B.Tech – COMPUTER SCIENCE AND ENGINEERING
CBCS CURRICULUM
Honors / Specialization / Minor
(With effect from 2021-2022)

Department of Computer Science and Engineering

School of Computing

Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology

Vision

The Vision of Computer Science and Engineering Department is

To produce intellectual graduates who could contribute significantly in the analysis, design, development, operation and maintenance of complex software systems for meeting the ever changing requirements and to compete globally towards professional excellence.

Mission

The mission of Computer Science and Engineering Department is to

M1: Design curricula for imparting training in adapting newer computing methods and technologies for providing effective and efficient solutions to the existing / new problems.

M2: Inculcate in-depth knowledge of various courses by employing Information and Communication Technology (ICT) based pedagogy methods.

M3: Create a conducive research environment for making technological innovations by the faculty and students.

M4: Provide leadership skills and professional ethics thereby making a prolific career in academics and industry.

PROGRAMME EDUCATIONAL OBJECTIVES

The Programme Educational Objectives (PEOs) are as follows:

After a few years of professional accomplishment in the program, the graduates will be able to

PEO1: Formulate, solve and analyze Computer Science and Engineering problems using necessary mathematical, Scientific and engineering fundamentals.

PEO2: Demonstrate the impact of cutting-edge technologies to accomplish social and professional responsibilities.

PEO3: Demonstrate critical thinking, communication, teamwork, leadership skills and ethical behavior necessary to function productively and professionally.

PEO4: Pursue higher education at reputed institution in India and abroad, work in product development companies and engage in lifelong learning.

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable

to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice are as in the engineering discipline;much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice(technology)in the practice are as in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & Interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Teamwork: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at≠ large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineeringmanagementprinciplesandeconomicdecision-makingandapplytheseto one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-LongLearning: Recognize the need for, and have the preparation and ability for

i) Independent and life-long learning ii) Adaptability to new and emerging technologies and iii) Critical thinking in the broadest context of technological change. (WK8)

PROGRAM SPECIFIC OUTCOMES (PSOs)

On successful completion of the program, the graduates will be able to,

PSO1: Mathematical Concepts: Equipped with the knowledge to infer the mathematical models for problem solving using data structures, design and analysis of algorithms.

PSO2: Software Development: Exhibit proficiency to analyze, design and develop applications in various domains to provide solutions using innovative ideas.

PSO3: Transferring Skills: Demonstrate the ability to provide solutions for real world problems through acquaintance and hands-on training

COURSE OUTCOME

Abilities of the student defined in terms of Course Outcomes (COs) as per the Bloom's Taxonomy at the end of every course in the programme.

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Credits required for regular students in various course categories for B. Tech(CSE)

The students shall earn 164 credits in various course categories given below for the award of degree of B.Tech (CSE).

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 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 with minor subject to the regulations.

Minimum credits required for regular students in various course categories for B.Tech Computer Science and Engineering 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 with Honors subject to the regulations.

Foundation Core (56 Credits) Batch- 2021-2022 Only

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	10210CH103	Environmental Science	BSC	2	0	0	2
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
26	10210CS303	IT Workshop	ESC	0	0	2	1
Total Credits							**56**

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

Foundation Core (56 Credits) (2022-2023) admitted batch Onwards

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

Program Core (58 Credits) Batch- 2021-2022 Only

L-Lecture, T-Tutorial, P-Practical, C-credit

S.No	Course Code	Course Name	L	T	P	C	Pg.No
		Theory Courses					
1	10211CS101	Discrete Mathematics	3	0	0	3	30
2	10211CS102	Data Structures	3	0	0	3	32
3	10211CS103	Operating Systems	3	0	0	3	35
4	10211CS129	Modern Computer Architecture	3	0	0	3	37
5	10211CS105	Computer Networks	3	0	0	3	40
6	10211CS130	Fundamentals of Computer Networks	3	0	0	3	43
7	10211CS106	Formal Languages and Automata Theory	3	0	0	3	46
8	10211CS107	Compiler Design	3	0	0	3	49
9	10211CS109	Microprocessor and Microcontroller	2	0	0	2	52
10	10211CS111	Image Processing	2	0	0	2	55
12	10211CS118	Image Processing Techniques	3	0	0	3	58
13	10211CS120	Machine Learning	3	0	0	3	61
		Integrated Courses					
14	10211CS201	Digital Electronics	2	0	2	3	64
15	10211CS202	Design and Analysis of Algorithms	3	0	2	4	68
16	10211CS204	Object Oriented Programming using Java	2	0	2	3	74
17	10211CS207	Database Management Systems	3	0	2	4	78
18	10211CS208	Software Engineering	2	0	2	3	83
19	10211CS212	Web and Mobile Application Development	3	0	2	4	87

20	10211CS213	Python Programming	1	0	2	2	92
21	10211CS223	Machine learning techniques	2	0	2	3	95
		Laboratory Courses					
22	10211CS302	Data Structures Laboratory	0	0	2	1	100
23	10211CS303	Computer Networks Laboratory	0	0	2	1	105
24	10211CS312	Fundamentals of Computer Networks Laboratory	0	0	2	1	110
25	10211CS313	Machine Learning Laboratory	0	0	2	1	137
26	10211CS304	Operating Systems Laboratory	0	0	2	1	116
27	10211CS305	Microprocessor and Microcontroller Laboratory	0	0	2	1	122
28	10211CS306	Competitive Coding –I	0	0	2	1	125
29	10211CS307	Competitive Coding –II	0	0	2	1	128
Total Credits						**58**	

