Identity Synchronization**:Azure AD Connect-Planning- Implementation- Identity Protection -Managing Synchronized Identities - Federated Identities-**Access Management:**Conditional access-Manage device access-Role Based Access Control (RBAC)-Solutions for external access.

UNIT II Security in Microsoft 365 L-6 Hours

Threat vectors and data breaches-Security strategy, principles and solutions -Microsoft Secure Score.**Advanced Threat Protection:**Exchange Online Protection- Azure -Microsoft Defender-Advanced Office365 Threat Protection-Manage Safe Attachments and Links-**Threat Management:**Threat investigation and response-Azure Sentinel.

UNIT III Mobility and Information Protection L-6 Hours

Mobility: Plan for Mobile Application Management-**Mobile Device Management**-Plan, Deploy and Enroll Devices -**Information Protection**: Concepts - Azure protection-Advance Windows Information Protection.

UNIT IV Rights Management and Encryption L- 6 Hours

Rights Management and Encryption: Information Rights Management- S/MIME-Office 365 Message Encryption**, Data Loss Prevention:** An Overview- Create and Customize Policies-Policy Tips, **Cloud Application Security:** An Overview.

UNIT V Compliance in Microsoft L-6 Hours

Compliance in Microsoft 365: Plan for compliance requirements- Build ethical walls in Exchange Online-Manage Retention in Email-Troubleshoot Data Governance, **Archiving and Retention:** Archive-Retention and its policies -In-place Records Management in SharePoint-**Content Search and Investigation**- Overview-Audit Log Investigations-Advanced eDiscovery.

Total: 30 Hours

G.Laboratory Experiments

Part 1

TASK 1 To Discover and Manage Azure Resources to create, update, and delete resources in your Azure account.

- Assign Directory Roles
- Activate and Deactivate PIM Roles
- Directory Roles (General)
- PIM Resource Workflows
- View audit history for Azure AD roles in PIM.

TASK 2 Use Conditional Access to enable MFA to make the right decisions as well as to enforce effective organizational policies.

- MFA Authentication Pilot (require MFA for specific apps)
- MFA Conditional Access (complete an MFA roll out)

TASK 3 Use Microsoft Secure Score to measure an organization's security posture, with a higher number indicating more recommended actions taken.

- Improve your secure score in the Microsoft 365 Security Center.

TASK 4 Manage Microsoft 365 Security Services to assist organizations to detect threats early and help minimize the impact of a breach.

- Implement ATP Policies.

TASK 5 Using Attack Simulator

- Conduct a simulated Spear phishing attack to recognize and respond to these types of cyber threats.
- Conduct simulated password attacks to assess the security posture of an organization's user accounts and identify potential vulnerabilities.

TASK 6 Configure Azure AD for Intune to establish a secure and streamlined environment for managing and protecting devices, applications, and data within an organization.

- Enable Device Management to manage and secure the devices used by the employees to access O365 resources.
- Create Intune Policies to manage and protect corporate data, applications, and resources on various types of devices, including Windows, iOS, Android, and macOS.

TASK 7 Implement Azure Information Protection and Windows Information Protection

- Implement Azure Information Protection to enhance data protection and control by classifying, labeling, and protecting sensitive information in an organization
- Implement Windows Information Protection to protect sensitive data on Windows devices by applying security controls and preventing data leakage or unauthorized access.

TASK 8 Configure Advanced Threat Analytics to detect and prevent attacks.

TASK 9 Configure Office 365 Message Encryption to protect sensitive information in emails and other communications by encrypting them and ensuring that only authorized recipients can access them.

- Validate Information Rights Management

TASK 10 Implement Data Loss Prevention policies to protect an organization's sensitive and confidential data from being disclosed or lost.

- Manage DLP Policies
- Test MRM and DLP Policies

TASK 11 Compliance and Retention to ensure that an organization's data is managed, retained, and disposed of in a compliant and secure manner.

- Initialize Compliance
- Configure retention tags and policies

TASK 12 Manage Search and Investigation to ensure that an organization is in compliance with data protection regulations and to fulfill the rights of data subjects.

- Investigate your Microsoft 365 Data
- Conduct a Data Subject Request

Part-2

Use cases:

1. Initialize your trial tenant: Set up your Microsoft 365 tenant

An IT administrator for a small company has decided to migrate their email, document management, and collaboration tools to Microsoft 365. The goal is to set up the Microsoft 365 tenant to ensure that all users have access to the tools they need and can work together seamlessly.

Technologies used: Microsoft 365 Admin Center,Azure Active Directory (AD),Exchange Online,SharePoint Online.

2. Configure Privileged Identity Management

A large organization uses Azure for their cloud infrastructure management. The security administrator has given goal to configure PIM to manage privileged access to Azure resources, assign directory roles, activate and deactivate PIM roles, and view audit history for Azure AD roles in PIM.

Technologies used: Azure Active Directory (Azure AD),Azure AD Privileged Identity Management (PIM),Microsoft Cloud App Security,Azure Security Center,Azure Sentinel.

3. Set up your organization for identity synchronization

A medium-sized organization uses both the on-premises Active Directory (AD) and Microsoft 365 cloud services. The goal is to set up identity synchronization between on-premises AD and

Microsoft 365 to ensure that users can access all necessary resources with a single set of credentials.
Technologies used: Azure Active Directory Connect,Active Directory Federation Services (AD FS),Azure Active Directory Domain Services (Azure AD DS),Microsoft Identity Manager (MIM),Azure AD Connect Health.

4. **Use Conditional Access to enable MFA-MFA Authentication Pilot (require MFA for specific apps) and MFA Conditional Access (complete an MFA roll out).**

A large organization that uses Microsoft 365 for their cloud services wants to improve its security posture by enabling multi-factor authentication (MFA) for all users accessing Microsoft 365, but wants to do so in a phased approach.
Technologies used: Azure Active Directory (Azure AD),Azure AD Identity Protection,Microsoft Endpoint Manager.

5. **Improve your secure score in the Microsoft 365 Security Center**

John is the IT manager for a medium-sized company that uses Microsoft 365 for its email, document management, and collaboration needs. He has been tasked by the company's CEO to ensure that their Microsoft 365 environment is secure and compliant with industry regulations.
Technologies used: Microsoft Defender for Endpoint,Azure Active Directory (Azure AD),Microsoft Cloud App Security,Microsoft Secure Score,Microsoft Compliance Manager.

6. **Manage Microsoft 365 Security Services - Implement ATP Policies.**

A large organization that uses Microsoft 365 for their cloud services wants to improve its security posture by managing Microsoft 365 security services and implementing ATP policies.
Technologies used: Microsoft 365 Defender,Microsoft Azure Security Center,Microsoft Intune,Azure Active Directory (Azure AD),Microsoft Cloud App Security.

7. **Conduct a simulated Spear phishing attack and Conduct simulated password attacks Using Attack Simulator**

XYZ Corporation is a large multinational company with a workforce of over 10,000 employees. The company has experienced several cybersecurity breaches in the past, which have resulted in the loss of sensitive data and intellectual property. To improve its cybersecurity defenses, the company has decided to use Attack Simulator to conduct simulated spear phishing and password attacks.
Technologies used: Microsoft Defender for Office 365,Exchange Online Protection (EOP),Azure Active Directory (Azure AD),Multi-Factor Authentication (MFA),Attack Simulator.

8. Azure AD for Intune to Enable Device Management and Create Policies

ABC Corp is a large enterprise organization with a diverse mobile workforce. The organization has recently implemented a new mobile device management solution, Microsoft Intune, to help manage its mobile devices and protect sensitive company data.

Technologies used: Azure Active Directory (Azure AD),Microsoft Intune,Microsoft Endpoint Manager,Group Policy,PowerShell.

9. Implementing Azure Information Protection and Windows Information Protection

XYZ Corp is a medium-sized organization that handles sensitive customer data, financial information, and intellectual property. To ensure the security and confidentiality of this data, XYZ Corp has decided to implement Azure Information Protection (AIP) and Windows Information Protection (WIP).

Technologies used: Azure Information Protection,Microsoft 365 E5 or Enterprise Mobility + Security (EMS) E5,Windows 10,Active Directory Rights Management Services (AD RMS),PowerShell.

10. Configure Office 365 Message Encryption and Validate Information Rights Management

LMN Corp is a large organization that deals with confidential information such as client data, employee information, and financial reports. To ensure the confidentiality and privacy of this information, LMN Corp has decided to configure Office 365 Message Encryption and validate Information Rights Management (IRM).

Technologies used: Office 365 Message Encryption,Azure Information Protection,Exchange Online,Information Rights Management,PowerShell.

11. Implement Data Loss Prevention policies

ABC Corp is a large organization that handles sensitive data such as customer information, financial data, and confidential business strategies. To ensure the protection of sensitive data, ABC Corp has decided to implement Data Loss Prevention (DLP) policies and test both the DLP and Messaging Records Management (MRM) policies.

Technologies used: Microsoft 365 Compliance Center,Azure Information Protection,Exchange Online,SharePoint Online,PowerShell.

12. Initialize Compliance and Configure retention tags and policies

XYZ Corp is a large organization that deals with a large amount of data, including confidential customer information and financial records. To ensure compliance with data protection regulations and to manage data effectively, XYZ Corp has decided to initialize compliance and configure retention tags and policies.

Technologies used: Microsoft 365 Compliance Center,Exchange Online,SharePoint Online,Azure Information Protection,PowerShell.

13. Manage Search and Investigate your Microsoft 365 Data and Conduct a Data Subject Request

DEF Corp is a large organization that handles a large amount of data, including customer data and financial records. To manage data effectively and ensure compliance with data protection regulations, DEF Corp has decided to manage search and investigation, investigate Microsoft 365 data, and conduct a data subject request.

Technologies used: Microsoft 365 Security & Compliance Center,Microsoft 365 Compliance Manager,Microsoft 365 Audit Logs,Azure Information Protection,Third-party eDiscovery and compliance solutions.

Total: 30 Hours

G.Learning Resources (in IEEE Format)

i. Text Books:

1. Thomas, Orin. 'Windows server 2019 inside out". Microsoft Press, 2020.
2. Jordan Krause, "Mastering Windows Server 2019", Packt Publishing Limited; 2nd edition (18 March 2019)

ii. Reference Books:

1. William R. Stanek, Jr. Stanek, William R." Windows Server 2016: The Administrator's Reference", Createspace Independent Pub (1 September 2016)
2. Jason Eckert, "Hands-On Microsoft Windows Server 2019", (MindTap Course List), Cengage Learning; 3rd edition (June 5, 2020)

iii. Online References:

1. "Windows Server documentation" , Accessed on Apr. 04, 2023 [Online]. Available: https://learn.microsoft.com/en-us/windows-server/
2. "Microsoft Certified: Windows Server Hybrid Administrator Associate" Accessed on Apr. 04, 2023 [Online]. Available: https://learn.microsoft.com/en-us/certifications/windows-server-hybrid-administrator/

Annexure-VII

To discuss and approve the revision of **specialization Cloud Computing in the existing** B**.Tech (IT) curriculum under the regulation VTR UGE 2021** to be implemented with effect from the academic year Summer 2024-2025 in view of employability and Skill. **(Annexure-VII)**

Track: Cloud Computing

S.No	Course Code	Course Name	L	T	P	C
1	10212IT126	Distributed Computing	3	0	0	3
2	10212IT251	Virtualization Techniques	2	0	2	3
3	10212IT127	Network Fundamentals for Cloud *	3	0	0	3
4	10212IT128	Cloud Computing: Tools and Techniques	3	0	2	4
5	10212IT129	Cloud Security	3	0	0	3
6	10212IT128	Cloud Infrastructure & Services*	3	0	2	4
7	10212IT129	Cloud Architectures and Deployment in IoT *	3	0	2	4

COURSE CODE	COURSE TITLE	L	T	P	C
10212IT129	Cloud Security	2	0	2	3

A.Preamble

This course covers the basic concepts of cloud security along with the impacts and governance in infrastructure, data and systems, which are widely used in the design of cloud environment. The Infrastructure security has been categorized into Network, Host and application levels. The Identity and storage management in cloud along with the internal and external compliance of the cloud service providers. The issues related with multi-tenancy operation, virtualized infrastructure security and methods to improve virtualization security along with its applications along with examples are also dealt with in this course.

B.Prerequisite Courses

- 10211IT119/10211IT108–Fundamentals of Computer Networks/ Computer Networks

C.Course Objectives

Learners are exposed to

- Identify the basic concepts of cloud and its deployments
- Apply the different levels of security in cloud including Network, application and host level
- Utilize security and storage management principles along with the necessity of availability management
- Make use of the concepts of policies and governance associated with cloud and its associated applications
- Utilize the necessity of security as a cloud service and hypervisors

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Identify the basic concept of cloud computing.	K3
CO2	Apply the infrastructure security and data security in cloud	K3
CO3	Identify the concepts of security and storage management in cloud	K3
CO4	Make use of concepts about privacy, audit and compliance in cloud	K3
CO5	Utilize the security-as-a-cloud service and Hypervisor Risks-VM.	K3

Knowledge Level (Based on revised Bloom's Taxonomy)
K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create

E.Correlation of Cos with Program Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**1**	**1**		**1**											
CO2	**2**		**2**	**2**	**3**									**2**	
CO3	**2**	**2**	**2**	**2**	**3**	2	1	**1**			**1**				**2**
CO4	**2**	**2**			2	2		**1**			1				
CO5	**2**	**2**		**2**	**3**	**2**	**1**				**1**			**2**	

High- 3; Medium-2; Low-1

F.Course Contents

UNIT I Cloud Computing fundamenta — L-6 Hours

Cloud Computing: SPI Framework for Cloud Computing - Traditional Software Model - Cloud Services Delivery Model - Cloud Deployment Models – Virtual Private Cloud - Key Drivers to Adopting the Cloud- Impact of Cloud Computing on Users - Governance in the Cloud.

UNIT II Infrastructure security at Network, Host and application level — L- 6Hours

Infrastructure Security: Web application security – Web attacks - The Network Level: Ensuring Data Confidentiality, Integrity and availability – Amazon RDS - Network-Level Mitigation: SaaS and PaaS Host Security. Host Level: Virtualization Software Security- Threats to the hypervisor - Virtual Server Security: The Application Level: Application Security features and requirements - DoS and EDoS - End User Security – PortSwigger

UNIT III Security and Storage Mangement in Cloud — L-6 Hours

Security issues: Unauthorized exposure – Data leakage - Security Management Standards Security Management in the Cloud – Identity and access management - Cloud Security Vulnerability - Patch and Configuration Management – Key Management in cloud - Availability Management: SaaS, PaaS, IaaS - Storage as a Service (STaaS) – Amazon EBS and S3

UNIT IV Privacy, Audit and Compliance — L- 6 Hours

Privacy: Data Life Cycle-Key Privacy Concerns- Responsible for Protecting Privacy-Changes to Privacy Risk Management and Compliance -Legal and Regulatory Implication-U.S. Laws and Regulations - International Laws and Regulations. Audit and compliance: Internal Policy Compliance -Governance, Risk, and Compliance - Control Objectives for Cloud Computing Cloud Security Alliance -Auditing the Cloud for Compliance

UNIT V Security-as-a-cloud-service — L-6 Hours

Security-as-a-[cloud] service: Origins -Email Filtering - Web Content Filtering - Vulnerability Management- Identity Management-As-a-Service-Impact of cloud computing in corporate-Security policy implementation and Types- Hypervisor Risks-VM Security Recommendations.

Total: 30 Hours

G.Laboratory Experiments

Part 1

Task 1: Install the Oracle VM Virtual box hosted hypervisor and mount an open virtual appliance School of Computing Department of Computer Science & Engineering file over the existing operating system. Tools: Oracle VM

Task 2: Import Kali Linux and mount the instance in the Oracle VM virtual box for implementing SQL map to detect SQL based vulnerabilities in web application. Tools: Oracle VM, Kali Linux

Task 3: Perform the security testing of web applications to identify its attack vectors, using burp suite package imported through kali Linux in Virtual machine. Tools: Oracle VM, Kali Linux

Task 4: Perform a 2FA (two factor authentication) bypass using a brute force attack mechanism using portswigger tool by burpsuite. Tools: Portswigger, Burpsuite

Task 5: Perform a Forced Open authentication profile linking by implementing CSRF attack using Portswigger tool by burpsuite. Tools: Portswigger, Burpsuite

Task 6: Implement URL based and Method based access control in the portswigger tool to circumvent the access control process. Tools: Portswigger, Burpsuite

Task 7: Build a Virtual private cloud in amazon web services environment and launch a web server in the sandbox module of AWS. Tools: Amazon web services

Task 8: Launch an Elastic cloud 2 instance in the amazon web service environment, and manage the instance by modifying the security group, resizing the instance and termination protection processes. Tools: Amazon web services

Task 9: Establish an Amazon EBS volume, attach it to an instance, apply a file system to the volume, and then take a snapshot back up in the sandboxed AWS environment. Tools: Amazon web services

Task 10: Launch an Amazon relational database service and configure the database instance to get interacted with a web application ensuring high availability. Tools: Amazon web services

Total: 30 Hours

G.Learning Resources (in IEEE Format)

i. Text Books:

1. Tim Mather, Subra Kumaraswamy, Shahed Latif, “Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance” O'Reilly Media; 1 edition [ISBN: 0596802765], 2009.

ii. Reference Books:

2. Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, 201

iii. Online References:

3. Bob Dill, David Smits. (2022, Nov.) [Online]. Available: https://www.ibm.com/in-en/cloud/security [Accessed on 25.11.22]
4. Rana Khalil, Michael Sommer (2023, May) Port Swigger[Online]. Available: https://portswigger.net/web-security/sql-injection/lab-login-bypass [Accessed on 18.5.23]

Annexure-VIII

To discuss and approve the courses to be offered in **Online MOOCs** platforms under open Elective of B.Tech(IT) under regulation VTR UGE 2021 during the **Summer semester of academic year 2024-2025** for B.Tech(IT).

Open Elective - Online Courses

S.No.	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1.	10213IT424	Social Networks	NPTEL	12	3
2.	10213IT425	Google Cloud Computing Foundations	NPTEL	8	2

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10213IT424	**Social Networks**	**12**	**-**	**3**

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1: Introduction

Week 2: Handling Real-world Network Datasets

Week 3: Strength of Weak Ties

Week 4: Strong and Weak Relationships (Continued) & Homophily

Week 5: Homophily Continued and +Ve / -Ve Relationships

Week 6: Link Analysis

Week 7: Cascading Behaviour in Networks

Week 8: Link Analysis (Continued)

Week 9: Power Laws and Rich-Get-Richer Phenomena

Week 10: Power law (contd..) and Epidemics

Week 11: Small World Phenomenon

Week 12: Pseudocore (How to go viral on web)

Course Provider : NPTEL
Professor : Prof. Sudarshan Iyengar

University : IIT Ropar

Hours: 30

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10213IT425	Google Cloud Computing Foundations	8	-	2

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 0 : Introduction to the course

Week 1 : So, What's the Cloud anyway? Start with a Solid Platform

Week 2 : Use GCP to build your Apps

Week 3 : Where do I store this stuff?

Week 4 : There's an API for that! You can't secure the Cloud right?

Week 5 : It helps to network!

Week 6 : It helps to network (continued)

Week 7 : Let Google keep an eye on things. You have the data, but what are you doing with it?

Week 8 : Let machines do the work

Course Provider : NPTEL
Professor : Prof. Soumya Kanti Ghosh

University : IIT Kharagpur

Hours: 30

M. Tech Information and Cyber Security
CBCS VTRPGE2023

(With effect from 2023-2024)

Minimum credits required for regular students in various course categories for M. Tech Information and Cyber Security

The students shall earn 80 credits in various course categories given below for the award of degree of M.Tech (ICS).

Course Category	Minimum Credits Required – Regular
Program Core	34
Program Elective	18
Open Elective	03
Independent Learning i) Technical Writing Tools /Business English ii) Research Methodology	 02 02
Project Work i) Phase – I ii) Phase – II iii) Phase – III	 03 06 12
Total	**80**

Vel Tech RangarajanDr.Sagunthala R&D Institute of Science and Technology

Department of Information Technology
M. Tech Information and Cyber Security- CBCS VTRPGE2023
Program Core (34 Credits)

L – Lecture; T – Tutorial; P – Practical; C – Credits

S. No	Subject Code	Course Name	L	T	P	C
1	20231IT101	Probability and Statistics	4	0	0	4
2	20231IT102	Advanced Data Structures and Algorithms	4	0	0	4
3	20231IT103	Advanced Operating Systems	4	0	0	4
4	20231IT104	Advanced Database Management Systems	4	0	0	4
5	20231IT105	Cryptography and Network Security	4	0	0	4
6	20231IT201	Network Technologies	3	0	2	4
7	20231IT202	Artificial Intelligence	3	0	2	4
8	20231IT203	Vulnerability Assessment and Penetration Testing	3	0	2	4
9	20231IT301	Advanced Data Structures and Algorithms Laboratory	0	0	2	1
10	20231IT302	Advanced Operating Systems Laboratory	0	0	2	1
		Total				**34**

Program Elective (18 Credits)

L – Lecture; T – Tutorial; P – Practical; C – Credits

S. No	Subject Code	Course Name	L	T	P	C
1	20232IT201	Advanced Routing Techniques and Security	3	0	2	4
2	20232IT202	Cloud Security	3	0	2	4
3	20232IT203	Web and Mobile Application Security*	3	0	2	4
4	20232IT204	Incident Response and Threat Intelligence*	3	0	2	4
5	20232IT205	Cyber Security Policy, Law and Ethics*	3	0	2	4
6	20232IT206	Intrusion Detection and Prevention Systems	3	0	2	4
7	20232IT207	BlockChain Technology	3	0	2	4
8	20232IT208	Identity Access Management	3	0	2	4
9	20232IT209	Digital Forensics	3	0	2	4
10	20232IT210	Security Audit, compliance and Policy	4	0	2	4
11	20232IT211	Data Privacy and Security	3	0	2	4
12	20232IT212	Malware Analysis and Reverse Engineering	3	0	2	4

***The Courses content has yet to be added.**

Open Electives (3 Credits)

- Open electives are the courses offered across the schools to enhance the knowledge breadth and professional competency of the students. The students shall register for appropriate electives offered in other PG programmes based on their area of interest. The courses offered under this category cover the interdisciplinary/ transdisciplinary knowledge.
- One course (Three credits) of twelve weeks duration shall be taken from the courses offered by the online platform like Swayam, NPTEL.

L-Lecture, T-Tutorial, P-Practical, C-credit

S.No	Course Code	Course Name	L	T	P	C
1	20233IT4XX	Open Elective from NPTEL /Swayam	3	0	0	3

Independent Learning (4 Credits)

Students shall take online platform courses from NPTEL/Swayam/MooC.

L-Lecture, T-Tutorial, P-Practical, C-credit

S. No	Course Code	Course Name	L	T	P	C
1	20234IT4XX	Technical Writing Tools /Business English	**2**	**0**	**0**	**2**
2	20234IT4XX	Research Methodology	**2**	**0**	**0**	**2**

Project Work (21 Credits)

S. No	Course Code	Course Name	L	T	P	C
1	20234IT701	Project Phase 1	**-**	**-**	**-**	**3**
2	20234IT702	Project Phase 2	**-**	**-**	**-**	**6**
3	20234IT703	Project Phase 3	**-**	**-**	**-**	**12**

Mandatory

It is mandatory to present/publish at least one paper of the project work in the National/International conference or Scopus Indexed/UGC Care listed Journals.

Annexure-IX

To discuss and approve the **course structure and course contents** of Program Core and few Program Electives of **PG programme M.Tech Information and Cyber Security** under the regulation **VTR PGE 2023** keeping in view of AICTE and National Education Policy (NEP) 2020 and employability skills to be implemented with effect Summer 2024-2025.

Program Elective (18 Credits)

L – Lecture; T – Tutorial; P – Practical; C – Credits

S. No	Subject Code	Course Name	L	T	P	C
1	20232IT201	Advanced Routing Techniques and Security	3	0	2	4
2	20232IT202	Cloud Security	3	0	2	4
3	20232IT203	Web and Mobile Application Security*	3	0	2	4
4	20232IT204	Incident Response and Threat Intelligence*	3	0	2	4
5	20232IT205	Cyber Security Policy, Law and Ethics	3	0	2	4
6	20232IT206	Intrusion Detection and Prevention Systems	3	0	2	4
7	20232IT207	BlockChain Technology	3	0	2	4
8	20232IT208	Identity Access Management	3	0	2	4
9	20232IT209	Forensics in Cyber Security	3	0	2	4
10	20232IT210	Security Audit, compliance and Policy	4	0	2	4
11	20232IT211	Data Privacy and Security	3	0	2	4
12	20232IT212	Malware Analysis and Reverse Engineering	3	0	2	4

COURSE CODE	COURSE TITLE	L	T	P	C
20232IT201	Advanced Routing Techniques and Security	2	0	2	3

A. Preamble

This course covers network configuration, operation, and examining IPv4 and IPv6 networks. It also includes network access, IP connectivity, IP services, network security, automation, and programmability.

B. Prerequisite Courses

1. 20231IT201–Network Technologies

C. Course Objectives

Learners are exposed to

- Examine the Network Configuration.
- Design and optimize the various routing protocols.
- Implement various IP connectivity and services.
- Implement the remote access and authentication protocols.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Explain the role and function of Routing Configuration.	K3
CO2	Configure IP Routing.	K3
CO3	Interpret the IGRP and EIGRP.	K3
CO4	Dynamic Routing Protocols.	K3
CO5	Border Gateway Protocol.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of Cos with Program Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO 2
CO1	2	2	1				3	
CO2	2	3	2	1			3	

CO3	2	3	2	1			3	
CO4	2	2	2				3	
CO5	2	2	3	1			3	

High- 3; Medium-2; Low-1

F.Course Contents

Unit 1 Routing Configuration L - 9 Hours

Introduction: The Internal Components of a Cisco Router and Switch, The Router and Switch Boot Sequence, Configuring DHCP, DHCP Relay, Network Time Protocol, Configuring IP Routing, Static Routing, Default Routing, Dynamic Routing, Routing Protocol Basics, Routing Information Protocol.

Unit 2 IGRP and EIGRP L-9 Hours

IGRP (Interior Gateway Routing Protocol) - Configuration, Timers, Loop Avoidance Mechanisms. EIGRP (Enhanced Interior Gateway Routing Protocol) - Neighbors, Topology Table, Packet Types.

Unit 3 Dynamic Routing Protocols L- 9 Hours

OSPF (Open Shortest Path First) - Neighbors, Designated Routers, Network Types and Metric. Border Gateway Protocol (BGP) – Peers, Neighbors, Synchronization, Routing Table.

Unit 4 Introduction to Security L-9 Hours

Introduction: Security Trends; Overview of Firewall–Needs for Firewall and Types; Infrastructure security- Port Security, Access Control List, Device Hardening.

Unit 5 Remote Access and Authentication L- 9 Hours

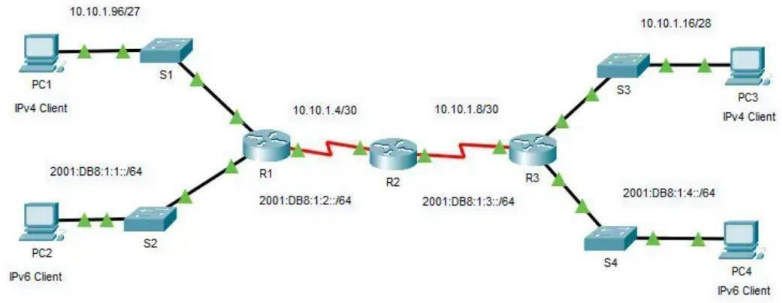
Introduction - Remote Access–Secure socket layer–VPN–IPSEC–Port Address Translator –Network Address Translator (NAT) –Access policies; Authentication: Authentication- Radius, AD, TACACS, Directory Access Protocol (DAP), Lightweight directory access protocol (LDAP), DAP, Link layer discovery protocol (LLDP).

Total: 45 Hours

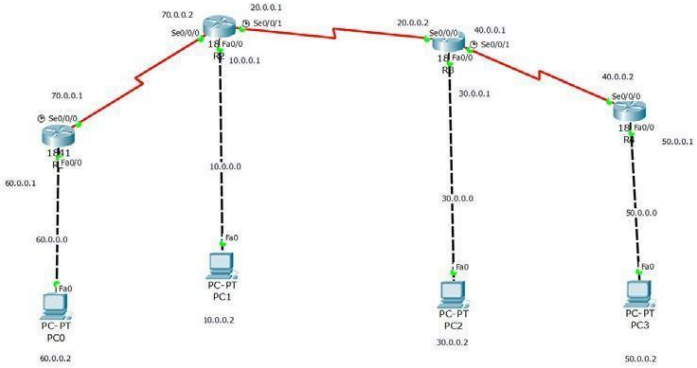
G. Laboratory Task: Total: 30 Hours

Task 1: Study of network command and configuration commands.

Task 2: Interpreting Ping and Traceroute Output.

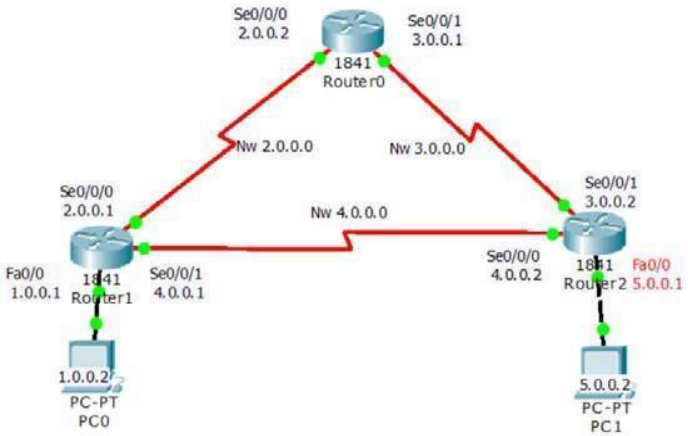


Task 3: Examining and observing Static and Dynamic Routing.

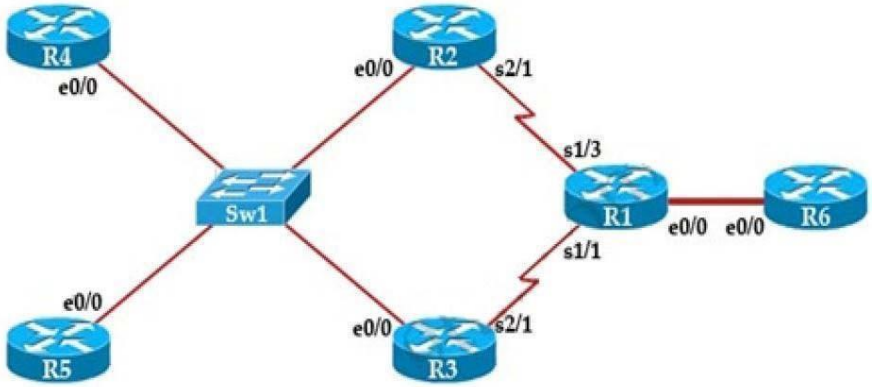


Task 4: Implementing and configuring a Default Route.

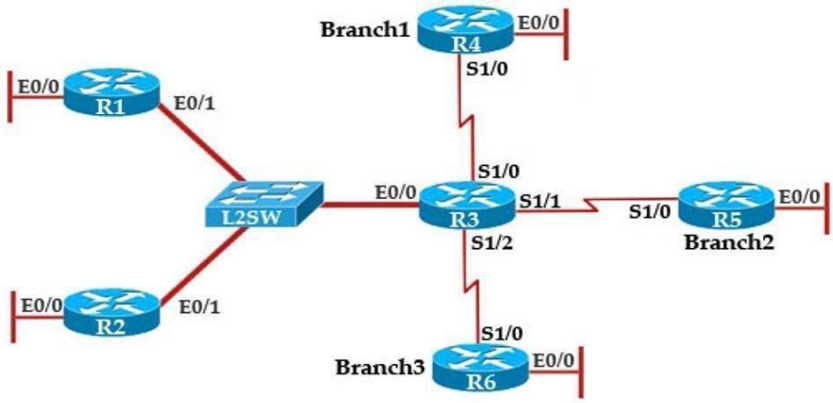
Task 5: Configuring RIP.



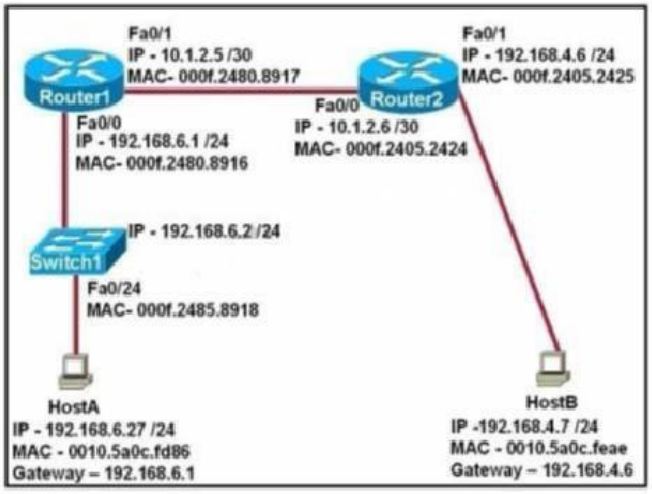
Task 6: The topology below is running EIGRP. You are required to troubleshoot and resolve the EIGRP issues between the various routers. Use the appropriate show commands to troubleshoot the issues.



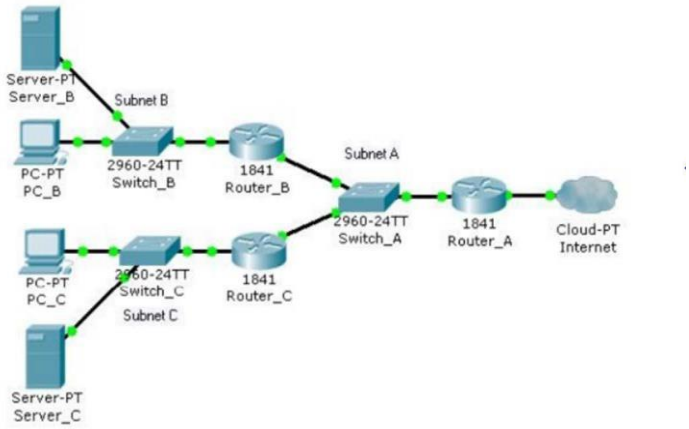
Task 7: The topology below is running OSPF. You are required to troubleshoot and resolve the OSPF issues between the various routers. Use the appropriate show commands to troubleshoot the issues.



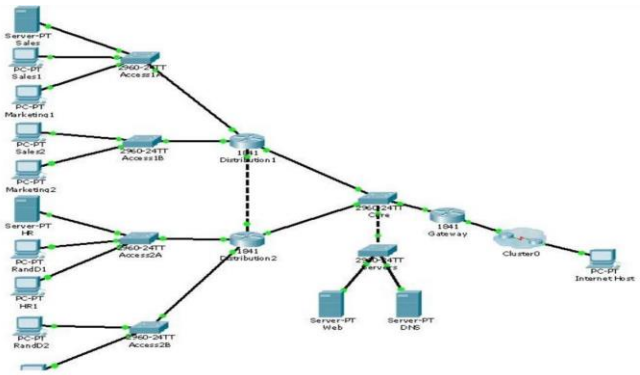
Task 8: After HostA pings HostB, which entry will be in the ARP cache of HostA to support this transmission?



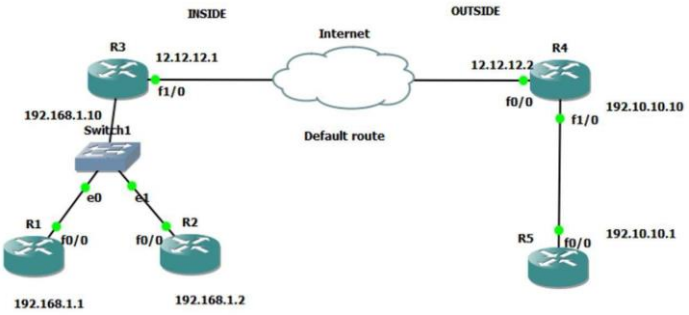
Task 9: Implement Firewall in The Given Network to Enhance Security.



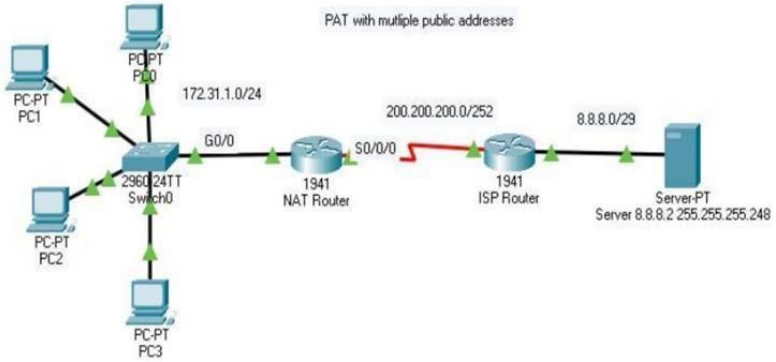
Task 10. Implement The ACLs and verify that the appropriate traffic is permitted or denied.



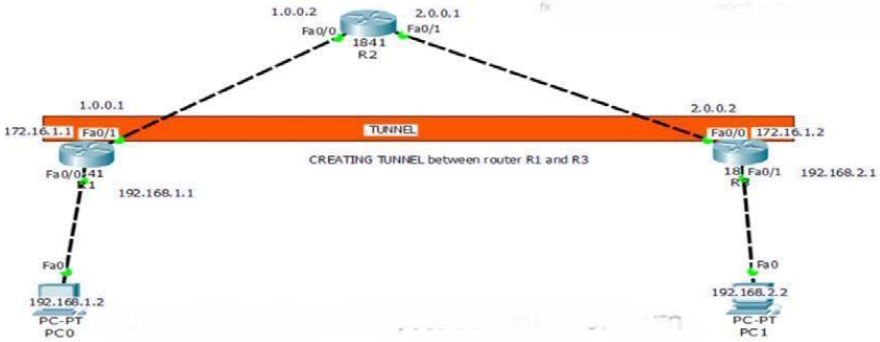
Task 11. Implement the Static NAT.



Task 12. Implement the Static PAT.



Task 13. Implement The VPNtunnels in the network using routers.



G. Learning Resources (in IEEE Format)

i. Text Books:

1. Behrouz Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 5th Edition, 2021.
2. Kurose and K.W. Ross, “Computer Networking: A Top-Down Approach Featuring the Internet”, Addison-Wesley, 2017

ii. Reference Books:

1. Richard Deal, “CCNA Cisco Certified Network Associate Study Guide”, DOI: 10.1036/0071497285.
2. Todd Lammle, “CCNA Routing and Switching Guide”, Sybex, 2016.

iii. Online References:

1. https://www.gratisexam.com/cisco/200-120/Cisco.Actualtests.200-120.v2014-02-12.by.GillBeast.299q.pdf
2. http://examsforall.com/exams/cisco/200-120/Cisco.Actualtests.200-120.v2013-12-09.by.Watson.314q.vce/#.ZD94AXZBzic
3. http://ppdi.stmik-banjarbaru.ac.id/data.bc/24.%20Mc%20Graw%20Hill%20Series/McGraw.Hill.Cisco.Certified.Network.Associate.Study.Guide.Ex.pdf

COURSE CODE	COURSE TITLE	L	T	P	C
20232IT202	Cloud Security	3	0	2	4

A.Preamble

This course covers the basic concepts of cloud security along with the impacts and governance in infrastructure, data and systems, which are widely used in the design of cloud environment. The Infrastructure security has been categorized into Network, Host and application levels. The Identity and storage management in cloud along with the internal and external compliance of the cloud service providers. The issues related with multi-tenancy operation, virtualized infrastructure security and methods to improve virtualization security along with its applications along with examples are also dealt with in this course.

B.Prerequisite Courses

- 20231IT105-Cryptography and Network Security

C.Course Objectives

Learners are exposed to

- Identify the basic concepts of cloud and its deployments
- Apply the different levels of security in cloud including Network, application and host level
- Utilize security and storage management principles along with the necessity of availability management
- Make use of the concepts of policies and governance associated with cloud and its associated applications
- Utilize the necessity of security as a cloud service and hypervisors

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Identify the basic concept of cloud computing.	**K3**
CO2	Apply the infrastructure security and data security in cloud	**K3**
CO3	Identify the concepts of security and storage management in cloud	**K3**
CO4	Make use of concepts about privacy, audit and compliance in cloud	**K3**

CO5	Utilize the security-as-a-cloud service and Hypervisor Risks-VM.	**K3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of Cos with Program Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	**1**	**1**		**1**				
CO2	**2**		**2**	**2**	**3**			**2**
CO3	**2**	**2**	**2**	**2**	**3**	2		
CO4	**2**	**2**			2	2		
CO5	**2**	**2**		**2**	**3**	**2**		**2**

High- 3; Medium-2; Low-1

F.Course Contents

UNIT I Cloud Computing fundamenta L-9 Hours

Cloud Computing: SPI Framework for Cloud Computing - Traditional Software Model - Cloud Services Delivery Model - Cloud Deployment Models – Virtual Private Cloud - Key Drivers to Adopting the Cloud- Impact of Cloud Computing on Users - Governance in the Cloud.

UNIT II Infrastructure security at Network, Host and application level L- 9 Hours

Infrastructure Security: Web application security – Web attacks - The Network Level: Ensuring Data Confidentiality, Integrity and availability – Amazon RDS - Network-Level Mitigation: SaaS and PaaS Host Security. Host Level: Virtualization Software Security- Threats to the hypervisor - Virtual Server Security: The Application Level: Application Security features and requirements - DoS and EDoS - End User Security – PortSwigger

UNIT III Security and Storage Mangement in Cloud L-9 Hours

Security issues: Unauthorized exposure – Data leakage - Security Management Standards Security Management in the Cloud – Identity and access management - Cloud Security Vulnerability - Patch and Configuration Management – Key Management in cloud - Availability Management: SaaS, PaaS, IaaS - Storage as a Service (STaaS) – Amazon EBS and S3

UNIT IV Privacy, Audit and Compliance L- 9 Hours

Privacy: Data Life Cycle-Key Privacy Concerns- Responsible for Protecting Privacy-Changes to Privacy Risk Management and Compliance -Legal and Regulatory Implication-U.S. Laws and Regulations - International Laws and Regulations. Audit and compliance: Internal Policy Compliance -Governance, Risk, and Compliance - Control Objectives for Cloud Computing Cloud Security Alliance -Auditing the Cloud for Compliance

UNIT V Security-as-a-cloud-service **L-9 Hours**

Security-as-a-[cloud] service: Origins -Email Filtering - Web Content Filtering - Vulnerability Management- Identity Management-As-a-Service-Impact of cloud computing in corporate-Security policy implementation and Types- Hypervisor Risks-VM Security Recommendations.

Total: 45 Hours

G.Laboratory Experiments

Part 1

Task 1: Install the Oracle VM Virtual box hosted hypervisor and mount an open virtual appliance School of Computing Department of Computer Science & Engineering file over the existing operating system. Tools: Oracle VM

Task 2: Import Kali Linux and mount the instance in the Oracle VM virtual box for implementing SQL map to detect SQL based vulnerabilities in web application. Tools: Oracle VM, Kali Linux

Task 3: Perform the security testing of web applications to identify its attack vectors, using burp suite package imported through kali Linux in Virtual machine. Tools: Oracle VM, Kali Linux

Task 4: Perform a 2FA (two factor authentication) bypass using a brute force attack mechanism using portswigger tool by burpsuite. Tools: Portswigger, Burpsuite

Task 5: Perform a Forced Open authentication profile linking by implementing CSRF attack using Portswigger tool by burpsuite. Tools: Portswigger, Burpsuite

Task 6: Implement URL based and Method based access control in the portswigger tool to circumvent the access control process. Tools: Portswigger, Burpsuite

Task 7: Build a Virtual private cloud in amazon web services environment and launch a web server in the sandbox module of AWS. Tools: Amazon web services

Task 8: Launch an Elastic cloud 2 instance in the amazon web service environment, and manage the instance by modifying the security group, resizing the instance and termination protection processes. Tools: Amazon web services

Task 9: Establish an Amazon EBS volume, attach it to an instance, apply a file system to the volume, and then take a snapshot back up in the sandboxed AWS environment. Tools: Amazon web services

Task 10: Launch an Amazon relational database service and configure the database instance to get interacted with a web application ensuring high availability. Tools: Amazon web services

Total: 30 Hours

G.Learning Resources (in IEEE Format)

Text Books:

1. Tim Mather, Subra Kumaraswamy, Shahed Latif, “Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance” O'Reilly Media; 1 edition [ISBN: 0596802765], 2009.

Reference Books:

1. Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, 201

Online References:

1. Bob Dill, David Smits. (2022, Nov.) [Online]. Available: https://www.ibm.com/in-en/cloud/security [Accessed on 25.11.22]
2. Rana Khalil, Michael Sommer (2023, May) Port Swigger[Online]. Available: https://portswigger.net/web-security/sql-injection/lab-login-bypass [Accessed on 18.5.23]

COURSE CODE	COURSE TITLE	L	T	P	C
20232IT205	Cyber Security Policy, Law and Ethics	4	0	0	4

A.Preamble

This course will enable the students to operate effectively in the cybersecurity governance arena, starting from introduction to cybersecurity by implementing frameworks and developing policy responses to issues that arise with respect to the cyber laws and regulations. The course will give deep insight about the changing nature of cybersecurity threats and the requirement for managers to maintain an up-to-date tool kit in relation to cyber law and policy. The significance of ethics in various cybersecurity applications are catered in this course.

B.Prerequisite Courses

- 20231IT105-Cryptography and Network Security

C.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Interpret the need of Cybersecurity policy and its operation	K3
CO2	Classify the cyber laws and the restrictions in cybersecurity	K3
CO3	Understand the Cybersecurity regulations and risk management	K3
CO4	Infer the vulnerabilities and threats in cybersecurity and exploitation	K3
CO5	Summarize the concept of cyber ethics, and the accountability standards	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E.Correlation of Cos with Program Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2		2					
CO2			2					
CO3		2	3					
CO4	2	2						
CO5								

High- 3; Medium-2; Low-1

F.Course Contents

Unit 1 Introduction to Cybersecurity 12 Hours

Essential Terminologies: The hierarchy of standards and policies – Need of Security Policies – Firewall Policy - Host Integrity policy - Service level agreement – Risk based approach – Information Gathering - Collection limitation principles – Transfer and accountability principles - Social Engineering. Case study: Scan a network and determine whether the remote host has a firewall enabled.

Unit 2 Cyber Laws 12 Hours

Introduction to Cyber Law - An Overview of Cyber law in India - Cybercrime and Legal perspectives - Need of Improvement in Indian Cyber Law - International perspective on Cyber Laws – Investigations on Cyber laws – Phases of digital crime investigation - Governance of cybercrime and the internet - Corporate policy- Policy framework – Intellectual property issues – Legal aspects of Digital contracts. Case study: Reporting of network breach in sensitive domains such as banks and their impact in cyber laws

Unit 3 Cyber Security Regulations 12 Hours

Introduction - Roles of International Law - the state and Private Sector in Cyberspace - Cyber Security Standards - National Cyber Security Policy - Continuous improvement principles - Privacy Acts- ISO/IEC 27,000 – Systrust – Webtrust – Statement on auditing standards 70 – Sabanes oxley Act – HIPAA - Information Technology Act -Information Security Governance and Risk Management – NIST: Standard reference data – National Vulnerability database
Case Study on implementation of secure architecture for financial services adhering to the regulations

Unit 4 Cybercrimes and laws 12 Hours

Introduction – Cyberattack - An Important Commonality for Exploitation and Attack - Inherent Vulnerabilities of Information Technology –Cyber Lawyers – Cyber law advantages – Two sides of cyber law – Computer crime and insecurity – IT amendment act 2008 – Role of Computer emergency response team (CERT) – Digital products and federal policy – Intellectual property rights considerations – Bayh-Dole Act – Patents and Trade secrets on digital products.

Unit 5 CyberEthics 12 Hours

Introduction to dimensions of cyberethics in cybersociety – Significance of Cyberethics- Corevalues and virtues – Cyberethics by norms, laws and relations – Artificial Intelligence Ethics: AI for good – Ethics in information society: Nine P's- CyberBullying – Limiting access of technology – Accountability and Liability. Case study: Analyse and judge the cybercrimes in e-commerce and social media.

Total: 60 Hours

G.Learning Resources (in IEEE Format)

Text Books:

1. Jeff Kosseff, "Cybersecurity Law", ISBN: 978-1-119-23150-9, Wiley Publicatons, 2017. (Unit II, III, IV)
2. David Clark, Thomas Berson and Herbert, "At the Nexus of Cybersecurity and public policy, Basic concepts and issues", National academic press, ISBN 13: 978-0-309-30318-7, 2014. (Unit I, IV)
3. Christopher Stuckelbergerc, Pavan Duggal, "Cyber Ethics 4.0, Serving humanities with values",Globalethics publications 4th edition, ISBN 978-2-88931-265-8 2018 (Unit V)

Reference Books:

1. Joakim Kavrestad, "Fundamentals of digital forensics, theory, methods, and real life applications", Second Edition, ISBN 978-3-030-38954-3, Springer, 2020

Online References:

1. "Cybersecurity". Accessed on: June 20, 2021 [Online]. Available: https://www.nap.edu/catalog/18749/at-the-nexus-of-cybersecurity-and-public-policy-some-basic.
2. "ISO 27000 standards". Accessed on: June 15, 2021 [Online]. Available: https://www.iso.org/standards.html.
3. "Cyber Conflicts". Accessed on: June 20, 2021 [Online]. Available: https://www.coursera.org/lecture/cyber-conflicts/introduction-to-cybercrime-and-fundamental-issues-xndSq.
4. "Cyber Laws". Accessed on: July 2, 2021 [Online]. Available: https://www.cyberlawsindia.net/2sides.html

COURSE CODE	COURSE TITLE	L	T	P	C
20232IT207	Blockchain Technology	3	0	2	4

A. Preamble

Blockchain technology has become popularly known because of its use in the implementation of Cryptocurrencies such as BitCoin, Ethereum. The technology itself holds much more promise in various areas such as time stamping, logging of critical events in a system, recording of transactions and trustworthy e-governance. This course covers the technical aspects of public distributed ledgers, blockchain systems, cryptocurrencies, and smart contracts. Students will learn how these systems are built, how to interact with them, how to design and build secure distributed applications.

B. Prerequisite Courses

20231IT201–Network Technologies

C. Course Objectives

Learners are exposed to

Access blockchain applications in a structured manner.

Impart knowledge in block chain techniques and able to present the concepts clearlyand structured. To get familiarity with future currencies and to create own crypto token.

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Explain Blockchain with types of consensus mechanisms and protocol	K2
CO2	Illustrate the concepts of Cryptocurrency and Smart Contracts to build blockchain	K3
CO3	Construct Public, Private and **Consortium** Blockchain System for real time implementation	K3
CO4	Use **Initial Coin Offering, security** and privacy in blockchain with Hyperledger Fabric	K3
CO5	Implement Blockchain applications in real time using solidity.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of Cos with Program Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
CO1	2														
CO2	3	3											2		
CO3		3													
CO4					3										
CO5			3		3									3	

High- 3; Medium-2; Low-1

F. Course Contents

Unit 1 Introduction to Blockchain, Types and Consensus Mechanism 9 Hours

Fundamentals of Blockchain- Introduction - Origin of Blockchain -Blockchain Solution - Components of Blockchain - Block in a Blockchain - Technology and the Future**Blockchain Types and Consensus Mechanism -** Introduction - Decentralization and Distribution - Types of Blockchain - Consensus Protocol

Unit 2 Cryptocurrency and Smart Contracts 9 Hours

Cryptocurrency – Bitcoin, Altcoin and Token -Bitcoin and the Cryptocurrency-Cryptocurrency Basics - Types of Cryptocurrencies - Cryptocurrency Usageb**Smart Contracts -** Characteristics of a Smart Contract - Types of Smart Contracts -Types ofOracles - Smart Contracts in Ethereum - Smart Contracts in Industry

Unit 3 Types of Blockchain 9Hours

Public Blockchain System - Popular Public Blockchain - Bitcoin Blockchain -Ethereum Blockchain **Private Blockchain System -** Key Characteristics of Private Blockchain – Need of Private Blockchain -Private Blockchain Examples- Private Blockchain and Open Source - Various Commands (Instructions) in E-commerce Blockchain -Smart Contract in Private Environment -State Machine -Different Algorithms of Permissioned Blockchain -Byzantine Fault - Multichain**Consortium Blockchain -** Key Characteristics of Consortium Blockchain -Need of ConsortiumBlockchain - Hyperledger Platform -Overview of Ripple - Overview of Corda

Unit 4 Security and Application of Blockchain 9 Hours

Initial Coin Offering - Blockchain Fundraising Methods -Launching an ICO - Investing in an ICO - Pros and Cons of Initial Coin Offering - Successful Initial Coin Offerings - Evolution of ICO - ICO Platforms S**ecurity in Blockchain -** Security Aspects in Bitcoin -Security and Privacy Challenges of Blockchain in General - Performance and Scalability –Identity

Management and Authentication Regulatory Compliance and Assurance -Safeguarding Blockchain Smart Contract (DApp) - Security Aspects in Hyperledger Fabric.

Unit 5 Development Tools and Frameworks **9 Hours**

Blockchain Ethereum Platform using Solidity - Remix IDE -Structure of a Smart Contract Program -Using Remix to Write and Run a Solidity Program – Modifiers – Events - Arrays in Solidity - Function Visibility - Variable Visibility - Function Modifier Keyword -How Funds Are Accepted - Fallback Function - Contract Inheritance -Contract Communicating with Another Contract - External Libraries - ERC20 Token Transfer - Error Handling in Solidity - Application Binary Interface (ABI) - Swarm (Decentralized Storage Platform) -Whisper (Decentralized Messaging Platform)

Total: 45 Hours

G. Laboratory Experiments **Total: 30 Hours**

Task1: Creating Meta Mask wallet and crypto

- Meta Mask Setup
- Deposit the Crypto
- Make a Transaction and Extracting the transaction details
- Ethereum Transaction

Tool: Meta Mask

Task 2:Implement the Smart Contract using Remix, Solidity

- Working With Variables
- Sending Money
- Starting, Pausing, Stopping and Deleting transaction
- Mapping and Struct
- Error Handling
- View/Pure, Receive Function and Fallback Function
- Inheritance, Modifier and Importing
- Events and Return Variables

Tool: Remix, Solidity

Task 3: Installation and Configuration of Node.js and Web3.js

- Transfer Ether
- Interacting with Smart Contract
- Using Web3.js with Chrome to Interact with Smart Contracts

Tool: Node.js and Web3.js

Task 4: Creating the Hyper Ledger Fabric using solidity

- Create the Fabric Test Network
- ringing up the test network
- Creating a channel
- Starting a chain code on the channel
- Interacting with the network
- Bringing down the network

Tool: Node.js and Web3.js

Task 5: Creating the Shared Wallet using solidity

Task 6: Deploying MEW with Ganache

Task 7: Establish the transaction using Remix with Ganache

Tool: Remix with Ganache
Part 2
Use cases:

Use Case 1: Retail - Establishing unconditional transparency in the food supply chain using blockchain Hyperledger fabric

Use Case 2: Banking and Financial Services – Increasing transaction volume and network resilience while maintaining confidentiality requirements for real time gross settlement among different banks of a central banking consortium

Use Case 3: Healthcare - Electronic health records and medical research data digitization

Use Case 4: Energy and Utilities – Renewable energy trading which are locally owned deliver benefits that are environmentally relevant for the communities involved

Use Case 5: Blockchain in Real-estate – The real estate market currently faces several issues related to housing affordability, rising rate and economy, many of which cannot be addressed with blockchain

H. Learning Resources

i. Text Books:

1.Chandramouli Subramanian, Asha A George, Abhilash K A and MeenaKarthikeyan, “Blockchain Technology”, Universities Press,2021(Unit1-Unit5)

2.Imran Bashir, “Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained”, Birmingham – Mumbai: Packt, 2nd Edition Kindle, 2018 (Unit1&2)

ii. Reference Books:

1. Narayanan, Arvind, et al. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction. Princeton University Press, 2016.

2.Antonopoulos, Andreas M. Mastering Bitcoin: Programming the Open Blockchain. O'Reilly Media, Inc., 2017.

3.Antonopoulos, Andreas M. and Wood, Gavin. Mastering Ethereum. O'Reilly Media, Inc., 2018.

iii.Web Resource(s):

1.Ethereum project documentation", Jan 21 2016, Accessed on: Jan 21 2016 [Online]. Available: https://ethdocs.org/en/latest/

2."Monero Research Lab papers" 01 April2014, Accessed on: 01 April 2014 [Online].Available: https://www.getmonero.org/resources/research-lab/

3. "ZCash documentation", 10 Jan 2021 Accessed on: 10 Jan 2021 [Online]. Available:https://z.cash/

COURSE CODE	COURSE TITLE	L	T	P	C
20232IT209	Forensics in Cyber Security	3	0	2	4

A.Preamble

Forensics in cyber security is a specialized course in the stream of Computer Science & Engineering. This Course gives the comprehensive understanding of computer forensics and investigation tools and techniques in acquisition, recovery, documentation, and analysis of information contained within and created with computer systems and computing devices. Digital evidence methods and standards, techniques and standards for preservation of data, application forensics, web forensics, network forensics, mobile device forensics, and information security audit. This course discusses about various tools, incident response, report writing and gives the introduction about the different digital forensics methods such as network forensics, email forensics, cloud forensics

B.Prerequisite Courses

- 20231IT105-Cryptography and Network Security

C.Course Objectives

Learners are exposed to

- Identify the basic concepts of cloud and its deployments
- Apply the different levels of security in cloud including Network, application and host level
- Utilize security and storage management principles along with the necessity of availability management
- Make use of the concepts of policies and governance associated with cloud and its associated applications
- Utilize the necessity of security as a cloud service and hypervisors

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Outline and Explore the fundamentals of cyber forensic analysis.	K3
CO2	Infer and conduct basic network forensic analysis	K3
CO3	Classify the evidence acquisition and forensics duplication	K3
CO4	Evaluate and validate the types of Forensic tools	K3
CO5	Detect cyber security incidents and its response	K3

Knowledge Level (Based on revised Bloom's Taxonomy)
K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create

E.Correlation of Cos with Program Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	1	1		1				
CO2	2		2	2	3			2
CO3	2	2	2	2	3	2		
CO4	2	2			2	2		
CO5	2	2		2	3	2		2

High- 3; Medium-2; Low-1

F.Course Contents

UNIT I Forensic Science L-9 Hours

Principles and Methods: Scientific approach to Forensics, Identification and Classification of Evidence, Location of Evidence: Storage Media, Hard drives, Hardware Interfaces, Recovering Data, Media File Forensic Steps-Forensic Analysis: Planning, Case Notes and Reports, Quality Control

UNIT II Network Forensics L- 9 Hours

Network forensics overview-Securing a Network- Developing procedures for network forensics-Investigating virtual networks-Examining Honeynet projects-E-mail Investigations: Role of client and server in E-mail, Investigating E-mail crimes and violations, E-mail Servers, E-mail Forensic tools.

UNIT III Digital Forensics Approach and Duplication L-9 Hours

Introduction to Forensic Duplication - Rulesof Forensic Duplication (Thumb Rule) - Necessity of Forensic Duplication - Forensic Duplicates as Admissible Evidence - Important Terms in Forensic Duplicate - Forensic Duplication ToolRequirements - Creating a Forensic Duplicate of a Hard Drive - Creating a Qualified ForensicDuplicate of a Hard Drive.

UNIT IV Forensics Tools L- 9 Hours

Evaluating Forensics Tool Needs- Tasks performed by forensics tools- Forensics Software Tools: Command-line forensic tools, Linux forensic tools- Forensics Hardware Tools: Forensic workstation, Write-Blocker- Validating and Testing Forensics Software

UNIT V Incidence Response and Tool **L-9 Hours**

Incidence Response Goals of Incident Response - People Involved in Incident Response Process - Incident Response Methodology - Activities in Initial Response - Phases after Detection of an Incident - Report Writing and Presentation - Tools: Internet and E-Mail Examinations - Mobile Forensics Tools – Write Blockers -Imaging – Visual Analysis – Secured Storage – Damaged Media.

Total: 45 Hours

G.Laboratory Experiments

Part 1

Task1: Study of Computer Forensics and different tools used for forensic investigation.

Task 2: To extract Exchangeable image file format (EXIF) Data from Image Files.

Task 3: Forensics Case Investigation using live data

Task 4: To Recover Deleted Files using Forensics Tools

Task 5: To Find Last Connected USB on your system

Task 6: To View Last Activities on Your PC

Task7: To analyze network-related incident

Task 8: To make the forensic image of the hard drive to find the suspicious activity

Task 9: To Restore the Evidence Image to find criminal activity

Task 10: To hide and extract any text file behind an image file/ Audio file using Comma

Task 11: To capture the physical memory of a computer and analyze artifacts in memory

Task 12: To Collect Email Evidence in Victim PC

Part 2

Use Cases:

Use case 1: You are on-site, conducting a preliminary examination of a Linux system. The hardware suite includes a 56KB modem. What areas of search should be included in your examination? Prepare an examination plan that details what you will look for, and why.

Use case 2: You receive a Windows OS X system and are asked to summarize the applications and data on the hard drive. In addition, you are asked to report any recent system usage and any signs of encryption, external storage media, or clock tampering.

Use case 3: As a security investigator, you have been asked to determine if company confidential information (intellectual property) has been copied from enterprise computers. Investigation

centers on a particular computer that has shown a high volume of network traffic at unusual times. In the course of conducting your investigation you discover that large capacity removable media has been attached to the suspect computer. A preview examination reveals that software used for secure deletion had been downloaded to the desktop. Prepare an investigative plan listing the lines of investigation that you plan to pursue.

Use case 4: A large accounting MNC company is going to audit certain activities by officers of a medium size, publicly traded bank. During the investigation, the appointed auditor needed to examine several computer systems used by certain Bank employees. After collecting the evidence, the digital forensic examiners were immediately dispatched and sent in to arrange for the formal investigation of those systems to search for corroborating evidence in support of the audit team's suspicions and findings.

Use case 5: Discover you have known the existence of threatening e-mails being sent to the CEO of your company at that time predict will you do the examination of the e-mails revealed that they originated from outside of the country? Describe the steps you would take in your investigation. In particular, address the issue of jurisdiction and locating your counterparts in the target country.

Total: 30 Hours

G.Learning Resources (in IEEE Format)

iv. Text Books:

1. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" O'Reilly Media; 1 edition [ISBN: 0596802765], 2009.

v. Reference Books:

1. Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, 201

vi. Online References:

1. Bob Dill, David Smits. (2022, Nov.) [Online]. Available: https://www.ibm.com/in-en/cloud/security [Accessed on 25.11.22]
2. Rana Khalil, Michael Sommer (2023, May) Port Swigger[Online]. Available: https://portswigger.net/web-security/sql-injection/lab-login-bypass [Accessed on 18.5.23]

Annexure – X

To discuss and approve the courses to be offered in Online MOOCs platforms under **Open Elective** during Summer 2024-2025 for PG programme.M.Tech-ICS **(Annexure-X)**

S.No.	Course Code	Course Name	Course Provider	Duration in weeks	Credits
1.	20233IT407	Deep Learning for Computer Vision	NPTEL	12	3
2.	20233IT408	Responsible & Safe AI Systems	NPTEL	12	3
3.	20233IT409	Digital Image Processing	NPTEL	12	3

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
20233IT407	Deep Learning for Computer Vision	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1: Introduction and Overview:

● Course Overview and Motivation; History of Computer Vision; Image Representation; Linear Filtering, Correlation, Convolution; Image in Frequency Domain

● (Optional) Image Formation; Image Sampling

Week 2: Visual Features and Representations:

● Edge Detection; From Edges to Blobs and Corners; Scale Space, Image Pyramids and Filter Bank; SIFT and Variants; Other Feature Spaces

● (Optional) Image Segmentation, Human Visual System

Week 3: Visual Matching:

● Feature Matching; From Points to Images: Bag-of-Words and VLAD Representations; Image Descriptor Matching; From Traditional Vision to Deep Learning

● (Optional) Hough Transform; Pyramid Matching

Week 4: Deep Learning Review:

● Neural Networks: A Review; Feedforward Neural Networks and Backpropagation; Gradient Descent and Variants; Regularization in Neural Networks; Improving Training of Neural Networks

Week 5: Convolutional Neural Networks (CNNs):

● Convolutional Neural Networks: An Introduction; Backpropagation in CNNs; Evolution of CNN Architectures for Image Classification; Recent CNN Architectures; Finetuning in CNNs

Week 6: Visualization and Understanding CNNs:

● Explaining CNNs: Visualization Methods; Early Methods (Visualization of Kernels; Backprop-to-image/Deconvolution Methods); Class Attribution Map Methods (CAM,Grad-

CAM, Grad-CAM++, etc); Going Beyond Explaining CNNs

● (Optional) Explaining CNNs: Recent Methods

Week 7: CNNs for Recognition, Verification, Detection, Segmentation:

● CNNs for Object Detection; CNNs for Segmentation; CNNs for Human Understanding: Faces

● (Optional) CNNs for Human Understanding: Human Pose and Crowd; CNNs for Other Image Tasks

Week 8: Recurrent Neural Networks (RNNs):

● Recurrent Neural Networks: Introduction; Backpropagation in RNNs; LSTMs and GRUs; Video Understanding using CNNs and RNNs

Week 9: Attention Models:

● Attention in Vision Models: An Introduction; Vision and Language: Image Captioning; Self-Attention and Transformers

● (Optional) Beyond Captioning: Visual QA, Visual Dialog; Other Attention Models

Week 10: Deep Generative Models:

● Deep Generative Models: An Introduction; Generative Adversarial Networks; Variational Autoencoders; Combining VAEs and GANs

● (Optional) Beyond VAEs and GANs: Other Deep Generative Models

Week 11: Variants and Applications of Generative Models in Vision:

● GAN Improvements; Deep Generative Models across Multiple Domains; Deep Generative Models: Image Application

● (Optional) VAEs and Disentanglement; Deep Generative Models: Video Applications

Week 12:Recent Trends:

● Few-shot and Zero-shot Learning; Self-Supervised Learning; Adversarial Robustness; Course Conclusion

● (Optional) Pruning and Model Compression; Neural Architecture Search

Course Provider	**:**	NPTEL
Professor	**:**	Prof. Vineeth N Balasubramanian
University	**:**	IIT Hyderabad

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
20233IT408	**Responsible & Safe AI Systems**	**12**	**-**	**3**

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1 & 2:

- AI Capabilities Improvement in last 5-10 years
- Imminent risks from AI Models: Toxicity, bias, goal misspecification, adversarial examples etc.
- Long-term risks from AI Models: Misuse, Misgeneralization, Rogue AGI
- Principles of RAI - Transparency; Accountability; Safety, Robustness and Reliability;Privacy and Security; Fairness and non-discrimination; Human-Centred Values; Inclusive and Sustainable development, Interpretability
- Recap of Deep Learning Techniques, Language/Vision Models
- AI Risks for Gen models
- Adversarial Attacks – Vision, NLP, Superhuman Go agents

Week 3 & 4:

- ML Poisoning Attacks like Trojans
- Implications for current and future AI safety
- Explainability
- Imminent and Long-term potential for transparency techniques
- Mechanistic Interpretability
- Representation Engineering, model editing and probing
- Critiques of Transparency for AI Safety

Week 5 & 6:

- Privacy & Fairness in AI

Week 7 & 8:

- Metrics and Tools for RAI - measuring bias/fairness, adversarial testing, explanations (Lime/SHAP/GradCam), audit mechanisms
- Regulation landscape - DPDP act (India), GDPR (EU), EU AI act, US presidential declaration, Ethical approvals, informed consent, participatory design, future of work, Indian context
- What is AGI? When could it be achieved?
- Instrumental Convergence: Power Seeking, Deception etc.

Week 9 & 10:

- RAI in Legal domain
- RAI in Health care domain
- RAI in Education domain
- A few other domains
- Policy issues in RAI

Week 11 & 12:

- Couple of panel discussion with industry practitioners, academic, government (possibly), and others.
- Fireside chat with eminent personalities
- Recorded Paper reading discussion

Course Provider : NPTEL
Professor : Prof Ponnurangam Kumaraguru

Prof Balaraman Ravindran
Prof Arun Rajkumar

University : IIIT Hyderabad
IIT Madras

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
20233IT409	Digital Image Processing	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Contents

Week 1: Introduction and signal digitization

Week 2: Pixel relationship

Week 3: Camera models & imaging geometry

Week 4: Image interpolation

Week 5: Image transformation

Week 6: Image enhancement I

Week 7: Image enhancement II

Week 8: Image enhancement III

Week 9: Image restoration I

Week 10: Image restoration II & Image registration

Week 11: Colour image processing

Week 12: Image segmentation

Week 13: Morphological image processing

Week 14: Object representation ,description and recognition

Course Provider : NPTEL
Professor : Prof. Prabir Kumar Biswas
University : IIT Kharagpur

Annexure – XI

Ratification of Program Electives course contents in the existing B.Tech (IT) curriculum VTU UGE 2021. **under Industry Institute Interaction(III) Intiatives collaboration of ATOS in the existing** B**.Tech IT curriculum under the regulation VTR UGE 2021** in Winter summer 2023-2024 in view of employability skills.

Sno	Course code	Course Name	L	T	P	C
1	10212IT270	Introduction to System Programming, zOS Commands and Panel on IBM Z	2	0	2	3

COURSE CODE	COURSE TITLE	L	T	P	C
10212IT270	Introduction to System Programming, z/OS commands and Panel on IBMZ	2	0	2	3

A.Preamble

This course is intended to provide the foundational skills required to launch a career in the enterprise platform that powers over 68% of worldwide transactions. Companies around the world are searching for these skills to run their critical system workloads. In this course, the student will be introduced to various operating systems, mainframe applications, and get real-time hands-on experience on an IBM Z server. The skills acquired on completion of this course allows the learner to pursue a career as a mainframe application developer, system programmer, system administrator, or a DBA Practitioner.

B. Prerequisite Courses

10212IT120 -Operating Systems

C.Course Objectives

Learners are exposed to

- IBM z/OS Mainframe
- z/OS Commands and Panels on IBM Z
- System Programming on IBM Z

D.Course Outcomes

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	K - Level
CO1	Explain mainframe hardware components and the structured nature of the mainframe I/O architecture.	K2
CO2	Demonstrate z/OS Commands and Panels on IBM Z.	K3
CO3	Describe the responsibilities of JES and JCL.	K3
CO4	ExplainSystem Programming Components.	K2
CO5	Explain the z/OSMF and UNIX System Services.	K2

Knowledge Level (Based on revised Bloom's Taxonomy)
K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create

E.Course Contents

UNIT I Introduction to IBM z/OS L-6 Hours

Mainframe Environment: Computer Architecture - Mainframe Architecture – Virtualization - Mainframe Operating System - Diving Deeper into z/OS - Mainframe Infrastructure - IBM Z components - Mainframe Features - IBM Z Configuration Setup – Millicode - HMC and SE – Sysplex - Mainframe Security - z/OS Security - Security Addendum - Transaction Level Security - Crypto Express Key Management – IOCDS - Activation Profiles - IPLing an Operating System - z/OS MVS System Initialization Logic Initial Program Load (IPL).

UNIT II Introduction to z/OS Commands and Panels on IBM Z L-6 Hours

Introduction to Commands and Panels - Introduction to TSO and ISPF - z/OS 2.3 ISPF User Guide - Creating, editing, and displaying members in ISPF - Working with Data Sets - Allocating a data set in TSO - Working with data sets - TSO Commands.

UNIT III Introduction to JESand JCL L-6 Hours

System Programming - JES and JCL - Submitting and Viewing JCL - Lab Familiarization - Getting Connected - Terminal and Password Issues - Access lab environment - Submit a job - JCL exercises - JCL Procedures

UNIT IV System Programming Components L- 6 Hours

VSAM - zOS Components - zOS System Libraries - Application Infrastructure - Language Environment - Generation data groups – RAIM - IBM DB2 12 for z/OS – Networking Utilities

UNIT V z/OSMF and UNIX System Services L-6 Hours

z/OSMF Interactive Content - Lab - Using z/OSMF - IBM z/OS Management Facility V2R3 - UNIX System Services - USS file systems - ISHELL and hierarchical file system - USS Processes and Permissions

Total: 30 Hours

G.Laboratory Experiments

Part 1

z/OS Commands and Panels

Task 1. System Familiarization

Section 1: Gathering information and accessing the lab image

Section 2: The logon screen

Section 3: ISPF Primary Menu

Section 4: ISPF Settings

Section 5: ISPF Settings: Action bar choices

Section 6: View a data set

Section 7: Exit ISPF

Section 8: Log Data Set Disposition

Section 9: Logoff

Task 2. Allocate new data sets

Section 1: Lab exercise assistance

Section 2: Allocate a Physical Sequential data set

Section 3: Allocate a Partitioned Data Set

Section 4: Allocate a Partitioned Data Set Extended

Task 3. ISPF editor primary commands

Section 1: Create a PDS member

Section 2: Edit the LITLGAME member

Section 3: Ending the exec

Task 4. ISPF editor line commands

Section 1: Create a new memberand copy data

Section 2: Copy / overlay commands

Section 3: Insert lines

Section 4: Add and repeat lines

Task 5. Copy, move, rename, delete data sets and members

Task 6. Data set lists

Task 7. Using TSO/E commands

Section 1: Accessing the TSO command line

Section 2: TSO commands

JES and JCL

Task 8. System Familiarization

Section 1: Gathering information and accessing the lab image

Section 2: Exit ISPF

Section 3: Logoff

Task 9. Submit a job

Section 1: Create a data set

Section 2: JCL and viewing help

Section 3: Rename a data set member

Task 10. JCL exercises

Section 1: Copy a selected member of a PDS

Section 2: Copy an entire data set

Section 3: Copy and replace a selected member

Section 4: Perform a securecompress

Section 5: Compress a data set in place

Section 6: Copy a PDS and a PDSE data set

Section 7: Copy in-stream data to PS

Section 8: Print a Sequential data set to SYSOUT

Section 9: Print a PDS member

Section 10: Create a PDS member

Task 11. Procedures

Section 1: Override DD-statements of an in-stream procedure

Section 2: Run cataloged procedure

Section 3: Create cataloged procedure

Section 4: Use of DFSORT (ICEMAN)

Section 5: Create PS from in-stream

Section 6: Conditional processing

Section 7: Route a job to INTRDR using IEBGENER

Task 12. z/OS Management Facility

Section 1: Accessing the z/OS Management Facility

Section 2: z/OSMF interface layout

Section 3: TSO interface

Section 4: Links

Section 5: Setting up a z/OS console

Section 6: Using the z/OS console

Section 7: Entering z/OS commands and interpreting the output

Section 8: Identifying the system configuration

Section 9: The DEVSERV command

Task 13. ISHELL and hierarchical file system

Section 1: ISHELL introduction

Section 2: Introduction to the file system

Section 3: Customize ISHELL

Section 4: UNIX directory list

Section 5: Create a hierarchical file system

Section 6: Managing files

Section 7: Additional UNIX activities Section 8: Introduction to the file system

Total: 30 Hours

G.Learning Resources (in IEEE Format)

i. Text Books:

1. Mike Ebbers, John Kettner, Wayne O'Brien, Bill Ogden, "Introduction to the New Mainframe z/OS Basics", IBM Redbooks, Third Edition, 2011

ii. Online References:

1. Introduction to IBM z/OS. Accessed on: Apr. 18, 2023 [Online].Available: https://learn.ibm.com/course/view.php?id=6815
2. Introduction to z/OS Commands and Panels on IBM Z. Accessed on: Apr. 18, 2023 [Online]. Available: https://learn.ibm.com/course/view.php?id=7419
3. Introduction to System Programming on IBM Z. Accessed on: Apr. 18, 2023 [Online]. Available: https://learn.ibm.com/course/view.php?id=7512

Annexure – XII

Ratification of courses offered by **Industry Experts** for B.Tech IT for **Skill enhancement and Employment opportunities** under Industry/Higher Institute Interaction Learning Category during the **Winter of academic year 2023-2024** for B.Tech IT

List of Courses

Sno	Course code	Course Name	T	T	P	C
1	1157IT923	Computer Vision with Deep Learning	1	0	0	0
2	1157IT924	UI UX	1	0	0	0
3	1157IT924	Agile and Scrum	1	0	0	0

COURSE CODE	COURSE TITLE	L	T	P	C
1157IT923	Computer Vision with Deep Learning	1	0	0	0

Course Content

1. Introduction to Deep Learning and Convolutional Neural Networks (CNN)
2. Different deep learning architectures
3. Data Augmentation
4. Transfer Learning
5. Ideas to make a successful deep learning model in computer vision
6. Generative Adversarial Networks (GAN)
7. Computer vision works in medical domain (a real time application)

Total : 15 Hours

COURSE CODE	COURSE TITLE	L	T	P	C
1157IT924	UI UX	1	0	0	0

Course Content:

1. Introduction UI and UX
2. Basics of web application Development
3. HTML Tags and CSS
4. JavaScript (Datatypes, Functions, Typecasting, Variable Hoisting, Control Structures)
5. Data Structures in JavaScript (Stack, Queue, Arrays, JSON, Map, Set)
6. Creating API Calls (AJAX through fetch and Axios Library)
7. HTML 5 (Local Storage, Session Storage, Web Workers, Semantic Tags, app Cache etc)
8. CSS3 (Transformations, Transitions, Keyframes Animations, Grid, Flex, Multicolumn layouts etc)
9. ECMA

Total : 15 Hours

COURSE CODE	COURSE TITLE	L	T	P	C
1157IT925	Agile and Scrum	1	0	0	0

Course Content

SDLC – Waterfall Model

SDLC – Agile methodology

Waterfall Vs Agile Methodology

Agile Framework

Agile Values & Principals

Scrum Values, Methodology

Scrum Framework

- Ceremonies
- Roles
- Artefacts
- Rules

Scrum & Kanban Board

Project Management

- Project Roadmap
- Deployments
- Release management
    - Release checklist
    - Release notes

PM Management tools

- Jira
- Confluence
- ServiceNow

Total : 15 Hours

Annexure – XIII

Ratification of **Value added Courses** offered during the Winter 2023-2024 for B.Tech IT programme.

List of Courses

Sno	Course code	Course Name	**L**	**T**	**P**	**C**
1	10218IT924	Python Developer	2	0	0	0
2	10218IT925	Data Structures and Algorithms using Python	2	0	0	0
3	10218IT926	IoT Engineer	2	0	0	0
4	10218IT927	Bash Shell Script administrator	2	0	0	0
5	10218IT928	Machine learning using Python	2	0	0	0
6	10218IT929	Adobe XD for web designer	2	0	0	0

Thank you

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

39th Board of Studies

22nd June 2024, 10:00 a.m., CASA Lab

Minutes of Meeting

DEPARTMENT OF MECHANICAL ENGINEERING

SCHOOL OF MECHANICAL & CONSTRUCTION

School of Mechanical and Construction

Department of Mechanical Engineering

Minutes of 39th Board of Studies Meeting of Mechanical Engineering

22 June 2024 @ 10.00 a.m. CASA Laboratory

The 39th Board of Studies Meeting was held on 22nd June 2024 at 10.00 a.m. in Hall No. 2122 (CASA Lab) and the following members were present during the meeting.

Members Present

Chairman, Board of studies (Mechanical Engineering)

1. Dr.S.Jayavelu, Associate Professor & Head, Department of Mechanical Engineering.

External Experts

2. Dr.G.L.Samuel, Professor, IIT-Madras
3. Dr.Omkumar, Professor, Anna University

Industry Experts

4. Mr.Ravikumar Samuthiram, General Manager, Daimler India

Internal Experts

5. Dr.N.Lenin, Professor
6. Dr.P.Sivamurugan, Professor
7. Dr.S.Christopher, Professor
8. Dr. Mohammad Iqbal, Professor
9. Dr.Sumathy Muniamuthu, Professor
10. Dr.P. Anand, Professor
11. Dr.M.Meikandan, Professor
12. Dr.C.Rathinasuriyan, Associate Professor
13. Dr.V.Balaji, Assistant Professor

Alumni Representative

14. Mr.S.Prabhu

Final Year Student

15. Mr.Arpit Sinha

The Chairman of the Board of Studies (BoS) warmly welcomed the members and thanked the external experts for their valuable time and insights. He began by discussing the agenda for the 39th BoS meeting and sought the external experts' input on updating the syllabus and course content to align with the institution's goals.

The Chairman then explained the vision and mission of the institution and the department, along with the Program Outcomes (PO), Program Educational Objectives (PEO), and Program Specific Outcomes (PSO). The Chairman emphasized the importance of aligning the syllabus and course content with these foundational elements to ensure that the educational experience is comprehensive, current, and relevant to both industry standards and societal needs. He then invited the external experts to provide their insights and suggestions on the proposed updates.

School of Mechanical and Construction

Department of Mechanical Engineering

39th Board of Studies Meeting of Mechanical Engineering

22 June 2024 @ 10.00 a.m. CASA Laboratory

Agenda No.	Agenda

OPENING

39 BoS 01 Action taken report on 38th BoS meeting

39 BoS 02 To record leave of Absence of members

ITEMS FOR CONFIRMATION

39 BoS 03 To confirm the minutes of meetings of the 38th Board of Studies, held on 6th January 2024

ITEMS FOR DISCUSSION

39 BoS 04 Discussions and Approval of changes in LTPC for B.Tech Mechanical Engineering Courses as per the amendments approved in the 41st Academic Council Meeting.

39 BoS 05 Discussions and Approval of Syllabus for Minor degree in department of mechanical engineering (offered to other school students)

1. Automation and Robotics
2. Additive Manufacturing

39 BoS 06 Discussion and Approval of Changes in Course title for R23 PG Courses:

1. M.Tech. – Industrial Safety and Engineering
2. M.Tech. – Metallurgical and Material Science Engineering

39 BoS 07 List of Courses recommended under Self Learning Courses (NPTEL/MooC)

ITEMS FOR REPORTING

39 BoS 08 Courses offered by International /Industrial Faculty under VTUR15 section 7.2.8.3, specialized courses

39 BoS 09 Students carried out projects, in Foreign Universities/Laboratories, Industries & In-House

39 BoS 10 Students attended Industrial Visits and In Plant Training

39 BoS 11 Students undergone NPTEL courses

ANY OTHER POINTS

OPENING

39 BoS 01 Action taken report on Minutes of 38th BoS meeting

The chairman –BoS presented the Action taken report on Minutes of 38th BoS meeting held on 6th January 2024.

S.No.	Agenda No.	Points Discussed	Action Taken
1.	38 BoS 01	To confirm the minutes of the 37th Board of Studies meeting held on 27th May 2023	Confirmed by the members of BoS
2.	38 BoS 02	To review the Action Taken Report on the minutes of the 37th BoS meeting	Reports were presented by the Chairman - BoS, and noted by the members.
3.	38 BoS 03	To record leave of Absence of member-Industry Expert -Mr.Ravikumar Samuthiram, General Manager, Daimler India	The member was absent for the 38th BoS meeting and the attendance has been recorded.
4.	38 BoS 04	To discuss the List of NPTEL courses recommended under self-learning courses for UG & PG programs for the Winter Semester of AY 2023–24	Approved NPTEL courses offered to the students
5.	38 BoS 05	To discuss the new courses for PhD scholars under the coursework category	BoS accepted the new courses for PhD coursework.
6.	38 BoS 06	BoS presented the list of program elective courses offered under VTR UGE -2021 Regulations for B.Tech. Mechanical with Energy Management Specialization	Approved program elective courses offered to the students
7.	38 BoS 07	To discuss the minor revisions in the syllabus of courses offered under VTR UGE -2021 Regulations	The suggestions were incorporated into the syllabus at appropriate places.
8.	38 BoS 08	Presented the details of students awarded credits for independent learning – MOOC courses under VTUR15 7.2.7.1 for UG	Credits awarded to the students
9.	38 BoS 09	Discussed the number of students awarded credits for independent learning - Seminar under VTUR15 Sec. 7.2.7.2	Credits awarded to the students
10.	38 BoS 10	Discussed the Bucket system and PSO	Changes implemented as per the BoS suggestions.

The members have gone through the actions taken on the discussions and satisfied.

39 BoS 02 **To record leave of Absence of members**

The following members were absent for the 39th BoS meeting and the attendance has been recorded.

1. Academic Expert- Dr.Omkumar, Professor, Anna University
2. Final Year Student - Mr.Arpit Sinha

39 BoS 03 **To confirm the minutes of meeting of the 38th Board of Studies, held on 6th January 2024**

The chairman –BoS briefed about the minutes of meeting of the 38th Board of Studies, held on 6th January 2024.

The members noted and confirmed it.

39 BoS 04 Discussions and Approval of changes in LTPC for B.Tech Mechanical Engineering Courses as per the amendments approved in the 41st Academic Council Meeting.

S.No.	COURSE CODE	COURSE	L	T	P	C
DESIGN DOMAIN						
1	10211ME101	ENGINEERING MECHANICS	~~3~~	~~2~~	~~0~~	~~4~~
			3	1	0	4
2	10211ME201	THEORY OF MACHINES	3	0	2	4
3	10211ME202	STRENGTH OF MATERIALS	3	0	2	4
4	10211ME102	MACHINE DESIGN	~~2~~	~~2~~	~~0~~	~~3~~
			2	1	0	3
5	10211ME203	FINITE ELEMENT ANALYSIS	2	0	2	3
6	10211ME301	COMPUTER AIDED DESIGN AND DRAFTING	0	0	2	1
MANUFACTURING DOMAIN						
7	10211ME204	MANUFACTURING TECHNOLOGY	3	0	2	4
8	10211ME205	MACHINING AND MACHINE TOOLS TECHNOLOGY	3	0	2	4
9	10211ME103	MATERIALS AND METALLURGY	3	0	0	3
10	10211ME206	MEASUREMENTS AND CONTROL	2	0	2	3
11	10211ME207	MECHATRONICS	3	0	2	4
THERMAL DOMAIN (18 Credits)						
12	10211ME104	ENGINEERING THERMODYNAMICS	~~2~~	~~2~~	~~0~~	~~3~~
			2	1	0	3
13	10211ME208	FLUID MECHANICS AND MACHINERY	3	0	2	4
14	10211ME105	APPLIED ENGINEERING THERMODYNAMICS	~~2~~	~~2~~	~~0~~	~~3~~
			2	1	0	3
15	10211ME209	THERMAL ENGINEERING	3	0	2	4
16	10211ME210	HEAT AND MASS TRANSFER	3	0	2	4

GENERAL (3 Credits)						
17	10211ME106	SOFT COMPUTING FOR MECHANICAL ENGINEERS	3	0	0	3

Note: One Credit is equivalent to one contact hour of lecturing/tutorial or two contact hours of practical work or three hours of field work per week.

Discussion: The members accepted and endorsed the recommendations.

39 BoS 05 Discussions and Approval of Curriculum and Syllabus for Minor degree in department of mechanical engineering (offered to other school students)

1. Automation and Robotics
2. Additive Manufacturing

Minor Degree in Automation and Robotics

Sl. No.	COURSE CODE	COURSE	L	T	P	C
1.	10213ME128	INTRODUCTION TO ROBOTICS	3	0	0	3
2.	10213ME129	MICROPROCESSOR AND MICROCONTROLLER	3	0	0	3
3.	10213ME130	SENSORS AND ACTUATORS FOR ROBOT OPERATION	3	0	0	3
4.	10213ME131	DESIGN OF ROBOT WITH ARTIFICIAL INTELLIGENCE	3	0	0	3
5.	10213ME132	DYNAMICS AND KINEMATICS OF ROBOTS	3	0	0	3
6.	10213ME133	DRIVES AND CONTROLS FOR AUTOMATION	3	0	0	3

COURSE CODE	INTRODUCTION TO ROBOTICS	L	T	P	C
10213ME128		3	0	0	3

1. Preamble

This course is designed to provide knowledge about the concepts of various tools and approaches available for product design and process development.

2. Pre-requisite

NIL

3. Link to the other courses

Project Work

Total Quality Management

4. Course Educational Objectives

Students, after undergoing this course would

- Understand the concepts of the robot to the operation of the robot which includes components, parts, operations, and programming
- It gives a complete idea about the unmanned vehicle and a strong basis for the development of the new robot.

5. Course Outcomes

Upon the successful completion of the course, learners will be able to

CO Nos	Course Outcomes	Level of learning domain (Based on
CO1	Describe the types and basic robot motions of robot	K2
CO2	Illustrate the features, specifications, operations, and applications	K2
CO3	Describe the functions of robot drivers, actuators, sensors, and	K2
CO4	Explain the basic operation , programming and applications of robot in AI & ML	K2
CO5	Explain the uses of robot for Humanoid and industrial applications	K2

(K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 - Create)

6. Correlation of COs with POs

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M											H	
CO2	H	H											H	
CO3	H	M											H	
CO4	H	M											H	
CO5	H	H											H	

(H- High; M-Medium; L-Low)

7. Course Content

UNIT I INTRODUCTION L-9

History of the robot - Robot Laws - Types of robots - Robot configuration - Advantages of the robot - Disadvantages of the robot - Basic robot motions - continuous and point to point.

UNIT II UNMANNED VEHICLES L-9

Basic of unmanned vehicles - Opportunities and challenges – UAV - Features, specifications, operations, applications - USV - Features, specifications, operations, applications - UUV - Features, specifications, operations, applications – ROV – AUV - special robot (space robot).

UNIT III BASIC COMPONENTS L-9

Robot anatomy - Robot drives and actuators - Basic of Sensors - Range, proximity, touch, force and torque sensors - End effector - Types of Grippers.

UNIT IV ROBOT OPERATIONS L-9

Robot developing concept - Control and communication - Programming languages - Capabilities and limitation - Kinematics and inverse kinematics - Basic of AI & ML - Knowledge representation - Application of AI and ML.

UNIT V CASE STUDY OF ROBOT L-9

Humanoid robot - Industrial robot – UAV - USV UGV – UUV

TOTAL: 45 PERIODS

8. Text Books

1. John J. Craig, Introduction to Robotics Mechanics and Control, Prentice-Hall, 3rd Edition, 2004.
2. M.W. Spong, S. Hutchinson and M. Vidyasagar, “Robot modeling and control,” John Wiley and Sons, First Edition, 2005.
3. Norman S.Nise, “Control Systems Engineering", John Wiley and Sons, 6th Edition, 2010.

9. References

1. Richard D. Klafter, Thomas. A Chri Elewski, Michael Negin, Robotics Engineering an Integrated Approach, Prentice-Hall, 1989.
2. Frank L. Lewis, Chaouki T. Abdallah, D. M. Dawson, "Robot manipulator control: theory and practice", CRC Press, 2nd Edition, 2003.

COURSE CODE	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
10213ME129		3	0	0	3

1. Preamble

This course provides the learners to learn about the inception of microprocessor and microcontroller, their configuration, interfacing, programming. And to learn about the working of peripheral devices along with plc programming.

2. Pre-requisite

Nil

3. Link to the other courses

Project Work

4. Course Educational Objectives

Students, after undergoing this course would

- To gain knowledge on microprocessor, its architecture and pin configuration
- To be able to understand the working of microcontroller, it's architecture and interfacing
- To acquire the knowledge on 8051 microcontroller programming
- To understand the peripheral devices associated with microprocessor and controller
- To identify the working of PLA and applications of mechatronics.

5. Course Outcomes

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on
CO1	Explain the architecture and working of 8085 microprocessor and its associated functions.	K2
CO2	Describe the operating principle of 8051 microcontroller and its interfacing provisions.	K2
CO3	Develop C and assembly language programme using 8051 microcontroller for the given conditions	K3
CO4	Describe the 8255 architecture along with timer, counters and Interrupt controllers.	K2
CO5	Explain the PLC and the applications of microcontrollers	K2

(K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 - Create)

6. Correlation of COs with POs

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M											L	
CO2	H	M											L	
CO3	H	H	M										L	
CO4	H	M											L	
CO5	H	M											L	

(H- High; M-Medium; L-Low)

7. Course Content

UNIT I 8085 MICROPROCESSOR L-9

Introduction to microprocessor, Architecture of 8085, Pin configuration, Addressing modes, Instruction set, Timing diagram, I/O interfacing, Assembly language programming, Recent upgrades in microprocessor (Architecture of PIC, ARM, ATMEGA processors).

UNIT II 8051 MICROCONTROLLER L-9

Introduction to microcontroller, Architecture of 8051, I/O ports & circuits, Timers, Interrupts, Serial communication, Keyboard & LCD interfacing, External memory interfacing.

UNIT III 8051 PROGRAMMING L-9

Addressing modes, Instruction set, Assembly language programming and C Programming, Timer counter programming, Serial communication programming, Interrupt Programming.

UNIT IV PROGRAMMABLE PERIPHERAL DEVICES L-9

Introduction to PPI, Architecture of 8255, Timer & Counter (8253), Keyboard & Display Controller (8279), USART (8251), Interrupt Controller (8259), DMA Controller (8237).

UNIT V PLC AND APPLICATIONS OF MICROCONTROLLER L-9

Introduction to PLC, Basic structure, Input and output processing, Programming, Mnemonics, Timers, counters and internal relays, Programming the PLC using Ladder diagram, Temperature control system, Motor speed control system, Data Acquisitions system.

TOTAL: 45 PERIODS

8. Text Books

1. Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 6th Edition, Penram International Publishing.
2. W. Bolton, Electronic Control Systems in Mechanical and Electrical Engineering, Prentice Hall, New Delhi, 2003.
3. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D McKinlay, "The 8051 microcontroller and embedded systems using assembly and C", second edition Pearson education Asia.

9. References

1. Kenneth J Ayala, The 8051 Microcontroller Architecture Programming and Application, third Edition, Penram International Publishers.
2. A.K Ray & K.M. Burchandi, Advanced Microprocessor and peripherals Architectures, Programming and interfacing “, second edition, Tata McGraw-Hill.
3. David W. Pessen, Industrial Automation Circuit Design and Components, John Wiley, New York, 1990.
4. James Harter, Electromechanics, Principles and Concepts and Devices, Prentice Hall, New Delhi, 2003.

COURSE CODE	SENSORS AND ACTUATORS FOR ROBOTICS OPERATION	L	T	P	C
10213ME130		3	0	0	3

1. Preamble

This course provides the classification of sensors and their real time application along with their association with micro actuator, micro sensor and microbotics.

2. Pre-requisite

NIL

3. Link to the other courses

Project Work

4. Course Educational Objectives

Students, after undergoing this course would

- Understand the classification and working sensor and its applications.
- Understand the concept of micro actuator, micro sensor and microbotics.

5. Course Outcomes

Upon the successful completion of the course, learners will be able to

CO Nos	Course Outcomes	Level of learning domain (Based on
CO1	Classify the types of internal sensors used in robots for industrial applications	K3
CO2	Classify the types of external sensors used in robots for industrial applications	K3
CO3	Explain the use of vision based sensors for image analysis	K2
CO4	Explain the types and working of actuators and micro actuators	K2
CO5	Describe the working and applications of micro sensors and microbotics.	K2

(K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 - Create)

6. Correlation of COs with POs

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M											M	
CO2	H	M	L										M	L
CO3	H	M											M	
CO4	H	M											M	
CO5	H	M											M	

(H- High; M-Medium; L-Low)

7. Course Content

UNIT I INTERNAL SENSORS L-9

Introduction, Requirement of a sensors in robots used in various industries, Static and dynamic characteristics, Performance measures of sensors, Classification of sensors, Internal sensors - Position sensors, Encoders, Potentiometers, LVDTs, velocity sensors, Tacho generator, Hall effect sensor, Acceleration sensors, Heading sensors- Compass, Gyroscope sensor, IMU, GPS, real time differential GPS, Force sensors, strain gauge based & Piezo electric based, Torque sensors, Interpreting typical manufacturer's data sheet of internal sensors.

UNIT II EXTERNAL SENSORS L-9

Contact type, noncontact type, Tactile, proximity detection of physical contact or closeness, contact switches, bumpers , inductive proximity, capacitive proximity; semiconductor displacement sensor; Range sensors- IR, sonar, laser range finder, optical triangulation (1D), structured light (2D), performance comparison range sensors; motion/ speed sensors-speed relative to fixed or moving objects, Doppler radar, Doppler sound; Interpreting typical manufacturer's data sheet of external sensors.

UNIT III VISION BASED SENSORS L-9

Elements of vision sensor, image acquisition, image processing, edge detection, feature extraction, object recognition, pose estimation and visual servoing, hierarchy of a vision system, CCD and CMOS Cameras, Monochrome, stereovision, night vision cameras, still vs video cameras, kinect sensor.

UNIT IV ACTUATORS AND MICROACTUATORS L-9

Actuators: Electrical, Hydraulic and Pneumatic. Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.

UNIT V MICROSENSORS AND MICROBOTICS L-9

Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors. Microbotics: Drive principle, classification, and application, micro assembly with the help of microbots, flexible microbots, and Automated desktop station using micromanipulation robots.

TOTAL: 45 PERIODS

8. Text Books

1. Patranabis D.," Sensor and Actuators", Prentice Hall of India (Pvt) Ltd., 2005.
2. Robotics Engineering: An Integrated Approach, by Richard D. Klafter, Prentice Hall Inc.
3. Sergej Fatikow and Ulrich Rembold, Microsystem Technology and Microbotics First edition, Springer – Verlag Newyork, Inc, 1997.

9. References

1. Renganathan S.," Transducer Engineering", Allied Publishers (P) Ltd., 2003.

2. Clarence W. de Silva, Sensors and Actuators: Control System Instrumentation, CRC Press 2007, ISBN-13: 978-1420044836

3. Introduction to Robotics, S K Saha, Mc Graw Hill Eduaction Massood Tabib and Azar, Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures , First edition, Kluwer academic publishers, Springer.

COURSE CODE	DESIGN OF ROBOT WITH ARTIFICIAL INTELLIGENCE	L	T	P	C
10213ME131		3	0	0	3

1. Preamble

This course is designed to provide knowledge about the concepts of various tools and approaches available for product design and process development.

2. Pre-requisite

NIL

3. Link to the other courses

Project Work

4. Course Educational Objectives

Students, after undergoing this course would

- Get a complete idea about the robot design point of view from the structural design to the operation of the robot for different applications.
- Importance and application of AI in robot design and operation.

5. Course Outcomes

Upon the successful completion of the course, learners will be able to

CO Nos	Course Outcomes	Level of learning domain (Based on
CO1	Explain the different types of robots and its design procedure	K2
CO2	Explain different types of control system for the design of robot.	K2
CO3	Develop main structures of robot and its parts	K3
CO4	Choose actuating systems for the design of robot.	K3
CO5	Describe the importance and implementation of Artificial intelligence in robot	K2

(K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 - Create)

6. Correlation of COs with POs

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	L											H	L
CO2	H	H	L			L		L					H	L
CO3	H	H	L			L		L					H	L
CO4	H	L											H	L
CO5	H	L	L			L		L				L	H	L

(H- High; M-Medium; L-Low)

7. Course Content

UNIT I DESIGN THINKING OF ROBOT L-9

Design concept - Mobile robot - Fixed robot - Humanoid robot - Industrial robot - Aerial robot - Underwater robot.