Program Core (58 Credits) (2022-2023)

L-Lecture, T-Tutorial, P-Practical, C-credit

S.No	Course Code	Course Name	L	T	P	C
		Theory Courses				
1	10211CS101	Discrete Mathematics	3	0	0	3
2	10211CS102	Data Structures	3	0	0	3
3	10211CS103	Operating Systems	3	0	0	3
4	10211CS129	Modern Computer Architecture	3	0	0	3
5	10211CS130	Fundamentals of Computer Networks	3	0	0	3
6	10211CS106	Formal Languages and Automata Theory	3	0	0	3
7	10211CS107	Compiler Design	3	0	0	3
8	10211CS109	Microprocessor and Microcontroller	2	0	0	2
9	10211CS118	Image Processing Techniques	3	0	0	3
		Integrated Courses				
10	10211CS201	Digital Electronics	2	0	2	3
11	10211CS202	Design and Analysis of Algorithms	3	0	2	4
12	10211CS204	Object Oriented Programming using Java	2	0	2	3
13	10211CS207	Database Management Systems	3	0	2	4
14	10211CS208	Software Engineering	2	0	2	3
15	10211CS212	Web and Mobile Application Development	3	0	2	4
16	10211CS213	Python Programming	1	0	2	2

17	10211CS223	Machine Learning Techniques	2	0	2	3
		Laboratory Courses				
18	10211CS302	Data Structures Laboratory	0	0	2	1
19	10211CS312	Fundamentals of Computer Networks Laboratory	0	0	2	1
20	10211CS304	Operating Systems Laboratory	0	0	2	1
21	10211CS305	Microprocessor and Microcontroller Laboratory	0	0	2	1
22	10211CS306	Competitive Coding –I	0	0	2	1
23	10211CS307	Competitive Coding –II	0	0	2	1
Total Credits						**58**

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Honors / Specialization / Minor

Minimum credits required for Lateral Entry students in various course categories for B.Tech(CSE) – VTR UGE 2021

The students shall earn 120 credits in various course categories given below for the award of degree of B.Tech (CSE).

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**

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CBCS CURRICULUM
Honors / Specialization / Minor

VTR UGE 2021
Lateral Entry 2022-2023 Admitted Batch (2021-2022)

Foundation Core (22 Credits)

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
7	10210ME103	Innovation & Entrepreneurship	ESC	2	0	0	2
9	10210ME102	Universal Human Values	HSC	3	0	0	3
11	10210ME104	Project Management & Finance	HSC	2	0	0	2
12	10210ME105	Engineers and Society	HSC	1	0	0	M
13	10210BL101	Constitution of India	HSC	1	0	0	M
Integrated Courses							
14	10210EN201	Professional Communication – I	HSC	1	0	2	2
Laboratory Courses							
15	10210CS301	Problem Solving using C Lab	ESC	0	0	2	1
Total Credits							**22**

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VTR UGE 2021
Lateral Entry Admitted 2023-2024 Batch (2022-2023)onwards

Foundation Core (22 Credits)

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	10210CS101	Problem Solving using C	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
Integrated Courses							
11	10210EN201	Professional Communication – I	HSC	1	0	2	2
		Total Credits					**23**

Lateral Entry 2022-2023 Admitted Batch (2021-2022)

Program Core (48 Credits)

(Common for both the batches**)**

S.No	Course Code	Course Name	L	T	P	C
		Theory Courses				
1	10211CS101	Discrete Mathematics	3	0	0	3
2	10211CS102	Data Structures	3	0	0	3
4	10211CS129	Modern Computer Architecture	3	0	0	3
5	10211CS105	Computer Networks	3	0	0	3
6	10211CS106	Formal Languages and Automata Theory	3	0	0	3
7	10211CS107	Compiler Design	3	0	0	3
8	10211CS109	Microprocessor and Microcontroller	2	0	0	2
9	10211CS120	Machine Learning	3	0	0	3
		Integrated Courses				
10	10211CS201	Digital Electronics	2	0	2	3
11	10211CS202	Design and Analysis of Algorithms	3	0	2	4
12	10211CS204	Object Oriented Programming using Java	2	0	2	3
13	10211CS207	Database Management Systems	3	0	2	4
14	10211CS212	Web and Mobile Application Development	3	0	2	4
15	10211CS213	Python Programming	1	0	2	2
		Laboratory Courses				
16	10211CS302	Data Structures Laboratory	0	0	2	1
17	10211CS303	Computer Networks Laboratory	0	0	2	1
18	10211CS313	Machine Learning Laboratory	0	0	2	1
20	10211CS305	Microprocessor and Microcontroller Laboratory	0	0	2	1
21	10211CS306	Competitive Coding –I	0	0	2	1
22	10211CS307	Competitive Coding –II	0	0	2	1
		Total Credits				**48/ 49**

Lateral Entry Admitted 2023-2024 Batch (2022-2023) onwards

Program Core (48 Credits)