UNIT II DESIGN OF CONTROL SYSTEM L-9

Basic control system - Control components - Control software - Differential motion – Navigation - Path planning.

UNIT III DESIGN OF MAIN STRUCTURES L-9

DH parameters - End effector design - Legged robot - Multi-fingered Robot – Manipulators.

UNIT IV DESIGN OF DRIVES AND ACTUATOR L-9

Identify the requirements - Robot actuation and feedback - Coordinate transformation - Rotational transformation - Kinematics and inverse kinematics - Trajectory design and configuration space - Motion planning.

UNIT V DESIGN OF ROBOT WITH ARTIFICIAL INTELLIGENCE L-9

Humanoid Needs of AI - Implementation of AI - Application of commercial robot with AI - Application of industrial robot with AI - Case: One robot with AI.

TOTAL: 45 PERIODS

8. Text Books

1. John J. Craig, Introduction to Robotics Mechanics and Control, Prentice-Hall, 3rd Edition, 2004.
2. M.W. Spong, S. Hutchinson and M. Vidyasagar, “Robot modeling and control,” John Wiley and Sons, First Edition, 2005.
3. Norman S.Nise, “Control Systems Engineering", John Wiley and Sons, 6th Edition, 2010.

9. References

1. Richard D. Klafter, Thomas. A Chri Elewski, Michael Negin, Robotics Engineering an Integrated Approach, Prentice-Hall, 1989.
2. Frank L. Lewis, Chaouki T. Abdallah, D. M. Dawson, "Robot manipulator control: theory and practice", CRC Press, 2nd Edition, 2003.

COURSE CODE	DYNAMICS AND KINEMATICS OF ROBOTS	L	T	P	C
10213ME132		3	0	0	3

1. Preamble

This course helps the student to learn the basics of a Robot. Students are introduced to the basic design consideration of robots. Concepts of Dynamics and Kinematics of robots are introduced.

2. Pre-requisite

NIL

3. Link to the other courses

Project Work

4. Course Educational Objectives

Students, after undergoing this course would

- Understand the dynamic and kinematics motions of robots.
- Understand the design considerations, differential motion and force analysis.

5. Course Outcomes

Upon the successful completion of the course, learners will be able to

CO Nos	Course Outcomes	Level of learning domain (Based on
CO1	Explain the kinematics of robots	K2
CO2	Discuss the working of inverse kinematics of different axis robots.	K2
CO3	Describe the workspace analysis for robots and its associated fixtures.	K2
CO4	Discuss about the tool configuration and manipulator concepts of jacobian matrix for robots.	K2
CO5	Discuss the theories of Langrangian mechanics, trajectory planning and various motions.	K2

(K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 - Create)

6. Correlation of COs with POs

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	L										L	L	
CO2	M	L										L	L	
CO3	M	L										L	L	
CO4	M	L										L	L	
CO5	M	L										L	L	

(H- High; M-Medium; L-Low)

7. Course Content

UNIT I DIRECT KINEMATICS L-9

Dot and cross products, Co-ordinate frames, Rotations, Homogeneous Coordinates, Link coordinates, D-H Representation, Arm equation -Two axis, three axis, four axis, five axis and six axis robots.

UNIT II INVERSE KINEMATICS L-9

General properties of solutions, Tool configuration, Inverse Kinematics of Two axis, Three axis, Four axis and Five axis robots.

UNIT III WORKSPACE ANALYSIS L-9

Workspace analysis of Four axis, Five axis and Six axis robots, Perspective transformation, Structured illumination, Camera calibration, Work envelope of Four and Five axis robots, Workspace fixtures.

UNIT IV DIFFERENTIAL MOTION AND STATICS L-9

The tool Configuration jacobian matrix for three axis and four axis robots, joint space singularities, resolved motion rate control, manipulator jacobian for three and four axis joint space singularities, induced joint torques and forces.

UNIT V DYNAMIC ANALYSIS AND FORCES L-9

Introduction, Langrangian mechanics, Effects of moments of Inertia, Dynamic equation for two axis planar articulated robot. Trajectory planning, Pick and place operations, Continuous path motion, Interpolated motion, Straight line motion.

TOTAL: 45 PERIODS

8. Text Books

1. Robert J. Schilling, —Fundamentals of Robotics Analysis and Control‖, PHI Learning, 2009.
2. Niku S B, —Introduction to Robotics, Analysis, Systems, Applications‖, Prentice Hall, 2001

9. References

1. John J Craig, —Introduction to Robotics‖, Pearson, 2009.
2. Deb S R and Deb S, —Robotics Technology and Flexible Automation‖, Tata McGraw Hill Education Pvt. Ltd, 2010.
3. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.

COURSE CODE	DRIVES AND CONTROLS FOR AUTOMATION	L	T	P	C
10213ME133		3	0	0	3

1. Preamble

This course provides various concepts of Drives used in automation industry for the continuous process.

2. Pre-requisite

NIL

3. Link to the other courses

Project Work

4. Course Educational Objectives

Students, after undergoing this course would

- Understand the concept of DC, Synchronous motor and induction motor drive used in automation.
- Understand the concept of how to control the various types of drives.

5. Course Outcomes

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Select motor power rating and drive specifications for automation	K3
CO2	Analyze the performance of DC motor drives used in automation	K4
CO3	Analyze the performance of induction motor drives used in automation	K4
CO4	Analyze the performance of synchronous motor drives used in automation	K4
CO5	Select suitable drive control for steel rolling mills, paper mills, lifts and cranes application.	K3

(K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 - Create)

6. Correlation of COs with POs

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H											H	
CO2	H	H	M										H	L
CO3	H	H	M										H	L
CO4	H	H	M										H	L
CO5	H	H										M	H	

(H- High; M-Medium; L-Low)

7. Course Content

UNIT I INTRODUCTION L-9

Introduction to drives – Selection of Motor power rating – Drive specifications – Constant speed and constant power operation.

UNIT II DC DRIVE L-9

DC motor and their performance – Armature control and Field control - Ward Leonard drives – converter fed and chopper fed Drive – four quadrant operation – closed loop control.

UNIT III INDUCTION MOTOR DRIVE L-9

Induction motor fundamentals – voltage control and variable frequency control (AC chopper, Inverter fed induction motor drives). – Rotor resistance control – slip power recovery scheme.

UNIT IV SYNCHRONOUS MOTOR DRIVE L-9

Synchronous motor fundamentals – open loop, closed loop variable frequency control – voltage and current source fed synchronous motor.

UNIT V DRIVE CONTROLS L-9

Digital technique in speed control – Advantages and limitations – Microprocessor based control of drives – Selection of drives and control schemes for steel rolling mills, paper mills, lifts and cranes.

TOTAL: 45 PERIOD

8. Text Books

1. Dubey G.K., Fundamental of Electric Drives, Narosa publishing house 1995.
2. Pillai S.K., A first course on Electrical Drives, New Age International (p) Ltd., 1984.

9. References

1. Dubey G.K. "*Power Semiconductor Controlled Drives*, Narosa publishing house 1995.
2. Vedam Subramanian *Thyristor Control of Electrical Drives* Tata Mc Graw Hill Publications, 1996.

Minor Degree in Additive Manufacturing

Sl. No.	Course code	Course Name	L	T	P	C
1	10213ME134	Additive manufacturing processes	3	0	0	3
2	10213ME135	Design for additive manufacturing	3	0	0	3
3	10213ME136	Materials and applications for additive manufacturing	3	0	0	3
4	10213ME205	Computer-Aided Design (CAD)	2	0	2	3
5	10213ME206	AM software and Printing	2	0	2	3
6	10213ME137	Direct Ink Writing and Powder Bed Technology	3	0	0	3

Total credit: 18

Course code	ADDITIVE MANUFACTURING PROCESSES	L	T	P	C
10213ME134		3	0	0	3

Course content:

Unit 1: Introduction to additive manufacturing (AM) 9

Introduction to AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM.

Unit 2: Vat Photopolymerization and Material Jetting AM Processes 9

Stereolithography (SL), Materials, Process Modeling, SL resin curing process, SL scan patterns, Micro-stereolithography, Mask Projection Processes, Two-Photon vat photopolymerization, Process Benefits and Drawbacks, Applications of Vat Photopolymerization.

Material Jetting AM Processes: Materials, Process Benefits and Drawbacks, Applications of Material Jetting Processes.

Unit 3: Binder Jetting and Powder Bed Fusion AM Processes 9

Binder Jetting AM Processes: Materials, Process Benefits and Drawbacks, Applications of Binder Jetting Processes.

Powder Bed Fusion AM Processes: Selective laser Sintering (SLS), Materials, Powder fusion mechanism and powder handling, Process Modelling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.

Unit 4: Extrusion-Based and Sheet Lamination AM Processes 9

Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, Plotting and path control, Bio-Extrusion, Contour Crafting, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes.

Sheet Lamination AM Processes: Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications.

Unit 5: Directed Energy Deposition AM Processes 9

Directed Energy Deposition AM Processes: Process Description, Material Delivery, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Benefits and drawbacks, Applications of Directed Energy Deposition Processes.

Wire Arc Additive Manufacturing: Process, parameters, applications, advantages and disadvantages.

Text Books:

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer, 2015, 2nd Edition.

2. 3D Printing and Additive Manufacturing: Principles & Applications, Chua Chee Kai, Leong Kah Fai, World Scientific, 2015, 4th Edition.

References:

1. Rapid Prototyping: Laser-based and Other Technologies, Patri K. Venuvinod and Weiyin Ma, Springer, 2004.

2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov, Springer 2001.

3. Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley & Sons, 2006.

4. Additive Manufacturing, Second Edition, Amit Bandyopadhyay Susmita Bose, CRC Press Taylor & Francis Group, 2020.

5. Additive Manufacturing: Principles, Technologies and Applications, C. P. Paul, A. N. Jinoop, McGraw Hill, 2021.

Course code	DESIGN FOR ADDITIVE MANUFACTURING	L	T	P	C
10213ME135		3	0	0	3

Course content:

Unit 1: Introduction to Design for Additive Manufacturing (DfAM) 9

Design freedom with AM, Need for Design for Additive Manufacturing (DfAM), CAD tools vs. DfAM tools, Requirements of DfAM methods, General Guidelines for DfAM, The Economics of Additive Manufacturing, Design to Minimize Print Time, Design to Minimize Post-processing.

Unit 2: Design Guidelines for Part Consolidation 9

Design for Function, Material Considerations, Number of Fasteners, Knowledge of Conventional DFM/DFA, Assembly Considerations, Moving Parts, Part redesign, Opportunities for part consolidation, challenges with part consolidation.

Unit 3: Design for Improved Functionality and Minimal Material Usage 9

Design for Improved Functionality: Multi scale design for Additive manufacturing, Mass customization, Biomimetics, Generative design, Design of multi-materials and functionally graded materials.

Design for Minimal Material Usage: Topology Optimization, Modelling of Design space, defining design and manufacturing constraints, performing analysis for weight reduction.

Unit 4: Computational Tools for Design Analysis 9

Considerations for Analysis of AM Parts, Material Data, Surface Finish, Geometry, Simplifying Geometry, Mesh-Based Versus Parametric Models, Build Process Simulation: Model Slicing, Contour Data Organization, Layer-by-Layer Simulation, Hatching Strategies, Scan Pattern Simulation and Tool Path Generation.

Unit 5: Design for Metal AM 9

Powder Morphology, Powder Size Distribution, Material Characteristics, Designing to Minimize Stress concentrations, Residual Stress, Overhangs, shrinkage, warpage and Support Material, Design Guidelines for Wall Thickness, Clearance Between Moving Parts, Vertical Slots, Circular Holes, fillets, channels, vertical Bosses, circular pins, External Screw Threads and part positioning.

Text Books:

1. A Practical Guide to Design for Additive Manufacturing, Diegel, Olaf, Axel Nordin, and Damien Motte, Springer, 2020.

2. The 3D Printing Handbook: Technologies, Design and Applications, Redwood, Ben, Filemon Schoffer, and Brian Garret, 3D Hubs, 2017.

References:

1. Design for Advanced Manufacturing: Technologies and Process, Laroux K, Gillespie, McGraw Hill, 2017.

2. Additive Manufacturing Technologies, Gibson, Ian, David W. Rosen, Brent Stucker, and Mahyar Khorasani, Springer, 2021.
3. Laser-Induced Materials and Processes for Rapid Prototyping, L.Lu, J. Y. H. Fuh and Y.S. Wong, Springer, 2001.
4. Rapid Prototyping: Laser-based and Other Technologies, Patri K. Venu vinod and Weiyin Ma, Springer, 2004.
5. Mathematical Elements for Computer Graphics, David F. Rogers, J. A. Adams, TMH,2008.
6. Geometric Modeling, Michael E.Mortenson, Tata McGrawHill, 2013.

Web reference:

NPTEL IIT Madras, “Design for Additive Manufacturing”, Prof. G. Saravana Kumar https://www.youtube.com/watch?v=gcia0aqZMf0

Course code	MATERIALS AND APPLICATIONS FOR ADDITIVE MANUFACTURING	L	T	P	C
10213ME136		3	0	0	3

Course content:

Unit 1: Polymers and Metals **9**

Polymer molecules, Chemistry of polymer molecules, Classifications, Characteristics and Applications of polymers.

Metals – Classifications, Characteristics and Applications of metals, Failure of metals.

Unit 2: Ceramics and Composites **9**

Definition & scope of ceramic materials, Classification of ceramic materials – conventional and advanced, Properties, Areas of applications.

Introduction to composite materials along with its basic requirements and classification, Properties and Applications.

Unit 3: Characterization techniques **9**

Microstructural characterization: Optical microscopy techniques, X-ray diffraction, Sample preparation techniques, Scanning electron microscopy, Energy dispersive spectroscopy (EDS), Electron back scattering (EBSD).

Mechanical characterization: Tensile, Compressive and Bending Test, Hardness test, Fatigue test, Fracture toughness.

Unit 4: AM for Aerospace applications **9**

Aerospace materials requirements and the role of additive manufacturing (AM), Qualification and certification of metal additive manufactured hardware for aerospace, AM processes of Titanium and Ni-base alloys, Ti–6Al–4V alloy and aluminum alloys.

Unit 5: AM for Biomedical applications **9**

Materials for Biomedical Applications, Surgical Tools and Biomedical Implants, Drug Delivery and Healthcare, Artificial Organs.

Text books:

1. Mechanical Metallurgy, George E. Dieter, McGraw Hill, 2nd Edition, 2005.
2. Callister's Materials Science and Engineering, R. Balasubramaniam, Wiley; 2nd edition, 2014
3. Additive Manufacturing for the Aerospace Industry; Francis Froes and Rodney Boyer, Elsevier, 2019.
4. Advanced Materials and Manufacturing Techniques for Biomedical Applications, Arbind Prasad, Ashwani Kumar, and Manoj Gupta, 2023, Wiley

References:

1. Mechanical behaviour of Materials, Marc Andre Meyers and Krishna Kumar Chawla, 2009.
2. Bio-Medical applications of Additive Manufacturing: A Review, Ankita Jaisingh Sheoran, Harish Kumar, Pawan K Arora, and Girija Moona, 2020, https://doi.org/10.1016/j.promfg.2020.10.093

3. Additive manufacturing in the biomedical field-recent research developments, Thara Tom, Sithara P. Sreenilayam, Dermot Brabazon, Josmin P. Jose, Blessy Joseph, Kailasnath Madanan, and Sabu Thomas, 2022, https://doi.org/10.1016/j.rineng.2022.100661

Course code	COMPUTER-AIDED DESIGN (CAD)	L	T	P	C
10213ME205		2	0	2	3

Unit 1: Fundamentals of CAD **6**

CAD definition, concept & need, CAD process, Functional areas of CAD, Coordinate systems. Geometric transformation-concept and types, Dimensional (2D) geometric transformation- translation, scaling, rotation and mirror.

Unit 2: CAD Hardware **6**

CAD Workstation-types, functions and configuration; Input and output devices (including voice, gesture, 3-dimensional (3D) printer, etc)- types, configuration and applications.

Unit 3: Geometric modeling **6**

Difference between 2D & 3D models, Geometric modeling – concept, types, features and applications.
Solid modeling methods like Constructive Solid Geometry, Pure primitives & Boundary Representation, Feature base modeling-concept

Unit 4: 3D Modeling using AutoCAD **6**

Introduction to AutoCAD-3D features and 2D commands overview, 3D primitives-types and defining parameters, User coordinate system (UCS) and its options.
3D draw commands: 3D modify and editing commands, 3D viewing & views generation.

Unit 5: Surface modeling and Assembly **6**

Surface modelling, Creation of basic and advanced surfaces, Conversion of surfaces to solids, Assembly

Practical: **30**

(i) Prepare a 2D drawing using AutoCAD and 2D parametric sketcher environment.
(ii) Prepare 3D solid models using AutoCAD (Three components).
(iii) Prepare simple surface model using AutoCAD (Three components).
(iv) Prepare 3D solid models and its assembly using AutoCAD (Four components).

Text books:

1. CAD/CAM: Computer-Aided Design and Manufacturing, M. Groover and E. Zimmers, Pearson Education, 1st edition, 2003
2. AutoCAD for Engineers and Designers; Sham Tickoo, BPB Publications, 2021

References:

1. Machine drawing including AutoCAD, Ajeet Singh, McGraw-hill

Course code	AM SOFTWARE AND PRINTING	L	T	P	C
10213ME206		2	0	2	3

Unit 1: AM Data Formats and Pre-processing **6**

AM file formats, Part orientation and support structure generation, Model slicing, Contour generation, Tool path generation, Build file preparation, Machine set-up.

Unit 2: 3D printing with Tinkercad **6**

Work plane and various commands on Tinkercad, Grouping, Ungrouping, Align, Rulers function of Various commands, Dimensioning of Model, Use of Work plane tools, Making 3D Models in Tinkercad, Editing STL file in Tinkercad, Importing and Exporting 3D Model and converting to STL file.

Unit 3: 3D printing with Cura **6**

Introduction Cura slicer, Importing 3D Model, Different parameters and its setting, G-Code generation.

Unit 4: 3D Scanning **6**

Scanning Process, 3D Scanners, Classification, Scanning software, Converting scanned data into 3D model.

Unit 5: Fused deposition Modeling (FDM) printer **6**

FDM printer, Working, Components, machine setting, Filament making machine, Working and process parameters

Practical: **30**

(i) Modeling & Printing of Solid features (Eg: Circle, Rectangle, Pyramid)-

(ii) Modeling & Printing of a moderately complex geometry,

(iii) 3D Scanning & Printing of Human hand.

(iv) Design Project:

Students will be given a design challenge during which they will come out with a valid design and 3D printing of a functional component. Students are expected to record a report about their work as well as the deliverables of the design project.

Text books:

1. Additive Manufacturing: Principles, Technologies and Applications, C. P. Paul, A. N. Jinoop, McGraw Hill, 2021.
2. Mastering 3D Printing, Joan Horvath and Rich Cameron, 2nd Edition, Apress Media LLC

Course code	DIRECT INK WRITING AND POWDER BED TECHNOLOGY	L	T	P	C
10213ME137		3	0	0	3

Unit 1: Introduction to direct ink writing (DIW) **9**

Introduction to DIW, Stages of DIW, Paste /ink formulations, Process parameters, Rheological properties, Post processing, Challenges and opportunities

Unit 2: Materials and Applications of DIW **9**

Metals, Polymers, Ceramics, Clay and Food Materials like Chocolates, Millets etc and their applications Case studies: DIW of Bioceramics (ZrO_2, Al_2O_3, Hydroxyapatite), DIW of metals (Ti6Al4V, Steel) and Direct ink writing of composites

Unit 3: Laser based powder bed AM **9**

Laser based powder bed AM, Machine architecture, Classification and subcomponents, Case studies

Unit 4: Electron beam based powder bed AM **9**

Electron beam based powder bed AM, Working principle, Subsystems, Process cycle, Powder, Scanning system, Challenges, Beam powder interactions, case studies

Unit 5: Binder based powder bed AM **9**

Binder based powder bed AM, working principle, subsystems, case studies

Text books:

1. Rapid prototyping: laser-based and other technologies, Venuvinod, Patri K., and Weiyin Ma., Springer Science & Business Media, 2013.
2. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Ian Gibson, David Rosen, and Brent Stucker, Springer, New York, NY, 2015.

References:

1. Kumar, L. Jyothish, Pulak M. Pandey, and David Ian Wimpenny, eds. 3D printing and additive manufacturing technologies. Singapore: Springer, 2019.

Web reference:

1. NPTEL Course on Fundamentals of Additive Manufacturing Technologies by Prof. Sajan Kapil, IIT Guwahati, https://onlinecourses.nptel.ac.in/noc21_me115/preview
2. Rheological behavior of titania ink and mechanical properties of titania ceramic structures by 3D direct ink writing using high solid loading titania ceramic ink https://doi.org/10.1016/j.jallcom.2018.12.334
3. Optimization of the ceramic ink used in Direct Ink Writing through rheological properties characterization of zirconia-based ceramic materials https://doi.org/10.1016/j.ceramint.2021.11.013

Action: The members were satisfied with the explanation and recommended the courses.

39 BoS 06 Discussion and Approval of Changes in Course title for R23 PG Courses:

1. Safety and risk analytics to Data Analytics in Safety Engineering.
2. Advanced finite element method to mathematical modelling for finite element analysis.

M.Tech. – Industrial Safety and Engineering						
Sl. No.	**Code**	**Course**	**L**	**T**	**P**	**C**
1	20231ME120	~~Safety and risk analytics~~ Data Analytics in Safety Engineering	4	0	0	4

M.Tech. – Metallurgical and Material Science Engineering						
Sl. No.	**Code**	**Course**	**L**	**T**	**P**	**C**
1	20231ME110	~~Advanced finite element method~~ Mathematical modelling for finite element analysis	3	1	0	4

COURSE CODE	DATA ANALYTICS IN SAFETY ENGINEERING	L	T	P	C
20231ME120		4	0	0	4

Unit 1: Basics of safety and risk & Creation of safety database **12**

Introduction to Safety and Risk Management, Hazard Triangle, Safety Ontology, Qualitative Risk Assessment, Quantitative Risk Assessment, Hazard and Risk Data, Incident Investigation Data, Inspection and Audit Data, Behavioral and Organizational Safety Data, Data Dimensions and Information Quality, Missing Data Handling, Data transformation, Data Reduction.

Unit 2: Descriptive safety analytics & Safety performance evaluation and monitoring **12**

Probability Distribution, Sample and Statistics, Safety Data Visualization Tools, Safety Data Exploration, Leading and Lagging Indicators for Measuring Safety Performance, Control Charts for Safety Performance Evaluation and Monitoring, Safety Capability Analysis.

Unit 3: Analysis of Safety Reports and Narratives & Risk quantification **12**

Safety Reports and Use of Text Analytics, Preprocessing of Text Data, Document Classification using KNN, Topic Modeling - Latent Dirichlet Allocation, Bow-Tie Construction, Bow-Tie Quantification: Accident Scenarios/Paths, Accident Path Quantification, Probabilistic Approach using Monte Carlo Simulation, Consequence Modelling and Risk Distribution.

Unit 4: Predictive safety & risk analytics **12**

Introduction to Predictive Safety and Risk Analytics, Logistic Regression, Application of Logistic Regression, Classification and Regression Tree (CART), Support Vector Machine, Application of Support Vector Machine, Association Rule Mining, Application of Association Rule Mining, Statistical Measures of Safety Program Effectiveness, Intervention Design, Risk Based Decision Making, Risk Based Maintenance.

Unit 5: Behavioural safety analytics and injury epidemiology **12**

Introduction to Behavioral Safety, Behavioral Safety Data Collection and Preliminary Analysis, Causal Modelling,: Application of Path Model, Injury Epidemiology, existing statutory regulations and relevant applications

TOTAL: 60 PERIODS

References

1. Safety and Risk Analytics, NPTEL course
2. Probabilistic Risk Assessment and Management for Engineers and Scientists, by H Kumamoto and E J Henley, IEEE Press.
3. An Introduction to Statistical Learning by James, G., Witten, D., Hastie, T., and Tibshirani, R., Springer.
4. Pattern Recognition and Machine Learning by Christopher M Bishop, Springer.
5. Introduction to data mining by Tan, P. N., Steinbach, M., & Kumar, V. (2016). Pearson Education India.
6. Text mining: predictive methods for analysing unstructured information, by Weiss S M, Indurkhya N, Zhang T and Damerau F J, Springer.

COURSE CODE	MATHEMATICAL MODELING FOR FINITE ELEMENT ANALYSIS	L	T	P	C
20231ME110		3	1	0	4

UNIT I : INTRODUCTION **12**

Modeling and Discretization – Interpolation, Elements, Nodes and degrees-of-freedom - Computational Procedures–Stiffness Matrices – Boundary Conditions-Solution of Equations-Ritz method, Variational Method, Method of weighted residuals, etc – Boundary Element Technique

UNIT II: BASIC ELEMENTS **12**

Interpolation and shape functions - element matrices-linear triangular elements (CST)-quadratic triangular elements – bilinear rectangular elements-quadratic rectangular elements- solid elements-higher order elements-nodal loads-stress calculations-example problems

UNIT III: ISOPARAMETRIC ELEMENTS **12**

Introduction-bilinear quadrilateral elements – quadratic quadrilaterals – hexahedral elements – Determination of Shape Functions – Numerical Integration – quadrature – static condensation – load considerations –stress calculations -examples of 2D and 3D applications.

UNIT IV: FINITE ELEMENT FORMULATION FOR STRUCTURAL APLICATIONS **12**

Linear elastic stress analysis-2D and axisymmetric problems –Structural vibration – mass and damping matrices – damping – Harmonic response – direct integration techniques – explicitand implicit methods– Case studies.

UNIT V: HEAT TRANSFER AND FLUID MECHANICS APPLICATIONS **12**

Nonlinear Problems – Element formulation – Heat Conduction and Fluid flow – Transient Thermal Analysis - Incompressible and rotational flow – Applications for heat conduction and 2D stress analysis- Case Studies.

TOTAL: 60 PERIODS

REFERENCES

1. Chandrupatla & Belagundu, ‚Finite Elements in Engineering', Prentice Hall of India Private Ltd., 2010.
2. C.A. Brebbia and S. Walker, Boundary Element Techniques in Engineering, Newness Butterworths, 2011.
3. Cook, Robert Davis et al, Concepts and Applications of Finite Element Analysis, Wiley, John & Sons, 2012.
4. O.C.Zienkiewicz, The Finite Element Method, 3rd Edition, Tata McGraw-Hill, 2010.

Action:. Members accepted and recommended..

39 BoS 07 List of Courses recommended under Self Learning Courses (NPTEL/MooC)

UG

As per the regulation VTR UGE 2021, a student can choose the Open Elective courses which are recommended by the Board of Study (BoS) of departments of other than his/her school which he/she belongs.

S.No	Name of the Course	Link
1	Social Innovation in Industry 4.0	https://nptel.ac.in/courses/112104319
2	Metal Additive Manufacturing	https://nptel.ac.in/courses/112104312
3	Automation in Manufacturing	https://nptel.ac.in/courses/112103293
4	Energy Conservation and Waste Heat Recovery	https://nptel.ac.in/courses/112105221
5	Sustainable Power Generation Systems	https://nptel.ac.in/courses/127103236

As per the regulation VTR UGE 2021, a student can choose the program elective courses which are recommended by the Board of Study (BoS) of departments of other than his/her school which he/she belongs.

S.No	Name of the Course	Link
1	Design of Mechatronic Systems	https://nptel.ac.in/courses/112101304
2	Artificial Intelligence and Machine Learning in Materials Engineering	https://nptel.ac.in/courses/113104517
3	Industrial Robotics : Theories for Implementation	https://nptel.ac.in/courses/112105319
4	Fundamentals of Additive Manufacturing Technologies	https://nptel.ac.in/courses/112103306
5	Metal Additive Manufacturing	https://onlinecourses.nptel.ac.in/noc22_me130/preview
6	Sustainable Energy Technology	https://nptel.ac.in/courses/112106318

PG

Compulsory courses - (2 credits)

S.No	Name of the Course	Link
1	Human Factors Engineering	https://onlinecourses.nptel.ac.in/noc24_ge41/preview
2	English for Research Paper Writing	https://onlinecourses.swayam2.ac.in/ntr24_ed46/preview

Programme Elective - (3 credits) for M.Tech. - Industrial Safety and Engineering

S.No	Name of the Course	Link
1	Industrial Safety And Fire Safety Management	https://onlinecourses.swayam2.ac.in/nou24_ge81/preview
2	Human Factors Engineering	https://onlinecourses.nptel.ac.in/noc24_mg108/preview

Programme Elective - (3 credits) for M.Tech. – Material Science and Metallurgy Engineering

S.No	Name of the Course	Link
1	Advanced Materials and Processes	https://onlinecourses.nptel.ac.in/noc24_mg125/preview
2	Theory of Production Processes	https://onlinecourses.nptel.ac.in/noc24_mg116/preview
3	Fundamentals of Additive Manufacturing Technologies	https://onlinecourses.nptel.ac.in/noc24_mg119/preview
4	Metal Additive Manufacturing	https://onlinecourses.nptel.ac.in/noc24_mg107/preview
5	Basics of Materials Engineering	https://onlinecourses.nptel.ac.in/noc24_mg123/preview

Discussion: The members accepted and endorsed the recommendations.

39 BoS 08 Courses offered by International /Industrial Faculty under VTUR15 section, 7.2.8.3, specialized courses

S.No	Name of the Faculty	Course Code & Course Name	Duration	No. of Students attended
1	Dr.Lung-Jieh Yang Professor, Department of Mechanical and Electro-Mechanical Engineering, Tamkang University, Taiwan.	10215ME905 Sustainability and Offshore Wind Farm	03.04.2024 to 06.04.2024 (15 Hours)	39
2	Dr.Kapil Gupta Professor, Dept. of Mechanical and Industrial Engineering Technology, University of Johannesburg, South Africa	10215ME906 Advanced Research Methodology for Industrial Revolution 4.0	25.04.2024 to 30.04.2024 (15 Hours)	27

Action: Members have taken note.

List of students

S.no	Vtu No	StudentName	CourseName
1	VTU21134	ALOBO YEPTHOMI	Advanced Resesarch Methodology for Industrial Revolution 4.0
2	VTU20613	BONTHU SAI	Advanced Resesarch Methodology for Industrial Revolution 4.0
3	VTU20892	GAHALOTH KRISHNA	Advanced Resesarch Methodology for Industrial Revolution 4.0
4	VTU21110	M PRAVEEN KUMAR	Advanced Resesarch Methodology for Industrial Revolution 4.0
5	VTU20790	DALAVAI PRANEETH KUMAR	Advanced Resesarch Methodology for Industrial Revolution 4.0
6	VTU19719	GOVINDHU SHANMUKA SAI	Advanced Resesarch Methodology for Industrial Revolution 4.0
7	VTU19474	NAGOTHU BALA TRINESH KUMAR	Advanced Resesarch Methodology for Industrial Revolution 4.0
8	VTU21796	AHAMED ANAS A	Advanced Resesarch Methodology for Industrial Revolution 4.0
9	VTU24283	BAKKANI JASHWANTH	Advanced Resesarch Methodology for Industrial Revolution 4.0
10	VTU23882	KAGGANAPALLE GNANENDRA	Advanced Resesarch Methodology for Industrial Revolution 4.0
11	VTU22723	MUDDAMSETTI NARENDRA	Advanced Resesarch Methodology for Industrial Revolution 4.0
12	VTU23704	S CHAITHANYA VARMA	Advanced Resesarch Methodology for Industrial Revolution 4.0
13	VTU21702	SHAIK AFRIDI	Advanced Resesarch Methodology for Industrial Revolution 4.0
14	VTU22376	SHAIK SHAMMEL BASHA	Advanced Resesarch Methodology for Industrial Revolution 4.0
15	VTU27014	CHILIKESWARAPU BALARAM	Advanced Resesarch Methodology for Industrial Revolution 4.0
16	VTU26975	GUNNA SUDHAKAR	Advanced Resesarch Methodology for Industrial Revolution 4.0
17	VTU27011	NAGENDRAN I	Advanced Resesarch Methodology for Industrial Revolution 4.0
18	VTU26979	SASWANTH N V	Advanced Resesarch Methodology for Industrial Revolution 4.0
19	VTU26966	TALLAPRAGADA DHARANI SHIVA KRISHNA	Advanced Resesarch Methodology for Industrial Revolution 4.0
20	VTU27171	SIRIPIREDDY CHANDRA SEKHAR REDDY	Advanced Resesarch Methodology for Industrial Revolution 4.0
21	VTU27198	CHANDAPU SURESH	Advanced Resesarch Methodology for Industrial Revolution 4.0
22	VTU27256	BOYA KALYAN	Advanced Resesarch Methodology for Industrial Revolution 4.0
23	VTU27302	KANALA THARUN KUMAR REDDY	Advanced Resesarch Methodology for Industrial Revolution 4.0
24	VTU27328	MENDA SUDHEER	Advanced Resesarch Methodology for Industrial Revolution 4.0
25	VTU24148	KAMALESHWAR M S	Advanced Resesarch Methodology for Industrial Revolution 4.0

26	VTU22061	PAVAN KUMAR DEVARAKONDA	Advanced Resesarch Methodology for Industrial Revolution 4.0
27	VTU24253	KADAM ADARSH SANTOSH	Advanced Resesarch Methodology for Industrial Revolution 4.0
28	VTU20518	KARTHIKEYAN S	Sustainability and Offshore Wind Farm
29	VTU21365	SHIJO THOMAS T	Sustainability and Offshore Wind Farm
30	VTU21407	SARATH S K	Sustainability and Offshore Wind Farm
31	VTU21527	RAKESH M	Sustainability and Offshore Wind Farm
32	VTU22166	KANCHARLA GUNA NAGA SIDDESHWAR	Sustainability and Offshore Wind Farm
33	VTU22253	THAMBI DURAI V	Sustainability and Offshore Wind Farm
34	VTU22801	ARAVIND J NAIR	Sustainability and Offshore Wind Farm
35	VTU23557	P GURU SUBRAMANYA SAI	Sustainability and Offshore Wind Farm
36	VTU23614	BHARATH S	Sustainability and Offshore Wind Farm
37	VTU23687	PRINCE ALWIN G M	Sustainability and Offshore Wind Farm
38	VTU23878	SANTHOSH VEL P	Sustainability and Offshore Wind Farm
39	VTU23903	MONISH AR	Sustainability and Offshore Wind Farm
40	VTU23973	NIMMAKANTI SRAVAN KUMAR	Sustainability and Offshore Wind Farm
41	VTU23982	ABHAY HALDER	Sustainability and Offshore Wind Farm
42	VTU23984	J AKASH KUMAR	Sustainability and Offshore Wind Farm
43	VTU24025	KAIRAMEKALA MANI BHARATH	Sustainability and Offshore Wind Farm
44	VTU24059	GURRALA NANDA KUMAR	Sustainability and Offshore Wind Farm
45	VTU24245	KARRI RAM CHARAN	Sustainability and Offshore Wind Farm
46	VTU24285	JANAK D	Sustainability and Offshore Wind Farm
47	VTU24308	VINUWIN V	Sustainability and Offshore Wind Farm
48	VTU24400	SRI RAM PRASATH M	Sustainability and Offshore Wind Farm
49	VTU24481	JAYKUMAR SHARMA R	Sustainability and Offshore Wind Farm
50	VTU26723	JAIYANTH S	Sustainability and Offshore Wind Farm
51	VTU26724	AJAY KUMAR K B	Sustainability and Offshore Wind Farm
52	VTU27019	RAJIT RAJORA	Sustainability and Offshore Wind Farm
53	VTU27027	HARISH S	Sustainability and Offshore Wind Farm
54	VTU27029	GUNISETTY VENKATA LIKHITH KUMAR	Sustainability and Offshore Wind Farm
55	VTU27045	PERANDURU SANATRAAJ	Sustainability and Offshore Wind Farm
56	VTU27049	JOEL BERLIN J	Sustainability and Offshore Wind Farm
57	VTU27055	ABINASH A	Sustainability and Offshore Wind Farm
58	VTU27096	KASARABADA VENKATA MANI PRABHAS	Sustainability and Offshore Wind Farm
59	VTU27123	P.T JAGADEESAN	Sustainability and Offshore Wind Farm
60	VTU27148	KADIRI GNANENDRA KUMAR	Sustainability and Offshore Wind Farm
61	VTU27200	SHAMSUDEEN BASHA B	Sustainability and Offshore Wind Farm
62	VTU27217	TANNIRU ADITHYA SAI	Sustainability and Offshore Wind Farm
63	VTU27253	VASA NAGA DURGA VENKATA SURYA PRAKASH	Sustainability and Offshore Wind Farm
64	VTU27295	GANDEPALLI BHANU PRASAD	Sustainability and Offshore Wind Farm
65	VTU27308	VELMURUGAN M	Sustainability and Offshore Wind Farm
66	VTU27309	BADIGANTLA SIDDU	Sustainability and Offshore Wind Farm

39 BoS 09 Students carried out projects, in Foreign Universities/Laboratories, Industries & In-Campus

S.No	Name of the Project	In-Campus /Industry	No. of Students
1	2024 Minor Project	In-Campus	76
2	2024 Major Project	In-Campus	47
3	2024 Major Project	Industry (Internship)	10
4	2024 Major Project	Industry (Internship with Placement)	08
5	2024 Major Project	Aravalli Terrain Vehicle Championship	01
6	2024 Major Project	Abroad	02
7	2025 Minor Project	In-Campus	84

2024 Minor Project - In-Campus

Sl No	VTU	NAMEOF THE STUDENT	Titel	PROJECT TYPE
1	18401	NOOKALA NITHIN KUMAR	Structures for biomedical application using 3D printing	In-Campus
2	16031	VENNAPUSA BRAHMANANDA REDDY		In-Campus
3	21602	GUNTOJU.VINAY		In-Campus
4	12065	R SHRI RAHUL	Design and development of IOT-DRIVER GREEN HOUSE CROP MANAGEMENT	In-Campus
5	21617	S.SANTHOSH BABU	Design and Fabrication of Lithium-ion Battery Test KIT	In-Campus
6	21618	S.DHASHWANTH		In-Campus
7	16019	M SAKTHI VENKATESH		In-Campus
8	17904	CH HARIKRISHNA PADAL	Desing and Fabrication of Compactable Model of air jet impacting system	In-Campus
9	16837	RONGALA CHAITANYA VENKATA MANSATYA SAI RAM		In-Campus
10	18100	YEKAMBARAM NAVEEN		In-Campus
11	12588	HARINARAYANA VEMULAKONDA	Fabrication of heat sink using copper	In-Campus
12	18411	KAMANURU NAGA SAI RISHIK		In-Campus
13	18400	KODATHALA VENU MADHAV REDDY		In-Campus
14	21613	PREM G ROSHAN	Design and Fabrication of Biometric Attendance System with Health Monitoring Devices	In-Campus
15	21614	K.KEERTHIVASAN		In-Campus
16	21612	S.PRASANNA		In-Campus
17	15551	KORAPAKA KARTEEK	Fabriaction of Miniature Conveyor Model for Railway Closed Body Wagon	In-Campus
18	15687	MODALA CHAITHANYA SRI SAI		In-Campus
19	17310	N RAMA CHANDRA SURYA VISWANATH		In-Campus
20	21654	KAMBAMVENU GOPAL REDDY	Development of ortopeck braces of leg using 3D printing	In-Campus
21	21648	VADDITANDRA DILEEP KUMAR		In-Campus
22	21659	CLEMENT EPAENTUS BONI		In-Campus
23	18327	G HRUTHIK	Design and Fabrication of 3D Printed Bone Implants	In-Campus
24	17489	K HEMANTH KUMAR		In-Campus
25	17516	MONDIGONTLA GANESH		In-Campus
26	18049	ALLU G V VENKATA ESWAR	Design and Development of Fins for Battery Thermal Management	In-Campus
27	18415	ATHOTA NIKHIL		In-Campus
28	17048	KORAITLA RAJESH		In-Campus
29	17580	D PRAVEEN REDDY	Design and Fabrication of Food Packaging Container using Bio-Composite	In-Campus
30	17152	P VENKATA KALYAN REDDY		In-Campus
31	17463	G YUGANDHER		In-Campus
32	17735	D ADHITHYA DANRAJ	Design and Fabrication of Hydrogen Fuel Cell as Renewable Energy Source	In-Campus
33	17299	DHANTHALA KEERTHAN KUMAR		In-Campus
34	16728	KURUTHIVENTI AJAY		In-Campus
35	12067	AASIAN A	Design and Fabrication of Battery Operated Monocycle	In-Campus
36	16922	R RANJITH		In-Campus

37	16868	JOY SOLOMON		In-Campus
38	18703	PANKAJ RAUNYAR	Design and Fabrication of HHO Electrolysis Based Gas Cutter	In-Campus
39	17013	SHINDE OMKAR JHOTHIBE		In-Campus
40	21639	LOHIT RAJ		In-Campus
41	17427	K SAI KIRAN	Design and Fabrication of FML top hat structure	In-Campus
42	17767	N RAVI KIRAN		In-Campus
43	17101	KODAVALI HEMANTH KUMAR		In-Campus
44	12395	LALITH KUMAR E	Design and fabrication of electric bicycle	In-Campus
45	21665	SANTHOSH KUMAR NAIK		In-Campus
46	21601	S.RIYAZ AHMED		In-Campus
47	12043	ANKIT KUMAR B	Design and Fabrication of E-Skate Scooter	In-Campus
48	12078	SATHEES KUMAR N		In-Campus
49	15354	THOMAS HYDAN.J		In-Campus
50	16919	ARPITH SINHA	Design and fabrication of energy efficient regenerative braking system for automobile	In-Campus
51	18548	SUBHAM KUMAR		In-Campus
52	18054	KAVALA AVINASH	Design and development of solar powered vending machine	In-Campus
53	17448	M SIVA RAMA KRISHNA MANOJ		In-Campus
54	16062	MANNERU MADHUSUDHAN		In-Campus
55	12020	KUNAAL K	Design and fabrication of Regenerative braking system	In-Campus
56	15566	J JAYA KIRAN	Design and fabrication of thermoflask	In-Campus
57	18043	KOTTURI DURGA SRI DIVYESH		In-Campus
58	15567	Y V NAGA THARUN		In-Campus
59	17047	BANDREDDI VENKATA SAI BHANU	Design and fabrication of converted power sprayer	In-Campus
60	12072	NADILA KIRAN SURESH		In-Campus
61	17742	KURAPATI ROSHAN SAI		In-Campus
62	21630	M DEVA	Design and fabrication of 3D Modelled sensored robotic limb	In-Campus
63	17090	VOLETI UDAY VISWANATH		In-Campus
64	16913	KUSHMANAND KUMAR	Design and development of fuel cell for power generation	In-Campus
65	21629	G.NAVEEN		In-Campus
66	16721	SONU KUMAR YADAV		In-Campus
67	17261	SAKA HARSHAVARDHAN	Design and fabrication of heat sink for electronic cooling through CNC machining	In-Campus
68	17480	B SAI KIRAN		In-Campus
69	17941	CHITIKELA RAJU NAIDU		In-Campus
70	17754	KONDU BHARGAV	Design and fabrication of wheel type pump	In-Campus
71	15982	KONDURU ANANDHAM		In-Campus
72	17563	B VENKATA SAI		In-Campus
73	18599	GABREIL	Fabrication of chromium reinforced aluminium surface composite using friction stir processing	In-Campus
74	12396	SHAIK ABDUL AZEEL	Design and fabrication of automatic fier alaram system using LM393	In-Campus
75	17287	RAHUL KUMAR SARRAF		In-Campus

76	12314	IMRAN ISMAYIL	Numerical modeling and expriements of an atmospheric pressure plasma jet operated in air with shielding gas	Internship

Action: Members have taken note.

2024 Major Project

Sl No	VTU	NAMEOF THE STUDENT	Titel confermation	PROJECT TYPE
1	21613	PREM G ROSHAN	CHARACTERSTICS STUDY OF ALUMINIUM ZIRCONIUM MATERIAL USING DRILLING PROCESS	In-Campus
2	21614	K.KEERTHIVASAN		In-Campus
3	21601	S.RIYAZ AHMED		In-Campus
4	17904	CH HARIKRISHNA PADAL	DESIGN OF LITHIUM BATTERY AND CONSTRUCTION OF FRAME FOR ELECTRIC VEHICLE	In-Campus
5	21618	S.DHASHWANTH		In-Campus
6	18327	G HRUTHIK		In-Campus
7	18401	NOOKALA NITHIN KUMAR	DIGITAL LIGHT PROCESSING OF BIONIC STRUCTURES	In-Campus
8	16031	VENNAPUSA BRAHMANANDA REDDY		In-Campus
9	21602	GUNTOJU.VINAY		In-Campus
10	17516	MONDIGONTLA GANESH	ANALYSIS OF JET IMPACT SYSTEM A COMPUTATIONAL STUDY USING ANSYS	In-Campus
11	16837	RONGALA CHAITANYA VENKATA MANSATYA SAI RAM		In-Campus
12	12314	IMRAN ISMAYIL		In-Campus
13	21630	M DEVA	FABRICATION OF SOLAR BASED PICK AND PLACE ROBOT	In-Campus
14	21639	LOHIT RAJ		In-Campus
15	12020	KUNAAL K		In-Campus
16	17310	N RAMA CHANDRA SURYA VISWANATH	ENHANCEMENT OF ELECTRICAL CONDUCTIVITY OF NON CONDUCTIVITY FUELS	In-Campus
17	12588	HARINARAYANA VEMULAKONDA		In-Campus
18	17489	K HEMANTH KUMAR		In-Campus
19	17261	SAKA HARSHAVARDHAN	PERFORMANCE EVALUATION OF SOLAR THERMAL COLLECTOR USING PCM	In-Campus
20	17480	B SAI KIRAN		In-Campus
21	17941	CHITIKELA RAJU NAIDU		In-Campus
22	15566	J JAYA KIRAN	PERFORMANCE ENHANCEMENT ON PHOTOVOLTAIC THERMA (PVT) SYSTEM BY USING NANOFLUID	In-Campus
23	15567	Y V NAGA THARUN		In-Campus
24	18043	KOTTURI DURGA SRI DIVYESH		In-Campus
25	21648	VADDITANDRA DILEEP KUMAR	EXPRIEMENTAL INVESTIGATION OF SPLIT SOLAR DESATINATION SYSTEM	In-Campus
26	21659	CLEMENT EPAENTUS BONI		In-Campus
27	16913	KUSHMANAND KUMAR		In-Campus

28	17090	VOLETI UDAY VISWANATH	SURVEILLANCE IN THE LAKES FOR FARMERS BY ROV	In-Campus
29	18054	KAVALA AVINASH	DESIGN AND FABRICATION OF HHO SAFETY KIT	In-Campus
30	15687	MODALA CHAITHANYA SRI SAI		In-Campus
31	18049	ALLU G V VENKATA ESWAR		In-Campus
32	16728	KURUTHIVENTI AJAY	DESIGN AND FABRICATION OF HYDROGEN CYCLINDER WITH OTV	In-Campus
33	17047	BANDREDDI VENKATA SAI BHANU		In-Campus
34	17101	KODAVALI HEMANTH KUMAR		In-Campus
35	17735	D ADHITHYA DANRAJ	INVESTIGATION ON HEAT SINK GEOMETRY USING PHASE CHANGE MATERIAL IN COOLING APPLICATION	In-Campus
36	16919	ARPITH SINHA		In-Campus
37	17299	DHANTHALA KEERTHAN KUMAR		In-Campus
38	17048	KORAITLA RAJESH	ENHANCEMENT OF MECHANICAL BEHAVIOUR OF ROSELLE WITH A RAMIE FIBRE REINFORCED POLYMER COMPOSITE	In-Campus
39	18415	ATHOTA NIKHIL		In-Campus
40	17427	K SAI KIRAN		In-Campus
41	18411	KAMANURU NAGA SAI RISHIK		ATVC
42	21654	KAMBAMVENU GOPAL REDDY		
43	18400	KODATHALA VENU MADHAV REDDY		
44	17152	P VENKATA KALYAN REDDY	OPTIMIZATION OF AWJMPROCESS PARAMETERS OF ALUMINIUM MATRIX COMPOSITES	In-Campus
45	17463	G YUGANDHER		In-Campus
46	17742	KURAPATI ROSHAN SAI		In-Campus
47	17448	M SIVA RAMA KRISHNA MANOJ	MECHANICAL CHARACTERIZATION AND OPTIMIZATION OF MACHINING PARAMETERS IN ABRASIVE WATER JET MACHINE OF ALUMINIUM COMPOSITE	In-Campus
48	16062	MANNERU MADHUSUDHAN		In-Campus
49	21665	SANTHOSH KUMAR NAIK		In-Campus
50	18548	SUBHAM KUMAR	DESIGN AND DYANAMICS STRESS ANALYSIS OF ROBORT ARM BY THE EXCAVATOR SIMULATIONS IN ANSYS	In-Campus
51	21612	S.PRASANNA	Motherson Automotive Technologies & Engineering	Internship with Placement
52	17580	D PRAVEEN REDDY	Motherson Automotive Technologies & Engineering	Internship with Placement

53	21629	G.NAVEEN	Precision Electronic Components Manufacturing Company	Internship
54	16721	SONU KUMAR YADAV	Sundaram Fasteners	Internship
55	15354	THOMAS HYDAN.J	Sundaram Fasteners	Internship
56	12067	AASIAN A	Sundaram Fasteners	Internship
57	12078	SATHEES KUMAR N	Sundaram Fasteners	Internship
58	12395	LALITH KUMAR E	Sundaram Fasteners	Internship
59	12043	ANKIT KUMAR B	Sundaram Fasteners	Internship
60	16019	M SAKTHI VENKATESH	Sundaram Fasteners	Internship
61	16922	R RANJITH	Sundaram Fasteners	Internship
62	21617	S.SANTHOSH BABU	Sundaram Fasteners	Internship
63	18703	PANKAJ RAUNYAR	Motherson Automotive Technologies & Engineering	Internship with Placement
64	16868	JOY SOLOMON	Motherson Automotive Technologies & Engineering	Internship with Placement
65	17287	RAHUL KUMAR SARRAF	Motherson Automotive Technologies & Engineering	Internship with Placement
66	17013	SHINDE OMKAR JHOTHIBE	Motherson Automotive Technologies & Engineering	Internship with Placement
67	12065	R SHRI RAHUL	TAMKANG UNIVERSITY, TAIWAN, Prof.LUNG JIEH YANG, +866932159193,liyang@mail.tku.edu.tw	ABROAD
68	15551	KORAPAKA KARTEEK	Urmilla Enterprises.	Internship with Placement
69	18100	YEKAMBARAM NAVEEN	Milekal Engineering	Internship with Placement
70	18599	GABREIL	National Chung Cheng University ,TAIWAN	ABROAD

2025-Minor Project

SLNO	VTU	NAMEOF THE STUDENT	Title	PROJECT TYPE
1	23982	ABHAY HALDER	FABRICATION OF WASTE PLASTIC IN TO 3D PRINTING FILAMENT WIER	In-Campus
2	23987	KARRIMAJJI PRAVEEN KUMAR		In-Campus
3	23986	KONATHALA THANAY GANESH KUMAR		In-Campus
4	20419	YELUGOTI DHARANIDHAR REDDY	FABRICATION OF PROSTHETIC HAND	In-Campus
5	20489	KOLIKIPAMU ROHAN KARTHIK		In-Campus
6	24012	BANDI SAHITHI		In-Campus
7	20991	RIMMALAPUDI ESHWAR KARTHIK	FABRICATION OF WIND TURBINE FOR ELECTRIC VEHICLE	In-Campus
8	20955	VEDANTH AMBATI		In-Campus
9	23973	NIMMAKANTI SRAVAN KUMAR		In-Campus
10	24001	T NAVEEN VAMSI	DESIGN AND FABRICATION OFROBOTIC ARM USING BLUETOOTH CONNECTIVITY WITH ARDUNION PROGRAM	In-Campus
11	24099	GARAPATI SANJEEVI KUMAR		In-Campus
12	23991	VASAGIRI MANI DEEPAK		In-Campus
13	21033	KOTTAPALLI JAYABHARGAVAN	DESIGN AND FABRICATION OF CHAMBERT FOR FLUE GAS SEPERATION	In-Campus
14	24073	BORIGORLA AMARA NARASIMHA RAO		In-Campus
15	24074	NARAGA BRAHMAJI		In-Campus
16	24061	VETTI REVANTH	MINIATURE OF 3D PRINTING PICK AND PLACE ROBOTIC ARM	In-Campus
17	24025	KAIRAMEKALA MANI BHARATH		In-Campus
18	24060	PONNAPUDI DURGA PRASAD		In-Campus
19	23977	KURRA NAGENDRA	FABRICATION OF SOLAR BASED HYDROGEN PRODUCTION KIT	In-Campus
20	23979	YAMPALAKU SURYA PRASAD		In-Campus
21	24086	PEDDANABIONA GOVARDHAN		In-Campus
22	24117	GUNUPUDI KRANTHI KUMAR	DESIGN AND FABRICATION OF MULTIPURPOSE CUTTING PUNCHING BY USING GENEWA MECHANISM	In-Campus
23	24089	IMMIDI D N V V SATYANARAYANA		In-Campus
24	24078	KARE HARSHAVARDHAN		In-Campus
25	19848	SANTOSH RAJA	DEVELOPMENT OF PIN BASED IMPELLER FOR RADIAL FLOW PUMP	In-Campus
26	20741	DADINABOINA SYAM KUMAR		In-Campus
27	20331	YANNAMREDDY MANOHAR REDDY		In-Campus

28	21023	VATTI LOHITH MANISANKAR		In-Campus
29	21111	PUTTA SIVA CHARANSAI	FABRICATION OF ROBOTIC ARM	In-Campus
30	21237	MANDLA MANJUNADHA		In-Campus
31	24071	DINESHKUMAR G	DEVELOPMENT AND CHARACTERISATION OF AGRO RESIDUE AND RECYCLED POLYPROPYLENE COMPOSITE FILAMENT FOR 3D PRINTING	In-Campus
32	24082	GOKUL M		In-Campus
33	23953	J.VIDHYA LAKSHMI		In-Campus
34	20706	CHIKATI SHYAM SUNDER	FABRICATION OF WELDING FUME EXTRACTOR	In-Campus
35	20984	HEMANTH		In-Campus
36	19895	K S Chandra Sekhar		In-Campus
37	19300	VATHALURU. VENKATA SIVA REDDY	FABRICATION OF MARINE CLEANING ROBOTIC ARM	In-Campus
38	20946	B. LEELA VAMSI REDDY		In-Campus
39	19892	MIDATALA SAI KUMAR		In-Campus
40	24003	KAMAL K	FABRICATION OF POLYMER COMPOSITE USING ADDITIVE MANUFACTURING BY 3D PRINTER FOR AUTOMOBILE APPLICATION	In-Campus
41	24059	GURRALA NANDA KUMAR		In-Campus
42	24085	SHAIK MAHAMMAD IMRAN		In-Campus
43	19872	S KARAN	DESIGN AND DEVELOPMENT OF BIO-DEGRADBLE PROSETHIRC LIMBS FOR MOMENT DISABILITY PEOPLE BY ADDITIVE MANUFACTURING	In-Campus
44	20864	ROHAN TIRKEY		In-Campus
45	19712	K MANI BHARATH		In-Campus
46	19032	POLUMATI MURARJI	EXPRIMENTAL INVESTIGATION ON INVERT STABILIZ OF OPERATING RAILWAY TUNNEL	In-Campus
47	19719	GOVINDU SHANMUKA SAI		In-Campus
48	19766	Sama Stalin Reddy		In-Campus
49	21110	M PRAVEEN KUMAR	ECO FRIENDLY AND SUSTAINABLE PAPER BAGS USING WASTE LEAVES	In-Campus
50	19479	SHAIK IRFAN		In-Campus
51	21744	B.Nithish		In-Campus
52	19830	CHALLAM VINAY	DESIGN AND DEVELOPMENT OF BIO-DEGRADBLE PROSETHIRC LIMBS FOR MOMENT DISABILITY PEOPLE BY	In-Campus
53	21209	DORIGILLU ARJUN REDDY		In-Campus
54	19732	VAMSI KRISHNA KOTHAMASU		In-Campus

			ADDITIVE MANUFACTURING	
55	20790	DALAVAI PRANEETH KUMAR	DESIGN AND FABRICATION OF BELT CONVEYER FOR RAILWAY WAGON APPLICATION	In-Campus
56	20613	BONTHU SAI		In-Campus
57	19474	NAGOTHU BALA TRINESH KUMAR		In-Campus
58	24033	MOHAMED ASLAM S	FABRICATION OF SCROLL SAW MACHINE	In-Campus
59	24068	FARAJ HUQ A		In-Campus
60	24023	MOHAMED SULTHAN		In-Campus
61	21476	PANKAJ KUMAR YADAV	DESIGN AND FABRICATION OF COMBINED ELECTRIC MIXER	In-Campus
62	21488	ROSHAN BHATTA		In-Campus
63	20979	OBED IMLONG S	PET BATTEL RECYCLING WATE TO 3D PRINTING FILAMENT	In-Campus
64	20977	M PONGSO		In-Campus
65	21134	ALOBO YEPTHOMI		In-Campus
66	23984	J AKASH KUMAR	FABRICATION OF CRANK LEVER QUICK RETURN MECHANISM	In-Campus
67	24026	ARUN KUMAR		In-Campus
68	20136	SUNIT TIRPUDE	ATVC COMPETITON	In-Campus
69	19242	RISHABH SINGH		In-Campus
70	19672	U M GANESH SAGAR		In-Campus
71	19400	ABDUL WAHAB	ATVC COMPETITON	In-Campus
72	19876	P SUDAN		In-Campus
73	20518	KARTHIKEYAN.S		In-Campus
74	19127	MOHAMMED RIYAS.A	ATVC COMPETITON	In-Campus
75	19506	SUBASH		In-Campus
76	24039	GURUMALLAIYARAJ M		In-Campus
77	20730	YAUWANS XALXO	ATVC COMPETITON	In-Campus
78	20633	MOHAMED FAYIZ P		In-Campus
79	20341	FAHAD FAISAL MOOSA		In-Campus
80	21119	KARTHICK KUMAR A	ATVC COMPETITON	In-Campus
81	21491	SABYASACHI NATH		In-Campus
82	23993	RAJARISHI H P		In-Campus
83	19935	SIVA M PRAMOD		In-Campus
84	21064	MAHESHWER K T K		In-Campus

Action: Members have taken note.

39 BoS 10 Students attended Industrial Visits and In Plant Training

S.No	Name of the Industry	Date of Visit	No. of Students Visited
1	Brakes India Private Limited, Padi. Chennai	19-08-2023	30
2	Delphi TVS Technologies Limited, Oragadam	19-08-2023	25
3	Simpson & Co Ltd in Perambur,Chennai	21-08-2023	30
4	Toshniwal Hyvac Pvt. Ltd,Ambattur,Chennai	04-04-2024	45
5	Ennore Thermal Power Station	23-04-2024	36

39 BoS 11 Students undergone NPTEL courses

B.Tech Students

S.no	Vtu No	Name	Course Name	NPTEL Score %	Equivalent % as per VTU regulation (NPTEL score x 1.25)	Grade
1	vtu19872	S KARAN	Entrepreneurship Essentials	53	66	C
2	vtu20730	YAUWANS XALXO	Entrepreneurship Essentials	49	61	C
3	vtu21476	PANKAJ KUMAR YADAV	Entrepreneurship Essentials	47	59	D
4	vtu23987	PRAVEEN KUMAR KARRIMAJJI	Entrepreneurship Essentials	48	60	C
5	vtu23986	THANAY GANESH KUMAR	Entrepreneurship Essentials	49	61	C
6	vtu21110	M PRAVEEN KUMAR	Entrepreneurship Essentials	46	58	D
7	vtu23991	V MANI DEEPAK	Introduction To IoT	66	83	A
8	vtu24012	SAHITHI	Introduction To IoT	76	95	S
9	vtu20984	GANGAVARAPU HEMANTH	Introduction To IoT	75	94	S
10	vtu24086	PEDDANABOINA GOVARDHAN	Introduction To IoT	82	100	S
11	vtu20331	YANNAMREDDY MANOHAR REDDY	Introduction To IoT	73	91	S
12	vtu20489	KOLIKIPAMUROHAKARTHIK	Introduction To IoT	87	100	S
13	vtu20613	BONTHU SAI	Introduction To IoT	53	66	C
14	vtu19242	RISHABH SINGH	Introduction To IoT	86	100	S
15	vtu19300	VATHALURU VENKATA SIVA REDDY	Introduction To IoT	70	88	A
16	vtu19479	S IRFAN	Introduction To IoT	53	66	C
17	vtu20706	CHIKATI SHYAM SUNDER	Introduction To IoT	61	76	B
18	vtu19719	GOVINDU SHANMUKA SAI	Introduction To IoT	56	70	B
19	vtu19732	K VAMSI KRISHNA	Introduction To IoT	65	81	A
20	vtu19830	CHALAMPALEM VINAY	Introduction To IoT	53	66	C
21	vtu19848	SANTOSH	Introduction To IoT	67	84	A
22	vtu19892	MIDATALA SAI KUMAR	Introduction To IoT	75	94	S
23	vtu19895	KURUPUDI SRI CHANDRA SEKHAR	Introduction To IoT	81	100	S
24	vtu20790	DALAVAI PRANEETH KUMAR	Introduction To IoT	60	75	B
25	vtu20741	DADINABOINA SYAM KUMAR	Introduction To IoT	76	95	S
26	vtu20946	BAKKA LEELA VAMSI REDDY	Introduction To IoT	55	69	C
27	vtu20955	VEDANTH	Introduction To IoT	68	85	A
28	vtu21023	VATTI LOHITH MANI SHANKAR	Introduction To IoT	58	73	B
29	vtu21033	KOTTAPALLI JAYA BHAGAVAN	Introduction To IoT	73	91	S
30	vtu20979	OBED IMLONG S	Introduction To IoT	66	83	A
31	vtu20991	RIMMALAPUDI ESHWAR KARTHIK	Introduction To IoT	55	69	C

32	vtu21111	PUTTA SIVA CHARAN SAI	Introduction To IoT	81	100	S
33	vtu21134	ALOBO YEPTHOMI	Introduction To IoT	81	100	S
34	vtu21237	MANDLA MANJUNADHA	Introduction To IoT	60	75	B
35	vtu24061	VETTI REVANTH	Introduction To IoT	70	88	A
36	vtu24073	BORIGORLA AMARA NARASIMHARAO	Introduction To IoT	61	76	B
37	vtu24074	NARAGA BRAHMAJI	Introduction To IoT	60	75	B
38	vtu24085	SHAIK MAHAMMAD IMRAN	Introduction To IoT	60	75	B
39	vtu24099	GARAPATI SANJEEVI KUMAR	Introduction To IoT	75	94	S
40	vtu23973	NIMMAKANTI SRAVAN KUMAR	Introduction To IoT	53	66	C
41	vtu23977	KURRA NAGENDRA	Introduction To IoT	66	83	A
42	vtu23979	YAMPALAKU SURYA PRASAD	Introduction To IoT	62	78	B
43	vtu24001	T NAVEEN VAMSI	Introduction To IoT	71	89	A
44	vtu24059	GURRALA NANDA KUMAR	Introduction To IoT	62	78	B
45	vtu24026	ARUN KUMAR	Introduction To IoT	51	64	C
46	vtu23984	J AKASH KUMAR	Introduction To IoT	53	66	C
47	vtu21209	DORIGILLU ARJUN REDDY	Introduction To IoT	44	55	D
48	vtu20419	DHARANIDHAR REDDY	Introduction To IoT	55	69	C
49	vtu24082	GOKUL M	Introduction To IoT	56	70	B
50	vtu19672	U M GANESH SAGAR	Machine Learning for Engineering	71	89	A
51	vtu20136	SUNIT TIRPUDE	Machine Learning for Engineering	66	83	A
52	vtu24060	PONNAPUDI DURGA PRASAD	Machine Learning for Engineering	60	75	B

Action: Members have taken note.

M.Tech – Industrial Safety and Engineering

S.No	Stu ID	Stu Name	Independent learning	NPTEL Score %	Equivalent % as per VTU regulation (NPTEL score x 1.25)	Grade
1	VTP3899	SATHIYARAJ D	Research Methodology	76	95	S
2	VTP3900	SRIDHAR T V	Research Methodology	81	100	S
3	VTP3890	BALAKUMARAN R	Research Methodology	75	94	S
4	VTP3892	BALASUNDAR S	Research Methodology	67	84	A
6	VTP3894	JEFFRI PRASAD M	Research Methodology	73	91	S
7	VTP3888	M KARHTHIK	Research Methodology	65	81	A
9	VTP3889	MOHAMED SHARAF M	Research Methodology	53	66	C
10	VTP3901	MURALI G	Research Methodology	79	99	S
11	VTP3904	PURUSOTHAMAN R	Research Methodology	65	81	A
12	VTP3870	R BALA SUBRAMANIA PILLAI	Research Methodology	68	85	A
13	VTP3898	RAMESH S	Research Methodology	73	91	S
16	VTP3867	SIVA K	Research Methodology	60	75	B
17	VTP3893	SRIKANTH KUMAR MANNAVA	Research Methodology	63	79	B
19	VTP3905	SUNDAR I	Research Methodology	69	86	A
20	VTP3903	VETRIVEL PANDIAN S	Research Methodology	72	90	S

SNo	Stu ID	Stu Name	Open Elective	NPTEL Score %	Equivalent % as per VTU regulation (NPTEL score x 1.25)	Grade
1	VTP3899	SATHIYARAJ D	Training and Development	83	100	S
2	VTP3900	SRIDHAR T V	Training and Development	86	100	S
3	VTP3890	BALAKUMARAN R	Training and Development	81	100	S
4	VTP3892	BALASUNDAR S	Training and Development	79	99	S
6	VTP3894	JEFFRI PRASAD M	Training and Development	84	100	S
7	VTP3888	M KARHTHIK	Training and Development	80	100	S
9	VTP3889	MOHAMED SHARAF M	Training and Development	57	71	B
10	VTP3901	MURALI G	Training and Development	78	98	S
11	VTP3904	PURUSOTHAMAN R	Training and Development	68	85	A
12	VTP3870	R BALA SUBRAMANIA	Training and Development	84	100	S
13	VTP3898	RAMESH S	Training and Development	85	100	S
14	VTP3897	RUPESH M	Training and Development	47	59	D
16	VTP3867	SIVA K	Training and Development	56	70	B
17	VTP3893	SRIKANTH KUMAR	Training and Development	83	100	S
18	VTP3891	SRINIVASAN G	Training and Development	65	81	A
19	VTP3905	SUNDAR I	Training and Development	68	85	A
20	VTP3903	VETRIVEL PANDIAN S	Training and Development	86	100	S

M.Tech- Metallurgical and Materials Science Engineering

SNo	Stu ID	Stu Name	Independent learning	NPTEL Score %	Equivalent % as per VTU regulation (NPTEL score x 1.25)	Grade
1	VTP4052	GOPINATH S	Research Methodology	75	94	S
2	VTP4050	KABILAN K E	Research Methodology	52	65	C
3	VTP4051	ARUN BABU S	Research Methodology	48	60	C
4	VTP3877	BALASUBRAMANIYAN V	Research Methodology	53	66	C
5	VTP4046	PADALA MURALI KRISHNA	Research Methodology	77	96	S
6	VTP4121	PARPANATHAN G	Research Methodology	81	100	S
7	VTP4122	R THYAGARAJU	Research Methodology	60	75	
8	VTP4120	RAKESH KUMAR	Research Methodology	73	91	S
9	VTP4078	S S THANIGAI VEL	Research Methodology	55	69	C
10	VTP4083	SARAVANA KUMAR P	Research Methodology	65	81	A
11	VTP4106	SYEDSULTHAN KA	Research Methodology	60	75	B
12	VTP4084	T VELLADURAI	Research Methodology	70	88	A
13	VTP4077	VAIDEESWARY S	Research Methodology	53	66	C

S.No	Stu ID	Stu Name	Open Elective	NPTEL Score %	Equivalent % as per VTU regulation (NPTEL score x 1.25)	Grade
1	VTP4052	GOPINATH S	Training and Development	85	100	S
2	VTP4050	KABILAN K E	Training and Development	60	75	B
3	VTP4051	ARUN BABU S	Training and Development	61	76	B
4	VTP3877	BALASUBRAMANIYAN V	Intellectual Property	49	61	C
5	VTP4049	MURALITHARAN K	Training and Development	55	69	C
6	VTP4046	PADALA MURALI KRISHNA	Training and Development	88	100	S
7	VTP4121	PARPANATHAN G	Training and Development	85	100	S
8	VTP4122	R THYAGARAJU	Training and Development	71	89	A
9	VTP4120	RAKESH KUMAR	Training and Development	77	96	S
10	VTP4078	S S THANIGAI VEL	Training and Development	55	69	C
11	VTP4083	SARAVANA KUMAR P	Training and Development	77	96	S
12	VTP4106	SYEDSULTHAN KA	Training and Development	64	80	A
13	VTP4084	T VELLADURAI	Training and Development	86	100	S
14	VTP4077	VAIDEESWARY S	Training and Development	67	84	A

Action: Members have taken note.

Any Other Points

COURSE CODE		L	T	P	C
10211ME210	HEAT AND MASS TRANSFER	3	0	2	4

1. Preamble

This course deals with the different modes of heat transfer from one medium to another. It enables an understanding of the laws governing the heat transfer and mass transfer processes and helps in designing various thermal equipment's.

2. Pre-requisite

10211ME105 - Applied Engineering Thermodynamics

3. Link to the other courses Power Plant Engineering Automobile Engineering Computational Fluid Dynamics

4. Course Educational Objectives

Students, after undergoing this course would

- To understand the modes of heat transfer and their applications
- To apply the various methods on heat and mass transfer & their applications.
- To find the behaviour of fluids in various modes of heat and mass transfer
- To design and identify various types of heat exchangers for different thermal applications.

5. Course Outcomes

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Solve problems by applying the heat conduction equations to various surface configurations in both steady state and transient scenarios.	K3
CO2	Illustrate, contrast, and compare the heat transfer from forced and natural convection for different conditions.	K3
CO3	Explain the phenomena of condensation and boiling and to apply the LMTD and NTU thermal analysis techniques to various heat exchanger setups, and resolve issues.	K4
CO4	Apply the concept of fundamentals in radiation and use them to solve problems involving radiative heat transfer between various surfaces.	K4
CO5	Apply the equations and correlations for diffusive and convective mass transfer to resolve issues for various applications.	K4

(K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 - Create)

6. Correlation of COs with POs

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H								M			H	L
CO2	H	H	L							M			H	L
CO3	H	H	L							M			H	L
CO4	H	H	L			L	L			M			H	L
CO5	H	H	L				L			M			H	L

(H- High; M-Medium; L-Low)

7. Course Content

HMT Data book is permitted

UNIT I CONDUCTION L-9 P-6

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differential equation of Heat Conduction – Fourier Law of Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Infinite and Semi Infinite Solids - Analysis using Heisler chart

Experiments: Determination of thermal conductivity using thermal testing apparatus.

UNIT II CONVECTION~~, BOILING AND CONDENSATION~~ L-9 P-6

Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Forced Convection– External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes – Internal Flow – Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres. ~~Nusselt's Theory of condensation - Regimes of pool boiling and flow boiling, Correlations in boiling and Condensation.~~

Experiments: Determination of heat transfer coefficient in natural and forced convection setup.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS L-9 P-6

Nusselt's theory of condensation - Regimes of Pool boiling and Flow boiling concept. Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors – Analysis –LMTD Method- NTU Method.

Experiments: Comparison of parallel flow and counter flow heat exchanger

UNIT IV RADIATION L-9 P-6

Basic Concepts, Laws of Radiation – Wien's Displacement Law - Stefan Boltzmann Law, Kirchhoff Law –Black Body Radiation – Grey body radiation - Shape Factor – Electrical Analogy – Radiation Shields.

Experiments: Comparison of radiation heat transfer between different bodies.

UNIT V MASS TRANSFER L-9 P-6

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Introduction to Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

Experiments: Iso thermal evaporation of water into air

8. Text Books TOTAL: 75 PERIODS

1. Holman, J.P., Heat and Mass Transfer, 10e, McGraw Hill, 2011.
2. Sachdeva, R.C., Fundamentals of Heat and Mass Transfer, Fourth Edition, New Age International (P) Ltd., New Delhi, 2012

9. References

1. Yunus A. Cengel, Heat Transfer A Practical Approach – Tata McGraw Hill - 5e, 2015.
2. Frank P. Incropera and David P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley &Sons, Seventh Edition, 2013.
3. Nag, P.K., Heat Transfer, Tata McGraw Hill, New Delhi, 3e, 2011.
4. Ozisik, M.N., Heat Transfer, McGraw Hill Book Co., 2003.
5. Kothadaraman, C. P., Fundamentals of Heat and Mass Transfer, Fifth Edition, New Age International (P) Ltd., New Delhi, 4e, 2012
6. Incropera F.P., DeWitt D. P., "Fundamentals of Heat Transfer", 6th edition

Action: The members were satisfied with the explanation and recommended the changes.

As the meeting drew to a close, the Chairman extended a heartfelt vote of thanks, expressing gratitude to all members for their valuable insights and contributions. The Chairman highlighted the collaborative spirit that will continue to drive the department's progress.

22.06.2024

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Office of the Dean - Academics

Draft Note

On

Implementation of NEP2020 for UG and PG Programmes from the Academic Year 2025-26

(Phase – 1: 4-Year UG & 2-Year PG Programmes / Phase – 2 : Law Programmes)

Presented to
46th Academic Council Meeting

Held On
24 August 2024

CONTENT

1. List of Programmes Offered by the University presently.

S.No.	Type	Programme
1	Engg./Tech	B.Tech. - Aeronautical Engineering
2		B.Tech. - Artificial Intelligence (AI) and Data Science
3		B.Tech. - Artificial Intelligence and Machine Learning
4		B.Tech. - Biomedical Engineering
5		B.Tech. - Biotechnology
6		B.Tech. - Civil Engineering
7		B.Tech. - Computer Science and Engineering
8		B.Tech. - Computer Science and Design
9		B.Tech. - Computer Science and Engineering (AI & ML)
10		B.Tech. - Computer Science and Engineering (Cyber Security)
11		B.Tech. - Computer Science and Engineering (Data Science)
12		B.Tech. - Electrical and Electronics Engineering
13		B.Tech. - Electronics & Communication Engineering
14		B.Tech. - Information Technology
15		B.Tech. - Mechanical Engineering
16	UG Arts & Science	B.Com.
17		B.Sc. Multi Media
18		B.Sc. Visual Communication
19		BBA
20	PG Engg.	M.Tech. - Aeronautical Engineering
21		M.Tech. - Big Data Analytics
22		M.Tech. - Biotechnology
23		M.Tech. - Computer Science and Engineering
24		M.Tech. - Embedded Systems and Technologies
25		M.Tech. - Environmental Engineering
26		M.Tech. - Industrial Safety and Engineering
27		M.Tech. - Information and Cyber Security
28		M.Tech. - Metallurgical and Material Science Engineering
29		M.Tech. - Power Electronics
30		M.Tech. - Structural Engineering
31	PG Arts	M.A. - English
32	PG Science	M.Sc. - Chemistry
33		M.Sc. - Data Analytics
34		M.Sc. - Maths
35		M.Sc. - Physics
36	PG Mgt.	M.B.A
37	Law	B.A., LL.B. (Hons.)
38		B.Com., LL.B. (Hons.)

2. Type of Courses as per the UGC/AICTE

2.1. UG Engineering Programmes – B.Tech. All Branches

S. No.	Course Type	CT	#Courses	#Credits
1	Ability Enhancement Courses	AEC	4	8
2	Basic Engineering Courses	BEC	2	6
3	Basic Science Courses	BSC	4	14
4	Humanity and Social Science Courses	HSC	2	4
5	Open elective Courses	OEC	3	9
6	Programme Core Courses	PCC	21	77
7	Programme Elective Courses	PEC	10	30
8	Skill Enhancement Courses	SEC	4	8
9	Value Added Courses	VAC	4	8
		Total	54	164

2.2. UG Arts, Science & Commerce Programmes - BSc/BCom/BBA

S. No.	Course Type	CT	#Courses	#Credits
1	Ability Enhancement Course	AEC	5	10
2	Multi/Interdisciplinary Course	MDC	3	6
3	Open Elective Course	OEC	3	8
4	Programme Core Course	PCC	20	86
5	Programme Elective Course	PEC	8	32
6	Skill Enhancement Course	SEC	5	10
7	Value Added Course	VAC	4	8
		Total	48	160

2.3. PG Professional Programmes – M.Tech./M.Sc./M.B.A

S. No.	Course Type	CT	#Courses	#Credits
1	Skill Enhancement Course	SEC	1	2
2	Open Elective Course	OEC	1	2
3	Programme Core Course	PCC	10	34
4	Programme Elective Course	PEC	7	22
5	Value Added Course	VAC	1	2
6	Major/Spec. Project	PCC	2	26
Total			22	88

2.4. PG Arts Programme – M.A. (English)

S. No.	Course Type	CT	#Courses	#Credits
1	Skill Enhancement Course	SEC	2	4
2	Ability Enhancement Course	AEC	2	4
3	Programme Core Course	PCC	15	52
4	Programme Elective Course	PEC	4	12
5	Value Added Course	VAC	2	4
6	Internships & Projects	PCC	2	12
		Total	27	88

2.5. Levels of Courses

S No	Levels	Courses
1	001 – 099	Pre- requisite Courses: required to undertake an introductory course which will be a pass or fail course with no credits
2	100 - 199	Foundation or introductory courses: These are intended for students to gain an understanding and basic knowledge about the subjects and help decide the subject or discipline of interest. These courses may also be prerequisites for courses in the major subject. These courses generally would focus on foundational theories, concepts, perspectives, principles, methods, and procedures of critical thinking in order to provide a broad basis for taking up more advanced courses. Usually offered in the first year.
3	200 - 299	Intermediate-level courses: Includes, subject-specific courses intended to meet the credit requirements for minor or major areas of learning. These courses can be part of a major and can be pre-requisite courses for advanced-level major courses. These are offered in the 2nd year.
4	300 - 399	Higher-level courses which are required for majoring in a disciplinary/interdisciplinary area of study for the award of a degree.
5	400 - 499	Advanced Courses which would include lecture courses with practicum, seminar-based course, term papers, research methodology, advanced laboratory experiments/software training, research projects, hands-on-training internship/apprenticeship projects at the undergraduate level, offered usually in the final year.
6	500 - 599	Courses offered in the 1st year of Master's degree level for a 2-year PG Programme
7	600 - 699	Courses offered in the 2nd year of Master's degree level for a 2-year PG Programme
8	700 - 799 & Above	Courses required to be undertaken at Doctoral Degree level

2.6. Credit-Hour Requirement

S No	Course Delivery Method	Credit – Hour	Sample L-T-P-C Structures
1	Theory (L) and/or Tutorial (T) Only Courses	1 Hr. Theory = 1 Credit 1 Hr. Tutorial = 1 Credit	1-0-0-1 / 2-0-0-2 / 1-1-0-2 / 3-0-0-3 / 2-1-0-3 / 4-0-0-4 / 3-1-0-4
2	Practical (P) Only Courses	1 Hour Lab = 0.5 Credit 2 Hours Lab = 1 Credit	0-0-2-1 / 0-0-4-2 / 0-0-6-3
2	Theory, Tutorial & Practical	As stated in (1) & (2) above	1-1-2-3 / 2-0-2-3 / 3-0-2-4 / 2-0-4-4 / 3-1-2-5 / 0-0-6-3 / 0-0-8-4
3	Project (PJ) / Internship (IN)	1 Hour IN/PJ = 0.5 Credit 2 Hours IN/PJ = 1 Credit	Same as in (2) & 0-0-5-10 / 0-0-24-12 / 0-0-30-15
4	MOOC	6 Weeks = 1 Credits / 8 Weeks = 2 Credits / 12 Weeks – 3 Credits	

3. Programme Credit Structure TEMPLATE

3.1. B.Tech. All Branches

Draft Curriculum Structure for All UG Engineering Programmes - B.Tech. (All Branches) - 4 Years/8 Semesters (As per NEP 2020) - WEF A.Y.2025-26

Year	S. No.	Course Type		Cr.	S. No.	Course Type		Cr.	Tot. Cr.
First Year (Course Level: 100 to 199)	**Semester 1 (Common for all Branches)**				**Semester 2**				
	(Course Level - 100 to 150)				**(Course Level - 151 to 199)**				
	1	Humanity & Social Science Course-1	HSC	2	10	Humanity & Social Science Course-3 (Common)	HSC	2	
	2	Skill Enhancement Course-1	SEC	2	11	Skill Enhancement Course-2	SEC	2	
	3	Basic Sciences Course-1	BSC	4	12	Basic Sciences Course-3 (Common)	BSC	4	
	4	Basic Sciences Course-2 (T+P)	BSC	3	13	Basic Sciences Course-4 (Common) (T+P)	BSC	3	
	5	Basic Engineering Course -1 (T+P)	BEC	3	14	Basic Engineering Course - 2 (Common) (T+P)	BEC	3	
	6	Ability Enhancement Course - 1	AEC	2	15	Professional Core Course - 3 (Department/School)	PCC	3	
	7	Professional Core Course - 1	PCC	3	16	Professional Core Course Lab - 4 (Department/School)	PCC	1	
	8	Professional Core Course Lab - 2	PCC	1	17	Value Added Course - 2/Indian Knowledge System (IKS)	VAC	2	
	9	Value Added Course - 1	VAC	2	18	Ability Enhancement Course - 2	AEC	2	
		Total Cr.		22		**Total Cr.**		22	**44**
Second Year (Course Level: 200 to 299)	**Semester 3**				**Semester 4**				
	(Course Level - 200 to 250)				**(Course Level - 251 to 299)**				
	19	Professional Core Course - 5	PCC	3	27	Professional Core Course - 8	PCC	3	
	20	Professional Core Course - 6	PCC	3	28	Professional Core Course - 9	PCC	3	
	21	Professional Core Course - 7 (T+L)	PCC	4	29	Professional Core Course - 10 (T+L)	PCC	4	
	22	Professional Core/Specialization Elective - 1	PEC	3	30	Professional Core/Specialization Elective - 2	PEC	3	
	23	Multi/Interdisciplinary/Open Elective -1	OEC	3	31	Professional Core/Specialization Elective - 3	PEC	3	
	24	Ability Enhancement Course - 3	AEC	2	32	Skill Enhancement Course-4	SEC	2	
	25	Skill Enhancement Course-3	SEC	2	33	Value Added Course - 4	VAC	2	
	26	Value Added Course - 3	VAC	2	34	Ability Enhancement Course - 3	AEC	2	
		Total Cr.		22		**Total Cr.**		22	**44**

Year	S. No.	Course Type		Cr.	S. No.	Course Type		Cr.	Tot. Cr.
Third Year (Course Level: 300 to 399)	**Semester 5**				**Semester 6**				
	(Course Level - 300 to 350)				**(Course Level - 351 to 399)**				
	35	Professional Core Course - 11	PCC	3	42	Professional Core Course - 15	PCC	3	
	36	Professional Core Course - 12	PCC	3	43	Professional Core Course - 16	PCC	3	
	37	Professional Core Course - 14 (T+L)	PCC	4	44	Professional Core Course - 17 (T+L)	PCC	4	
	38	Professional Core/Specialization Elective - 4	PEC	3	45	Professional Core/Specialization Elective - 6	PEC	3	
	39	Professional Core/Specialization Elective - 5	PEC	3	46	Professional Core/Specialization Elective - 7	PEC	3	
	40	Multi/Interdisciplinary/Open Elective -2	OEC	3	47	Professional Core/Specialization Elective - 8	PEC	3	
	41	Minor Project/Internship	PCC	3	48	Multi/Interdisciplinary/Open Elective -3	OEC	3	
		Total Cr.		22		**Total Cr.**		22	**44**
Fourth Year (Level - 400 to 499)	**Semester 7**				**Semester 8**				
	(Course Level - 400 to 450)				**(Course Level - 451 to 499)**				
	49	Professional Core Course - 18	PCC	3	54	Capstone (Major) Project (Industry or Research)	PCC	14	
	50	Professional Core Course - 19 (T+L)	PCC	4					
	51	Professional Core/Specialization Elective - 9	PEC	3					
	52	Professional Core/Specialization Elective - 10	PEC	3					
	53	Project Phase - 1 - Industry or Research	PCC	5					
		Total Cr.		18		**Total Cr.**		14	**32**
								Total Programme Credits	**164**

3.2. B.Sc. / B.Com. / B.B.A.

Draft Curriculum Structure for 4 Year B.Com. (Hons.)/BBA (Hons.)/B.Sc. (Hons.) Programmes (As per NEP 2020) - WEF A.Y.2025-26

Year	S. No.	Course Type		Cr.	S. No.	Course Type		Cr.	Tot. Cr.
First Year (Course Level: 100 to 199)	Semester 1				Semester 2				
	(Course Level - 101 to 150)				(Course Level - 151 to 199)				
	1	Programme Core Course - 1	PCC	4	9	Programme Core Course - 4	PCC	4	
	2	Programme Core Course - 2	PCC	4	10	Programme Core Course - 5	PCC	4	
	3	Programme Core Course - 3	PCC	4	11	Programme Core Course - 6	PCC	4	
	4	Multi/Interdisciplinary -1	MDC	2	12	Multi/Interdisciplinary -2	MDC	2	
	5	Ability Enhancement Course - 1	AEC	2	13	Skill Enhancement Course-2	SEC	2	
	6	Ability Enhancement Course - 2	AEC	2	14	Value Added Course - 2	VAC	2	
	7	Skill Enhancement Course-1	SEC	2	15	Ability Enhancement Course - 3	AEC	2	
	8	Value Added Course - 1	VAC	2					
			Total Cr.	22			Total Cr.	20	**42**
Second Year (Course Level: 200 to 299)	Semester 3				Semester 4				
	(Course Level - 201 to 250)				(Course Level - 251 to 299)				
	16	Programme Core Course - 7	PCC	4	24	Programme Core Course - 7	PCC	4	
	17	Programme Core Course - 8	PCC	4	25	Programme Core Course - 8	PCC	4	
	18	Programme Core Course - 9	PCC	4	26	Programme Core Course - 9	PCC	4	
	19	Multi/Interdisciplinary -3	MDC	2	27	Programme Core Course - 10	PCC	2	
	20	Skill Enhancement Course-3	SEC	2	28	Skill Enhancement Course-4	SEC	2	
	21	Value Added Course - 3	VAC	2	29	Value Added Course - 4	VAC	2	
	22	Skill Enhancement Course-3-Lab	SEC	2	30	Ability Enhancement Course - 5	AEC	2	
	23	Ability Enhancement Course - 4	AEC	2					
			Total Cr.	22			Total Cr.	20	**42**

Year	S. No.	Course Type		Cr.		S. No.	Course Type		Cr.	Tot. Cr.
Summer Internship (Evaluation in 5th Semester) (4 Credits)										
Third Year (Course Level: 300 to 399)	**Semester 5**					**Semester 6**				
	(Course Level - 301 to 350)					**(Course Level - 351 to 399)**				
	31	Programme Core Course - 11	PCC	4		37	Programme Core Course - 14	PCC	3	
	32	Programme Core Course - 12	PCC	4		38	Programme Core Course - 15	PCC	3	
	33	Programme Elective Course - 1	PEC	4		39	Programme Elective Course - 3	PEC	4	
	34	Programme Elective Course - 2	PEC	4		40	Programme Elective Course - 4	PEC	4	
	35	Programme Core - 13 (Summer Internship)	PCC	4		41	Programme Elective Course - 5	PEC	4	
	36	Open Elective Course – 1	OEC	2		42	Open Elective Course - 2	OEC	2	
			Total Cr.	**22**				**Total Cr.**	**20**	**42**
Fourth Year (Level - 400 to 499)	**Semester 7**					**Semester 8**				
	(Course Level - 401 to 450)					**(Course Level - 451 to 499)**				
	43	Programme Elective Course - 6	PEC	4		48	Project Phase - 2 - Industry or Research	PCC	12	
	44	Programme Elective Course - 7	PEC	4						
	45	Programme Elective Course - 8	PEC	4						
	46	Open Elective Course-3	OEC	4						
	47	Project Phase - 1 - Industry or Research	PCC	6						
			Total Cr.	**22**				**Total Cr.**	**12**	**34**
								Total Programme Credits		**160**

3.3. M.Tech. / M.Sc. / M.B.A (Professional PG Programmes)

Draft Curriculum Structure for All 2 Years Master's Degree Programmes - M.Tech. / M.Sc. / M.B.A (As per NEP 2020) - WEF A.Y.2025-26

Year	S. No.	Course Type		Cr.	S. No.	Course Type		Cr.	Tot. Cr.
First Year (Course Level: 500 to 599)	**Semester 1**				**Semester 2**				
	(Course Level - 501 to 550)				(Course Level - 551 to 599)				
	1	Programme Core Course - 1	PCC	4	9	Programme Core Course - 6	PCC	4	
	2	Programme Core Course - 2	PCC	4	10	Programme Core Course - 7	PCC	4	
	3	Programme Core Course - 3	PCC	4	11	Programme Core Course - 8	PCC	4	
	4	Programme Core Course - 4	PCC	4	12	Programme Core/Spec. Elective Course - 1	PEC	4	
	5	Programme Core Course - 5	PCC	4	13	Programme Core/Spec. Elective Course - 2	PEC	4	
	6	Skill Enhancement Course-1	SEC	2	14	Programme Core/Spec. Elective Lab Course - 3	PCC	1	
	7	Programme Core Lab - 1	PCC	1	15	Programme Core/Spec. Elective Lab Course - 4	PCC	1	
	8	Programme Core Lab - 2	PCC	1	16	Open Elective Course	OEC	2	
		Total Cr.		**24**		**Total Cr.**		**24**	**48**
Second Year (Course Level:600 to 699)	**Semester 3**				**Semester 4**				
	(Course Level - 601 to 650)				**(Course Level - 651 to 699)**				
	17	Programme Core/Spec. Elective Course - 3	PEC	4	22	Major Project Phase - 1 (Research/Industry)	PCC	18	
	18	Programme Core/Spec. Elective Course - 4	PEC	4					
	19	Programme Core/Spec. Elective Course - 5	PEC	4					
	20	Value Added Course – 1	VAC	2					
	21	Major Project Phase - 1 (Research/Industry)	PCC	8					
		Total Cr.		**22**		**Total Cr.**		**18**	**40**
								Total Programme Credits	**88**

3.4. Master of Arts (M.A.) (English)

Draft Curriculum Structure for All 2 Years Master's Degree Programmes - MA (As per NEP 2020) - WEF A.Y.2025-26

Year	S. No.	Course Type		Cr.	S. No.	Course Type		Cr.	Tot. Cr.
First Year (Course Level: 500 to 599)	**Semester 1**				**Semester 2**				
	(Course Level - 501 to 550)				**(Course Level - 551 to 599)**				
	1	Programme Core Course - 1	PCC	4	9	Programme Core Course - 5	PCC	4	
	2	Programme Core Course - 2	PCC	4	10	Programme Core Course - 6	PCC	4	
	3	Programme Core Course - 3 (MOOC)	PCC	4	11	Programme Core Course - 7 (MOOC)	PCC	4	
	4	Programme Core Course - 4	PCC	2	12	Programme Core Course - 8	PCC	2	
	5	Programme Elective Course - 1	PEC	3	13	Programme Elective Course - 2	PEC	3	
	6	Value Added Course - 1	VAC	2	14	Value Added Course - 2	VAC	2	
	7	Skill Enhancement Course - 1 - Research Methodology	SEC	2	15	Ability Enhancement Course - 1 - Job Oriented Training	AEC	2	
	8	Ability Enhancement Course - 2	AEC	2					
			Total Cr.	23			**Total Cr.**	21	**44**
Second Year (Course Level: 600 to 699)	**Semester 3**				**Semester 4**				
	(Course Level - 601 to 650)				**(Course Level - 651 to 699)**				
	16	Programme Core Course - 9	PCC	4	23	Programme Core Course - 13	PCC	4	
	17	Programme Core Course - 10	PCC	4	24	Programme Core Course - 14 (MOOC)	PCC	4	
	18	Programme Core Course - 11 (MOOC)	PCC	4	25	Programme Core Course - 15	PCC	2	
	19	Programme Core Course - 12	PCC	2	26	Programme Elective Course - 4	PEC	3	
	20	Programme Elective Course - 3	PEC	3	27	Programme Core - Research Project - 2	PCC	8	
	21	Skill Enhancement Course - 2	SEC	2					
	22	Programme Core - Research Project - 1	PCC	4					
			Total Cr.	23			**Total Cr.**	21	**44**
							Total Programme Credits		**88**

4. Multiple Entry Multiple Exit (MEME) and Requirements

- Students may be allowed, subject satisfying certain criteria, to exit at the end of First, Second and Third Year in case of 4-Year Programmes and at the end of First year in case of 2 Year Programmes.
- There are some additional criteria to exit from and/or entry into the programmes as described below.
- UGC's ABC Account is mandatory for Credit Transfer up on Exit.

Exit Options – Requirements & Award Details:

a). B.Tech. Programmes (All Branches)

Credits Earned Progessivelly Over 4 Years												Details of Award on Exit@
First Year		SB	Second Year		SB	Third Year		SB	Fourth Year		Tot. Cr.	
Sem.1	Sem.2		Sem.3	Sem.4		Sem.5	Sem.6		Sem.7	Sem.8		
22	22	4	-	-	-	-	-	-	-	-	48	Exit at the end of 1st Year – Under Graduate Certificate
22	22	-	22	22	4	-	-	-	-	-	92	Exit at the end of 2nd Year – UG Diploma in <Domain Name)
22	22	-	22	22	-	22	22	-	-	-	132	Exit at the end of 3rd Year – Advanced Diploma in <Domain Name) or BSc <Domain Name)

*SB – Summer Break / @Exit Request of the students should be approved by Dean of the School/Dean (Academics)/Registrar Office, well in advance by at least 4 Months (Beginning of 2nd or 4th or 6th Semester).

b). B.Sc. (Hons.) / B.B.A (Hons.) / B.Com. (Hons.)

Credits Earned Progessivelly Over 4 Years												Details of Award on Exit@
First Year		SB	Second Year		SB	Third Year		SB	Fourth Year		Tot. Cr.	
Sem.1	Sem.2		Sem.3	Sem.4		Sem.5	Sem.6		Sem.7	Sem.8		
22	20	4	-	-	-	-	-	-	-	-	46	Exit at the end of 1st Year – Under Graduate Certificate in <Domain Name)
22	20	-	22	20	4	-	-	-	-	-	88	Exit at the end of 2nd Year – Under Graduate Diploma in <Domain Name)
22	20	-	22	20	-	22	20	-	-	-	126	Exit at the end of 3rd Year – Advanced Diploma in <Domain Name) or BSc <Domain Name)

*SB – Summer Break / @Exit Request of the students should be approved by Dean of the School/Dean (Academics)/Registrar Office, well in advance by at least 4 Months (Beginning of 2nd or 4th or 6th Semester)

c). M.Tech. / M.Sc. / M.B.A

Credits Earned Progessivelly Over 2 Years						Details of Award on Exit@
First Year		SB	Second Year		Tot. Cr.	
Sem.1	Sem.2		Sem.3	Sem.4		
24	24	4	-	-	52	Exit at the end of 1st Year – Post Graduate Diploma in <Domain Name)

*SB – Summer Break / @Exit Request of the students should be approved by Dean of the School/Dean (Academics)/Registrar Office, well in advance by at least 4 Months (Beginning of 2nd Semester).

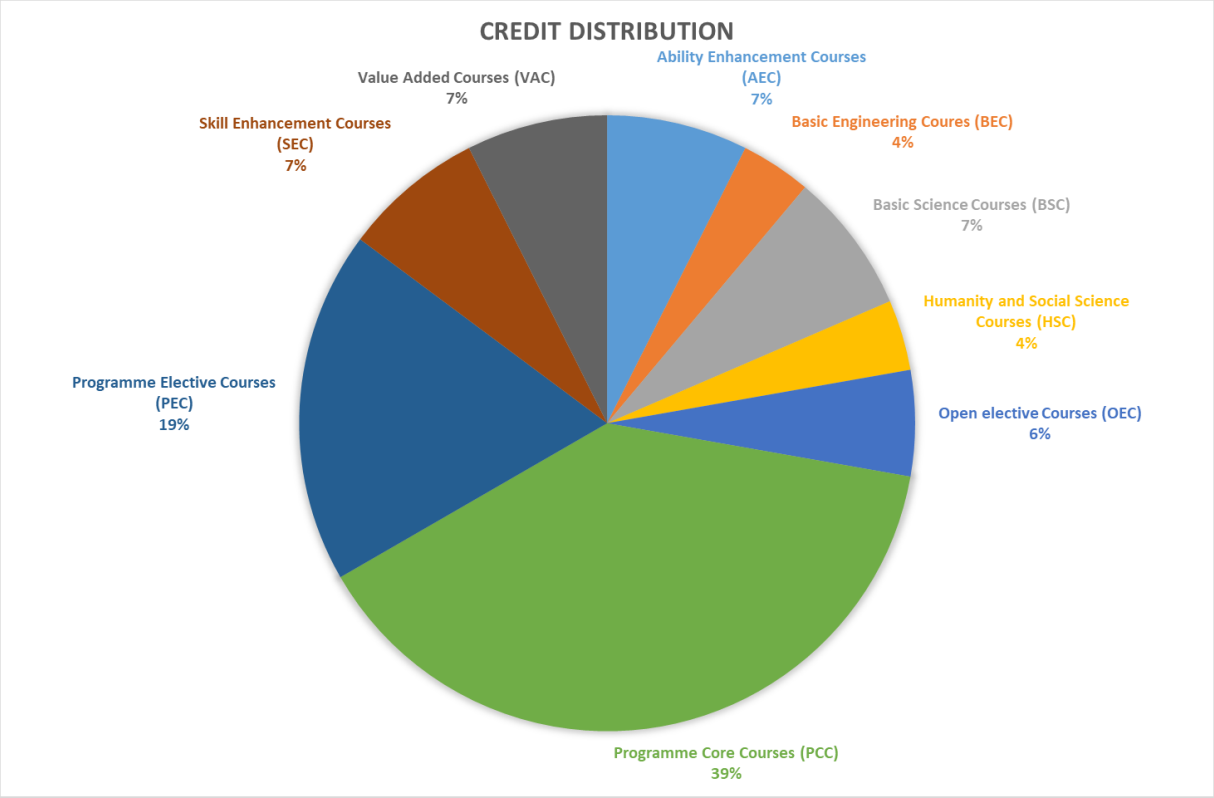
d). Master of Arts

Credits Earned Progessivelly Over 2 Years						Details of Award on Exit@
First Year		SB	Second Year		Tot. Cr.	
Sem.1	Sem.2		Sem.3	Sem.4		
23	21	4	-	-	48	Exit at the end of 1st Year – Post Graduate Diploma in <Domain Name)

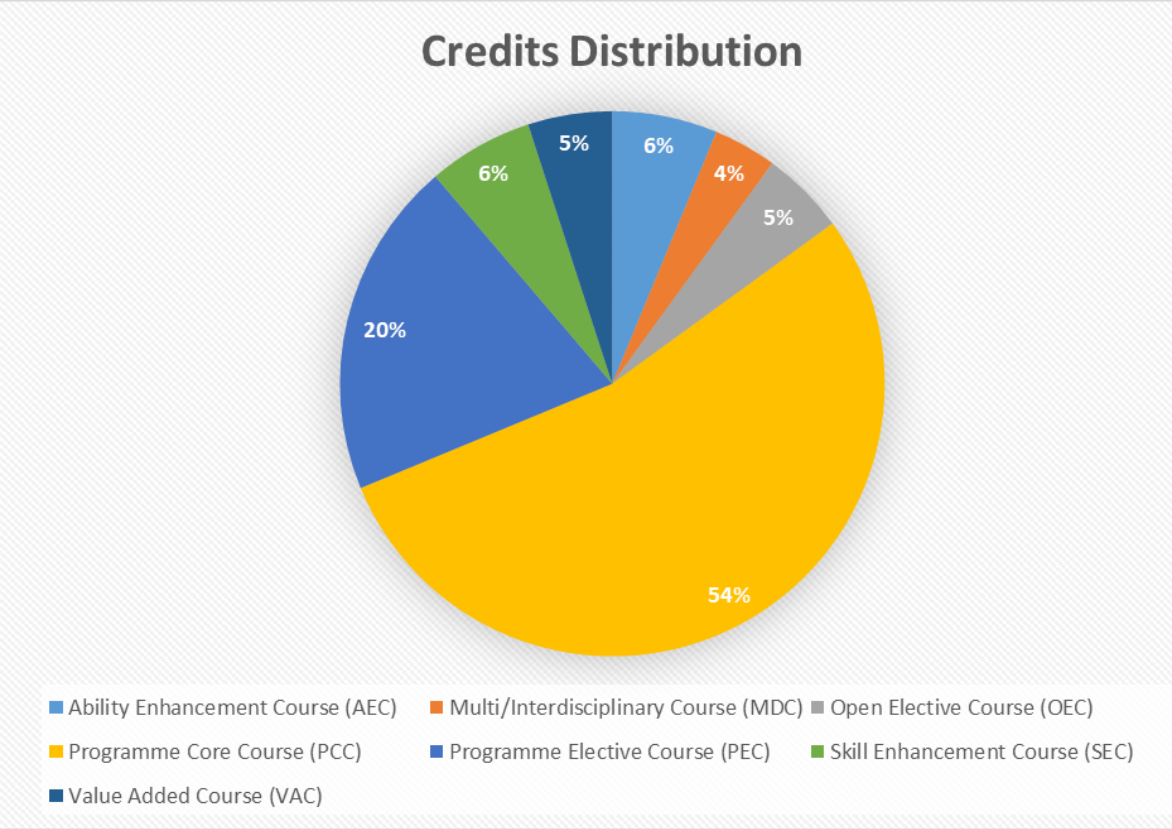
*SB – Summer Break / @Exit Request of the students should be approved by Dean of the School/Dean (Academics)/Registrar Office, well in advance by at least 4 Months (Beginning of 2nd Semester).