(Common for both the batches**)**

S.No	Course Code	Course Name	L	T	P	C
		Theory Courses				
1	10211CS101	Discrete Mathematics	3	0	0	3
2	10211CS102	Data Structures	3	0	0	3
4	10211CS129	Modern Computer Architecture	3	0	0	3
5	10211CS130	Fundamentals of Computer Networks	3	0	0	3
6	10211CS106	Formal Languages and Automata Theory	3	0	0	3
7	10211CS107	Compiler Design	3	0	0	3
8	10211CS109	Microprocessor and Microcontroller	2	0	0	2
		Integrated Courses				
10	10211CS201	Digital Electronics	2	0	2	3
11	10211CS202	Design and Analysis of Algorithms	3	0	2	4
12	10211CS204	Object Oriented Programming using Java	2	0	2	3
13	10211CS207	Database Management Systems	3	0	2	4
15	10211CS212	Web and Mobile Application Development	3	0	2	4
16	10211CS213	Python Programming	1	0	2	2
17	10211CS223	Machine Learning Techniques	2	0	2	3
		Laboratory Courses				
18	10211CS302	Data Structures Laboratory	0	0	2	1
19	10211CS312	Fundamentals of Computer Networks Laboratory	0	0	2	1
20	10211CS305	Microprocessor and Microcontroller Laboratory	0	0	2	1
21	10211CS306	Competitive Coding –I	0	0	2	1
22	10211CS307	Competitive Coding –II	0	0	2	1
		Total Credits				**48**

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
		Theory Courses					
1	10212CS110	Optimization Techniques	3	0	0	3	141
2	10212CS112	Cyber Security Policy, Law & Ethics*	3	0	0	3	337
3	10212CS113	Reinforcement Learning	3	0	0	3	143
4	10212CS119	Cryptography and Network Security	3	0	0	3	145
5	10212CS121	High Performance Computing	3	0	0	3	147
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	149
		Integrated Courses					
11	10212CS210	Big Data Analytics	3	0	2	4	151
12	10212CS211	Artificial Intelligence Techniques	3	0	2	4	155
13	10212CS214	Data Visualization	3	0	2	4	160
14	10212CS215	Deep Learning	3	0	2	4	164
15	10212CS216	Natural Language Processing	3	0	2	4	166
16	10212CS217	Data Science	2	0	2	3	171
17	10212CS218	Modeling for Data Science	3	0	2	4	175
18	10212CS219	Cyber Security	3	0	2	4	179
19	10212CS220	Animation Engineering	3	0	2	4	185
20	10212CS221	Game Design	3	0	2	4	189
21	10212CS222	Virtual and Augmented Reality	2	0	2	3	192
22	10212CS224	Computer Vision	3	0	2	4	195
23	10212CS225	Ethical Hacking	3	0	2	4	198
24	10212CS226	Secure Coding*	3	0	2	4	
25	10212CS228	Blockchain Technology	2	0	2	3	201
26	10212CS229	IoT and Cloud Computing	3	0	2	4	205
27	10212CS230	Forensics in Cyber Security	3	0	2	4	208
28	10212CS232	Vulnerability Analysis and Penetration Testing*	3	0	2	4	
29	10212CS239	3D Character Modeling	3	0	2	4	212
30	10212CS243	Mobile Game Development Tools*	3	0	2	4	
31	10212CS244	Computer Graphics	3	0	2	4	182
32	10212CS245	Story Telling*	2	0	2	3	
33	10212CS248	IoT with Blockchain Technology*	3	0	2	4	

34	10212CS249	Bitcoin and Cryptocurrencies*	3	0	2	4	
35	10212CS276	Generative AI	1	0	2	2	315
36	10212CS277	Deep Learning Techniques	3	0	2	4	340
37	10212CS278	Quantum Machine Learning	3	0	2	4	313
38	10212CS279	Application Development And Maintenance	3	0	2	4	320
39	10212CS280	Low code Development	1	0	2	2	325
40	10212CS282	Robotics & Automation	3	0	2	4	328
41	10212CS281	Industry Internet of Things	3	0	2	4	332
42	10212CS283	Industrial Automation	3	0	0	3	335
* The proposed course subject to the 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.

The following courses are 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	Pg No
1	10213CS101	Object Oriented Programming using Java	3	0	0	3	381
2	10213CS102	Data Structures	3	0	0	3	383
3	10213CS103	Operating Systems	3	0	0	3	386
4	10213CS104	Database Management Systems	3	0	0	3	388
5	10213CS105	Computer Networks	3	0	0	3	391
6	10213CS106	Data warehousing and Data mining	3	0	0	3	393
7	10213CS107	Design and Analysis of Algorithms	3	0	0	3	396
8	10213GE103	Software Development and Maintenance	3	0	0	3	399

The following courses are offered to the other departments/schools by School of Computing under Open Elective category. The students will solve the problems posted by Leet Code Platform, the grades will be offered based on the scores secured by the students by solving the problems posted in Leet Code Platform.

S.No	Course Code	Course Name	L	T	P	C	Pg No
1	10213GE302	Programming Challenges	0	1	4	2	402
2	10213GE204	Application Development and Maintenance	3	0	2	4	403

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	10214CS501	Community Service Project	0	0	2	1
2	10214CS601	Minor Project-I	0	0	4	2
3	10214CS602	Minor Project-II	0	0	4	2
4	10214CS701	Major Project	0	0	18	9

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.

L-Lecture, T-Tutorial, P-Practical, C-credit

S.No	Course Code	Course Name	L	T	P	C
1	10215CS901	Internship	-	-	-	2
2	10215CS902	Industry Expert Lecture-1	-	-	-	1
3	10215CS903	Industry Expert Lecture-2	-	-	-	1
4	10215CS951	Higher Institute Learning Interaction-1	-	-	-	1
5	10215CS952	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.