5. Credit Distribution and Statistics

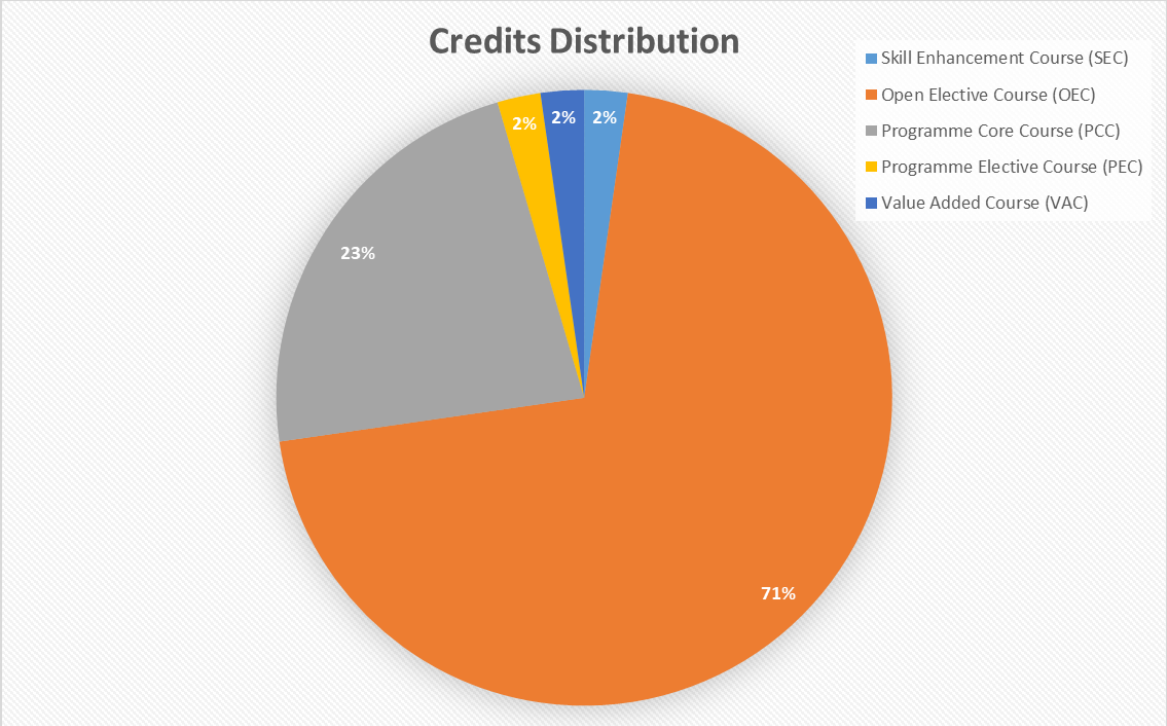
a). B.Tech. Programmes (All Branches)



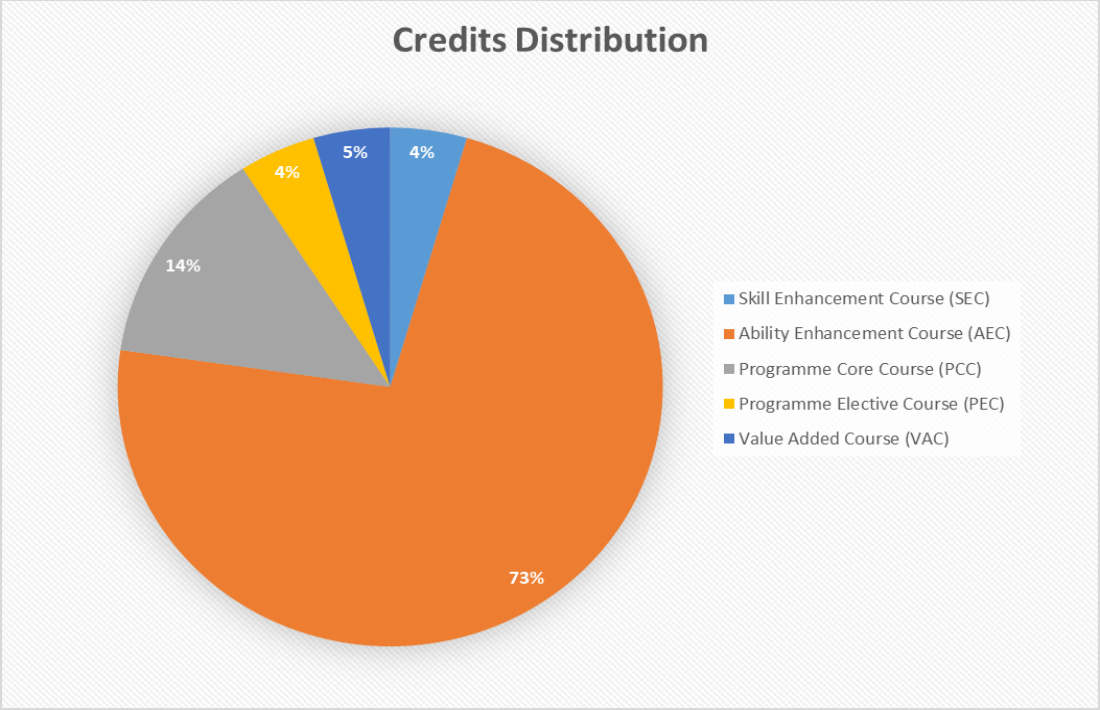
b). B.Sc. (Hons.) / B.B.A (Hons.) / B.Com. (Hons.)



c). M.Tech. / M.Sc. / M.B.A



d). Master of Arts



6. Schedule of Activities/Delibrations on Implementation of NEP2020 at VTU

S. No.	Date	Activities/Delibrations	Status
1	22 July 2024	Meeting with Controller of Examinations	Completed
2	23 July 2024	Meeting with Dean – Quality Assurance	Completed
3	24 July 2024	Meeting with Hon. Vice Chancellor	Completed
4	25 July 2024	Meeting with Hon. Chairperson and Trustee	Completed
5	27 July 2024	Meeting with Staff of Dean – Academic Office	Completed
6	29 July 2024	Meetings with Dean – R & D / Dean – Academic Research	Completed
7	3 Aug. 2024	Meeting with All School Deans & HoDs	Completed
8	23 Aug. 2024	Draft Template for implementing NEP2020 – DA Office	Completed
9	31 Aug. 2024	Meeting with Dean & HoDs of School of Computing	Planned
10	6 Sep. 2024	Meeting with Dean & HoDs of School of EC	Planned
11	14 Sep. 2024	Meeting with Dean & HoDs of School of MC	Planned
12	20 Sep. 2024	Meeting with Dean & HoDs of School of Management	Planned
13	28 Sep. 2024	Meeting with Dean & Hods of School of Commerce & Media	Planned
14	4 Oct 2024	Meeting with Dean & Hods of School of Law	Planned
15	12 Oct 2024	Finalizing Programme structure by all Schools as per NEP2020	Planned
16	14 oct - 23 Nov 2024	Discussion and Preparations of Syllabus at school level, monitored by respective Deans/HoDs	Planned
17	Dec 2024 – Jan 2025	Board of Studies Approval of New Curriculum and Syllabus as per NEP 2020 by all Schools	Planned

Dean - Academics

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Department wise Lateral Entry Count reported as on 14.08.2024

S.No.	Name of the Department	Count						
		LIST - 1	LIST - 2	LIST - 3	LIST - 4	LIST - 5	LIST - 6	Total
1	B.TECH - AERONAUTICAL ENGINEERING	3	1	1	-	-	2	7
2	B.TECH - AERONAUTICAL ENGINEERING WITH SPECIALIZATION IN AEROSPACE AND DEFENCE	-	1	2	-	-	-	3
3	B.TECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	8	1	-	-	-	-	9
4	B.TECH - ARTIFICIAL INTELLIGENCE(AI) AND DATA SCIENCE	1	-	1	-	1	-	3
5	B.TECH - BIO MEDICAL ENGINEERING	-	1	-	-	-	-	1
6	B.TECH - CIVIL ENGINEERING	-	-	1	-	2	2	5
7	B.TECH - CIVIL ENGINEERING WITH SPECIALIZATION IN COMPUTER AIDED INFRASTRUCTURE ENGINEERING	-	-	-	-	-	1	1
8	B.TECH - COMPUTER SCIENCE AND ENGINEERING	7	4	6	7	6	6	36
9	B.TECH - COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)	2	-	1	-	-	-	3
10	B.TECH - COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)	2	-	-	1	2	1	6
11	B.TECH - COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)	-	-	-	1	1	-	2
12	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE	1	1	2	-	-	-	4
13	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE	2	4	4	2	2	2	16
14	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	3	4	2	2	1	3	15
15	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN CYBER SECURITY	-	-	-	-	1	1	2
16	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING	4	5	3	2	5	6	25
17	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING WITH SPECIALIZATION IN COMPUTER SYSTEMS	-	1	-	-	-	-	1
18	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING	9	7	4	-	1	7	28
19	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE	5	-	1	-	-	-	6
20	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNI	5	3	4	-	-	4	16
21	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN CYBER SECURITY	1	1	-	-	-	-	2
22	B.TECH - INFORMATION TECHNOLOGY	1	2	-	-	-	-	3
23	B.TECH - MECHANICAL ENGINEERING	6	4	4	-	2	1	17
24	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS	3	3	-	7	1	-	14
	Grand Total	**63**	**43**	**36**	**22**	**25**	**36**	**225**

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

OverAll Lateral Entry Students Name List - Reported as on 14.08.2024

S No.	LIST	REPORTED DATE	VTU No	Name of the Student	Department
1	LIST - 1	26.06.2024	VTU28349	M.OMPRADEEP REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)
2	LIST - 1	26.06.2024	VTU28350	SRI DEEKSHITHA GUMMALLA	B.TECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
3	LIST - 1	26.06.2024	VTU28358	KOTA NAGA SANKAR BALAJI	B.TECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
4	LIST - 1	26.06.2024	VTU28364	THALLAPAKA DINESH RAGHAV	B.TECH - COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)
5	LIST - 1	26.06.2024	VTU28387	SNIKITHA REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING
6	LIST - 1	26.06.2024	VTU28784	SHAIK MOHAMMED ABBAS	B.TECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
7	LIST - 1	26.06.2024	VTU28815	AUSTIN ANTO V	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
8	LIST - 1	26.06.2024	VTU28899	JAKKULA VENUGOPAL AZAD	B.TECH - COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)
9	LIST - 1	26.06.2024	VTU29680	CHELLUBONI.SANDEEP	B.TECH - MECHANICAL ENGINEERING
10	LIST - 1	27.06.2024	VTU28351	KASTURI ESWAR VENKAT	B.TECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
11	LIST - 1	27.06.2024	VTU28367	VANKA MASTHANAMMA	B.TECH - COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)
12	LIST - 1	27.06.2024	VTU28369	VALLEPUANIL	B.TECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
13	LIST - 1	27.06.2024	VTU28370	V VISHNU VARDHAN	B.TECH - COMPUTER SCIENCE AND ENGINEERING
14	LIST - 1	27.06.2024	VTU28379	K LOGESHWARAN	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
15	LIST - 1	27.06.2024	VTU28394	BUDDAREDDYGARI BHAVANA	B.TECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
16	LIST - 1	27.06.2024	VTU28718	M SAI SHOBITH	B.TECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
17	LIST - 1	27.06.2024	VTU28721	KALLA SHIVA CHARAN REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
18	LIST - 1	27.06.2024	VTU28722	D.HANIMI.REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
19	LIST - 1	27.06.2024	VTU28733	AGHILESH V	B.TECH - MECHANICAL ENGINEERING
20	LIST - 1	27.06.2024	VTU28761	PRAGADEESH	B.TECH - COMPUTER SCIENCE AND ENGINEERING
21	LIST - 1	27.06.2024	VTU28781	S.GANGA TARUNI	B.TECH - COMPUTER SCIENCE AND ENGINEERING
22	LIST - 1	27.06.2024	VTU28790	GOWTHAM SAI	B.TECH - COMPUTER SCIENCE AND ENGINEERING
23	LIST - 1	28.06.2024	VTU28345	MAMIDI BHARGAVI	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
24	LIST - 1	28.06.2024	VTU28353	BHARATH CHANDRA SAI	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
25	LIST - 1	28.06.2024	VTU28357	BANKA VENKATA KOWSHIK	B.TECH - COMPUTER SCIENCE AND ENGINEERING
26	LIST - 1	28.06.2024	VTU28365	LINGADAHALLI SREENIVASA SARMA	B.TECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
27	LIST - 1	28.06.2024	VTU28372	MOPURI MANOHAR	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
28	LIST - 1	28.06.2024	VTU28375	ALURU MOHAN	B.TECH - COMPUTER SCIENCE AND ENGINEERING
29	LIST - 1	28.06.2024	VTU28380	ROHITH	B.TECH - MECHANICAL ENGINEERING
30	LIST - 1	28.06.2024	VTU28382	PRANAV GUHA A.P	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN CYBER SECURITY
31	LIST - 1	28.06.2024	VTU28391	SALIPINDI VENKATA AVINASH	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
32	LIST - 1	28.06.2024	VTU28392	VADDEMANI HARSHAVARDHAN REDDY	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
33	LIST - 1	28.06.2024	VTU28719	A.KALYAN CHAKRAVARTHI	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
34	LIST - 1	28.06.2024	VTU28723	MOHAMED FAZIL A	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
35	LIST - 1	28.06.2024	VTU28726	PULLA REDDY HARSHA VARDHAN	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
36	LIST - 1	28.06.2024	VTU28729	HARI KESHAV S	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
37	LIST - 1	28.06.2024	VTU28731	B. KAMALESH	B.TECH - AERONAUTICAL ENGINEERING
38	LIST - 1	28.06.2024	VTU28739	GUNDRALLA ANIL	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
39	LIST - 1	28.06.2024	VTU28740	CHAKALI DEVARAJU	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
40	LIST - 1	28.06.2024	VTU28744	L AJAY KUMAR	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
41	LIST - 1	28.06.2024	VTU28745	A .JAGADESHWAR REDDY	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
42	LIST - 1	28.06.2024	VTU28746	GUMPELLA RANGA SAI DEEKSHITH	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
43	LIST - 1	28.06.2024	VTU28762	M.BHARATH	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
44	LIST - 1	28.06.2024	VTU28774	DAVALLURU LOKESH KUMAR	B.TECH - MECHANICAL ENGINEERING
45	LIST - 1	28.06.2024	VTU28779	NAVEEN KUMAR Y C	B.TECH - INFORMATION TECHNOLOGY
46	LIST - 1	28.06.2024	VTU28780	VELPULA.NIKSHITHA	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
47	LIST - 1	28.06.2024	VTU28785	A.ROHITH KUMAR REDDY	B.TECH - ARTIFICIAL INTELLIGENCE(AI) AND DATA SCIENCE
48	LIST - 1	28.06.2024	VTU28786	T.GANGADHAR REDDY	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
49	LIST - 1	28.06.2024	VTU28788	MALLE VENKATA HARSHA VARDHAN	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
50	LIST - 1	28.06.2024	VTU28793	NARAIN KARTHICK T	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
51	LIST - 1	28.06.2024	VTU28835	M S HARISHVAR	B.TECH - AERONAUTICAL ENGINEERING
52	LIST - 1	28.06.2024	VTU28879	TAMILSELVAN.A	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
53	LIST - 1	28.06.2024	VTU28887	SANJAY.V	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
54	LIST - 1	28.06.2024	VTU29627	SHAIK AAKHEEL	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE
55	LIST - 1	28.06.2024	VTU29630	SAMA KRUPAKAR	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
56	LIST - 1	28.06.2024	VTU29631	KAMESH D	B.TECH - MECHANICAL ENGINEERING
57	LIST - 1	28.06.2024	VTU29636	B BARATH	B.TECH - AERONAUTICAL ENGINEERING
58	LIST - 1	28.06.2024	VTU29644	MONISH KUMAR B	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
59	LIST - 1	28.06.2024	VTU29645	MANO. M	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING

60	LIST - 1	28.06.2024	VTU29650	PRANAY CHOLLETI	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
61	LIST - 1	28.06.2024	VTU29682	VISHAL T	B.TECH - MECHANICAL ENGINEERING
62	LIST - 1	28.06.2024	VTU29686	KUMAR MAHENDRA VARMA	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
63	LIST - 1	28.06.2024	VTU29724	AHAMED HUSSAIN	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
64	LIST - 2	29.06.2024	VTU28396	AVINASH REDDY	B.TECH - INFORMATION TECHNOLOGY
65	LIST - 2	29.06.2024	VTU28397	PENUMALLU ARJUN REDDY	B.TECH - INFORMATION TECHNOLOGY
66	LIST - 2	01.07.024	VTU28944	BOYA UDAY KUMAR	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
67	LIST - 2	01.07.2024	VTU28348	C.SUBHASHINI	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
68	LIST - 2	01.07.2024	VTU28716	K.J.S.S.MANIKANTA	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
69	LIST - 2	01.07.2024	VTU29628	CHALLA VISWESWAR REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING
70	LIST - 2	01.07.2024	VTU28355	INUGANTI SARVAN SASI SEKHAR	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
71	LIST - 2	01.07.2024	VTU28717	CHALLAGUNDLA. SANDEEP	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
72	LIST - 2	01.07.2024	VTU28359	UYYALA NAGENDRA BABU	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
73	LIST - 2	01.07.2024	VTU28360	RUTHVIK	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
74	LIST - 2	01.07.2024	VTU28720	PRAVEEN	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
75	LIST - 2	01.07.2024	VTU29632	BHUMIREDDY VENKATA HARISH	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
76	LIST - 2	01.07.2024	VTU28385	V.DINESH	B.TECH - COMPUTER SCIENCE AND ENGINEERING
77	LIST - 2	01.07.2024	VTU28393	SIDDARTH S	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
78	LIST - 2	01.07.2024	VTU28395	D. DHARMA TEJA	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN CYBER SECURITY
79	LIST - 2	01.07.2024	VTU28783	Y VENKATAPRAVEEN	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
80	LIST - 2	01.07.2024	VTU28742	G.SIVA TEJA	B.TECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
81	LIST - 2	01.07.2024	VTU28778	OSCAR M	B.TECH - BIO MEDICAL ENGINEERING
82	LIST - 2	01.07.2024	VTU28787	K.PREM SAI	B.TECH - AERONAUTICAL ENGINEERING WITH SPECIALIZATION IN AEROSPACE AND DEFENCE
83	LIST - 2	01.07.2024	VTU29637	SIBYALA VIKAS	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
84	LIST - 2	01.07.2024	VTU29681	G. KOUSHIK	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
85	LIST - 2	01.07.2024	VTU28922	L SASIKARAN	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING WITH SPECIALIZATION IN COMPUTER SYSTEMS
86	LIST - 2	01.07.2024	VTU29827	GORLA BUCHAYYAGARI SUJITH	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
87	LIST - 2	01.07.2024	VTU29828	V PAVAN	B.TECH - MECHANICAL ENGINEERING
88	LIST - 2	02.07.2024	VTU28354	SEKU UDAYKIRAN REDDY	B.TECH - MECHANICAL ENGINEERING
89	LIST - 2	02.07.2024	VTU28386	PADMA SAMHITHA	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
90	LIST - 2	02.07.2024	VTU29635	GORIPARTHI HARISMITHA DEVI	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
91	LIST - 2	02.07.2024	VTU29822	CHATRASI ESWAR SAI AJAY	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE
92	LIST - 2	03.07.2024	VTU28724	GATTAPPAGARI SREENIVASULU	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
93	LIST - 2	03.07.2024	VTU28728	S.MOHAMMADSUHAIL	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
94	LIST - 2	03.07.2024	VTU28741	BANDELA ARAVINDU	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
95	LIST - 2	03.07.2024	VTU28743	AKULA.RAJESH	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
96	LIST - 2	03.07.2024	VTU28747	KURUVA HARINADH	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
97	LIST - 2	03.07.2024	VTU29639	DESAM VENKATA SAINATHA REDDY	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
98	LIST - 2	03.07.2024	VTU29722	MINCHALA BHANU PRAKASH	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
99	LIST - 2	03.07.2024	VTU29858	N GAGAN VIHAR	B.TECH - MECHANICAL ENGINEERING
100	LIST - 2	03.07.2024	VTU29860	YANNAM VENKATA MADHU KIRAN REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING
101	LIST - 2	03.07.2024	VTU29806	CHAMANTHI SUMANTH	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
102	LIST - 2	04.07.2024	VTU28368	D HARI SIDDHRATH	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
103	LIST - 2	04.07.2024	VTU28737	KOTAPATI YESWANTH	B.TECH - MECHANICAL ENGINEERING
104	LIST - 2	04.07.2024	VTU29642	MUPPALLA NAVEEN	B.TECH - COMPUTER SCIENCE AND ENGINEERING
105	LIST - 2	04.07.2024	VTU29721	ANSHIF PA	B.TECH - AERONAUTICAL ENGINEERING
106	LIST - 2	04.07.2024	VTU29804	SHELAM RAMA DHANUJAYA REDDY	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
107	LIST - 3	05.07.2024	VTU28883	D DEEPAK	B.TECH - ARTIFICIAL INTELLIGENCE(AI) AND DATA SCIENCE
108	LIST - 3	05.07.2024	VTU28715	JINKA YUVA RAJU	B.TECH - COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)
109	LIST - 3	05.07.2024	VTU28937	M VENUGOPAL REDDY	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
110	LIST - 3	05.07.2024	VTU28383	KATTELA HEMANTH	B.TECH - COMPUTER SCIENCE AND ENGINEERING
111	LIST - 3	05.07.2024	VTU28730	BALU MAHENDAR	B.TECH - AERONAUTICAL ENGINEERING WITH SPECIALIZATION IN AEROSPACE AND DEFENCE
112	LIST - 3	05.07.2024	VTU28734	MORCHI NIKHIL	B.TECH - AERONAUTICAL ENGINEERING WITH SPECIALIZATION IN AEROSPACE AND DEFENCE
113	LIST - 3	05.07.2024	VTU28735	CHELLANNAGARI VINAY	B.TECH - MECHANICAL ENGINEERING
114	LIST - 3	05.07.2024	VTU28748	SHAIK SADIQ AHAMMAD	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
115	LIST - 3	05.07.2024	VTU29638	KURUBA CHENNAKKI MAHESH	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
116	LIST - 3	05.07.2024	VTU29677	AAVINA VARDHAN BABU	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
117	LIST - 3	05.07.2024	VTU29678	SHAIK MUZAKEER	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
118	LIST - 3	05.07.2024	VTU29679	BUGGANA VIGNESWARAREDDY	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
119	LIST - 3	05.07.2024	VTU29646	BANDI JASWANTH	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
120	LIST - 3	05.07.2024	VTU28942	KURUVA GORANTLA AJAY KUMAR	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE
121	LIST - 3	05.07.2024	VTU29690	MULLA SOHEB	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
122	LIST - 3	08.07.2024	VTU28356	AZMEERA NAVANEETH	B.TECH - MECHANICAL ENGINEERING
123	LIST - 3	08.07.2024	VTU28363	B LOKESHWARAN	B.TECH - COMPUTER SCIENCE AND ENGINEERING

124	LIST - 3	08.07.2024	VTU28870	POPURLA BALAJI	B.TECH - MECHANICAL ENGINEERING
125	LIST - 3	08.07.2024	VTU28727	PULA LIKITHA	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
126	LIST - 3	08.07.2024	VTU28732	POLIREDDY GOWTHAM	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
127	LIST - 3	08.07.2024	VTU29708	KANDE KARTHIKEYA	B.TECH - COMPUTER SCIENCE AND ENGINEERING
128	LIST - 3	08.07.2024	VTU29863	B SUBASH CHANDRA BOSE	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
129	LIST - 3	09.07.2024	VTU29634	GURU CHANDRAYUDU	B.TECH - COMPUTER SCIENCE AND ENGINEERING
130	LIST - 3	09.07.2024	VTU29647	KONA PAVAN KUMAR	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
131	LIST - 3	09.07.2024	VTU29726	BODDUPALLY ESHWAR	B.TECH - CIVIL ENGINEERING
132	LIST - 3	09.07.2024	VTU29791	PERABATHULA OMKAR	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
133	LIST - 3	09.07.2024	VTU29939	ALLIGUDDAPPA GARI. YERRISWAMY	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE
134	LIST - 3	10.07.2024	VTU28361	ULLI YADHIDYA	B.TECH - COMPUTER SCIENCE AND ENGINEERING
135	LIST - 3	10.07.2024	VTU28377	JAGALUR VAMSI	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
136	LIST - 3	10.07.2024	VTU28791	KOTTAPALLI VISHNU VARDHAN REDDY	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
137	LIST - 3	11.07.2024	VTU29629	KARTHIKEYA	B.TECH - COMPUTER SCIENCE AND ENGINEERING
138	LIST - 3	11.07.2024	VTU28792	APPIREDDY SRAVAN ESWAR	B.TECH - MECHANICAL ENGINEERING
139	LIST - 3	11.07.2024	VTU29685	KASINA ROHITH	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
140	LIST - 3	11.07.2024	VTU29725	BHARGAVI CHAPPIDI	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
141	LIST - 3	11.07.2024	VTU29992	GADDE MAARUTHI RAM	B.TECH - AERONAUTICAL ENGINEERING
142	LIST - 3	11.07.2024	VTU30308	D ABDUL KHADAR VALLI	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
143	LIST - 4	13.07.2024	VTU28374	AVADUTALA PAVAN KUMAR	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
144	LIST - 4	13.07.2024	VTU28347	JAI SINGH	B.TECH - COMPUTER SCIENCE AND ENGINEERING
145	LIST - 4	13.07.2024	VTU28782	K YASHWANTH REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING
146	LIST - 4	13.07.2024	VTU29689	KUMMITHA VENKATA PAVAN KUMAR REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING
147	LIST - 4	13.07.2024	VTU30357	G.VEERA JAGADEESWAR	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
148	LIST - 4	13.07.2024	VTU30310	RENDLA ADITHYA	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
149	LIST - 4	13.07.2024	VTU30358	AMMA VAMSHI	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
150	LIST - 4	13.07.2024	VTU30311	PALAMARI JAGADEESWAR	B.TECH - COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)
151	LIST - 4	13.07.2024	VTU30312	SINGATHI SAI KUMAR	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
152	LIST - 4	13.07.2024	VTU30359	CHANDA SAI CHARAN	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
153	LIST - 4	15.07.2024	VTU29676	PAKANATI SAI NTISH REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
154	LIST - 4	16.07.2024	VTU29723	JUJJURI SRAVANTHI DEVI	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
155	LIST - 4	16.07.2024	VTU30406	SANGU DHANESH KUMAR	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
156	LIST - 4	18.07.2024	VTU27407	KUDIRI GOUTHAM	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
157	LIST - 4	18.07.2024	VTU29824	GANAKALA ABHINAGASAKETH	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
158	LIST - 4	18.07.2024	VTU30379	MAMIDI SIDDU	B.TECH - COMPUTER SCIENCE AND ENGINEERING
159	LIST - 4	18.07.2024	VTU30388	LADDIKA. VENKATA TIRUMALA RAO	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
160	LIST - 4	19.07.2023	VTU30413	KANCHARLA ESWAR	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
161	LIST - 4	19.07.2024	VTU29861	C . SASIDHAR REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING
162	LIST - 4	19.07.2024	VTU29993	ARAVA PRADEEP REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING
163	LIST - 4	19.07.2024	VTU30380	MANAM THULASIRAM	B.TECH - COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)
164	LIST - 4	19.07.2024	VTU30412	UPPUTURU VENKATA SUBBAIAH	B.TECH - COMPUTER SCIENCE AND ENGINEERING
165	LIST - 5	19.07.2024	VTU30415	P.VISWANTH CHOWDARY	B.TECH - ARTIFICIAL INTELLIGENCE(AI) AND DATA SCIENCE
166	LIST - 5	19.07.2024	VTU30434	SHAIK AMEER HAMJA	B.TECH - COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)
167	LIST - 5	19.07.2024	VTU30444	DEERAJ REDDY E	B.TECH - COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)
168	LIST - 5	19.07.2024	VTU30445	KASA SANDEEP REDDY	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
169	LIST - 5	22.07.2024	VTU29687	KOTTANA YOHITH TONY NIRMAL	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
170	LIST - 5	22.07.2024	VTU29859	G MANOJ KUMAR	B.TECH - COMPUTER SCIENCE AND ENGINEERING
171	LIST - 5	22.07.2024	VTU30391	SRIGHAKOLLAPU NAGA VENKATA PADMINI DURGA	B.TECH - COMPUTER SCIENCE AND ENGINEERING
172	LIST - 5	22.07.2024	VTU30417	GOTLURU MANI DEEP REDDY	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
173	LIST - 5	22.07.2024	VTU30442	MOHAMMAD ASHRUF PASHA	B.TECH - MECHANICAL ENGINEERING
174	LIST - 5	22.07.2024	VTU30443	PERAMANA VENKATA SAI NAGA SWAROOP	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
175	LIST - 5	22.07.2024	VTU30446	VULAVALA HIMA VARDHAN REDDY	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
176	LIST - 5	23.07.2024	VTU30309	TALLURI HEMACHANDRA	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
177	LIST - 5	23.07.2024	VTU30418	BULLI VENKATA SAI BANDARU	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
178	LIST - 5	23.07.2024	VTU30462	P.GANGADHAR	B.TECH - MECHANICAL ENGINEERING
179	LIST - 5	23.07.2024	VTU30514	JAYA MURALI	B.TECH - COMPUTER SCIENCE AND ENGINEERING
180	LIST - 5	23.07.2024	VTU30469	GINJUPALLI LAKSHMI GANESH	B.TECH - MECHANICAL ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND ROBOTICS
181	LIST - 5	23.07.2024	VTU30500	DESAM PARTHASARADHI REDDY	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
182	LIST - 5	23.07.2024	VTU30519	D.SUDHEER	B.TECH - COMPUTER SCIENCE AND ENGINEERING
183	LIST - 5	24.07.2024	VTU28738	MOHIT PRASAD	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN CYBER SECURITY
184	LIST - 5	30.07.2024	VTU27408	SUDHANSHU KUMAR SINGH	B.TECH - COMPUTER SCIENCE AND ENGINEERING
185	LIST - 5	30.07.2024	VTU29633	PALIMENI MARUTHI PRASAD	B.TECH - CIVIL ENGINEERING
186	LIST - 5	30.07.2024	VTU30419	BOLIKONDA VIJAYKUMAR	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
187	LIST - 5	30.07.2024	VTU30512	PUNIT KUMAR JHA	B.TECH - COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)
188	LIST - 5	31.07.2024	VTU29862	C HEMANTH KUMAR	B.TECH - CIVIL ENGINEERING
189	LIST - 5	31.07.2024	VTU30414	SHYAM REDDY CHALLA	B.TECH - COMPUTER SCIENCE AND ENGINEERING

190	LIST - 6	01.08.2024	VTU30608	K.SAI KRISHNA	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN CYBER SECURITY
191	LIST - 6	01.08.2024	VTU30587	VENGALA RAMA KRISHNA	B.TECH - CIVIL ENGINEERING WITH SPECIALIZATION IN COMPUTER AIDED INFRASTRUCTURE ENGINEERING
192	LIST - 6	01.08.2024	VTU30611	S.NAVYA	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
193	LIST - 6	08.08.2024	VTU29659	A MANI KUMAR REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
194	LIST - 6	09.08.2024	VTU28366	JARUGUMALLA AKHIL	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
195	LIST - 6	09.08.2024	VTU28376	B BHANU PRASAD REDDY	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
196	LIST - 6	09.08.2024	VTU28388	RAFAEE ABDUL RAHEEM	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
197	LIST - 6	09.08.2024	VTU28789	SUNKARA M MANIKANTA SATYA SRINIVAS	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
198	LIST - 6	09.08.2024	VTU29641	LAKKI .THEJESH KUMAR	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
199	LIST - 6	09.08.2024	VTU29643	THURPUNATI SUDHARSHAN	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
200	LIST - 6	09.08.2024	VTU28794	K CHARANESWAR REDDY	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
201	LIST - 6	09.08.2024	VTU29649	R RUSHI KESHAVA REDDY	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
202	LIST - 6	09.08.2024	VTU29683	G.THARUN TEJ REDDY	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
203	LIST - 6	09.08.2024	VTU30516	GARALA PAVAN KALAYAN	B.TECH - MECHANICAL ENGINEERING
204	LIST - 6	10.08.2024	VTU28352	CHILIVERU BHAVANA NETHA	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
205	LIST - 6	10.08.2024	VTU28378	LOTTIPITTALA VIJAYA SRI	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
206	LIST - 6	10.08.2024	VTU28754	RAMYA.T	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
207	LIST - 6	10.08.2024	VTU28795	NAGARURU VENKATA SUDHARSHAN REDDY	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
208	LIST - 6	12.08.2024	VTU30401	PENUMALA VENU	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
209	LIST - 6	12.08.2024	VTU28344	B.SRI PUJITHA	B.TECH - CIVIL ENGINEERING
210	LIST - 6	12.08.2024	VTU29688	GOSANGI DIGVIJAYARAM	B.TECH - CIVIL ENGINEERING
211	LIST - 6	12.08.2024	VTU29684	KODURU ANVESH	B.TECH - COMPUTER SCIENCE AND ENGINEERING
212	LIST - 6	12.08.2024	VTU29657	PALLAPU LOKESH	B.TECH - COMPUTER SCIENCE AND ENGINEERING
213	LIST - 6	12.08.2024	VTU29810	MALARAJU NITHIN KUMAR RAJ	B.TECH - COMPUTER SCIENCE AND ENGINEERING
214	LIST - 6	12.08.2024	VTU30317	D. AMEER SOHEL	B.TECH - COMPUTER SCIENCE AND ENGINEERING
215	LIST - 6	12.08.2024	VTU30517	C.LAKSHMI PRASANNA	B.TECH - COMPUTER SCIENCE AND ENGINEERING
216	LIST - 6	12.08.2024	VTU30518	NAREDDULA JAGAN MOHAN REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING
217	LIST - 6	12.08.2024	VTU28371	MEDICHARLA NAGA VENKATA SESHU	B.TECH - COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)
218	LIST - 6	12.08.2024	VTU29648	NANDYALA VARADARSHAN REDDY	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
219	LIST - 6	12.08.2024	VTU28796	ADISETTI HARINI	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
220	LIST - 6	12.08.2024	VTU29994	SANDLURI SASI	B.TECH - COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
221	LIST - 6	12.08.2024	VTU30307	INJETI HIMA SREE	B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING
222	LIST - 6	12.08.2024	VTU28381	VIGNESH S	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
223	LIST - 6	14.08.2024	VTU29713	KEDARNATH S	B.TECH - AERONAUTICAL ENGINEERING
224	LIST - 6	14.08.2024	VTU28389	KATTA AKHIL	B.TECH - ELECTRONICS AND COMMUNICATION ENGINEERING
225	LIST - 6	14.08.2024	VTU30378	L SRAVAN KUMAR	B.TECH - AERONAUTICAL ENGINEERING

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

OFFICE OF CONTROLLER OF EXAMINATIONS

Result Analysis

April / May – 2024 Examinations

RESULT ANALYSIS APRIL / MAY – 2024 EXAMINATIONS

B.TECH. PROGRAMME (REGULAR SEMESTER – MAY 2024)				
Department	**Semester**	**Student Count**	**All Clear Count**	**%**
Aeronautical Engineering	2nd	62	40	64.52
	4th	26	18	69.23
	6th	36	25	69.44
	8th	44	39	88.64
Automobile Engineering	8th	11	11	100
Biomedical Engineering	2nd	56	41	73.21
	4th	63	38	60.32
	6th	19	12	63.16
	8th	20	20	100
Biotechnology	2nd	64	45	70.31
	4th	62	55	88.71
	6th	44	41	93.18
	8th	38	38	100
Civil Engineering	2nd	8	4	50
	4th	22	12	54.55
	6th	34	27	79.41
	8th	61	58	95.08
Computer Science and Engineering (Artificial Intelligence and Machine Learning)	2nd	69	50	72.46
	4th	59	51	86.44
Computer Science and Engineering (CyberSecurity)	2nd	69	36	52.17
	4th	58	55	94.83
Computer Science and Engineering (Data Science)	2nd	68	54	79.41
	4th	61	51	83.61
Computer Science & Engineering	2nd	1254	985	78.55
	4th	1333	1083	81.25
	6th	1125	971	86.31
	8th	991	891	89.91
Artificial Intelligence and Machine Learning	2nd	68	52	76.47
	4th	68	57	83.82
	6th	70	61	87.14
Artificial Intelligence(AI) and Data Science	2nd	67	51	76.12
	4th	68	62	91.18
	6th	74	66	89.19

Computer Science and Design	2nd	67	46	68.66
	4th	67	57	85.07
	6th	66	57	86.36
Electronics and Communication Engineering	2nd	545	394	72.29
	4th	569	325	57.12
	6th	664	518	78.01
	8th	356	339	95.22
Electrical and Electronics Engineering	2nd	54	30	55.56
	4th	54	39	72.22
	6th	33	24	72.73
	8th	31	27	87.1
Information Technology	2nd	67	43	64.18
	4th	73	65	89.04
	6th	70	64	91.43
	8th	48	47	97.92
Mechanical Engineering	2nd	46	24	52.17
	4th	55	37	67.27
	6th	85	61	71.76
	8th	77	71	92.21

LAW PROGRAMMES				
Department	**Semester**	**Student Count**	**All Clear Count**	**%**
B.A LL.B.(Hons)	2nd	115	85	73.91
	4th	109	102	93.58
	6th	114	107	93.86
	8th	71	69	97.18
	10th	43	43	100
B.Com LL.B.(Hons)	2nd	114	106	92.98
	4th	117	103	88.03
	6th	86	82	95.35
	8th	56	55	98.21
	10th	31	31	100
ARTS AND SCIENCE PROGRAMMES				
Department	**Semester**	**Student Count**	**All Clear Count**	**%**
B.Com (Accounting and Finance)	2nd	54	38	70.37
	4th	34	31	91.18
	6th	21	21	100
B.Com (Corporate Secretaryship)	2nd	27	20	74.07
	4th	14	14	100
	6th	15	15	100
B.Com (General)	2nd	156	98	62.82
	4th	146	108	73.97
	6th	70	65	92.86

B.Com (Professional Accounting)	2nd	7	6	85.71
	4th	7	6	85.71
B.Com (Computer Applications)	2nd	47	34	72.34
BBA	2nd	55	44	80
	4th	47	42	89.36
	6th	26	26	100
B.Sc (Multimedia)	2nd	13	9	69.23
	4th	15	15	100
	6th	7	6	85.71
B.Sc (Visual Communication)	2nd	22	15	68.18
	4th	23	18	78.26
	6th	13	13	100

M.TECH. PROGRAMMES				
Department	**Semester**	**Student Count**	**All Clear Count**	**%**
M.Tech. (Aeronautical Engineering)	2nd	2	1	50
	4th	2	2	100
M.Tech. (Big Data Analytics)	2nd	10	10	100
	4th	4	4	100
M.Tech. (Metallurgical and Material ScienceEngineering)	2nd	16	16	100
	4th	18	18	100
M.Tech. (Structural Engineering)	2nd	16	15	93.75
	4th	3	2	66.67
M.Tech. (Power Electronics)	2nd	4	4	100
	4th	8	6	75
M.Tech. (Information and Cyber Security)	2nd	8	7	87.5
	4th	3	3	100
M.Tech. (Industrial Safety and Engineering)	2nd	19	18	94.74
	4th	21	21	100
M.Tech. (Environmental Engineering)	2nd	11	9	81.82
	4th	7	7	100
M.Tech. (Embedded Systems and Technologies)	2nd	4	4	100
	4th	12	11	91.67
M.Tech. (Computer Science and Engineering)	2nd	7	7	100
	4th	4	4	100
M.Tech. (Biotechnology)	2nd	7	7	100
	4th	10	10	100
M.Sc. PROGRAMMES				
M.Sc (Chemistry)	2nd	30	27	90
	4th	28	27	96.43
M.Sc (Physics)	2nd	8	8	100
	4th	23	23	100
M.Sc (Data Analytics)	2nd	28	28	100
	4th	20	20	100
M.Sc (Mathematics)	2nd	5	4	80
	4th	13	13	100

MBA PROGRAMMES				
MBA	4th	136	135	99.26
M.A. PROGRAMMES				
M.A (English)	2nd	12	10	83.33
	4th	1	1	100

CONTROLLER OF EXAMINATIONS

Ph.D. Awarded – Status – since last ACM (08.06.2024)

Part Time Research Scholars		Full Time Research Scholars	Total Research Scholars since Last ACM
Internal	External		
6	14	4	24

Ph.D. Research Scholars – Publication Details

No. of Scopus Research Articles	No. of SCI/ESCI/WoS indexed Journals	UGC Care Journals	ABDC Journals	Others	Total No. of Papers Published	Patents
57	14	2	4	7	84	1

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Ph.D. Awarded List - ACM - AUGUST 2024 (Since last ACM dated 08.06.2024)

S.No.	Name	Dept	Mode of Study (PT/FT)	Circular Date	Viva-voce Date	Supervisor Name	Title
1	Imran Javeed S	ECE	PT Internal	25.05.2024	10.06.2024	Dr. Aloy Anuja Mary G	*Design and Analysis of Wideband Antennas for Local Area Cognitive Radio Network Applications*
2	Ashok kumar Konduru	ECE	PT External	27.05.2024	11.06.2024	Dr. Mazher Iqbal J.L.	*A Comprehensive Study of Emotion Recognition from Speech Signals: Digital Feature Optimization and Diversity Measure Fusion for Improved Accuracy and Robustness*
3	Vinoth Kumar V	ECE	PT Internal	27.05.2024	12.06.2024	Dr. G. Sasikala	*Design and Development of Micro-heater MEMS based Gas Sensor to Monitor Air Quality in the Environment for UAV Applications*
4	Rajesh Yamparala	CSE	PT External	03.06.2024	21.06.2024	Dr. T. Kamaleshwar	*An Effective Routing Method for Secure Data Transmission using Group Key Management in MANET*
5	Thilagam T	CSE	PT External	21.05.2024	22.06.2024	Dr. R. Aruna	*Efficient Intrusion Detection in Cloud Computing using Deep Learning Algorithm*
6	S Kolangiammal	ECE	PT External	27.05.2024	24.06.2024	Dr. L. Balaji	*Design of Compact Planar Monopole UWB MIMO Antenna for Diversity Applications*
7	Venkateswara Rao Kota	CSE	PT External	14.05.2024	25.06.2024	Dr M Prabha	*Multichannel Stack of Neural Networks with Lexicon based Padding and attention Mechanism for Sentiment Analysis*
8	Pannangi Naresh	CSE	PT External	11.06.2024	28.06.2024	Dr. Suguna R	*Non Overlapping Incremental Association Rule Mining from Large Datasets using Efficient Tree Structures*
9	R Bhuvanya	CSE	PT External	04.06.2024	05.07.2024	Dr. M. Kavitha	*Design of Recommender System in E-Business for Analogous Add-ons by Utilizing Deep Learning Techniques*

10	Shaher Dwik	ECE	FT	19.06.2024	06.07.2024	Dr. G. Sasikala	*Design and Simulation of a Reconfigurable Multi functional Optical Sensor*
11	Sathya Aarthi R	Management Studies	PT External	14.06.2024	13.07.2024	Dr. Ravishankar K	*A study on Performance Management System in Private Banking Sector with Special Reference to Chennai*
12	Sri Raman Kothuri	CSE	PT Internal	28.06.2024	15.07.2024	Dr. N.R. Rajalakshmi	*Recognition of Emotion for Multimodal Data using Hybrid Feature Fusion Deep Learning Techniques*
13	Roselyn Besi P	MATHS	PT External	04.07.2024	19.07.2024	Dr. G.M. Vijayalakshmi	*Fractional Models on Epidemic Control Measures with Non Singular Kernels*
14	Annam Karthik	ECE	PT External	2.07.2024	19.07.2024	Dr. Mazher Iqbal J.L.	*Enhancing Speech Clarity: An Optimized Approach using Efficient Convolutional Neural Networks*
15	Saravana Kumar R M	CIVIL	PT Internal	04.07.2024	22.07.2024	Dr. Samson. S	*Reliability Based Seismic Analysis of Framed Structures Coupled with Shearwall*
16	Vivekanand Krishnaji Joshi	ECE	PT External	09.07.2024	26.07.2024	Dr. Kavitha T	*Analysis and Improvement of Speech Quality in Low Bandwidth Digital Mobile Radio*
17	R. Kalpana	ECE	PT External	10.07.2024	27.07.2024	Dr. M. Anto Bennet	*An Optimized Artiicial Intelligence Model for Brain Tumor Segmentation and Classification using MR Images*
18	Durairaj K	CSE	PT Internal	13.07.2024	30.07.2024	Dr. V. Dhilip Kumar	*Development of Animal Behavioural Analysis using IoT-Based Sensory Data*
19	R. Thilagavathi	MATHS	FT	15.07.2024	05.08.2024	Dr. Viswanath J	*A Study on some Two-Warehouse Deterministic Inventory Models with New Spatial and Modified Financial Implementations*
20	Sumithra M	CSE	PT External	25.07.2024	09.08.2024	Dr. N. Rajkumar	*Enhancing Facial Emotion Recognition through the Integration of AI and Meta-Heuristics Approaches for Accurate Classification*
21	Naresh Raj K L	MECH	FT	27.07.2024	12.08.2024	Dr. S. Jayavelu	*Investigation on Abrasive Water Jet Milling of Titanium Alloy*
22	Ebisa Asfaw Gemechu	CSE	FT	30.07.2024	14.08.2024	Dr. Kanagachidambaresan G.R.	*Designing English-AFAAN Oromo Machine Translation Model using Attention-Based NMT*
23	Ashlin Nimo JR	Management Studies	PT Internal	07.08.2024	22.08.2024	Dr. Ravishankar K	*Impact of Social Media on the Growth of Startups in Chennai*
24	Vanam Satyanarayana	EEE	PT External	06.08.2024	23.08.2024	Dr. K. Vinoth	*Implementation of Meta-Heuristic Optimization Algorithm to Improve the Power Quality of Grid-Tied PV System*

School of Computing

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology
Chennai, Tamil Nadu, India

Recognised as CATEGORY-1 DEEMED TO BE UNIVERSITY by the UGC University Grants Commission

Accredited by NAAC with the HIGHEST GRADE A++

Academic Progress - SoC

Initiatives, Process & Execution

in

46th ACM

Academic Year : 2023-24

Welcome to ACM Members

Presented By

Prof. Dr. SP. Chokkalingam

Dean – School of Computing

24th August 2024, Saturday

CONTENTS

ABOUT THE SCHOOL OF COMPUTING

Departments 8

- **Established in the year 1997**

UG – 1524

8

B.Tech., (CSE) with Honors/ Minor/ Specialization

Tracks: 1104

- Cyber Security
- Gaming and Animation
- Artificial Intelligence & Machine Learning
- Artificial Intelligence & Data Science
- Artificial Intelligence & Robotics

B.Tech., - AI & DS **- 60**

B.Tech., - AI & ML **– 60**

B.Tech., - Computer Science and Design **- 60**

B.Tech., CSE (AI & ML) **- 60**

B.Tech., CSE (DS) **- 60**

B.Tech., CSE (CS) **- 60**

B.Tech., - IT **- 60**

PG – 84

4

M.Tech - Computer Science and Engineering **- 18**

M.Tech - Big Data Analytics **- 18**

M.Tech - Information & Cyber Security **- 18**

M.Sc - Data Analytics **- 30**

Ph.D – 157

Pursuing

Ph.D. – Computer Science and Engineering

Ph.D. – Information Technology

(Full Time & Part Time)

***Ph.D –** Pursuing will vary according to the Supervisor Vacancy.

Vel Tech
Rangarajan Dr. Sagunthala R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

- **2006** – First time Accredited by NBA
- **2018** – Second time accredited by NBA under Tier –I (WA)
- **2022** – Third time accredited by NBA under Tier –I (WA)

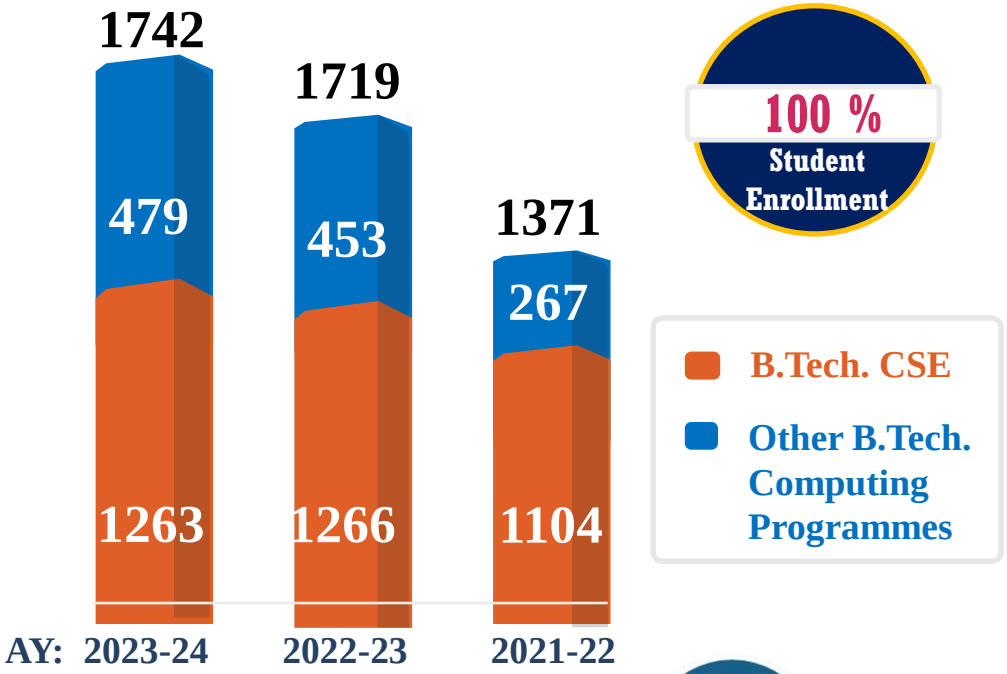
Upto June 2025

No. of Students Graduated till 2024
4651*

Ph.D. Awarded till 2024
87

STUDENT DEMOGRAPHICS

Students Enrollment Growth



Student Enrollment in Academic Year 2023-24

(SoC UG - II Year, III Year & IV Year)

B. Tech.,

4332

Total Students

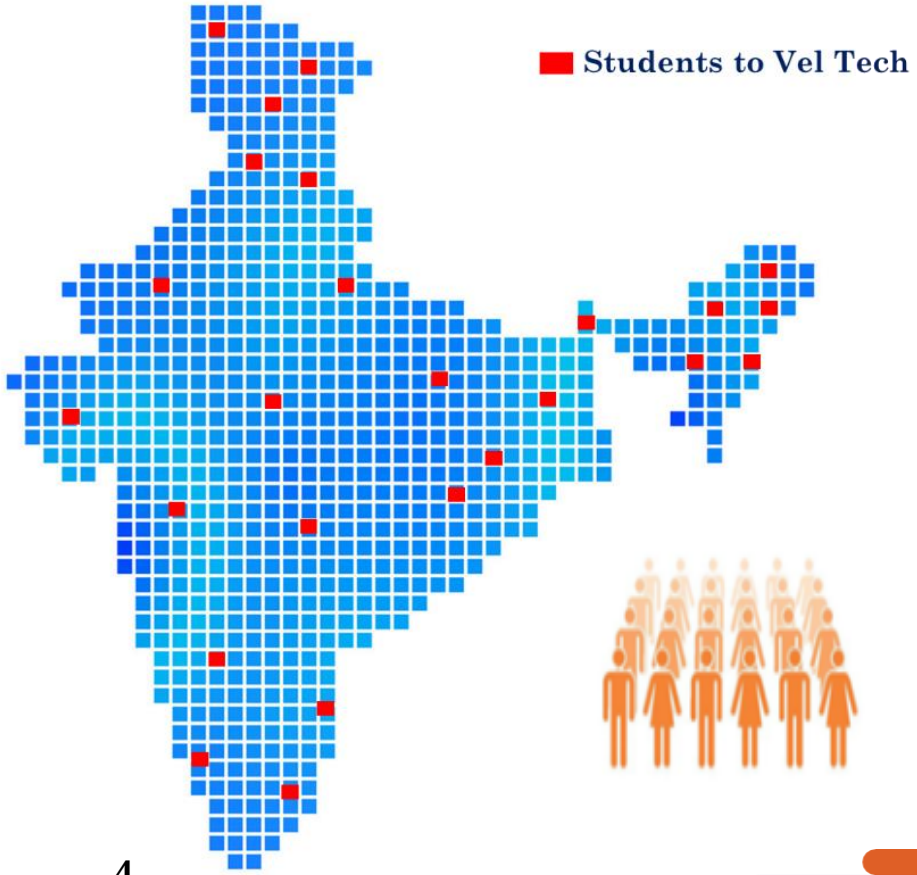
Male 80%

Female 20%

Students Diversity

From **27 States**

From **5 Countries**



M. Tech.,

39

Total Students

M. Sc.,

48

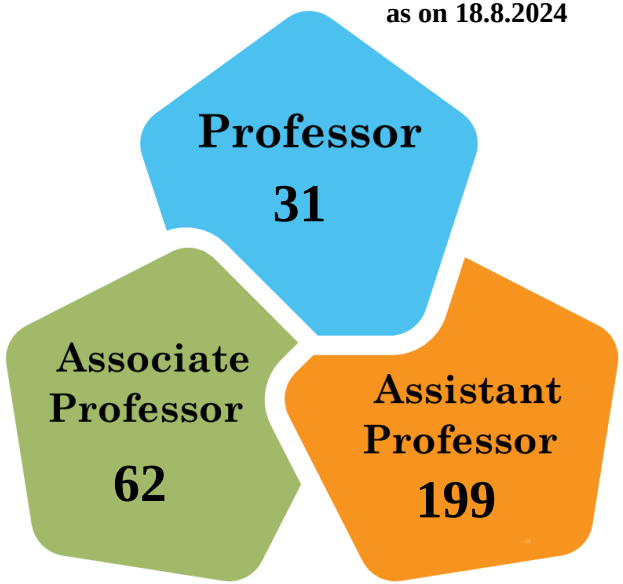
Total Students

FACULTY DEMOGRAPHICS

AY : 2024-25

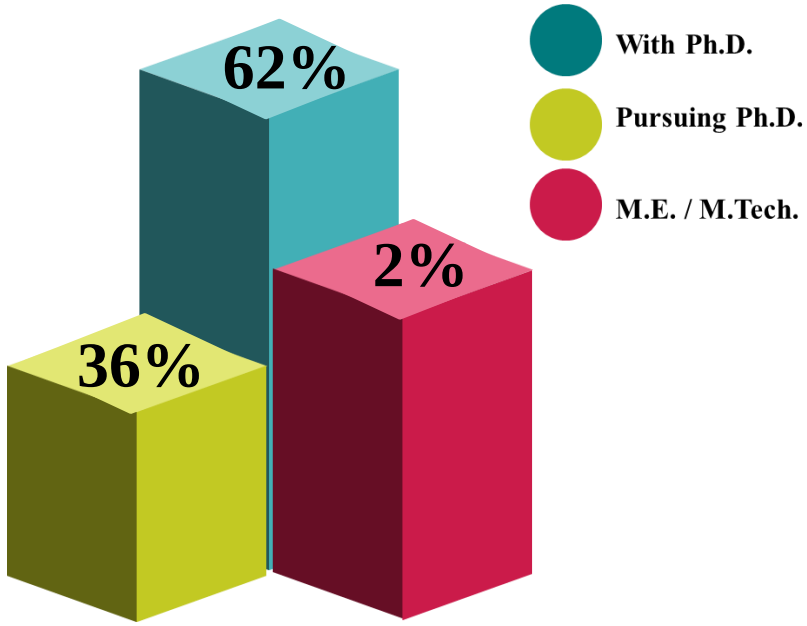
Total Faculty : 292*

as on 18.8.2024



Faculty Gender Percentage

Faculty Qualification



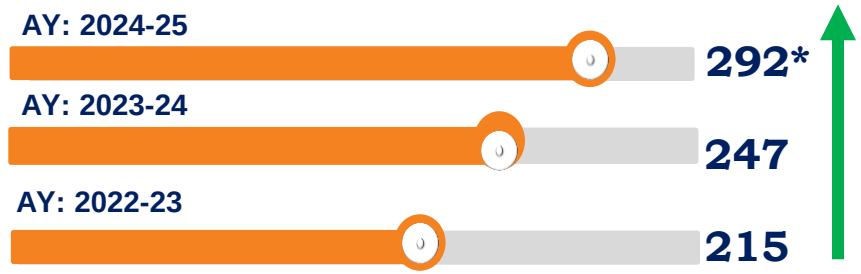
1:16
Faculty Student Ratio

8.17 years
Average Professional Teaching experience

Total Faculty with Ph.D. : 179

National Institute of Technology(NITs)	03
Central University	03
State University	94
Private University	79

Faculty On Roll for Last 3 years



ACADEMIC PRIORITIES

STRATEGIES

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
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1: Excellence in Teaching & Learning

Enablers : Faculty, Students , Academic Support

- Student Centered Learning
- Modern Pedagogy
- Faculty Professional Development
- Use Case Approach ✓

2: Progressive and Inspiring Curriculum

Enablers : Curriculum , Stake holders

- Academic Flexibility
- Emerging Areas
- Industry Collaborative Courses ✓

LOCF
NEP2020
ACM-IEEE

3: Highly Employable Graduates

Enablers : Faculty, Curriculum, Industry support

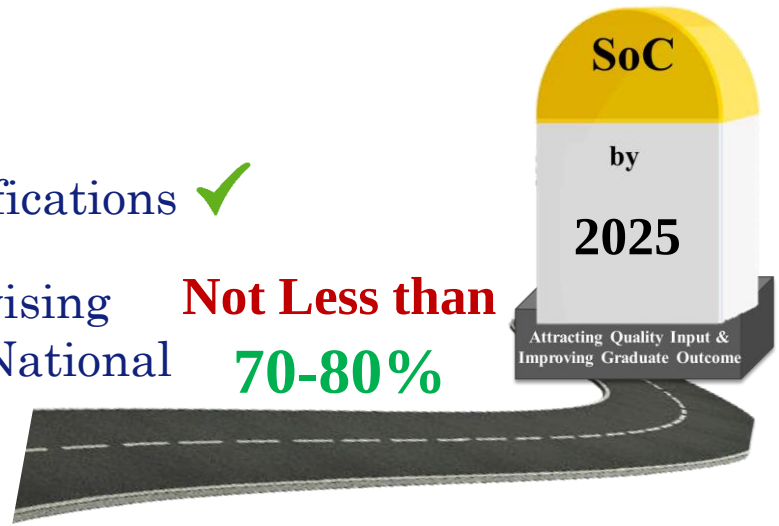
- Design Experience
- Industry Projects ✓
- Student Project Quality
- Innovations
- Global Professional Certifications ✓

4: Supporting for Student Progression & Achievements

Enablers : Faculty , Students, Ecosystem

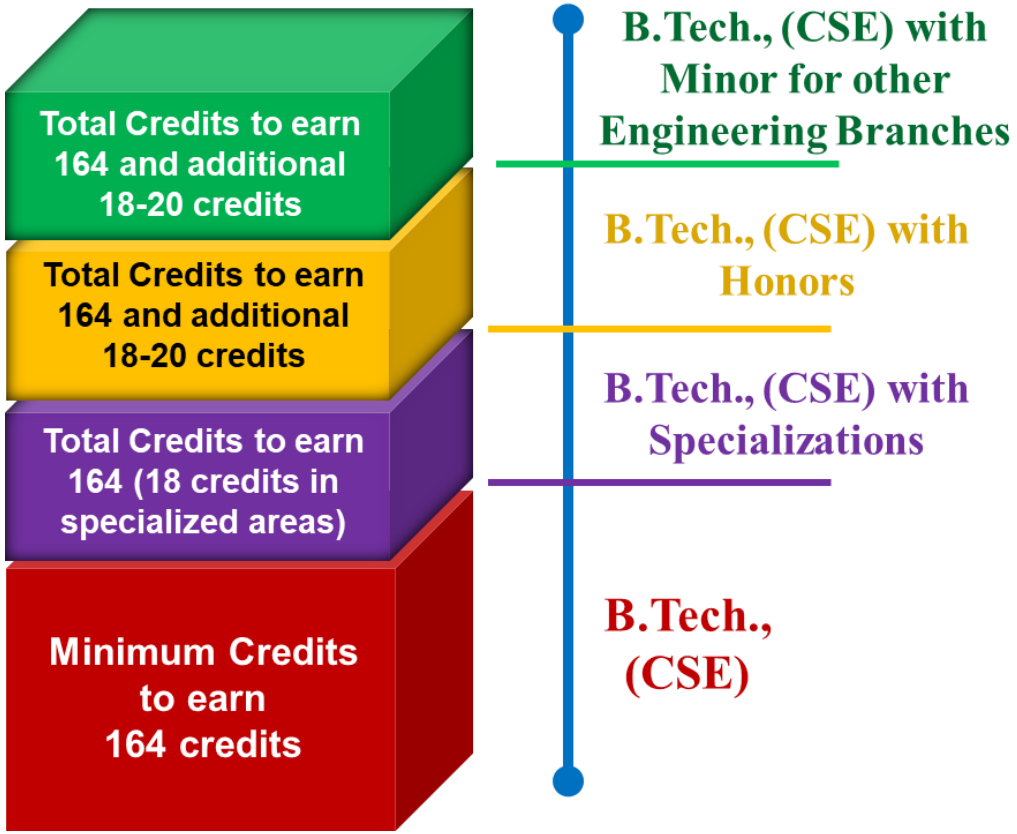
- Student mentoring & Advising
- Participation in Global / National level competitions ✓
- Alumni engagement
- Student Technical Clubs

Not Less than
70-80%

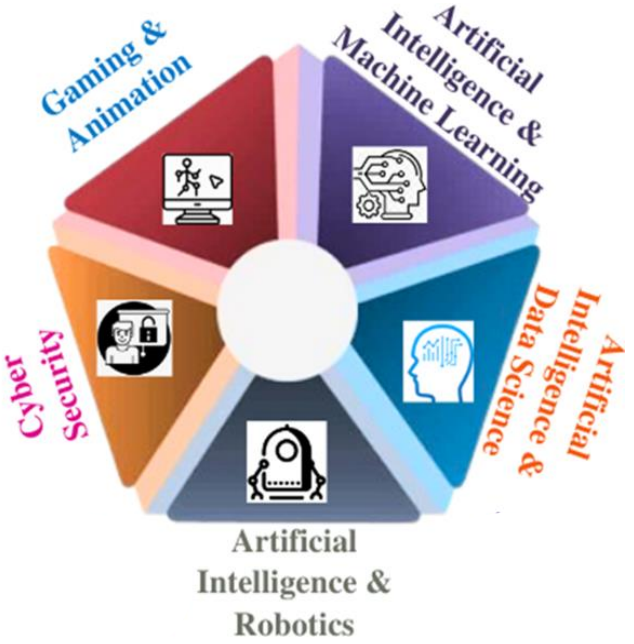


CURRICULUM FRAMEWORK

Programme Structure



Specializations/ Minor/ Honors Tracks in B.Tech. CSE



Suggestions from Industry Experts

- ✓ ATOS
- ✓ Virtusa
- ✓ Capgemini
- ✓ LTI Mindtree
- ✓ TCS
- ✓ Cognizant
- ✓ Genpact

Curriculum Enrichment

- Curriculum inline with National / Global / Local bodies.
- Academia Experts from NITs, IITs, IIITs, IISC
- Industry / Academia Experts involved in Curriculum design

✓ AICTE

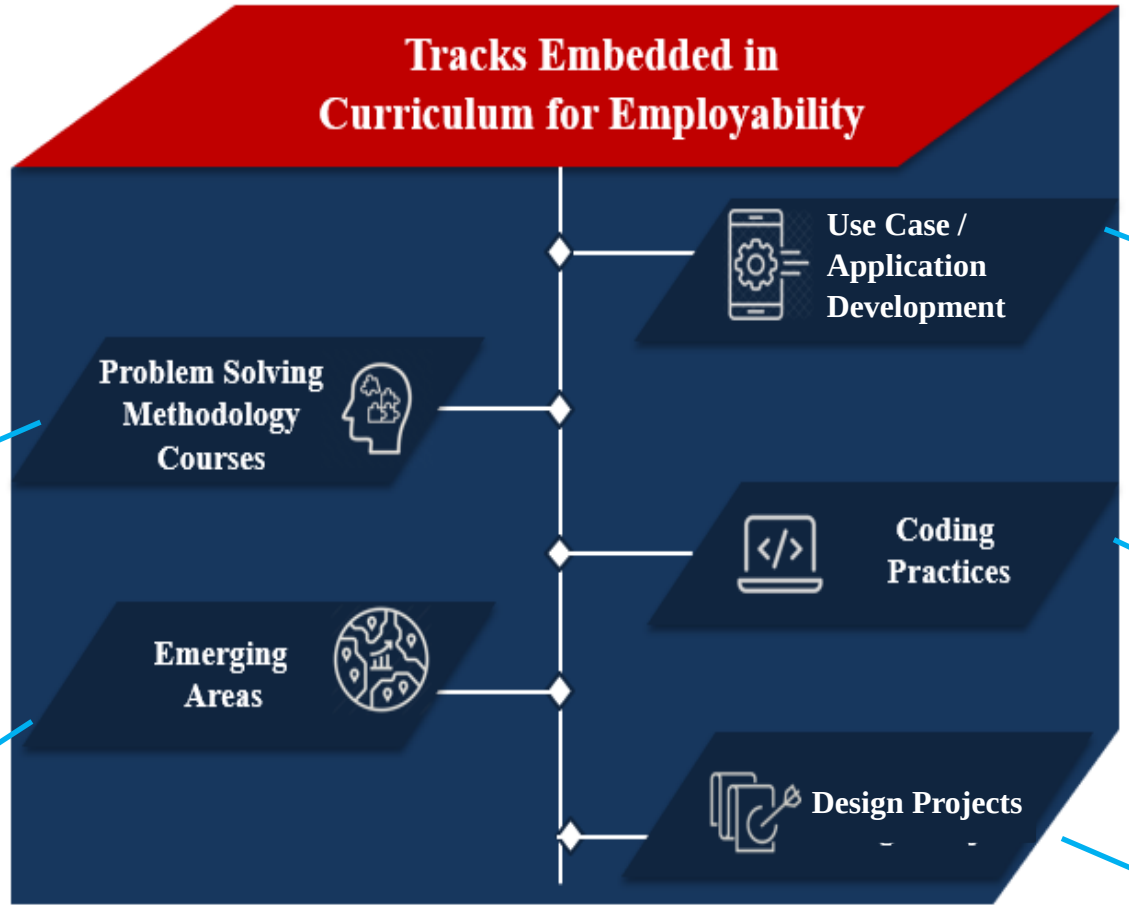
✓ Ministry of Education, Goverment of India

✓ Digital India, Power To Empower

✓ NASSCOM®

✓ acm

EMPLOYMENT FOCUS IN CURRICULUM



1
- Computational Thinking
- Competitive Coding I & II

2
- Programming Languages
- Web Technology
- Mobile Application Development
- Societal Application Project

3
- Daily Coding Practice in Hacker Earth Platform
- Coding Advisors

4
- AI & ML
- Data Science
- Cyber Security
- IoT & Cloud Computing

5
- Minor Project
- Major Project
- Community Service Project

INDUSTRY SPECIFIC COURSES IN THE CURRICULUM

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology (Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Atos

Cloud

01 **Cloud Infrastructure Management**
(4-5 Courses, 18 Credits)

Network

02 **Network and Server Management**
(4-5 Courses, 18 Credits)

Middleware

03 **Application Modernization Service**
(4-5 Courses, 18 Credits)

Mainframe

04 **Mainframe**
(4-5 Courses, 18 Credits)

cognizant

Software Application Development-1

Digital Nurture

Digital Nurture 2.0

RapidData

mendix

1. **Low-Code Development (Basic Level)**
2. **Low Code Development (Intermediate Level)**

TCS TATA CONSULTANCY SERVICES

Identity Access Management

Introduction to Cyber Security

Internet of Things and Cloud

genpact

Application Development and Maintenance

ATOS INDUSTRY SPECIALIZATION COURSES

Cloud Infrastructure Management

- Virtualization Techniques
- Windows Client Administration OS
- Windows Server Administration OS
- Cloud Fundamentals using Azure
- Administering Microsoft Exchange Server
- Office 365 Administration

Application Modernization Service

- IIS Web Server Technologies
- Application Server Technologies
- WebSphere Application Server
- WebSphere MQ
- Middleware Technologies
- Database Administration using MSSQL Server
- Database Administration using Oracle Server

Network and Server Management

- Data Center Hosting – Windows OS
- Data Center Hosting – Unix OS
- Advanced Routing Techniques and Security
- Advanced Switching and Networking Techniques
- Juniper Networking Techniques
- Storage Management

Mainframe

- Introduction to System programming, z/OS commands and Panel on IBMZ
- Z/OS System Service Structure
- Z/OS Administration
- Fundamentals of Networking, CICS and IMS
- IBM System z Parallel Sysplex Operations
- IBM MQ System Administration for z/OS

INDUSTRY PRACTICES IN THE CURRICULUM FOR PROPER SKILLING

MAJOR COURSES OFFERED

INDUSTRY EXPERTS	ABROAD EXPERTS
Agile and Scrum	Generative AI
DevOps	Programming for Data Analytics
UI/UX Design	Artificial Neural Networks
ML Ops	VR & AR
App Development using AR/VR	Computer Vision with Deep Learning
IoS Application creation	Cyber security threat handling and Incident Response
Data Science	Digital Forensics and Incident Response

To Get Industry Exposure

To Get Research Culture

Credit Courses – Delivered by Industry Experts / Higher Learning Professors (India / Abroad)

Industry Experts Oriented Courses

14 No. of Courses

705 Student Benefited

Higher Learning Experts – India/Abroad Courses

19 No. of Courses

967 Student Benefited

MAJOR INDIA/ABROAD INSTITUTES

- University of Michigan, USA
- Kristianstad University, Sweden
- East Stroudsburg University, USA
- Multimedia University, Malaysia
- University of West of Scotland, UK
- University Sains Islam, Malaysia

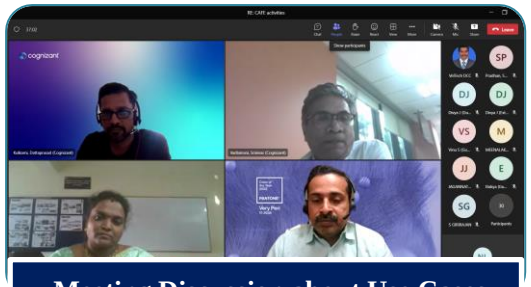
MAJOR INDUSTRIES

- Capgemini
- Thinkworks Infotech
- Grahas VR
- TVS Next Limited
- Innova Solutions

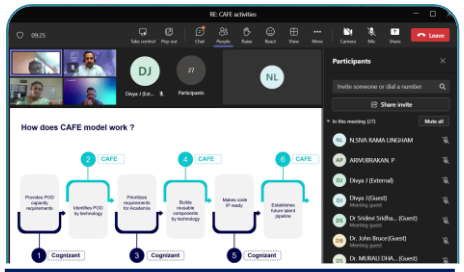
Industry Use Cases - Cognizant

01	Azure AD Authentication with Node
02	File Upload in angular 13 and spring boot Java
03	SeriLog with .NET 6.0
04	Dynamic Load Component VueJS
05	Logging Framework with .NET

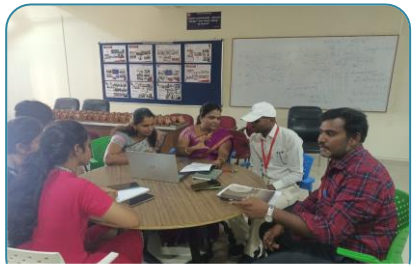
Cognizant Team Discussions



Meeting Discussion about Use Cases



Discussion – CAFÉ Workplan



Student Teams – Review Meeting

Outcomes

In **CAFE Grand Finale** Out of 5 colleges, Top 3 colleges were shortlisted based on the criteria who have completed all 5 business use cases with best enterprise level industry standard codes. Vel Tech University is selected as one of the best colleges among the Top 3.

The students have created reusable components with Enterprise-Level Coding capabilities.

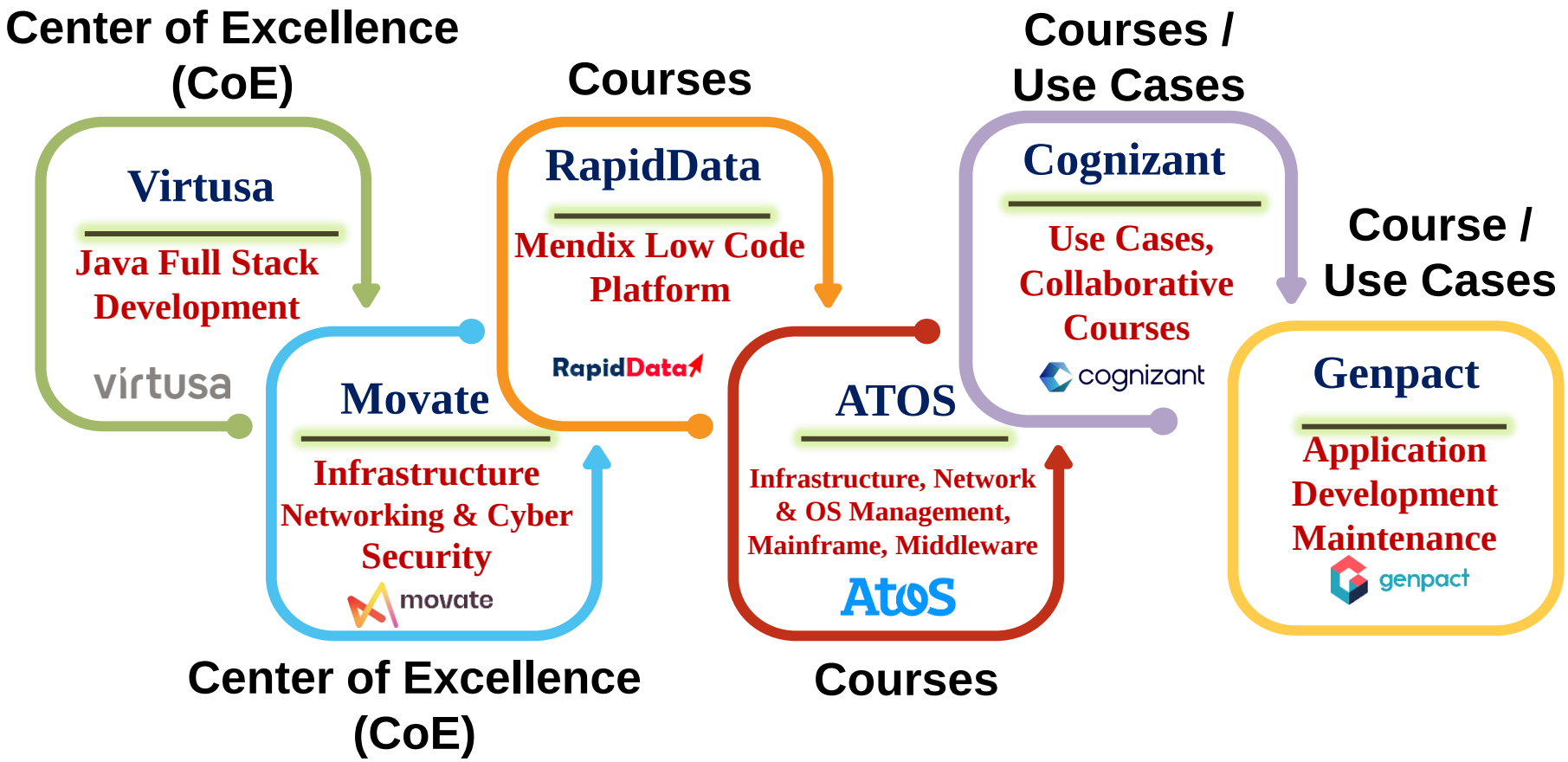
Aniket Kumar / VTU 16970
"Best Developer Award"

2nd Runner Up Team Award

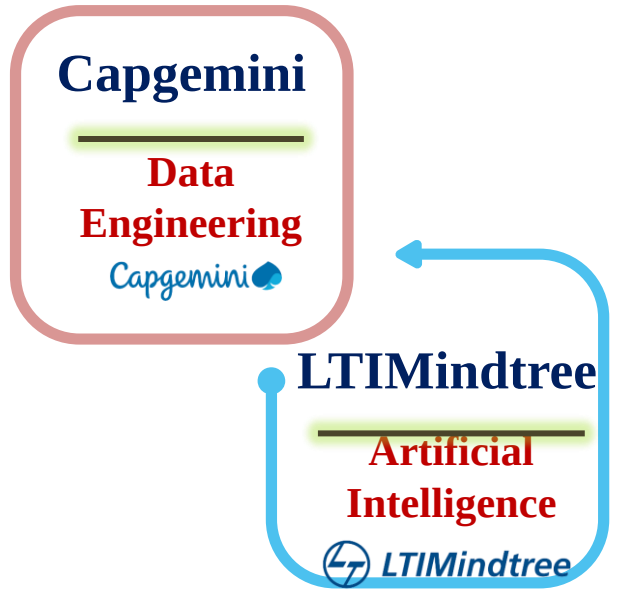
INDUSTRY COLLABORATIVE LABORATORIES

Major Industry Collaborative Laboratories

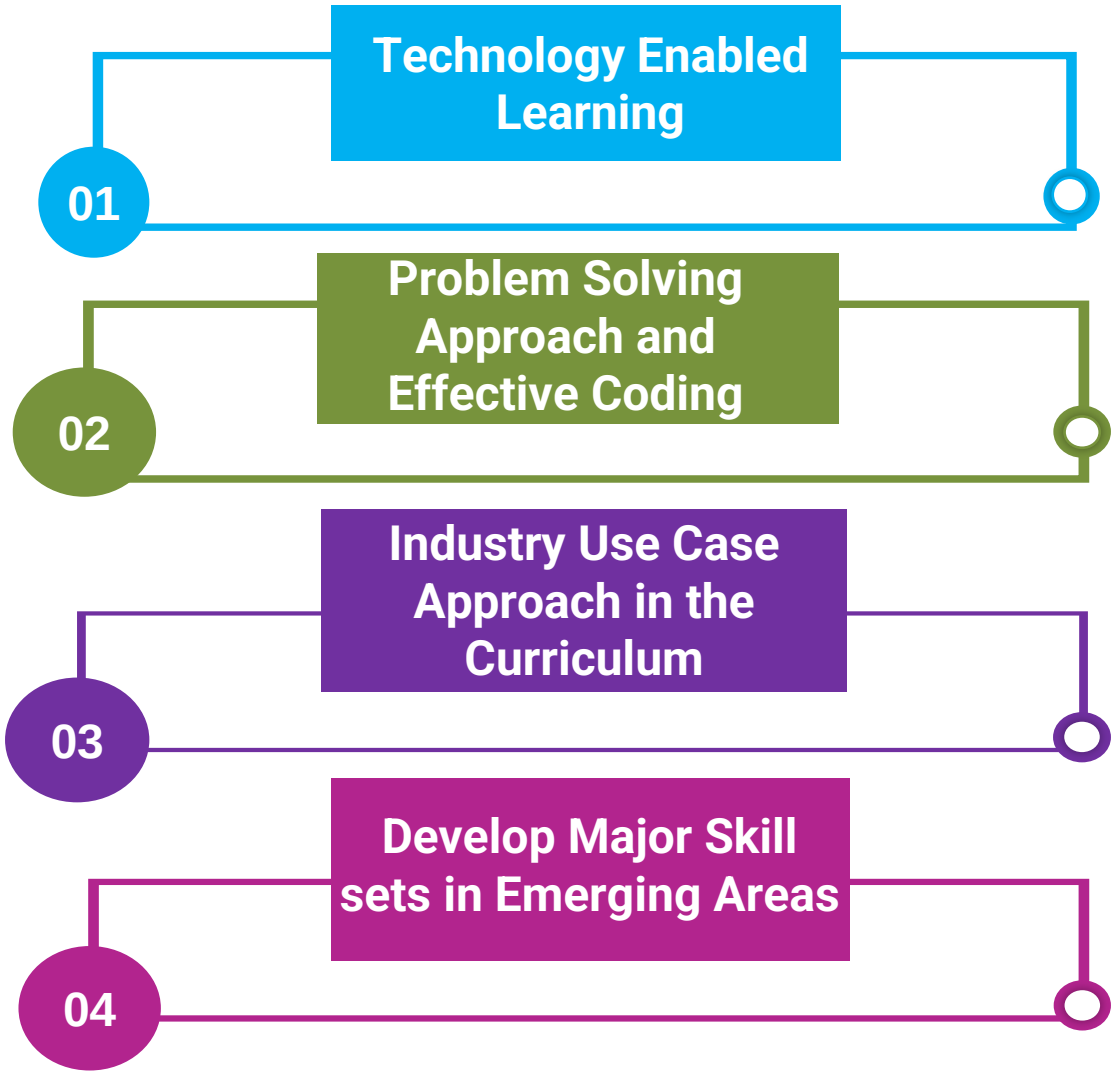
AY: 2023-24



Collaborative Laboratories - in Pipeline



UNIQUE PRACTICES



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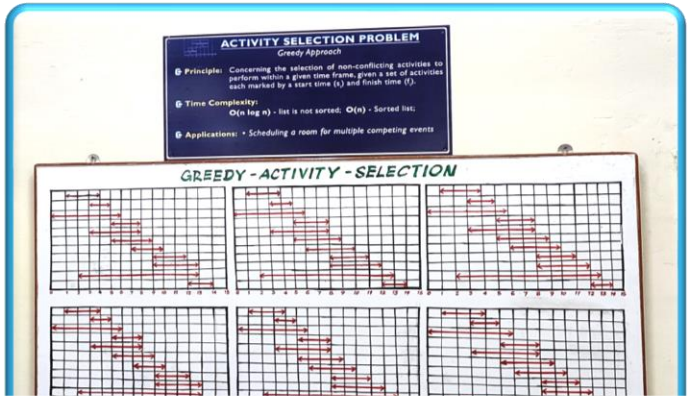
PROBLEM SOLVING AND LOGIC BUILDING PRACTICES LABORATORY

Selection Sort

Radix Sort



Greedy Activity Selection

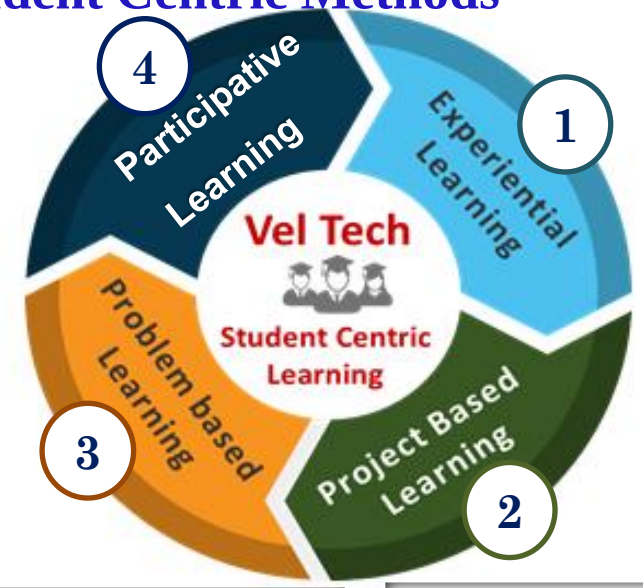
Knapsack Problem

Rod Cutting Problem

Tower of Hanoi

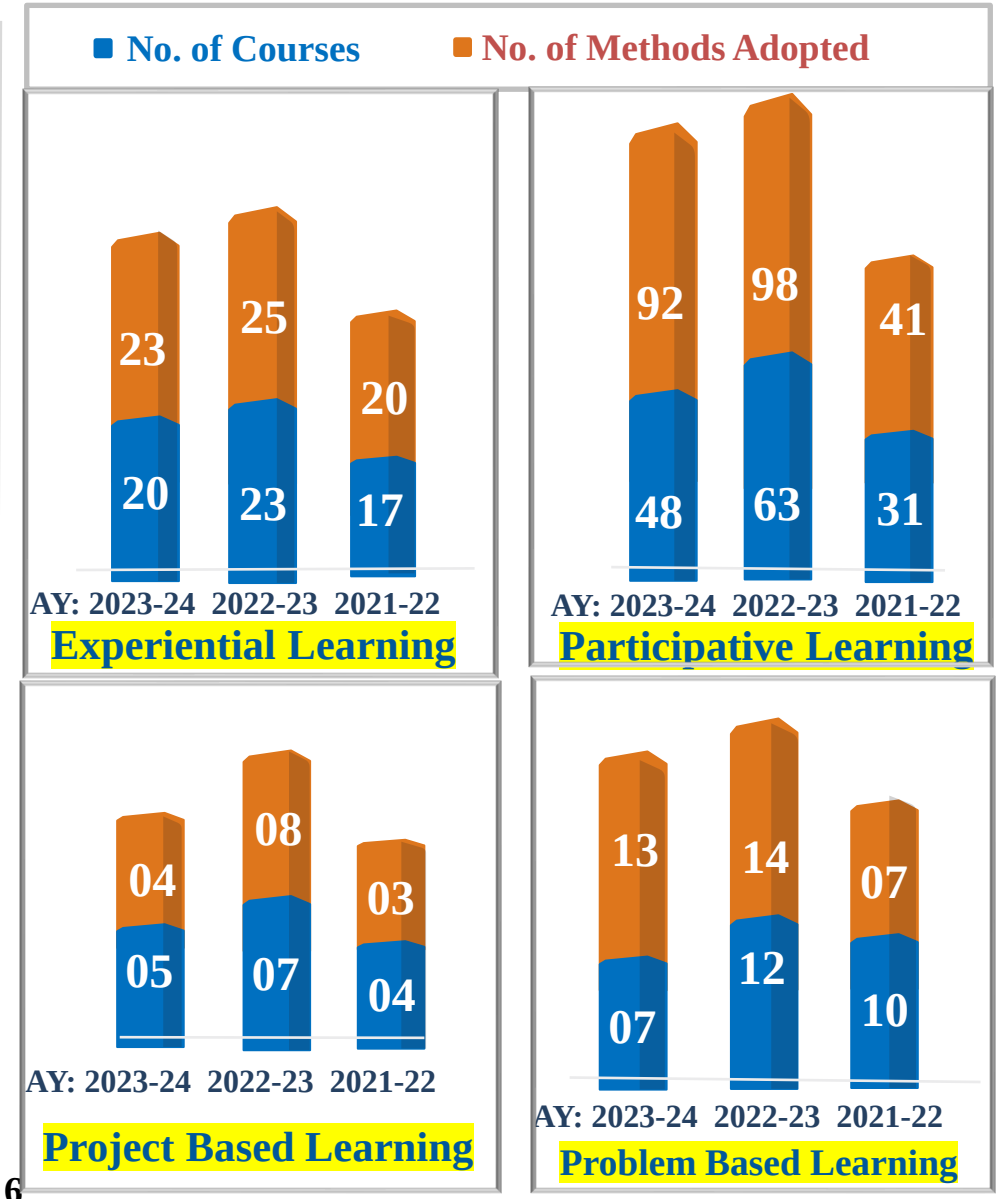
TEACHING LEARNING PRACTICES

Student Centric Methods

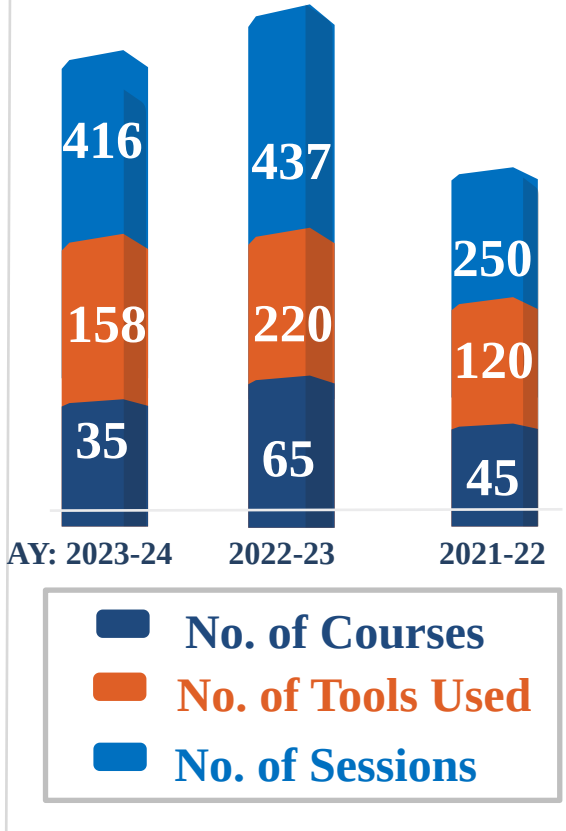


1. Computer Networks
   - Internet of Things
2. Mobile Application Development
   - Web Programming
3. Data Structures
   - Design and Analysis of Algorithm
4. Data Structures
   - Blockchain
   - Computer Networks

Student Centric Approaches adopted for last 3 Years



ICT Tools used for last 3 Years



Tools Utilized for Assessment

1. Kahoot!
2. Quizlet
3. Quizizz
4. Google Forms
5. MsTeams

Major Outcomes

- Monitoring Learning Levels of the students
- Changing the teaching methodology based on learning level of the students
- Student Attentions

STUDENT LEARNING OUTCOME IMPROVEMENT – LEARNING DIVERSITY

- ❑ Mentoring ✓
- ❑ Slow Learners ✓
- ❑ Advanced Learners ✓

Advanced Learners - Various Activities

438 Total Students Attended

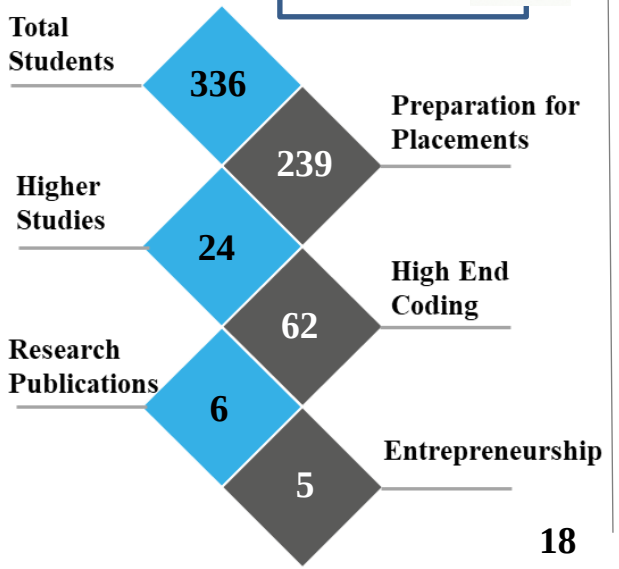
336 Total Students Benefited

Major Outcomes

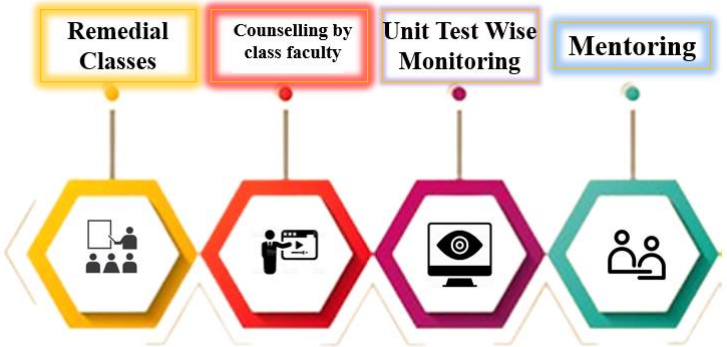
- Perform better in Coding Competitions, Hackathons
- Employment with Higher Package
- Higher Studies
- Quality Publications
- Launch Startups

AY: 2023-24

77%



Slow Learners - Various Activities



2173 Total Students Attended

28 Courses

2054 Total Students Benefited

94.5%

Major Outcomes

- Compete with Peers
- Move towards Progressive way
- Achieve Academic success
- Become an active learner

AY: 2023-24

Summer 2023-24

12 – Courses

1219 – Students Attended

1160 – Students Benefited

Winter 2023-24

16 – Courses

954 – Students Attended

894 – Students Benefited

GRADUATE OUTCOME (GO)

Graduation Statistics

Batch : 2019-2023

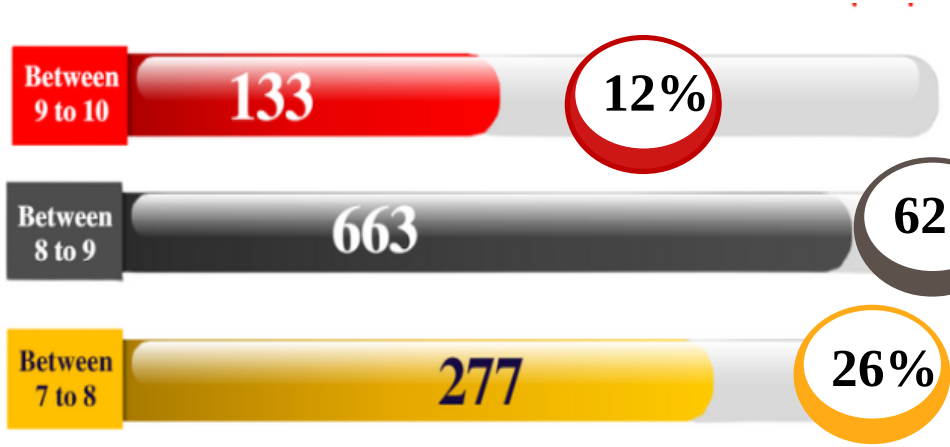
1114 Students Appeared	54.24% First Class With Distinction	96.32% Graduation Percentage
1073 Students Graduated	45.75% First Class	

Batch : 2020-2024

1002 Students Appeared	87.8*% Graduation Percentage
880 Students Graduated	

CGPA Statistics

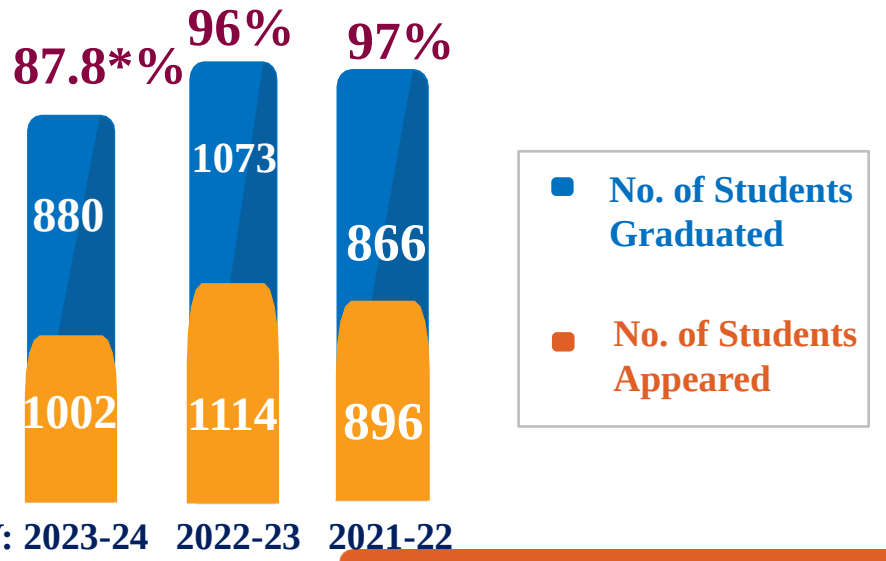
Batch : 2019-2023



B.Tech., (CSE)
Gold Medal Achiever
KALAGANI KEERTHI PRIYA
VTU12828
CGPA 9.6

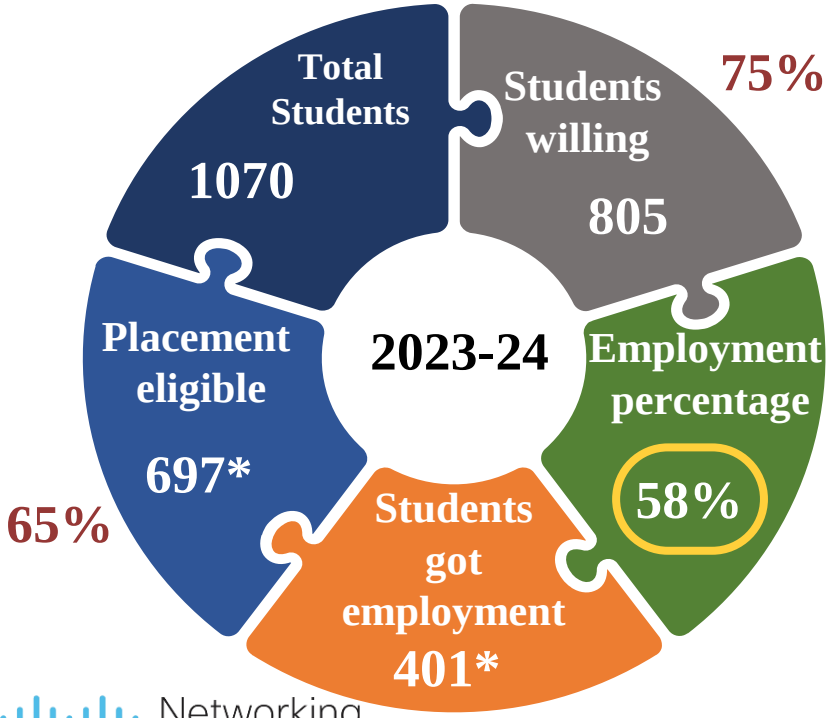
B.Tech., (CSE)
Gold Medal Achiever
UDAY KOCHERLA
VTU17359
CGPA 9.61