L-Lecture, T-Tutorial, P-Practical, C-credit

S.No	Course Code	Course Name	L	T	P	C
1	10216GE901	Soft Skill-I	2	-	-	1
2	10216GE902	Soft Skill-I	2	-	-	1
3	10216GE903	Aptitude Skill-I	2	-	-	1
4	10216GE904	Aptitude Skill-II	2	-	-	1

Specialization / Honors (Specialization: 18 credits Honors: Additional 20 credits)

Track: Artificial Intelligence

S.No	Course Code	Course Name	L	T	P	C	Pg No
		Artificial Intelligence – Core					
1	10212CS211	Artificial Intelligence Techniques	3	0	2	4	154
2	10212CS210	Big Data Analytics	3	0	2	4	150
3	10212CS110	Optimization Techniques	3	0	0	3	138
4	10212CS214	Data Visualization	3	0	2	4	159
5	10212CS215	Deep Learning	3	0	2	4	163
6	10212CS224	Computer Vision	3	0	2	4	196
7	10212CS216	Natural Language Processing	3	0	2	4	166
8	10212CS113	Reinforcement Learning	3	0	0	3	140
9	10212CS229	IoT and Cloud Computing	3	0	2	4	206
		Honors					
13	10212CS122	Cognitive Computing*	3	0	0	3	
*The proposed course subject to the approval/ratification in the upcoming BoS meetings							

Track: Data Science

S.No	Course Code	Course Name	L	T	P	C	Pg. No
		Data Science – Core					
1	10212CS217	Data Science	2	0	2	3	170
2	10212CS218	Modeling for Data Science	3	0	2	4	175
3	10212CS210	Big Data Analytics	3	0	2	4	150
4	10212CS214	Data Visualization	3	0	2	4	159
5	10212CS211	Artificial Intelligence Techniques	3	0	2	4	154
6	10212CS110	Optimization Techniques	3	0	0	3	138
7	10212CS215	Deep Learning	3	0	2	4	163
8	10212CS229	IoT and Cloud Computing	3	0	2	4	206
9	10212CS276	Generative AI	1	0	2	2	315
10	10212CS277	Deep Learning Techniques	3	0	2	4	340
11	10212CS278	Quantum Machine Learning	3	0	2	4	313
Honors							
12	10212CS234	Time Series and Forecasting*	3	0	2	4	

13	10212CS233	Social Media Analytics*	3	0	2	4	
14	10212CS122	Cognitive Computing*	3	0	0	3	
15	10212CS224	Computer Vision	3	0	2	4	196
*The proposed course subject to the approval/ratification in the upcoming BoS meetings							

Track : Artificial Intelligence and Machine Learning

S. No	Course Code	Course Name	L	T	P	C	Pg. No
		Artificial Intelligence and Machine Learning Core Electives					
1	10212CS210	Big Data Analytics	3	0	2	4	150
2	10212CS214	Data Visualization	3	0	2	4	159
3	10212CS211	Artificial Intelligence Techniques	3	0	2	4	154
4	10212CS110	Optimization Techniques	3	0	0	3	138
5	10212CS215	Deep Learning	3	0	2	4	163
6	10212CS216	Natural Language Processing	3	0	2	4	166
7	10212CS122	Cognitive Computing *	3	0	0	3	
8	10212CS113	Reinforcement Learning	3	0	0	3	140
9	10212CS121	High Performance Computing	3	0	0	3	145
10	10212CS229	IoT and Cloud Computing	3	0	2	4	206
11	10212CS276	Generative AI	1	0	2	2	315
12	10212CS277	Deep Learning Techniques	3	0	2	4	340
13	10212CS278	Quantum Machine Learning	3	0	2	4	313
		Honors					
		Artificial Intelligence					
14		Speech Recognition*	3	0	0	3	
15		Robotics & Automation*	3	0	2	4	
16		Intelligent Agents*	2	0	2	3	
17	10212CS206	Human Computer Interaction*	3	0	2	4	
18	10212CS124	Artificial Intelligence for Cyber Security*	3	0	0	3	
19		Artificial Intelligence for Health Care*	2	0	4	4	
		Machine Learning					
20	10212CS224	Computer vision	3	0	2	4	196
21	10212CS234	Time series and Forecasting*	3	0	2	4	
22	10212CS233	Social Media Analytics*	3	0	2	4	

Track: Artificial Intelligence and Data Science

S.No	Course Code	Course Name	L	T	P	C	Pg. No
		Artificial Intelligence and Data Science - Core					
1	10212CS110	Optimization Techniques	3	0	0	3	138
2	10212CS113	Reinforcement Learning	3	0	0	3	140
3	10212CS123	Data Security and Privacy*	2	0	0	2	
4	10212CS210	Big Data Analytics	3	0	2	4	150

S.No	Course Code	Course Name	L	T	P	C	Pg. No
5	10212CS211	Artificial Intelligence Techniques	3	0	2	4	154
6	10212CS214	Data Visualization	3	0	2	4	159
7	10212CS215	Deep Learning	3	0	2	4	163
8	10212CS216	Natural Language Processing	3	0	2	4	166
9	10212CS217	Data Science	2	0	2	3	170
10	10212CS218	Modeling for Data Science	3	0	2	4	175
11	10212CS229	IoT and Cloud Computing	3	0	2	4	206
12	10212CS276	Generative AI	1	0	2	2	315
13	10212CS277	Deep Learning Techniques	3	0	2	4	340
14	10212CS278	Quantum Machine Learning	3	0	2	4	313
Honors							
Artificial Intelligence							
15	10212CS122	Cognitive Computing*	3	0	0	3	
16	10212CS224	Computer Vision	3	0	2	4	196
17	10212CS231	Artificial Intelligence for Health Care*	3	0	2	4	
Data Science							
18	10212CS234	Time Series and Forecasting*	2	0	2	3	
19	10212CS233	Social Media Analytics*	2	0	2	3	
*The proposed course subject to the approval/ratification in the upcoming BoS meetings							