Last Three Year Statistics



GRADUATE OUTCOME - EMPLOYMENT OFFERS

Placement Statistics for AY: 2023-24



Networking Academy

17.9 LPA Salary Package

RAGHAV RAJVANSHI
VTU12050
B.Tech. CSE

K SAI SRINIVAS VARA PRASAD
VTU17342
B.Tech. CSE

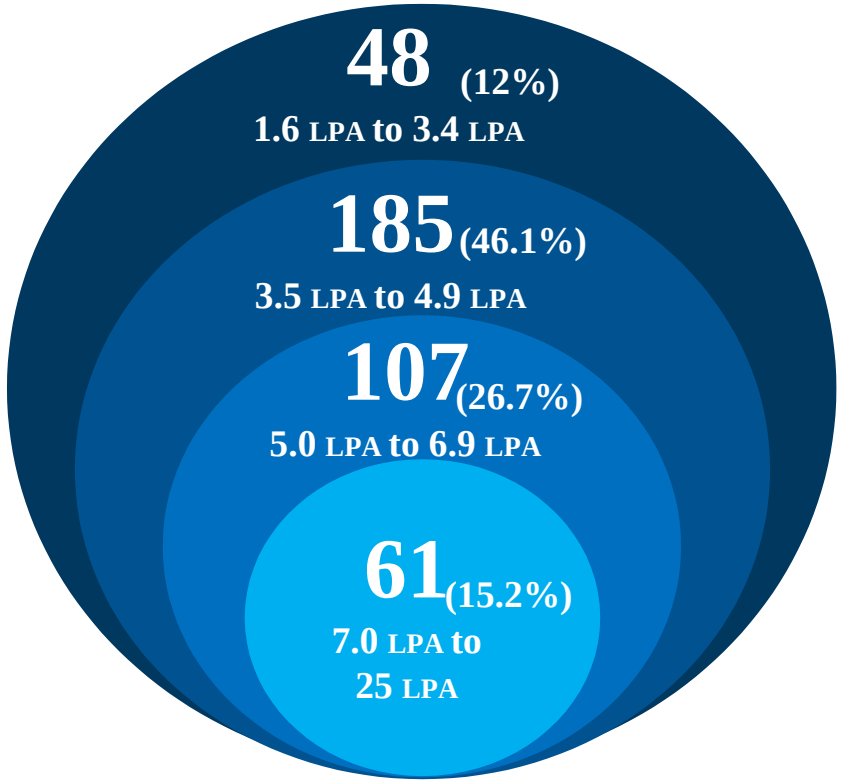
amadeus

12.6 LPA Salary Package

Jaswanth Vagicharla
VTU18163
B.Tech. CSE

Graduate Outcome Statistics

AY: 2023-24

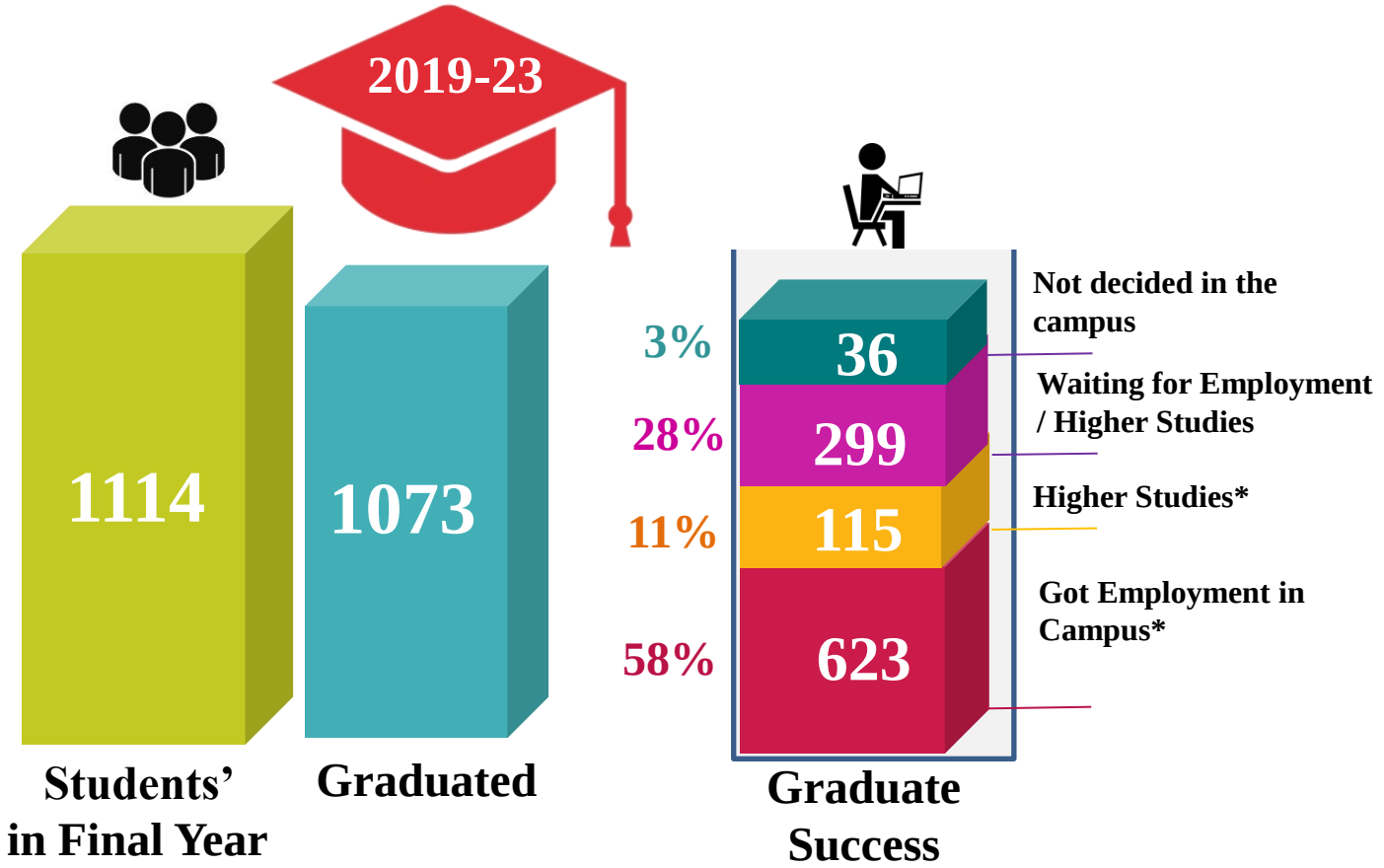


Total **60***

QS World University Ranking

#201-500	13
#501-600	6
#601-700	11
#701-800	3
#801-1000	6
#1001-1500	18
#1500 Above	3

GRADUATION OUTCOME STATISTICS



69% (738 Students)

RESEARCH AND DEVELOPMENT

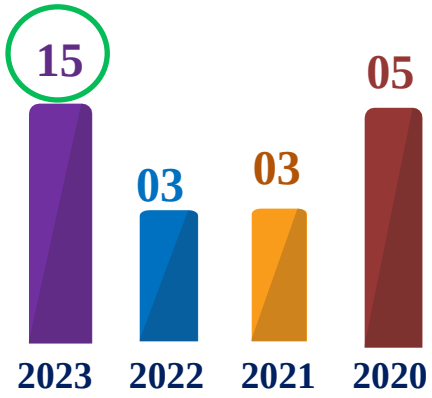
At a Glance (2023)

Vel Tech
Rangarajan Dr. Sagunthala R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Research Groups

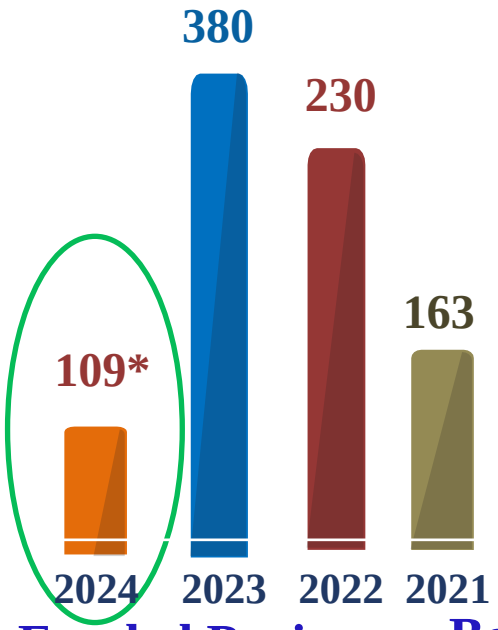
- Image Processing
- Intelligent Systems (AI, ML,DL)
- Computer Networks & Security
- IoT & Cloud Computing
- Software Engineering

Faculty -Research Guidance



- Publications in SCI – 97 & Scopus -165
- Journal Editor - 6 & Reviewer - 8
- Publications in Conferences - 118
- Published Books & Book Chapters - 37
- Patents Filed / Published/Awarded - 37
- Citations – 5532

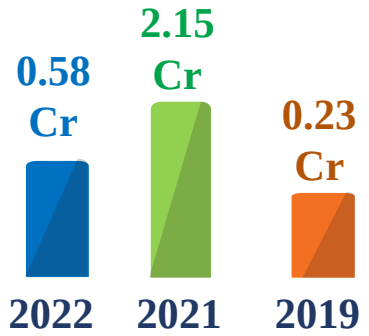
Faculty Publications in Journals



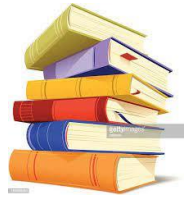
2023

Total Publications Per Faculty : 1.6

Funded Projects



Books/Book Chapters



2023 - 37
2022 - 28
2021 - 16

RESEARCH AND DEVELOPMENT

Sanctioned Projects

01

Project Agency : DBT

Amount : RS. 62,13,000

"Drone Assisted Mapping of Seaweeds" of Odisha coast including Chilika Lake especially for Gracilaria sp. and Enteromorpha sp.

02

Research Proposal Sanctioned by DBT

02

Project Agency : DBT

Amount : RS. 1,53,00,000

"Precision Brackish water Aquaculture Technology using Machine Intelligence"

Books / Book Chapters

Publishers: 7

- Springer
- CRC Press

Dr. N. R. Rajalakshmi

Cloud IoT Systems for Smart Agricultural Engineering — CRC Press

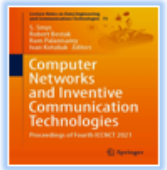
Dr. M. Kavitha — Springer

Integrated Image Recommendation Based on Category and Color Utilizing CNN and VGG-16

Dr. R. Srinivasan — Springer

Implementing OpenCV and Dlib Open-Source Library for Detection of Driver's Fatigue

Dr. M. Shyamala Devi — Springer



Mutual Information Score-Based Clustering for Evaluation of Image Dominant Color

Mr. Siva Rama Lingham N — Springer

Artificial Intelligence and Blockchain: The Future of Healthcare

Dr. A. Prathik — Springer

Prediction of Carcinoma Cancer Type Using Deep Reinforcement Learning Technique

Mrs. Minu Inba Shanthini Watson — Springer

Improvement of Clarity for Foggy / Dusty Weather Images Using Triple Threshold Method

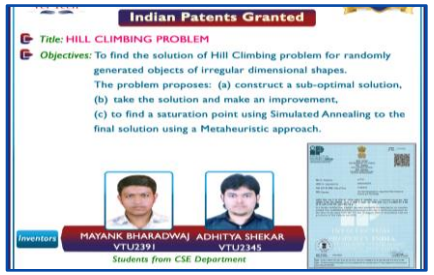
5 Indian Patents Granted

Patent 1

"Hill Climbing Problem"

VTU 2391 -MAYANK BHARADWAJ

VTU2345 – ADHITYA SHEKAR

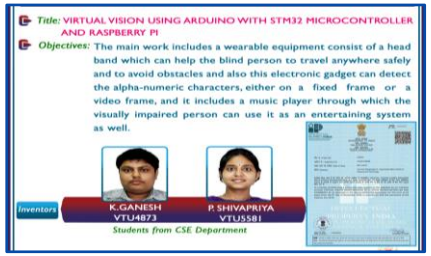


Patent 2

"Virtual Vision using Arduino with STM32 Microcontroller and Raspberry Pi"

VTU4873 – GANESH K

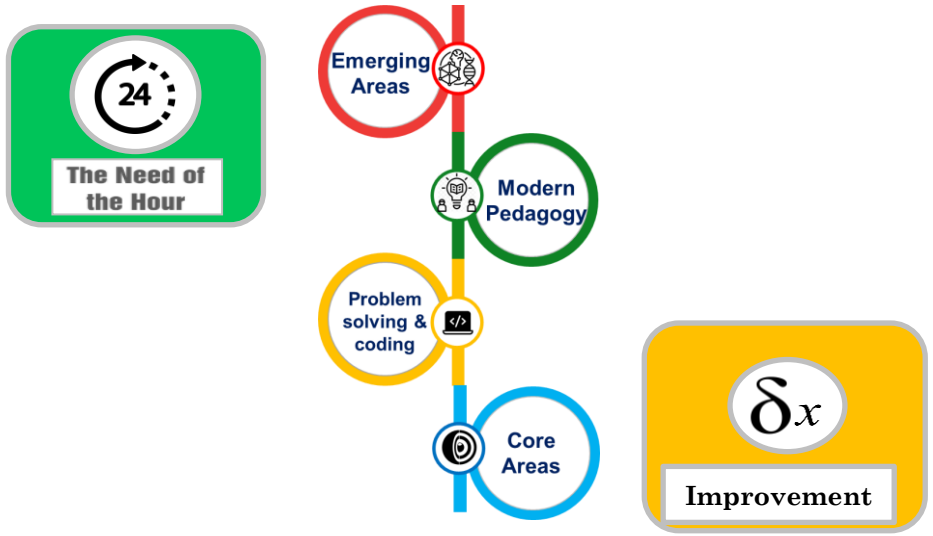
VTU5581 – P. SHIVAPRIYA



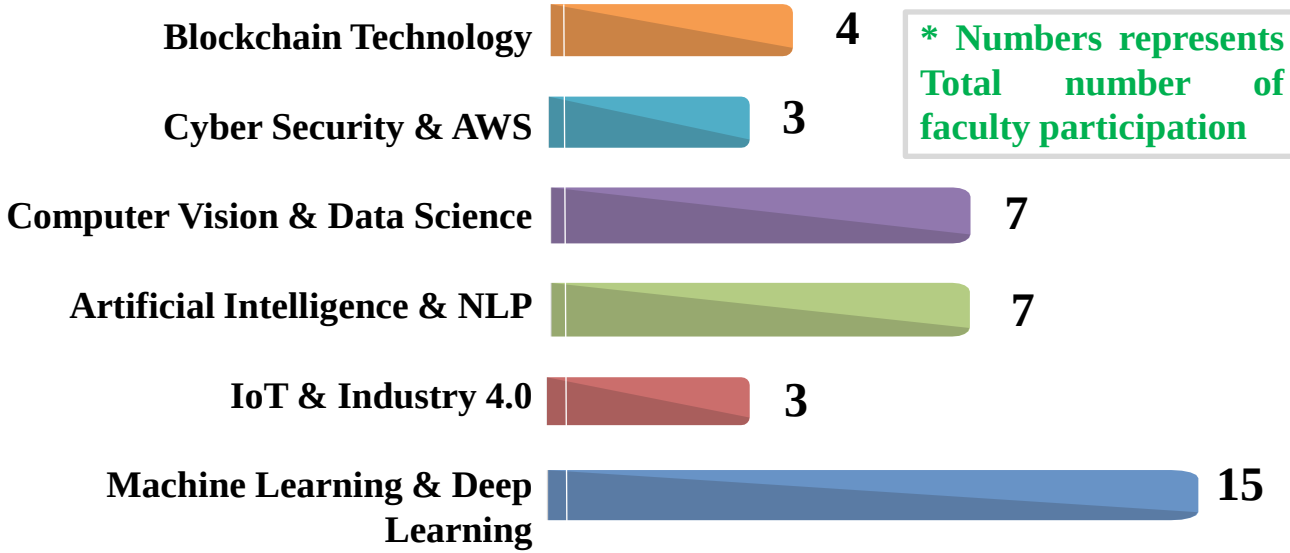
FACULTY PROFESSIONAL DEVELOPMENT

AY: 2023-24

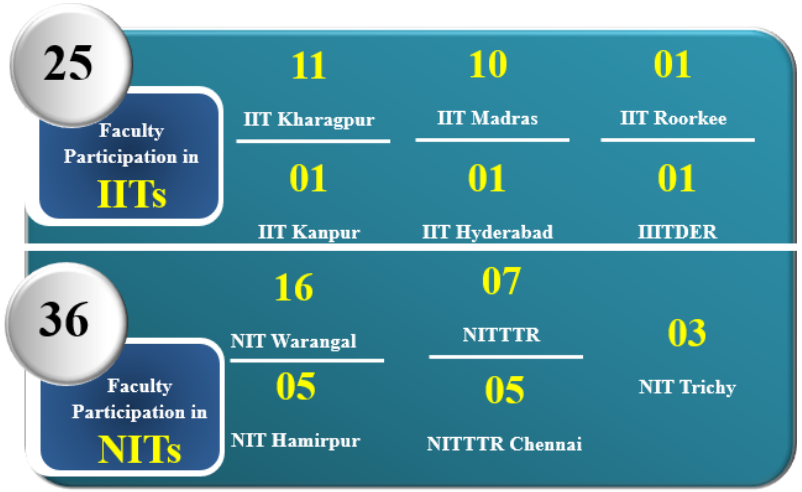
Training Need Analysis (TNA)



Faculty Participation in Emerging Areas



Faculty Participation in events conducted by IITs, NITs, AICTE-ATAL



Faculty Participation Outside the Institute

Online/Offline

FACULTY TRAINED AT INDUSTRY

Industries

ATOS 43
- Cloud & Infrastructure
- Middleware Technologies
- Mainframe & Networks

Infosys 14
- Java Programming
- Angular JS
- Artificial Intelligence

Cognizant 8
- Digital Nurture Reverence
- Metaverse
- Secure Coding

LTIMindtree 4
- ChatGPT

Technologies

Celonis 2
- Business Process Mining Expert

UiPath 2
- RPA Design and Development

Microsoft Azure 4
- RPA Design and Development

Wipro 4
- .Net Full Stack Development

Cisco 3
- CCNA

Virtusa 2
- Java

Faculty at ATOS

ICTACADEMY

Some of the training conducted by ICTAcademy in Various Tracks

- Faculty Trained under the following four Specialized Technologies – ATOS
  1. Cloud Infrastructure Management
  2. Network and Server Management
  3. Application Modernization Service
  4. Mainframe

Faculty Achievements & Awards

ATOS

NPTEL Discipline Star Award

Mr. Siva Rama Lingham N
TTS 3219
Assistant Professor
Dept. of CSE

Mr. K. Prabakaran
TTS 2819
Assistant Professor
Dept. of CSE

Wipro Certified Faculty — .Net Full Stack Development

Mr. Siva Rama Lingham N
TTS 3219
Assistant Professor
Dept. of CSE

Mr. Y. Ayyappa
TTS 3644
Assistant Professor
Dept. of CSE

Dr. R. Parthasarathy
TTS 3353
Associate Professor & Head
Dept. of CSD

Dr. S. Balamurugan
TTS 3704
Assistant Professor (SG)
Dept. of CSE

Cisco Certified Faculty — CCNA

Dr. T. Kamaleshwar
TTS 3219
Associate Professor
Dept. of CSE

Dr. Udayakumar A
TTS 3804
Assistant Professor (SG)
Dept. of CSE

M.Saravana Karthikeyan
TTS 3575
Assistant Professor (SG)
Dept. of CSE

Virtusa Certified Faculty — Java

Dr. Murali Dhar M S
TTS 3274
Associate Professor & Head
Dept. of CSE

Mrs. S. Prema
TTS 3398
Assistant Professor / CSE

Faculty Achievements & Awards

Best Paper Award

Title of Innovation: LEVERAGING THE TRIO OF 5G, MIMO, AND IOT FOR PROACTIVE VEHICULAR
CRASH PREVENTION IN VANET
College: SRM Institute of Science and Technology, Chennai – 26.
Faculty Details:
Mrs. S. Bharathi
TTS 3779
Assistant Professor
Dept. of CSE

Best Paper Award

Title of Innovation: Detection and Categorization of Tomato Plant Diseases using Convolution Neural Network
College: S.J.B. Institute of Technology, Bangalore.
Faculty Details:
Dr. S. Sridevi
TTS 3217
Professor
Dept. of CSE
Date: 15th & 16th March 2024

Cognizant Award

Dr. K. Prema, TTS 2446
Assistant Professor, Dept. of CSE

Received Award for
Top 5 Performers Award from Cognizant

Faculty Research Achievements & Awards

Article Publications

Dr. M. A. Mukunthan, TTS 3230
Professor
Dept. of CSE

Received Award for High Impact factor publications – 7.8
Journal Name: Computation in Neural Systems / Q1

Article Publications

Dr. R. Srinivasan, TTS 1303
Professor
Dept. of CSE

Received Award for High Impact factor publications – 8.5
Journal Name: Expert Systems with Applications / Q1

Article Publications

Dr. S. Sridevi, TTS 3217
Professor
Dept. of CSE

Received Award for High Impact factor publications – 7.5
Journal Name: Expert System with Applications / Q1

Article Publications

Dr.R.Rajesh, TTS 3732
Assistant Professor (SG)
Dept. of CSE

Received Award for High Impact factor publications – 7.5
Journal Name: Expert System with Applications / Q1

Article Publications

Received Award for High Impact factor publications – 9
Journal Name: Expert System with Applications / Q1

Dr. Sivajothi E, TTS 3450
Assistant Professor
Dept. of CSE

EVENTS CONDUCTED IN DEPARTMENT FOR FACULTY DEVELOPMENT

Major Events conducted

Computer Vision with Gen AI

Resource person from
Cardiff Metropolitin University,UK

Microsoft Power BI Data Analyst Associate

Resource person from
ICT Academy

Modernized cloud platform

Resource person from
Johnson & Johnson, Bangalore.

IEEE Funding Schemes

Resource person from
Panimalar Engineering College

Quantum Computing

Resource person from
PWC, Bangalore

Hands-On Session

Hands-On Practice

Lecture Deliver by Experts

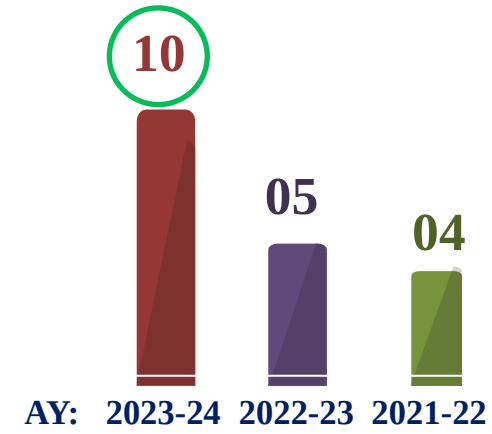
Lecture Deliver by Experts

AY: 2023-24

Total Events 10

10 FDPs

Events Conducted for Faculty – Last 3 Years



STUDENT EXPERIENCE

- Cocurricular Activities
- Extra Curricular Activities
- Hackathons
- Coding Competitions
- Paper Presentation
- Conference
- Skill based Training

STUDENT SKILL ENRICHMENT

AY: 2023-24

Total Event Participation per Student: 6.5

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology (Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Student Participation in Various Events : 5995

308 Hackathon	226 Idea Contest
3212 Workshop	399 Seminar
1500 Technical Contest	350 Project Contest

Major Coding Competitions

	IV year	III year	II year
Quest Global Ingenium 2023	340	-	-
TCS TechQuest Series	310	220	-
Amazon ML Challenge	220	240	-
Morgan Stanley Virtual Hackathon	230	120	-
Flipkart GRiD 5.0	260	115	130
Accenture Innovation challenge	230	108	130
TCS CodeVIta	790	1222	1332
Wipro - Ideas to Impact Challenge	240	115	220
CliqTrix 2024 - Zoho	250	120	113
TCS Codevita Season 11	750	1000	1300
Tally CodeBrewer	120	85	80
Flipr Hackathon	352	220	-
Samsung IDEATHON	240	110	-
PEC HACKS (36 Hours Hackathon)	230	96	-
Walmart Global Tech India	200	106	-
G20 IDEATHON	320	201	-
Juspay ONDC Hackathon	346	210	-
Infosys HackWithInfy	650	110	-

Total No. of Students Participated in various coding Competitions

II year 3305

III year 5187

IV year 9497

30

Total Coding Competitions

Student Achievements & Awards

Student Participation in Virtusa Jatayu Competition

Virtusa

Major Achievements

CISCO Ideathon Contest

- 230 Registered
- Quiz Round Shortlisted 43
- 15 Idea Submission
- Technical Round 5
- 5 Final Interview
- 2 Got Placed for 17.9 LPA

Major Achievements

CISCO

Student Participation in CISCO Global Level Competition

Student Achievements & Awards

IIIT-Sri City

Faculty Project Mentor

Dr. S. RAVIKUMAR

TTS2096

Associate Professor / CSE

Hackathons

IIT Roorkee

Faculty Project Mentor

Mrs. C. SHYAMALA KUMARI

TTS2450

Assistant Professor / CSE

Hackathons

IIT Roorkee

Faculty Project Mentor

Mrs. C. SHYAMALA KUMARI

TTS2450

Assistant Professor / CSE

Hackathons

IIT Guwahati

Faculty Project Mentor

Mrs. C. SHYAMALA KUMARI

TTS2450

Assistant Professor / CSE

Hackathons

Student Achievements & Awards

IIT Jodhpur

Faculty Project Mentor

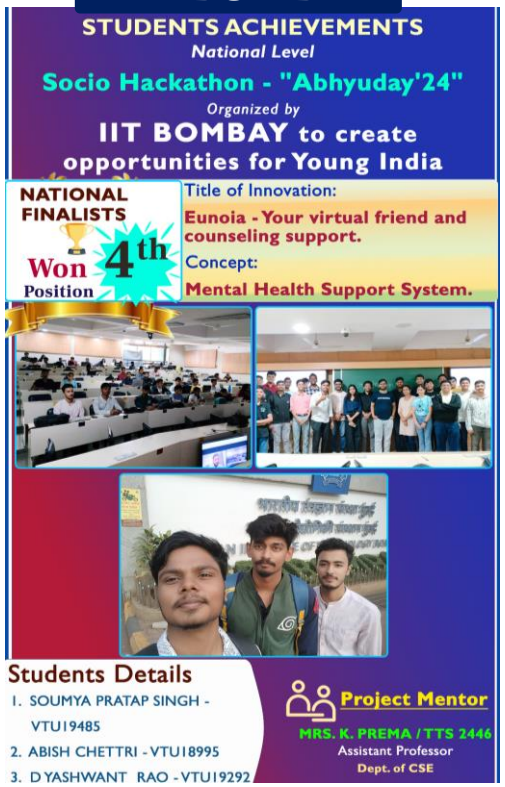
Mrs. C. SHYAMALA KUMARI

TTS2450

Assistant Professor / CSE

Hackathons

IIT BOMBAY



Faculty Project Mentor

Dr. K. PREMA

TTS2446

Assistant Professor / CSE

Hackathons

Delhi University

Faculty Project Mentor

Dr. K. PREMA

TTS2446

Assistant Professor / CSE

Hackathons

Student Achievements & Awards

VNRVJIET

Faculty Project Mentor
Dr. RAJESH KAMBATTAN K
TTS3275
Associate Professor / CSE

Hackathons

VNRVJIET

Faculty Project Mentor
Mr. V. KARTHIKEYAN
TTS3139
Associate Professor / CSE

Hackathons

IEEE Grant

Faculty Project Coordinator & Mentor
Dr. M. KAVITHA / TTS277
Professor / CSE
(Project Coordinator)
Dr. M. PRABHA / TTS3366
Assistant Professor / CSE
(Project Mentor)

Vel Tech Community Service Project

Student Achievements & Awards

Vel Tech - VISAI

Title of Innovation: Automatic Waste Segregation

Student Details:

1. SHAHIRUN VTU22147
2. ALTAF SARWAR VTU23782
3. ANSHU KUMAR VTU23893

Faculty Mentor:

Dr.T.Kamaleshwar, TTS2901

Associate Professor/ CSE

Date of Event: 23rd and 24th February 2024

Cash Prize Worth: Rs. 4,000

CSI Chapter

Won 3rd Prize

Title of Innovation: Shri Shankarlal Sundarbai Shasun Jain College for Women, Chennai

Title of Innovation: Stage wise breast lump characterization by shearwave elastography using Deep Learning Techniques

Student Details:

1. BOLLEPALLI LAVANYA- VTU20608
2. KUNAMNENI SRAVYA - VTU19076
3. S G DEVI VARA PRASAD - VTU19741

Faculty Mentor:

Dr.S.Sridevi, TTS 3217

Professor/ CSE

Date of Event: 17 February 2024

Saveetha University

Won 2nd Prize

National Hackathon Level 2024

Title of Innovation: Automatic Waste Segregation System

Student Details:

1. SHAHIRUN VTU22147
2. ALTAF SARWAR VTU23782
3. ANSHU KUMAR VTU23893

Faculty Mentor:

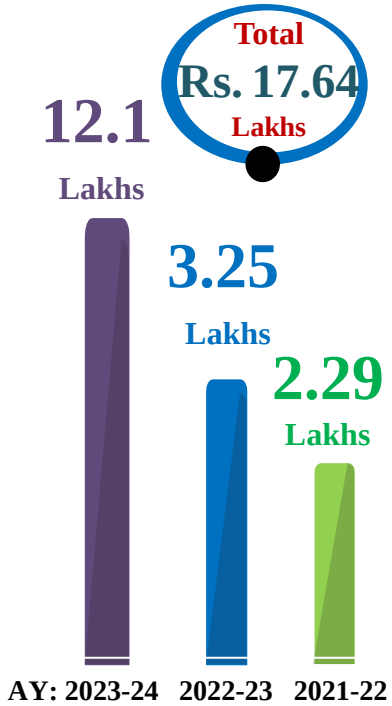
Dr.T.Kamaleshwar, TTS2901

Associate Professor/ CSE

Date of Event: 21st February 2024

Cash Prize Worth: Rs. 5,000

Cash Reward Statistics – Last 3 Years



Student Achievements & Awards

IIT Roorkee Technical contest on **COGNIZANCE - IDEAZ 2024**

"COGNIZANCE Contest"

Title of Innovation: EasziW -- A Sustainable Waste Tech

Student Details:

1. MOUMONI ROY-VTU 22702
2. VAISHNAV V H – VTU 20096
3. J S N AKHIL -VTU19714

Faculty Mentor:

Dr. D. Umanandhini
TTS 2803
Professor
Department of CSE

"COGNIZANCE Contest"

Title of Innovation: EasziW -- A Sustainable Waste Tech

Student Details:

1. MOUMONI ROY-VTU 22702
2. VAISHNAV V H – VTU 20096

Faculty Mentor:

Dr. D. Umanandhini
TTS 2803
Professor
Department of CSE

"COGNIZANCE Contest"

Title of Innovation: Resilient Minds

Student Details:

1. Uttkarsh kumar:vtu20041
2. Yashraj anand:vtu20763
3. Sushant kumar:vtu20074
4. Ashique ali:vtu20055
5. Saurav kumar:vtu19091
6. Abhinav anand:vtu20015

Faculty Mentor:

Dr Ravikumar S
TTS 2096, Associate Professor
Department of CSE

"COGNIZANCE Contest"

Title of Innovation: The Rise of AI-Reshaping Jobs and Growth in Developing Countries

Student Details:

1. YASH RAJ - VTU23168
2. YESHWANTH GUPTA-VTU20497
3. VANKADARI CHAKRADHAR-VTU22842

Faculty Mentor:

Mrs. C. Shyamala Kumari
TTS 2450, Assistant Professor/CSE

Student Achievements & Awards

Cash Prize Worth
Rs. 40,000

"COGNIZANCE Contest"

Title of Innovation: Park Smart - IoT based car parking application

Student Details:

1. Jay Bardhan Singh -19691
2. G Sruthi -19610
3. Shanu Kumar -19462
4. Ch V Sriram -19643
5. Rajnish Kumar-19607

Faculty Mentor:

Dr Dhilip Kumar V, Professor - CSE TTS 2750

IIT Roorkee

Technical contest on **COGNIZANCE - IDEAZ 2024**

Total
Rs. 1.5 Lakhs

Student Achievements & Awards

Dear Participant,

The moment we've all been waiting for is here! We are beyond excited to announce the winners of the Infosys Springboard Ideathon. Your creativity and dedication have truly impressed us. Each idea was not only unique but also remarkable in its own way.

Without further ado, let's celebrate our Ideathon winners!

Problem Statement	Winning Team
Future of Hybrid Work	Creative Titans
Ethical Use of AI	Ethical Alliance
Revolutionizing Urban Areas	AIvengers
Role of Technology in Healthcare	Wellness Warriors

Warmest congratulations to all winning teams and heartfelt thanks to everyone who participated. Let's continue to innovate and inspire together!

Best Regards,

Team Infosys Springboard

Infosys Springboard Ideathon 2024

Won First Prize

Title of Innovation: Blockchain & VR Integration in Hybrid Network

Student Details:

1. Kamalesh T - VTU21442
2. Sanjai A - VTU21510
3. Madhumita Kannan – VTU 22364
4. T FABIO MUGHILAN - VTU22423
5. Ari hara sudhan V - VTU23457

Faculty Mentor:

Dr.G.Anurekha

Assistant Professor - CSE TTS3653

STUDENT PROFESSIONAL DEVELOPMENT

AY:2023-24

Average Student Professional Certification 1:1

CISCO NetAcademy Certification

Networking Academy

- CCNA: Introduction To Networks — 689
- CCNA Switching Routing and Wireless Essential — 142
- Devnet Associate — 95
- Introduction To Cyber security — 233
- Cyber Security Essentials — 114
- IoT Fundamentals: Connecting Things — 34
- PCAP - Programming Essentials in Python — 431
- Cloud Security — 184

23-08-2024 Total 1922

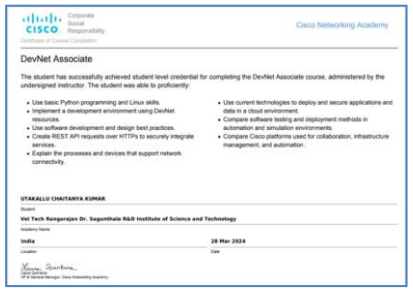
Industry Professional Global Certifications

2048 Total

Java Oracle Certification: 31

Industry Global Certifications

Cisco DevNet Associate: 95



Students

organized events under IEEE Computer Society & IEEE Computational Intelligence Society

12

IEEE COMPUTER SOCIETY

IEEE Computational Intelligence Society

IEEE Madras Section

EVENTS CONDUCTED IN DEPARTMENT FOR STUDENT DEVELOPMENT

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology (Deemed to be University Estd. u/s 3 of UGC Act, 1956)

AY: 2023-24

Major Events

01 Hackathon

02 PROTIYOGITA-24

03 CODEATHON 24

04 Workshop

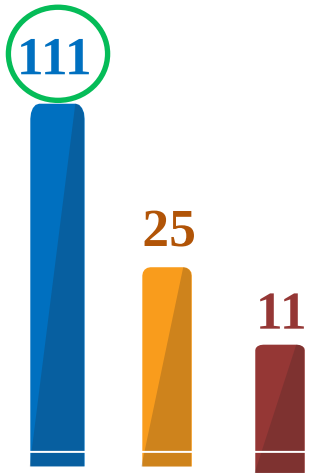
Hackathon

PROTIYOGITA-24

Codeathon 24

Workshop

Events Conducted for Students – Last 3 Years



Total Events 111

- 53 Workshops
- 39 Technical Contest
- 9 Seminar
- 5 Idea Contest
- 3 Project Contest
- 2 Hackathon

Department Achievements & Awards

IEEE WIE

CISCO

UIPATH

School of Computing Recognition on MoU

MEMORANDUM OF UNDERSTANDING
MoU

EC-Council

Vel Tech School of Computing and the Department of Cyber Security

Signed MoU with EC-Council for Establishment of Academic Partnership

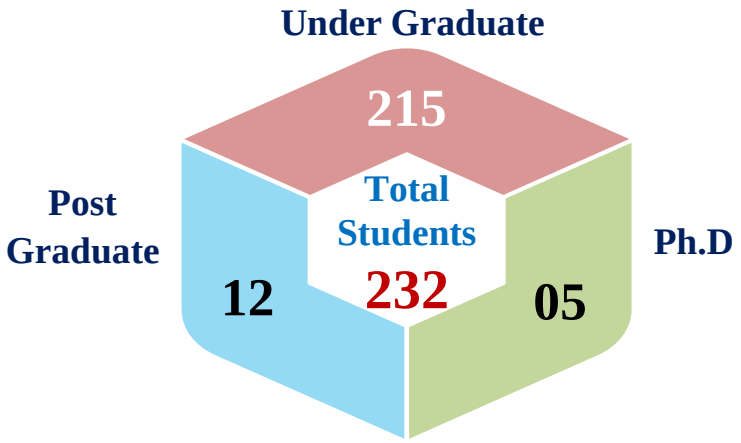
Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

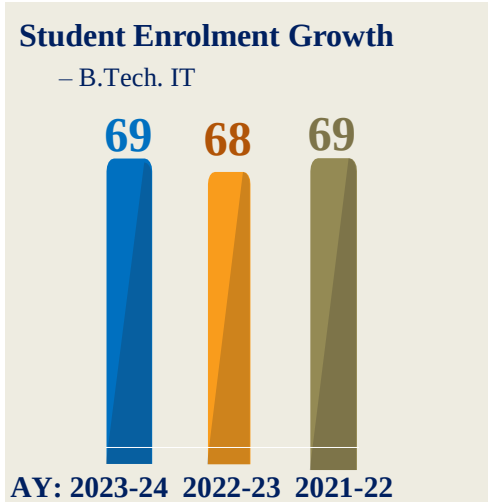
Department of Information Technology

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology (Deemed to be University Estd. u/s 3 of UGC Act, 1956)

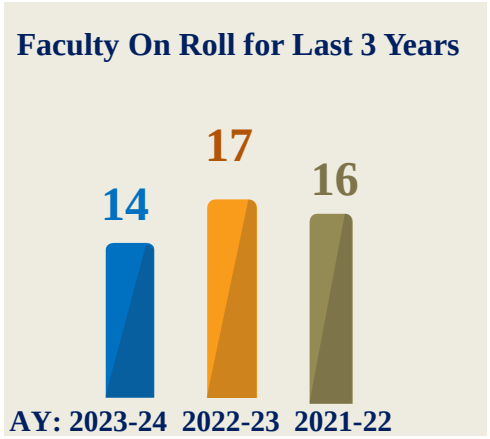
Student Enrollment in AY: 2023-24

(II Year, III Year & IV Year)





Faculty On Roll – Last 3 Years



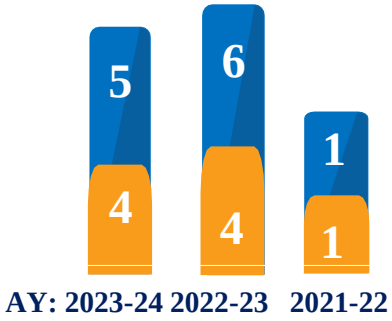
AY:2023-24

Professor : 1

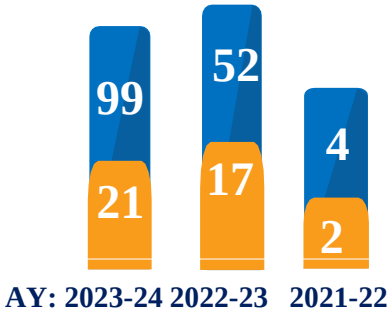
Associate Professor : 3

Assistant Professor : 10

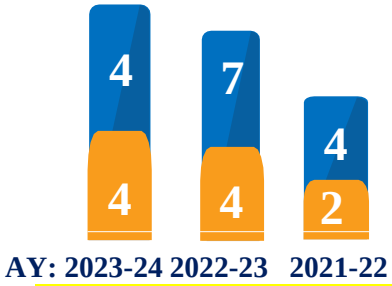
Student Centric Methods – Last 3 Years



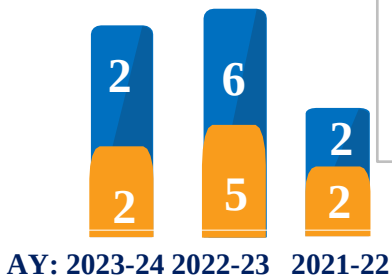
Experiential Learning



Participative Learning

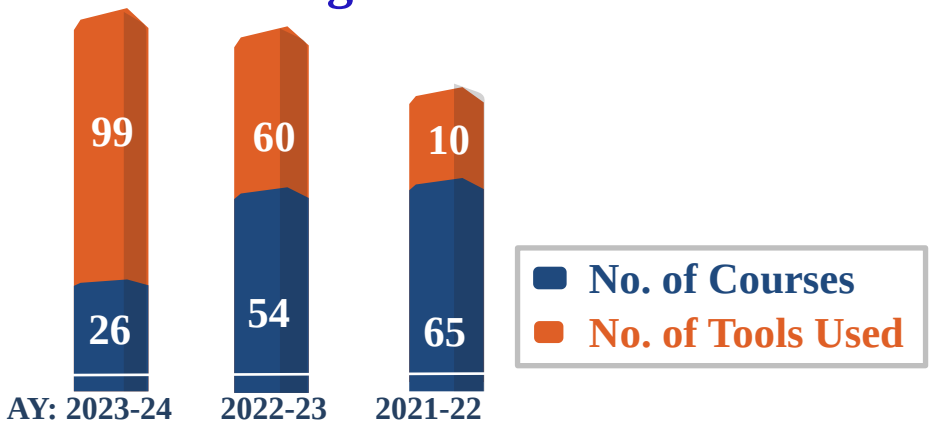


Problem Based Learning



Project Based Learning

ICT Tool Usage – Last 3 Years



B.TECH INFORMATION TECHNOLOGY

AY: 2023-24

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology (Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Graduate Statistics

Batch : 2020-2024

48 Students Registered	91.66*% Graduation Percentage
44 Students Graduated	

Batch : 2019-2023

62 Students Registered	42.85% First Class with Distinction	91% Graduation Percentage
56 Students Graduated	57.15% First Class	

Prashant Kumar Singh
VTU16998
Batch: 2020-24
CGPA: 9.53

Dayanand Kumar
VTU11920
Batch: 2019-2023
CGPA: 9.32

Employment Offers

48	Total Students
41	Students Eligible
8	Students Got Employment
5	Higher Studies
32%	Placement / Higher Studies Percentage

Prashant Kumar Singh
VTU16998
B.Tech. IT
AppViewX

12.0
LPA
Salary Package

appviewX

EVENTS CONDUCTED IN DEPARTMENT FOR STUDENT DEVELOPMENT

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology (Deemed to be University Estd. u/s 3 of UGC Act, 1956)

AY: 2023-24

Major Events

01 Dum Bugs 24

02 Byte Minds Forum

03 CODEATHON 23

04 WebSyn 24

Dum Bugs 24

Byte Minds Forum

CODEATHON 23

WebSyn 24

Total Events 8

- 3 Workshops
- 5 Technical Contest

Student Achievements & Awards

Paper Presentation


SRM School of Computing · IEEE Madras Section · Great Learning

IEEE Sponsored Second International Conference
on
NETWORKING AND COMMUNICATIONS 2024 (ICNWC 2024)

CERTIFICATE
OF MERIT

This is to certify that Dr./Mr./Mrs. P.V. Sai Ram Reddy
of Vel Tech University has presented a paper
titled Advanced Brain Tumor Segmentation Using UNet and Multiple Residual Networks
in the " IEEE Sponsored Second IEEE International Conference on Networking and Communications 2024 (ICNWC 2024)"
Organized by Department of Networking and Communications, School of Computing, SRM Institute of Science and Technology, Kattankulathur on 02nd to 04th April 2024.

Dr.M.Thenmozhi, Convenor / ICNWC, Networking and Communications, SRMIST
Dr.Annapurani Panaiyappan.K, Professor & Head, Networking and Communications, SRMIST
Dr.Revathi Venkataraman, Chairperson, School of Computing, SRMIST

P. V. Sai Ram Reddy / VTU20667
III year, Department of IT
March 3 2024
2nd International Conference on Networking and Communications (ICNWC)
SRM Institute of Science and Technology, Kattankulathur

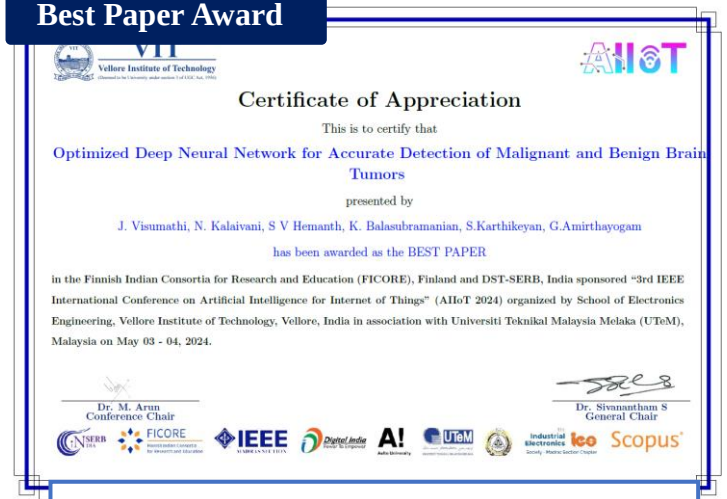
Certificate of Merit

IDEATHON

M.Pravin Kumar / VTU23135
III year, Department of IT
Third prize (Rs. 2000)
Federal Institute of Science and Technology (FISAT)
20.04.2024

Faculty Achievements & Awards

Best Paper Award


Vellore Institute of Technology · AIIoT

Certificate of Appreciation

This is to certify that

Optimized Deep Neural Network for Accurate Detection of Malignant and Benign Brain Tumors

presented by

J. Visumathi, N. Kalaivani, S V Hemanth, K. Balasubramanian, S.Karthikeyan, G.Amirthayogam

has been awarded as the BEST PAPER

in the Finnish Indian Consortia for Research and Education (FICORE), Finland and DST-SERB, India sponsored "3rd IEEE International Conference on Artificial Intelligence for Internet of Things" (AIIoT 2024) organized by School of Electronics Engineering, Vellore Institute of Technology, Vellore, India in association with Universiti Teknikal Malaysia Melaka (UTeM), Malaysia on May 03 - 04, 2024.

Dr. M. Arun, Conference Chair
Dr. Sivanantham S, General Chair

Dr. J. Visumathi, TTS 2915
Professor
Dept. of IT

Title: Optimized Deep Neural Network for Accurate Detection of Malignant and Benign Brain Tumors
IEEE Conference - AIIoT 2024: VIT Vellore.