Track : Artificial Intelligence and Robotics

S.No	Course Code	Course Name	L	T	P	C	Pg. No
		Artificial Intelligence and Robotics - Core					
1	10212CS211	Artificial Intelligence Techniques	3	0	2	4	154
2	10212CS210	Big Data Analytics	3	0	2	4	163
3	10212CS214	Data Visualization	3	0	2	4	196
4	10212CS216	Natural Language Processing	3	0	2	4	
5	10212CS281	Industry Internet of Things	3	0	2	4	
6	10212CS282	Robotics & Automation	3	0	2	4	
7	10212CS283	Industrial Automation	3	0	0	3	335
*The proposed course subject to the approval/ratification in the upcoming BoS meetings							

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

S.No	Course Code	Course Name	L	T	P	C
3	10212CS230	Forensics in Cyber Security	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	0	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						
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: Financial Technology

S.No	Course Code	Course Name	L	T	P	C	Pg. No
		Financial Technology- Core					
1	10212CS127	Introduction to FinTech*	3	0	0	3	
2	10212CS210	Big Data Analytics	3	0	2	4	150
3	10212CS214	Data Visualization	3	0	2	4	159
4	10212CS211	Artificial Intelligence Techniques	3	0	2	4	154
5	10212CS223	Machine Learning Techniques	3	0	2	4	93
6	10212CS128	Financial Accounting	3	0	0	3	148
7	10212CS228	Block Chain Technology	2	0	2	3	202
8	10212CS229	IoT and Cloud Computing	3	0	2	4	206
Honors							
9	10212CS215	Deep Learning	3	0	2	4	163
10	10212CS249	Bit coin and Crypto currencies*	3	0	2	4	
*The proposed course subject to the approval/ratification in the upcoming BoS meetings							

Track: Gaming and Animation

S.No	Course Code	Course Name	L	T	P	C	Pg. No
		Gaming and Animation- Core					
1	10212CS244	Computer Graphics	3	0	2	4	
2	10212CS220	Animation Engineering	3	0	2	4	185
3	10212CS221	Game Design	3	0	2	4	189
4	10212CS222	Virtual and Augmented Reality	2	0	2	3	191
5	10212CS239	3D Character Modeling	3	0	2	4	213
6	10212CS243	Mobile Game Development Tools *	3	0	2	4	
7	10212CS229	IoT and Cloud Computing	3	0	2	4	206
		Honors					
8		Mobile Game Programming *	3	0	2	4	
9		3D Architecture and Art Design *	2	0	4	4	
10		Computer Animation Algorithm and Techniques*	3	0	2	4	
11		Visual Effects*	3	0	2	4	
12	10212CS245	Story Telling*	2	0	2	3	
*The proposed course subject to the approval/ratification in the upcoming BoS meetings							

Track: IoT and Cyber Security including Block Chain Technology

S.No	Course Code	Course Name	L	T	P	C	Pg. No
		Cyber Security - Core					
1	10212CS119	Cryptography and Network Security	3	0	0	3	142
2	10212CS219	Cyber Security	3	0	2	4	179
3	10212CS225	Ethical Hacking	3	0	2	4	199
4	10212CS230	Forensics in Cyber Security	3	0	2	4	209
5	10212CS228	Blockchain Technology	2	0	2	3	202
6	10212CS248	IoT with Blockchain Technology*	3	0	2	4	
7	10212CS249	Bitcoin and Cryptocurrencies*	3	0	2	4	
8	10212CS229	IoT and Cloud Computing	3	0	2	4	206

Track: Cloud Infrastructure Management

S.No	Course Code	Course Name	L	T	P	C	Pg. No
1	10212CS251	Virtualization Techniques	2	0	2	3	219
2	10212CS252	Windows Client Administration Operating System	2	0	2	3	223
3	10212CS253	Windows Server Administration Operating System	2	0	2	3	226
4	10212CS254	Cloud Fundamentals using Azure	2	0	2	3	231
5	10212CS255	Administering Microsoft Exchange Server	2	0	2	3	234
6	10212CS256	Office 365 Administration	2	0	2	3	239

Track: Network and Server Management

S.No	Course Code	Course Name	L	T	P	C	Pg. No
1	10212CS257	Data Center Hosting – Windows operating System	2	0	2	3	243
2	10212CS258	Data Center Hosting – Unix operating System*	2	0	2	3	
3	10212CS259	Advanced Switching and Networking Techniques	2	0	2	3	252
4	10212CS260	Advanced Routing Techniques and Security	2	0	2	3	258
5	10212CS261	Juniper Networking Techniques*	2	0	2	3	
6	10212CS262	Storage Management	2	0	2	3	264

Track: Application Modernization Service

S.No	Course Code	Course Name	L	T	P	C	Pg. No
1	10212CS263	IIS Web Server Technologies	2	0	2	3	294
2	10212CS264	Application Server Technologies	2	0	2	3	299
3	10212CS265	Web Sphere Application Server	2	0	2	3	272
4	10212CS266	WebSphere MQ	0	0	2	1	275
5	10212CS267	Middleware Technologies	1	0	2	2	279
6	10212CS268	Database Administration Using MSSQL Server	2	0	2	3	302
7	10212CS269	Oracle Database Administration	2	0	2	3	285