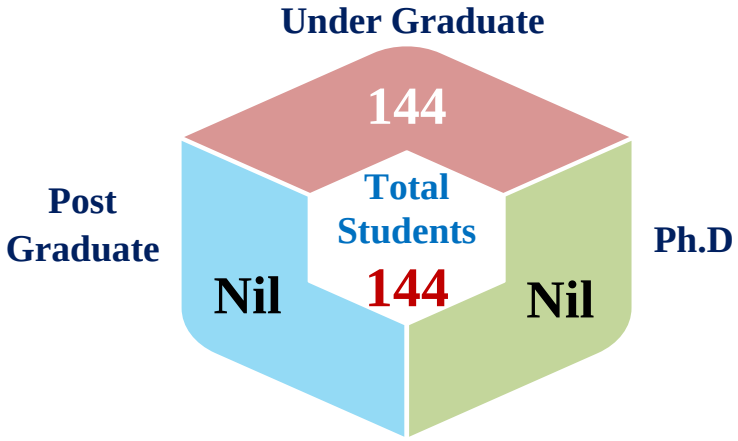
Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

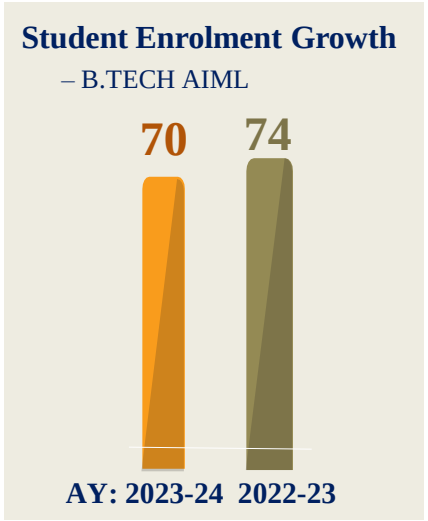
Department of Artificial Intelligence
&
Machine Learning

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology (Deemed to be University Estd. u/s 3 of UGC Act, 1956)

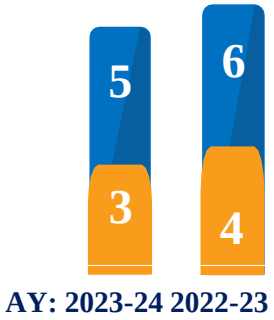
Student Enrollment in AY: 2023-24

(II Year, III Year)

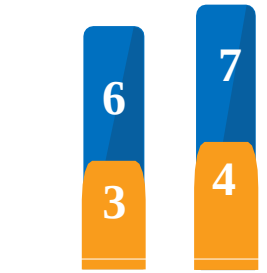




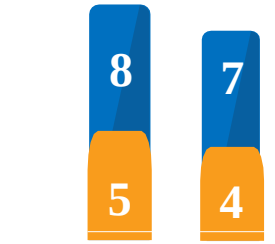
Student Centric Methods – Last 2 Years



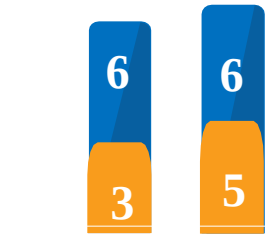
Experiential Learning



Participative Learning

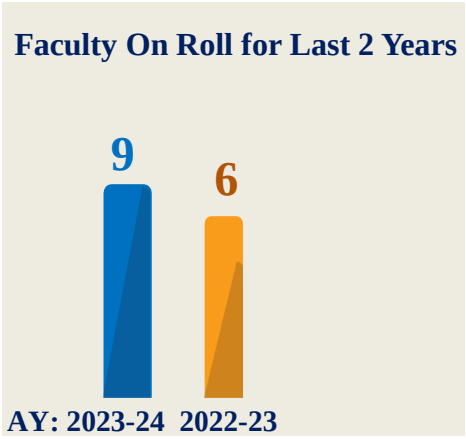


Problem Based Learning



Project Based Learning

Faculty On Roll – Last 2 Years



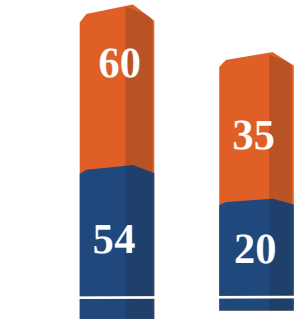
AY:2023-24

Professor : 1

Associate Professor : 2

Assistant Professor : 6

ICT Tool Usage – Last 2 Years



EVENTS CONDUCTED IN DEPARTMENT FOR STUDENT DEVELOPMENT

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology (Deemed to be University Estd. u/s 3 of UGC Act, 1956)

AY: 2023-24

Major Events

01 ChatterBox Challange

02 Protiyogita 24

03 Seven Habits of Successful people

04 Career Development and Interview Skills

05 Techtonic shift24

ChatterBox Challange

Protiyogita 24

Seven Habits of Successful people

Workshop

Techtonic shift24

Total Events 10

- 2 Workshops
- 4 Technical Contest
- 1 Seminar
- 1 Idea Contest
- 1 Project Contest
- 1 Hackathon

Student Achievements & Awards

Paper Presentation

Title: Exploring Deep Neural Network for accurate Diabetic Retinopathy prediction

PASALA MANI SANKAR/ VTU20122
III year, Department of AIML
Paper Presentation
SAIRAM Engineering College

Certificate of Merit

Participation

Bollepalli Lavanya / VTU20608
III year, Department of AIML
Hackathon/ Makethon/ Coding Challenges
AMAZON

Certificate of Merit

Paper Presentation

Title: AI Based Skin Cancer Diagnosis

PASALA MANI SANKAR
/ VTU20122
III year, Department of AIML
IIT , Madras

Certificate of Merit

Student Achievements & Awards

Participation

Undavalli Bhavya sri / VTU20589
III year, Department of AIML
Innovation Challenge
Accenture

Certificate of Merit

Participation

Thanuja Upperi
/ VTU20598
III year, Department of AIML
Hackathon/ Makethon/ Coding Challenges
AMAZON

Certificate of Merit

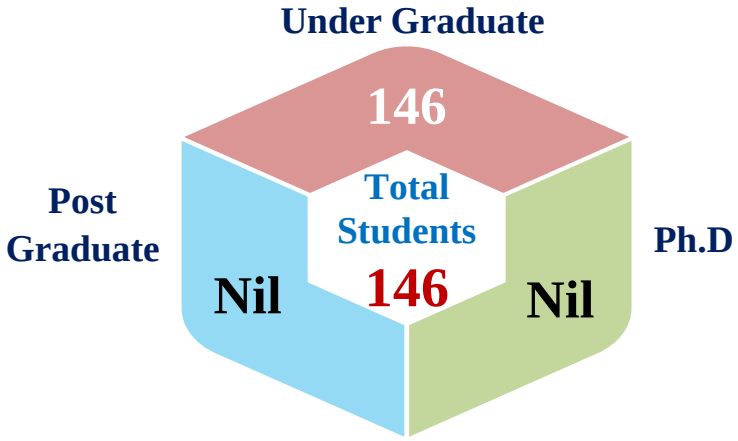
Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

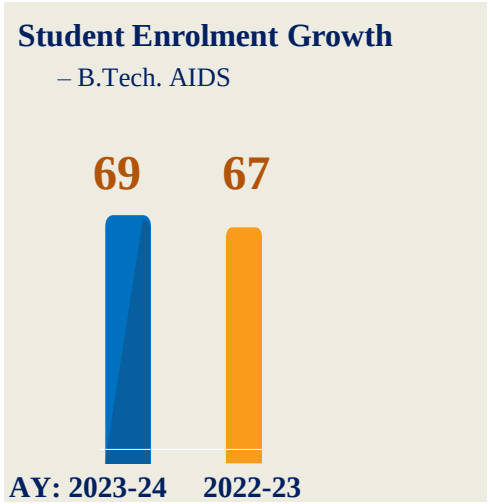
Department of Artificial Intelligence
&
Data Science

B.TECH ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

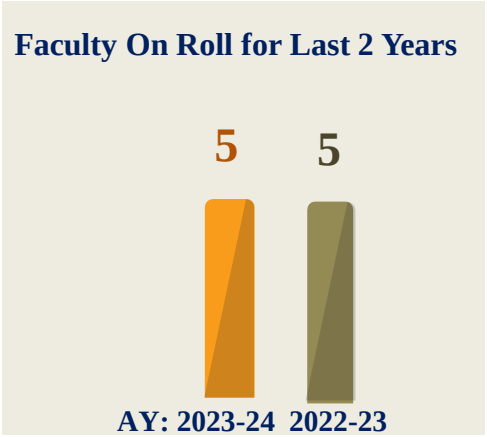
Student Enrollment in AY: 2023-24

(II Year, III Year)





Faculty On Roll – Last 2 Years



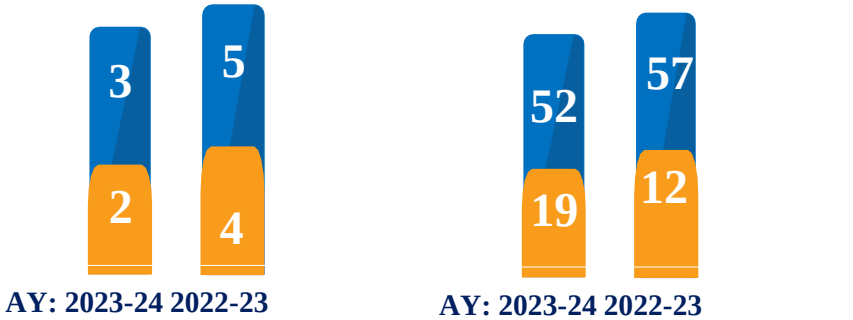
AY:2023-24

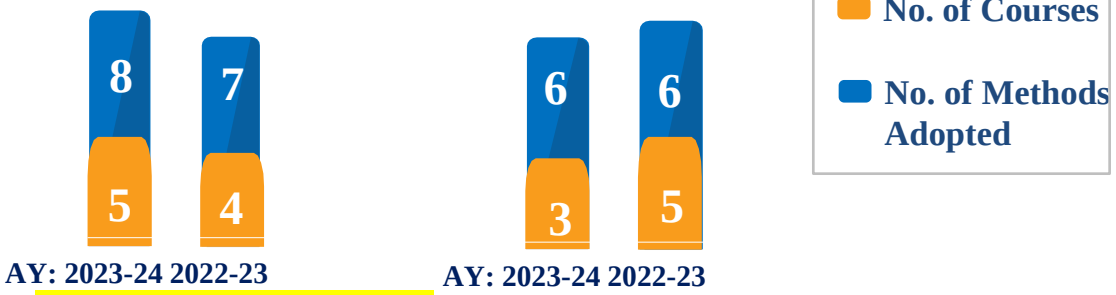
Professor : 1

Associate Professor : Nil

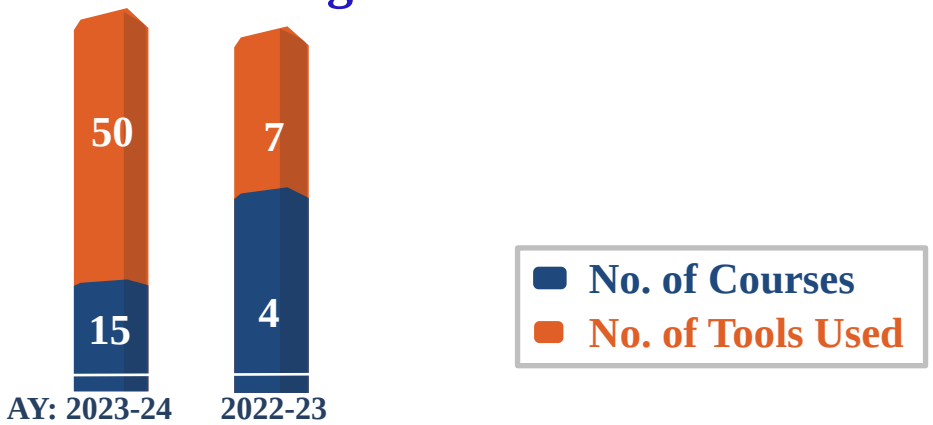
Assistant Professor : 4

Student Centric Methods – Last 2 Years





ICT Tool Usage – Last 2 Years



EVENTS CONDUCTED IN DEPARTMENT FOR STUDENT DEVELOPMENT

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

AY: 2023-24

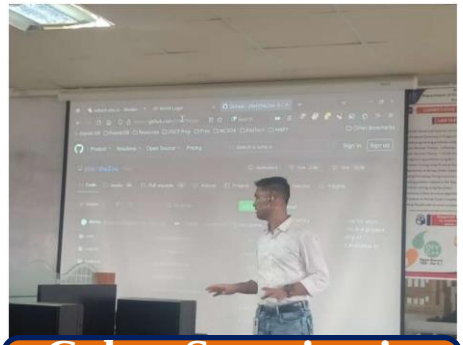
Major Events

01 Workshop

02 Technical Contest

Art of AI '24

Data Quest 2024



Cyber Security in Action

Deep Learning Using Tensor Flow

IoT Automation

Group Discussion

Total Events 06

5 Workshops

1 Technical Contest

Student Achievements & Awards

Top Performer in Academic

THAMMISETTY VENKATA MOHAN RAO / VTU19803
IV year, Department of AI&DS
CGPA :9.3

Certificate of Merit

GRE Score

ETS GRE

TEST TAKER SCORE REPORT

Note: This report is not valid for transmission of scores to an institution.

RAHUL CHALLAGUNDLA

Most Recent Test Date: December 17, 2022

Address: kothaganushuni padu, MACHAVARAM, Guntur, 522413 India

Registration Number: 1786287
Print Date: June 28, 2024

Email: challagundlarahul@gmail.com
Phone: 91-7013830544
Date of Birth: March 13, 2003
Gender: Male
Intended Graduate Major: Other Fields - Not Listed (5199)

Your Scores for the General Test Taken on December 17, 2022

Verbal Reasoning	Quantitative Reasoning	Analytical Writing
Your Scaled Score: 152	Your Scaled Score: 169	Your Score: 2.5
130 – 170	130 – 170	0 – 6
50th Percentile	91st Percentile	7th Percentile

Your Test Score History

General Test Scores

	Verbal Reasoning		Quantitative Reasoning		Analytical Writing	
Test Date	Scaled Score	Percentile	Scaled Score	Percentile	Score	Percentile
December 17, 2022	152	50	169	91	2.5	7

CH Ragul / VTU20226
IV year, Department of AI&DS
Score : 324 /340

Certificate of Merit

Open House Event 2024

IV year Students Participated in Open House Event Conducted by IIT Madras

Faculty Achievements & Awards

JOURNAL PUBLICATION

Title - VAG Signal Based Computational System for Consumer's Utilization Devices in Osteoarthritis Data Extraction and Classification

IEEE Transactions on Consumer Electronics

Q1 Electrical and Electronic Engineering best quartile

Indexed – WOS

Dr.V. Dhilip Kumar
TTS2750
Professor

JOURNAL PUBLICATION

Title - Module Lattice-Based Post-Quantum Secure Blockchain Empowered Authentication Framework for Autonomous Truck Platooning

IEEE Access

Indexed – WOS

Dr. P. Santhi
TTS37899
Assistant Professor

JOURNAL PUBLICATION

Title - A comprehensive health assessment approach using Ensemble deep learning model for remote patient monitoring with IoT

SCIENTIFIC REPORTS

Indexed – WOS

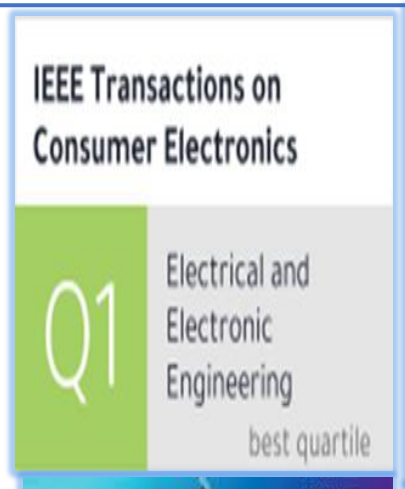
Dr.S. Maheswari
TTS3784
Assistant Professor

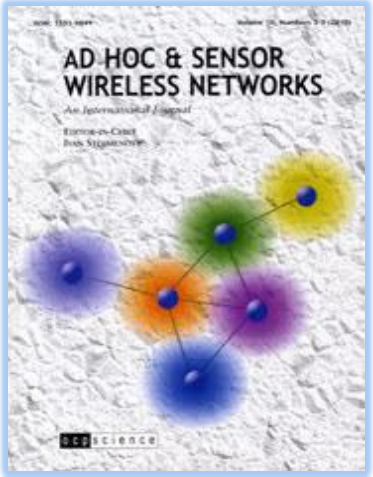
Faculty Achievements & Awards

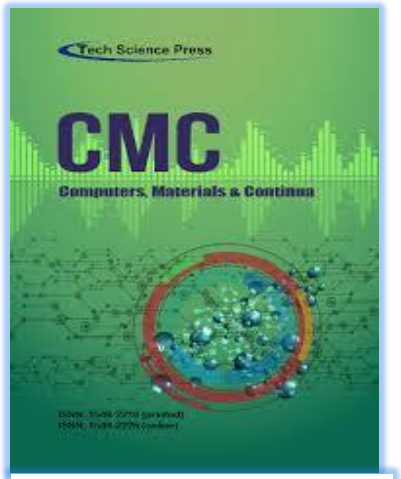
JOURNAL PUBLICATION

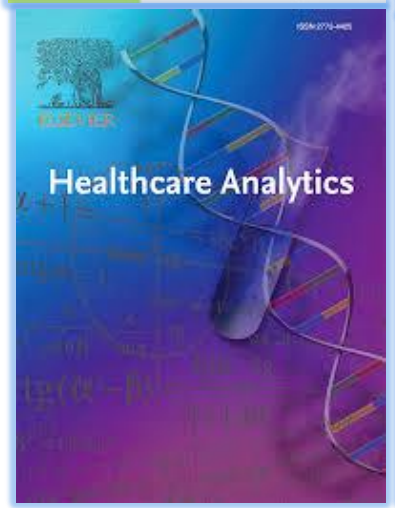
Indexed – WOS

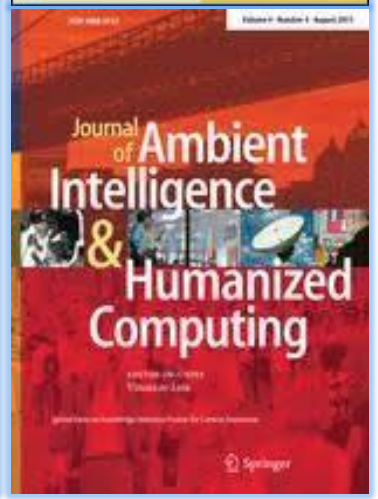
Dr. V. Dhilip Kumar
TTS2750
Professor

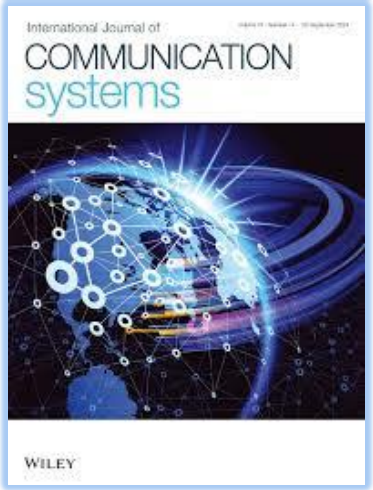








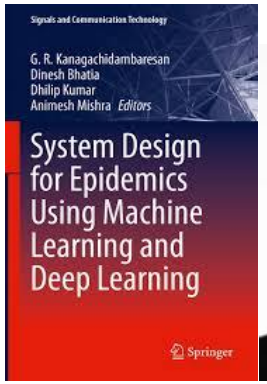




Faculty Achievements & Awards

BOOK PUBLICATION

Title - System Design for Epidemics Using Machine Learning and Deep Learning



Indexed – Springer

Dr.V. Dhilip Kumar
TTS2750
Professor

PATENT PUBLICATION

Title - Advanced Method and System for Discrete Signal Transformation using the P-Transform" Indian Patent: 202441039057 A Published on 31.05.2024

INTELLECTUAL PROPERTY INDIA

Dr.V. Dhilip Kumar
TTS2750
Professor

PATENT PUBLICATION

Title - A Device for removing noise from acoustic Signals" Indian Patent: 202441042487A Publish on 07.06.2024

INTELLECTUAL PROPERTY INDIA

Dr.V. Dhilip Kumar
TTS2750
Professor

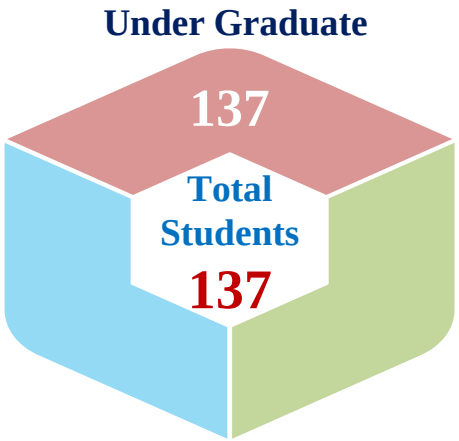
Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

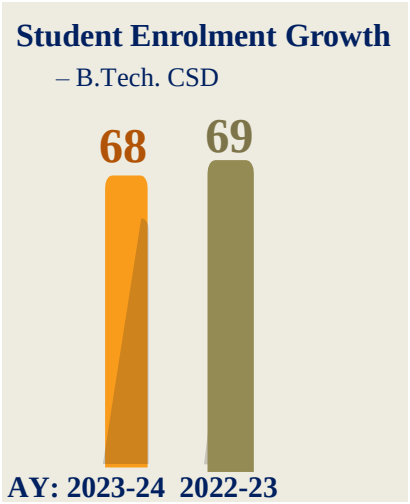
Department of Computer Science and Design

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology (Deemed to be University Estd. u/s 3 of UGC Act, 1956)

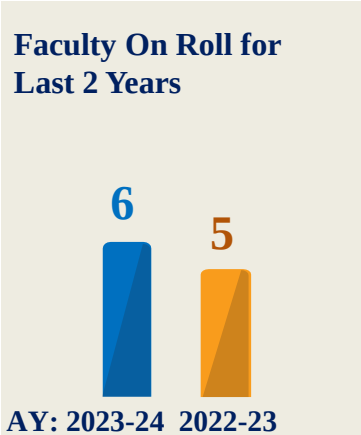
Student Enrollment in AY: 2023-24

(II Year, III Year)





Faculty On Roll – Last 2 Years



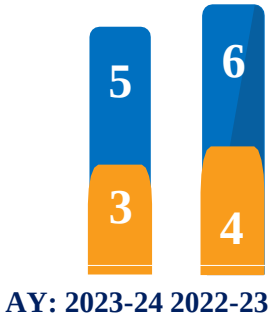
AY:2023-24

Professor : Nil

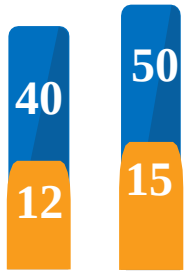
Associate Professor : 2

Assistant Professor : 4

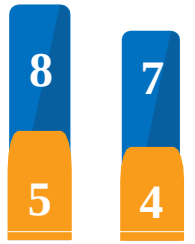
Student Centric Methods – Last 2 Years



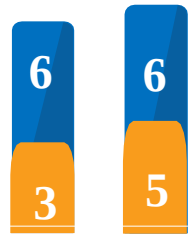
Experiential Learning



Participative Learning

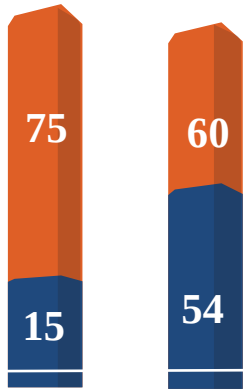


Problem Based Learning



Project Based Learning

ICT Tool Usage – Last 2 Years



EVENTS CONDUCTED IN DEPARTMENT FOR STUDENT DEVELOPMENT

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology (Deemed to be University Estd. u/s 3 of UGC Act, 1956)

AY: 2023-24

Major Events

01 Modeling Marathon

02 Game Forge

03 Sustainathon 24

04 Workshop

Modeling Marathon

Sustainathon 24

Total Events 9

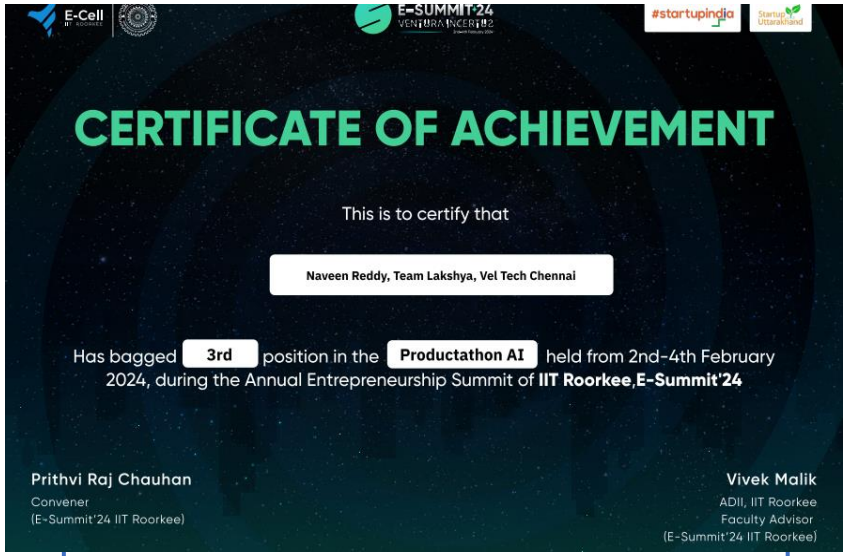
5 Workshops

3 Technical Contest

1 Seminar

Student Achievements & Awards

Productathon AI



Mr. Naveen Reddy - VTU 20906
Mr. Bandi Anod Kumar Reddy - VTU20428
Mr. Ramakrishna Reddy - VTU20745
Mr. Abhishek Kumar - VTU20712

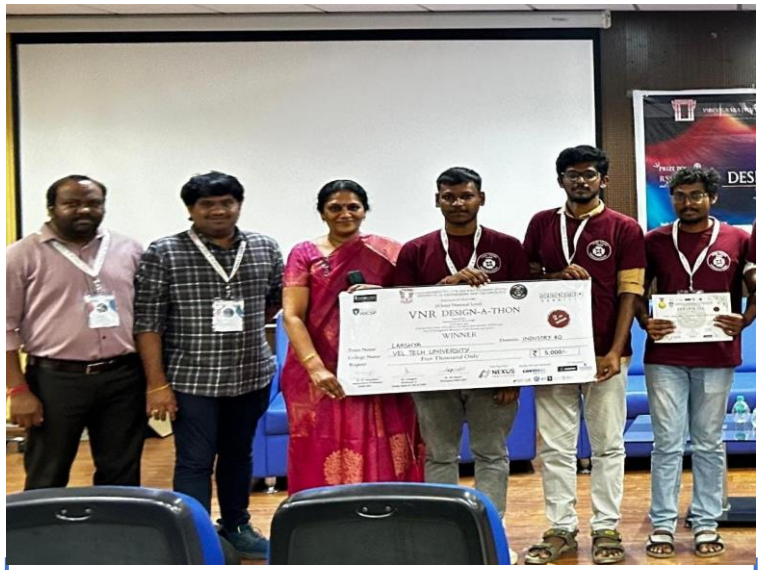
February 02 – 04, 2024

3rd Position

Annual Entrepreneurship Summit
IIT Roorkee

Certificate of Achievement

Design-A-thon



Mr. Abhishek Kumar - VTU20712
Mr. Ramakrishna Reddy - VTU20745
Mr. Bandi Anod Kumar Reddy - VTU20428

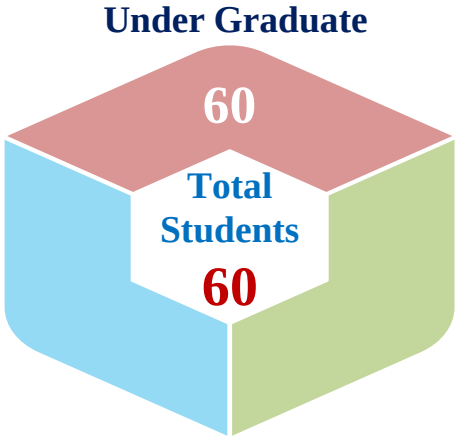
WINNER (Rs.5000)

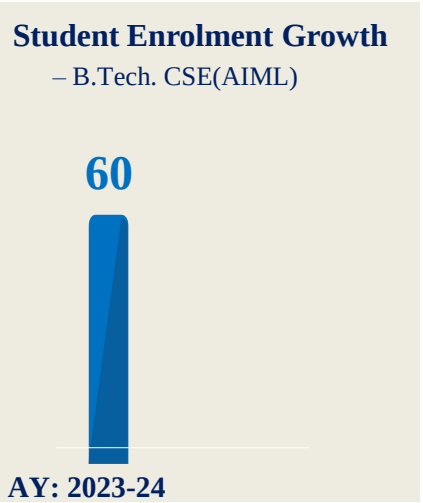
March 1 & 2, 2024
VNR Vignana Jyothi Institute of Engineering and Technology

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

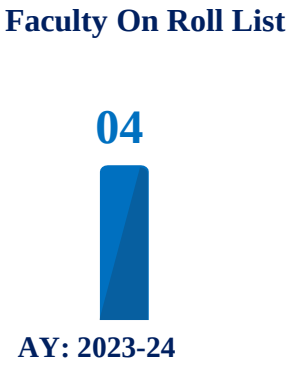
Department of CSE
(Artificial Intelligence & Machine Learning)

Student Enrollment in (II Year) AY: 2023-24





Faculty On Roll AY: 2023-24



AY:2023-24

Professor : Nil

Associate Professor : 1

Assistant Professor : 3

Student Centric Methods – AY:2023-24

Experiential Learning

Participative Learning

Problem Based Learning

Project Based Learning

ICT Tool Usage – AY:2023-24

EVENTS CONDUCTED IN DEPARTMENT FOR STUDENT DEVELOPMENT

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology (Deemed to be University Estd. u/s 3 of UGC Act, 1956)

AY: 2023-24

Major Events

01 INNOVATE IGNITE'24

02 HUSTLERS- STARTUP'24

03 POSTER PRESENTATION

04 Workshop

INNOVATE IGNITE

HUSTLERS-STARTUP'24

POSTER PRESENTATION

Workshop

Total Events 12

- 3 Workshops
- 5 Technical Contest
- 3 Seminar
- 1 Idea Contest

Student Achievements & Awards

IEEE INTERNATIONAL CONFERENCE

Habeeb Rahman N K / VTU22336
II year, Department of CSE(AIML)
December 11 2023
2nd International Conference on Automation, Computing and Renewable Systems(ICACRS)
Mount Zion College of Engineering and Technology, Pudukottai

Certificate of Merit

MOUNT ZION
COLLEGE OF ENGINEERING AND TECHNOLOGY
(Approved by AICTE, Affiliated to Anna University & Accredited by NAAC with A+ Grade)
Lena Vilakku, Pilivalam P.O, Tirumayam TK, Pudukkottai - 622507
Email : info@mzcet.in | www.mzcet.in

IEEE XPLORE COMPLIANT ISBN 979-8-3503-4023-5

Certificate of Presentation

This certificate is awarded to

Habeeb Rahman K T

in recognition of his/her research contribution and oral presentation titled

Automated Moisture Monitoring and Irrigation Vehicle

at the

2nd International Conference on Automation, Computing and Renewable Systems (ICACRS - 2023)
organized by Department of Electronics and Communication Engineering, Mount Zion College of Engineering and Technology
held during 11-13, December 2023 in Pudukkottai, Tamil Nadu, India.

Session Chair
Dr. Robinson S
Dean/ICT, MZCET

Conference Chair
Dr. Balamurugan P
Principal, MZCET

Chief Patron
Dr. Jayson K. Jayabarathan
Director, MZCET

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

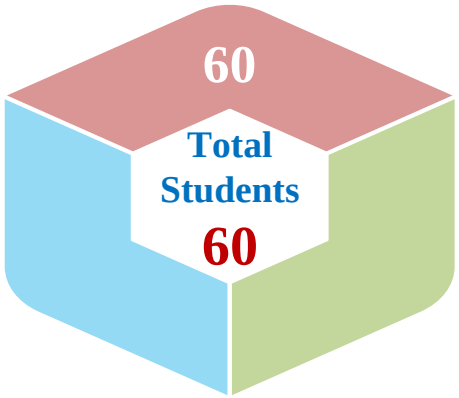
Department of CSE
(Cyber Security)

B.TECH - COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)

Student Enrollment in AY: 2023 - 24

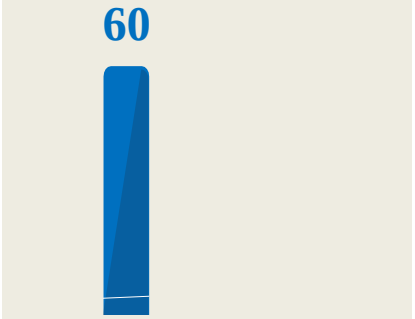
(II Year)

Under Graduate



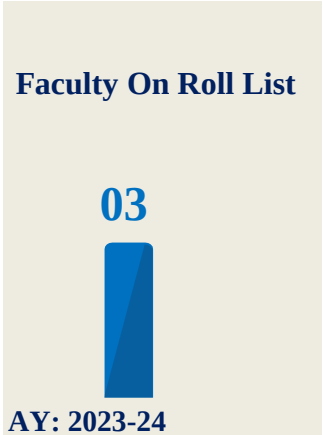
Student Enrolment Growth

B.Tech. CSE(CS)



Faculty On Roll AY: 2023-24

Faculty On Roll List

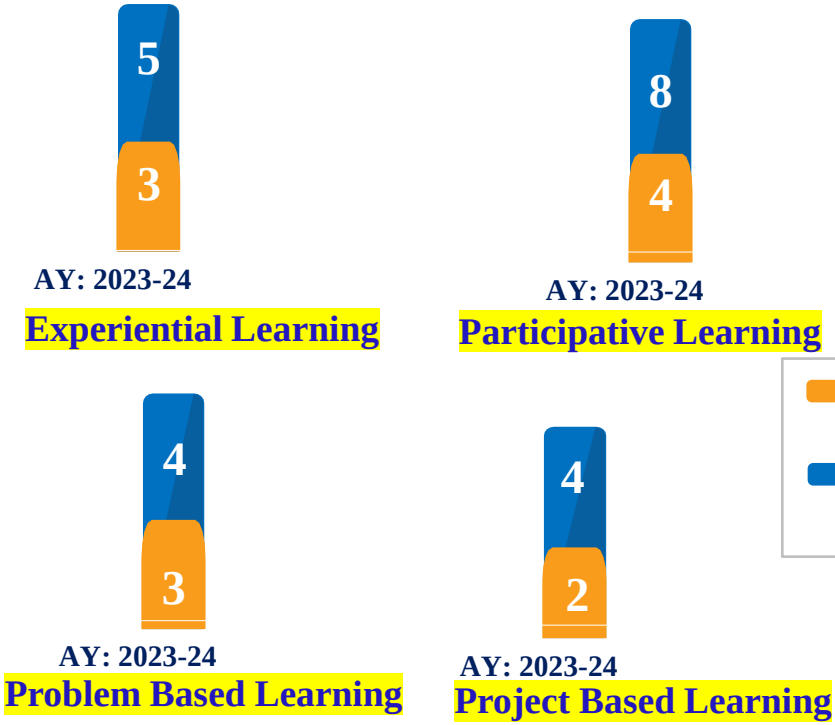


AY:2023-24

Professor : 1

Assistant Professor : 2

Student Centric Methods AY: 2023-24



ICT Tool Usage AY: 2023-24

EVENTS CONDUCTED IN DEPARTMENT FOR STUDENT DEVELOPMENT

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

AY: 2023 - 24

Major Events

1. Cyber Security Essentials

2. Strategies in Master Data Management(MDM) for workforce Enhancement and Data Security

Workshop

Cyber Security Essentials

Strategies in MDM

Total Events 02

02 Workshops

Student Achievements & Awards

AptiMind

K.Guru Prasad Reddy/ VTU22071
II year, Department of CSE(CS)
Second prize Rs.3000
Vel Tech AptiMind, Feb 2024

VelTech Scriptura

Mohib Rasool/ VTU23503
II year, Department of CSE(CS)
Third prize Rs.2000
Feb 2024

AptiMind

Mohib Rasool/ VTU23503
II year, Department of CSE(CS)
First prize Rs.5000
Vel Tech AptiMind, Feb 2024

Protiyogita - 23

Mohib Rasool/ VTU23503
II year, Department of CSE(CS)
Third prize Rs.1000
11.01.2024

Faculty Achievements & Awards

National Cyber Security Summit'24

Dr. S. Saravanan, Participated in the National Cyber Summit'24

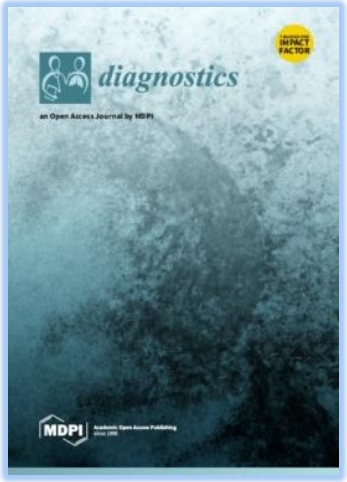
from 01st & 02nd May 2024

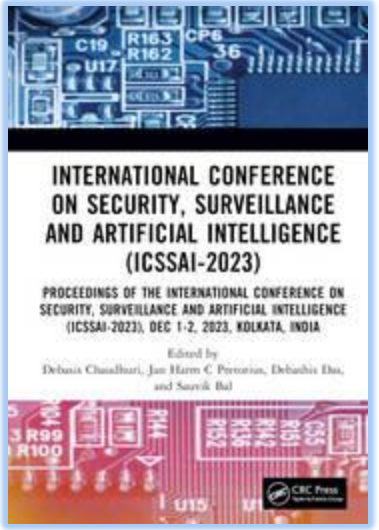
Faculty Achievements & Awards

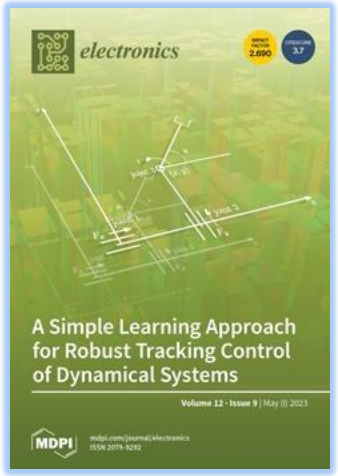
JOURNAL PUBLICATION

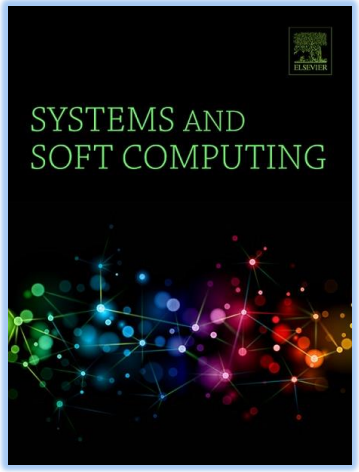
Indexed – WOS

Dr.S.Saravanan
TTS3435
Associate Professor









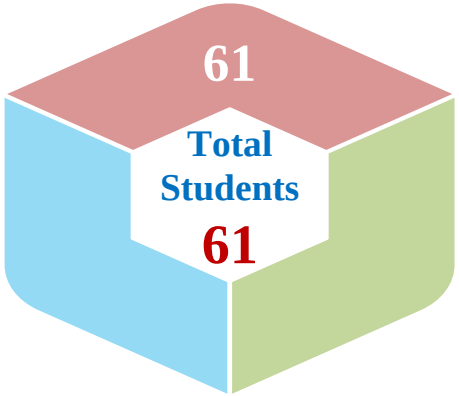
Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Department of CSE
(Data Science)

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology (Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Student Enrollment in AY: 2023-24 (II Year)

Under Graduate



Student Enrolment Growth – B.Tech. CSE(DS)

Faculty On Roll AY: 2023-24

Faculty On Roll List

AY:2023-24

Professor : Nil

Associate Professor :2

Assistant Professor :7

Student Centric Methods – AY:2023-24

Experiential Learning

Participative Learning

Problem Based Learning

Project Based Learning

ICT Tool Usage – AY:2023-24

EVENTS CONDUCTED IN DEPARTMENT FOR STUDENT DEVELOPMENT

Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology (Deemed to be University Estd. u/s 3 of UGC Act, 1956)

AY: 2023-24

Major Events

01 TECHNOVANZA '24

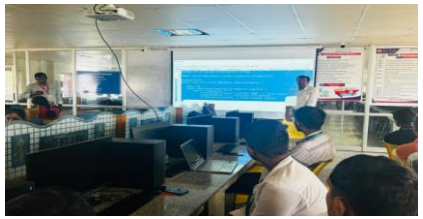
02 TECHNO CRACKERS '24

03 RESTFUL API DESIGN

04 Tools and Techniques for Data Science

TECHNOVANZA '24

TECHNO CRACKERS '24



RESTFUL API DESIGN

Tools and Techniques for Data Science

Total Events 5

- 2 Workshops
- 2 Technical Contest
- 1 Idea Contest

Student Achievements & Awards

QUIZ - WINNER

Y.Gangadhar / VTU22275
III year, Department of CSE (DS)
July 30 2024
AURORA'24
Department of Knowledge Engineering, SIMATS Engineering, Chennai

Certificate of Merit

PAPER PRESENTATION

T.Ratna Shamith / VTU21530
II year, Department of CSE(DS)
First prize (Rs. 3000)
Technovanza'24
01.02.2024

Guest Lecture

G. Sai Kumar / VTU23360
II year, Department of CSE(DS)
First prize (Rs. 3000)
Technovanza'24
01.02.2024

Faculty Achievements & Awards

GUEST LECTURE

Title: "UNLOCK YOUR POTENTIAL & REACH YOUR PROFESSIONAL ASPIRATION"

Guest Lecture

Vel Tech University, Chennai

Dr.M Gokuldhev
TTS 3231
Professor
Dept. of CSE(DS)

PAPER PRESENTATION (ABROAD)

Title - Ontology for Contextual Fake News Assessment based on Text and Images

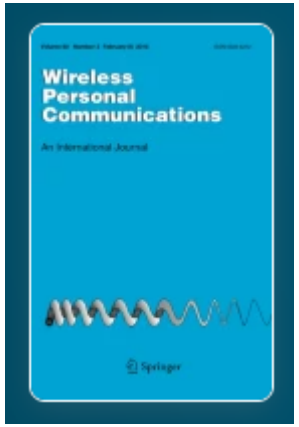
PDP 2024
32nd Euromicro International Conference on Parallel, Distributed and Network-based Processing
20-22 March 2024 Dublin

Indexed – WOS

Dr.M Gokuldhev
TTS 3231
Professor
Dept. of CSE(DS)

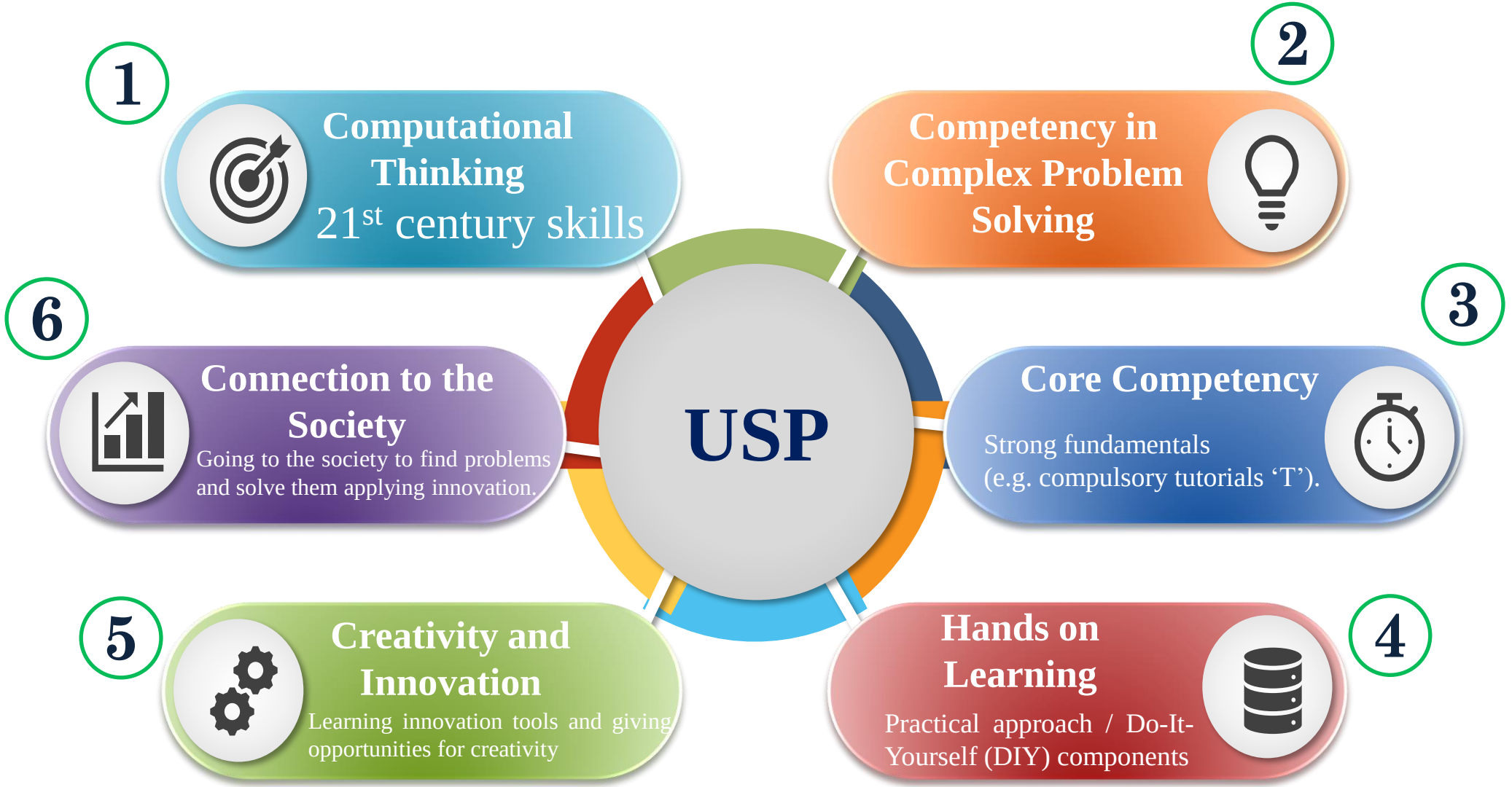
JOURNAL PUBLICATION

Title - Diabetes Detection by Data Mining Methods
In
Wireless Personal Communication journal with Impact factor – 2.2



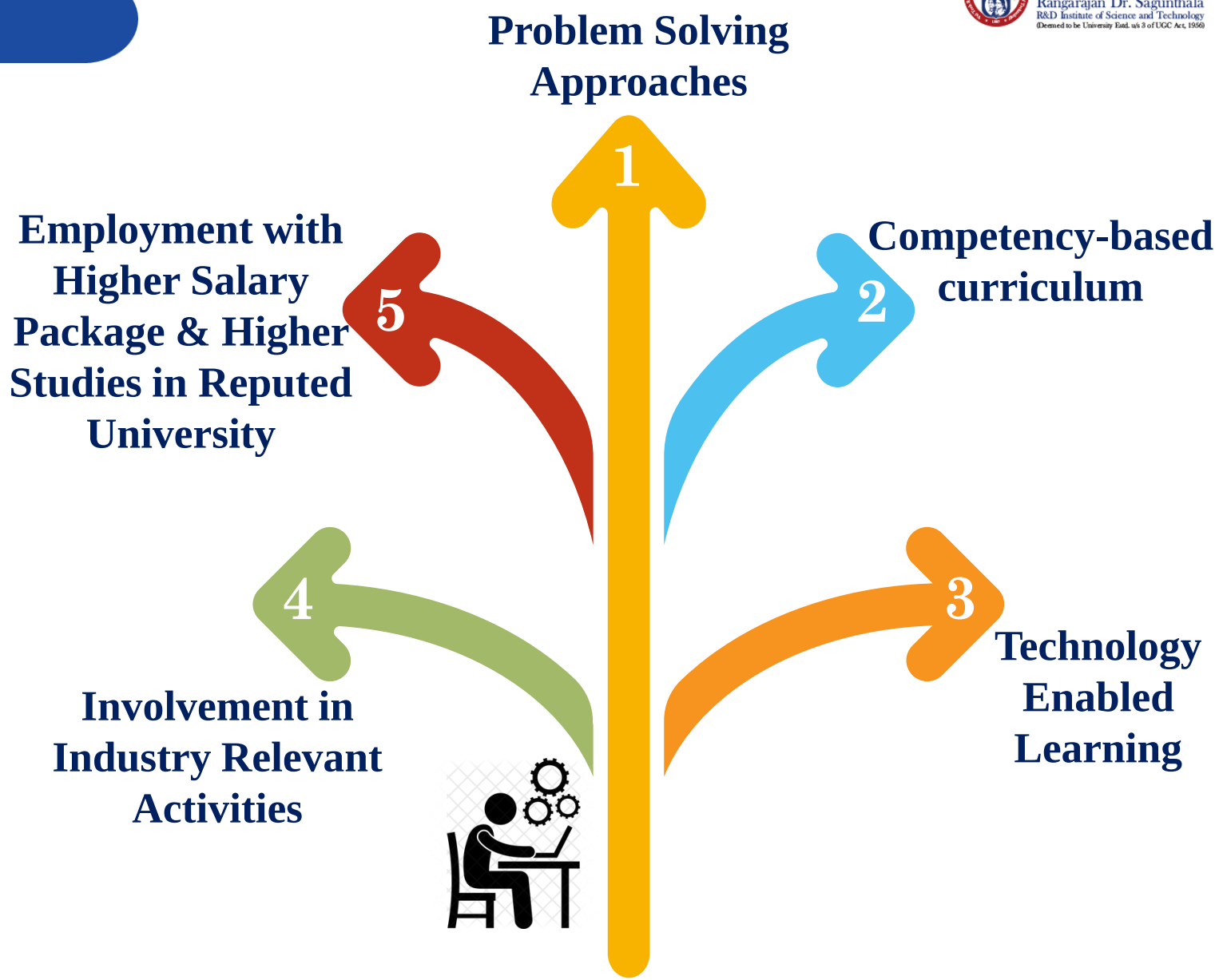
Dr.P.Jose
TTS 3631
Associate Professor
Dept. of CSE(DS)

UNIQUE SELLING POINT



CONCLUSION


GO
01
Excellence in teaching & learning
Progressive and inspiring curriculum
02
03
Highly employable graduates
Supporting for student progression and achievements
04


Problem Solving Approaches
1
Competency-based curriculum
2
Technology Enabled Learning
3
Involvement in Industry Relevant Activities
4
Employment with Higher Salary Package & Higher Studies in Reputed University
5

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Thank You