Track: Mainframe

S.No	Course Code	Course Name	L	T	P	C	Pg. No
1	10212CS270	Introduction to System Programming z/OS commands and Panel on IBMZ	2	0	2	3	308
2	10212CS271	Fundamentals of Networking, CICS and IMS*	2	0	2	3	
3	10212CS272	z/OS Administration*	2	0	2	3	
4	10212CS273	z/OS System Service Structure*	2	0	2	3	
5	10212CS274	IBM System z Parallel Sysplex Operations*	2	0	2	3	
6	10212CS275	IBM MQ System Administration for z/OS*	2	0	2	3	

Minors tracks for B.Tech offered to the other Schools by Department of CSE (18 Credits)

Track :Artificial Intelligence

Other branch students who want to complete minor in Artificial Intelligence, have to complete the prerequisite course Data Structures, Database Management System, Data Warehousing and Data mining and Digital Image Processing in Open Electives Category

S.No	Course Code	Course Name	L	T	P	C	Pg No
		Artificial Intelligence – Core					
1	10212CS211	Artificial Intelligence Techniques	3	0	2	4	154
2	10212CS210	Big Data Analytics	3	0	2	4	150
3	10212CS110	Optimization Techniques	3	0	0	3	138
4	10212CS214	Data Visualization	3	0	2	4	159
5	10212CS215	Deep Learning	3	0	2	4	163
6	10212CS224	Computer Vision	3	0	2	4	196
7	10212CS216	Natural Language Processing	3	0	2	4	166
8	10212CS113	Reinforcement Learning	3	0	0	3	140
9	10212CS229	IoT and Cloud Computing	3	0	2	4	206
10	10212CS218	Modeling for Data Science	3	0	2	4	175
11	10212CS276	Generative AI	1	0	2	2	315

Track :Data Science

Other branch students who want to complete minor in Data Science, have to complete the prerequisite course Data Structures, Database management System and Data warehousing and Data mining in Open Electives Category

S.No	Course Code	Course Name	L	T	P	C	Pg. No
		Data Science – Core					
1	10212CS217	Data Science	2	0	2	3	170
2	10212CS218	Modeling for Data Science	3	0	2	4	175
3	10212CS210	Big Data Analytics	3	0	2	4	150
4	10212CS214	Data Visualization	3	0	2	4	159
5	10212CS211	Artificial Intelligence Techniques	3	0	2	4	154
6	10212CS110	Optimization Techniques	3	0	0	3	138
7	10212CS215	Deep Learning	3	0	2	4	163
8	10212CS229	IoT and Cloud Computing	3	0	2	4	206
9	10212CS224	Computer Vision	3	0	2	4	196
10	10212CS276	Generative AI	1	0	2	2	312

Track :Cyber Security

Other branch students who want to complete minor in Cyber Security, have to complete the prerequisite course Data Structures, Operating Systems and Computer Networks in Open Electives Category

S.No	Course Code	Course Name	L	T	P	C	Pg. No
Cyber Security - Core							
1	10212CS219	Cyber Security	3	0	2	4	179
2	10212CS225	Ethical Hacking	3	0	2	4	199
3	10212CC230	Digital Forensics*	3	0	2	4	
4	10212CC232	Vulnerability Assessment and Penetration Testing*	3	0	2	4	
5	10212CC250	Identity Access Management*	3	0	2	4	216
6	10212CC112	Cyber Security Policy, Law & Ethics*	3	0	0	3	
7	10212CS119	Cryptography and Network Security	3	0	0	3	142
8	10212CC228	Blockchain Technology*	2	0	2	3	
9	10212CS229	IoT and Cloud Computing	3	0	2	4	206
10	10212CC226	Secure Coding*	3	0	2	4	
Independent Learning Courses (MOOC/Swayam)							
1	10212CS431	Computer Networks And Internet Protocol	-	-	-	3	
2	10212CS432	Blockchain and its Applications	-	-	-	3	
3	10212CS433	Cryptography and Network Security	-	-	-	3	
4	10212CS434	Foundations of Cryptography	-	-	-	3	
5	10212CS413	Quantum Algorithms and Cryptography	-	-	-	3	
6	10212CS435	Secure Computation: Part I	-	-	-	3	
7	10212CS436	Privacy and Security in Online Social Media	-	-	-	3	

Track :Gaming and Animation

Other branch students who want to complete minor in Gaming and Animation, prerequisite course is NIL

S.No	Course Code	Course Name	L	T	P	C	Pg. No
		Gaming and Animation- Core					
1	10212CS244	Computer Graphics	3	0	2	4	182
2	10212CS220	Animation Engineering	3	0	2	4	185
3	10212CS221	Game Design	3	0	2	4	189
4	10212CS222	Virtual and Augmented Reality	2	0	2	3	191
5	10212CS245	Story Telling*FF	2	0	2	3	
6	10212CS239	3D Character Modeling	3	0	2	4	213

S.No	Course Code	Course Name	L	T	P	C	Pg. No
7	10212CS243	Mobile Game Development Tools *	3	0	2	4	
8	10212CS229	IoT and Cloud Computing	2	0	2	3	206
Independent Learning Courses (MOOC/Swayam)							
1	10212CS437	Games and Information	-	-	-	3	
2	10212CS438	Human Computer Interaction	-	-	-	3	
3	10212CS439	Introduction to Graphic Design	-	-	-	3	
4	10212CS440	Augmenting Design Thinking with Human-Computer Interaction	-	-	-	3	

Track: Financial Technology

Other branch students who want to complete minor in Financial Technology, have to complete the prerequisite course Data Structures, Database Management Systems, Data warehousing and Data mining and Computer Networks in Open Electives Category

S.No	Course Code	Course Name	L	T	P	C	Pg. No
		Financial Technology- Core					
1	10212CS127	Introduction to FinTech*	3	0	0	3	
2	10212CS210	Big Data Analytics	3	0	2	4	150
3	10212CS214	Data Visualization	3	0	2	4	159
4	10212CS211	Artificial Intelligence Techniques	3	0	2	4	154
5	10212CS128	Financial Accounting	3	0	0	3	148
6	10212CS228	Block Chain Technology	2	0	2	3	202
7	10212CS229	IoT and Cloud Computing	3	0	2	4	206

Track : Artificial Intelligence and Machine Learning

Other branch students who want to complete minor in Artificial Intelligence/Machine Learning, have to complete the prerequisite course Data Structures, Database Management System and Data warehousing and Data mining in Open Electives Category

S. No	Course Code	Course Name	L	T	P	C	Pg. No
		Core Electives					
1	10212CS210	Big Data Analytics	3	0	2	4	150
2	10212CS214	Data Visualization	3	0	2	4	159
3	10212CS211	Artificial Intelligence Techniques	3	0	2	4	154
4	10212CS110	Optimization Techniques	3	0	0	3	138
5	10212CS215	Deep Learning	3	0	2	4	163
6	10212CS216	Natural Language Processing	3	0	2	4	166
7	10212CS122	Cognitive Computing *	3	0	0	3	
8	10212CS113	Reinforcement Learning	3	0	0	3	140
9	10212CS121	High Performance Computing	3	0	0	3	145
10	10212CS229	IoT and Cloud Computing	3	0	2	4	206

11	10212CS218	Modeling for Data Science	3	0	2	4	175
12	10212CS224	Computer Vision	3	0	2	4	196
13	10212CS276	Generative AI	1	0	2	2	315
Independent Learning Courses (MOOC/Swayam)							
1	10212CS415	Applied Linear Algebra in AI and ML	-	-	-	3	
2	10212CS416	Artificial Intelligence: Knowledge Representation And Reasoning	-	-	-	3	
3	10212CS417	Introduction to Machine Learning	-	-	-	3	
4	10212CS418	Natural Language Processing	-	-	-	3	
5	10212CS419	Computer Vision And Image Processing - Fundamentals And Applications	-	-	-	3	
6	10212CS404	Reinforcement Learning	-	-	-	3	
7	10212CS420	Deep Learning	-	-	-	3	
8	10212CS421	Machine Learning for Soil and Crop Management	-	-	-	3	
9	10212CS422	Algorithms in Computational Biology and Sequence Analysis	-	-	-	3	
10	10212CS423	Introduction to Large Language Models (LLMs)	-	-	-	3	
11	10212CS405	Responsible & Safe AI Systems	-	-	-	3	

Track : Artificial Intelligence and Data Science

Other branch students who want to complete minor in Artificial Intelligence/Data Science, have to complete the prerequisite course Data Structures, Database Management System and Data warehousing and Data mining in Open Electives Category

S.No	Course Code	Course Name	L	T	P	C	Pg. No
		Artificial Intelligence and Data Science - Core					
1	10212CS110	Optimization Techniques	3	0	0	3	138
2	10212CS113	Reinforcement Learning	3	0	0	3	140
3	10212CS123	Data Security and Privacy *	2	0	0	2	
4	10212CS210	Big Data Analytics	3	0	2	4	150
5	10212CS211	Artificial Intelligence Techniques	3	0	2	4	154
6	10212CS214	Data Visualization	3	0	2	4	159
7	10212CS215	Deep Learning	3	0	2	4	163
8	10212CS216	Natural Language Processing	3	0	2	4	166
9	10212CS217	Data Science	3	0	2	4	170
10	10212CS218	Modeling for Data Science	3	0	2	4	175
11	10212CS229	IoT and Cloud Computing	3	0	2	4	206
12	10212CS224	Computer Vision	3	0	2	4	196
13	10212CS276	Generative AI	1	0	2	2	315
Independent Learning Courses (MOOC/Swayam)							

S.No	Course Code	Course Name	L	T	P	C	Pg. No
1	10212CS416	Artificial Intelligence: Knowledge Representation And Reasoning	-	-	-	3	
2	10212CS417	Introduction to Machine Learning	-	-	-	3	
3	10212CS411	Deep Learning for Natural Language Processing	-	-	-	3	
4	10212CS424	Deep Learning For Visual Computing				3	
5	10212CS425	Essentials of Data Science With R Software-1: Probability and Statistical Inference	-	-	-	3	
6	10212CS426	Essentials of Data Science With R Software-2: Sampling Theory and Linear Regression Analysis	-	-	-	3	
7	10212CS427	Data Science for Engineers	-	-	-	2	
8	10212CS428	Data Analytics with Python	-	-	-	3	
9	10212CS429	Business Intelligence & Analytics	-	-	-	3	
10	10212CS423	Introduction to Large Language Models (LLMs)	-	-	-	3	
11	10212CS430	Predictive Analytics - Regression and Classification	-	-	-	3	
12	10212CS412	Machine Learning for Engineering and science applications	-	-	-	3	

Track : Artificial Intelligence and Robotics

Other branch students who want to complete minor in Artificial Intelligence/Robotics, prerequisite course is Digital Image Processing

S.No	Course Code	Course Name	L	T	P	C	Pg. No
		Artificial Intelligence and Robotics - Core					
1	10212CS211	Artificial Intelligence Techniques	3	0	2	4	154
2	10212CS215	Deep Learning	2	0	2	3	163
3	10212CS224	Computer Vision	3	0	2	4	196
4	10212CS281	Industry Internet of Things	3	0	2	4	
5	10212CS282	Robotics & Automation	3	0	2	4	
6	10212CS283	Industrial Automation	3	0	0	3	
*The proposed course subject to the approval/ratification in the upcoming BoS meetings							

PROGRAM CORE

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS101	DISCRETE MATHEMATICS	3	0	0	3

A. Preamble

This course aims to develop the skills on network mathematics, statements in logic, and decision–making problems. The course gives a hands–on exploration of the value of mathematics in the real world problems and it develops the knowledge to rectify the analytical problems and challenges in their field.

B. Prerequisite Course

10210MA102-Calculus and Ordinary differential equations

C. Course Objectives

Learners are exposed to:

To provide the fundamental concepts of logical statements sets, functions, permutations, recurrence relations, graphs, and algebraic structures.

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Apply the logical statements and validity of arguments	**K3**
CO2	Implement the concepts of sets and relations in computer science engineering problems	**K3**
CO3	Solve the practical problems in computer science courses using functions and recurrence	**K3**
CO4	Demonstrate the concepts of algebraic structures and its properties	**K3**
CO5	Use the basic knowledge of graph theory in developing the 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	PSO1	PSO2	PSO3
CO1	3			2								3		
CO2	3		2									3		
CO3	3			2								3		
CO4	3	2		2								3		
CO5	3		2	3								3		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Propositional and Predicate Logic **L-9 Hours**

Propositional Logic: Logical connectives – Truth tables – Tautologies and contradictions – Contrapositive – Logical equivalences and implications. Rules of inference: Validity of arguments. Predicate Logic: Predicates – Variables – Free and bound variables – Universal and Existential Quantifiers – Universe of discourse – Mathematical induction.

Unit 2 Sets and Relations **L-9 Hours**

Finite Sets, Power Set, Cardinality of finite sets, Infinite sets, Countable and Uncountable sets, Cartesian product, Properties of Sets. Relations: Relations on sets – Partitions – Equivalence relations – Partial ordering– Posets – well–ordering – Meet and Join – Hasse diagrams – Lattices – Boolean Algebra.

Unit 3 Functions and Recurrence **L-9 Hours**

Functions: Injective, Surjective and Bijective functions – Inverse of a function– Composition. Counting: Permutations and combinations – Sum and product rule, Principle of Inclusion Exclusion. Pigeon Hole Principle.Recurrence Relations: Linear recurrence relations with constant coefficients– methods of solutions –Generating Functions.

Unit 4 Systems and Groups **L–9 Hours**

Algebraic systems – Semigroups, Monoids, Submonoids, Groups, Abelian groups, Subgroups Cosets, permutation group, transpositions, cycle representation symmetries as a group. Homomorphism and Isomorphism, Lagrange's Theorem – Generators – Cyclic Groups.

Unit 5 Graph Theory **L– 9 Hours**

Definitions– degree of a vertex, walk–trail–path–cycle and connected graphs, Matrix representation of Graph, Isomorphism, Hamiltonian and Eulerian graphs, Trees, cut edges, cut vertices, spanning tree, shortest path problem – Warshall's Algorithm.

Total: 45 Hours

G. Learning Resources

i. Text Books:

1. Trembly J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw–Hill Pub.Co.Ltd, New Delhi, 2008.[Unit 1-5].

ii. Reference Books:

1. Ralph. P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", 4/e, Pearson Education Asia, Delhi, 2002.
2. Liu C. L., "Elements of Discrete Mathematics", 2/e, McGraw–Hill Int. editions, 1988.
3. Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, "Discrete Mathematical Structures", Pearson Education Pvt Ltd., New Delhi, 2003.
4. Kenneth H.Rosen, "Discrete Mathematics and its Applications", 5/e, Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 2003.

iii. Online References:

1. "Discrete Mathematics Shanghai". Accessed on April 22, 2021 [Online]. Available: https://www.coursera.org/learn/discrete-mathematics.
2. "Discrete Mathematics", 2013, Accessed on April 22, 2021 [Online]. Available: http://discrete.openmathbooks.org/dmoi3.html.

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS102	DATA STRUCTURES	3	0	0	3

A. Preamble

This course aims at molding the learner to understand the various data structures, their organization and operations. The course helps the learners to assess the applicability of different data structures and associated algorithms for solving real world problem.

B. Prerequisite Course

10210CS101 - Problem Solving using C.

C. Course Objectives

Learners are exposed to:

- Understand basic elementary data structures.
- Illustrate the basic properties of Trees and Graphs.
- Implement various techniques of sorting and searching algorithms.
- Choose efficient data structure and apply them to solve problems.

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Design modular algorithms to find solution for computational problem with time and space complexities using suitable linear data structure.	K3
CO2	Demonstrate the familiarity with tree data structure, rule to manipulate those, and their canonical applications.	K3
CO3	Solve unstructured problem using balanced search tree algorithm, hashing function.	K3
CO4	Implement an appropriate algorithm using graph ADT for an application.	K3
CO5	Apply sorting and searching techniques for real world 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	PSO1	PSO 2	PSO 3
CO1	3	3	3	2				1	1		3	3		

CO2	**3**	**3**	**3**	**2**				**1**	**1**		**3**	**3**		
CO3	**3**	**3**	**3**	**3**				**1**	**1**		**2**	**3**		
CO4	**3**	**3**	**3**	**3**				**1**	**1**		**3**	**3**	**2**	
CO5	**3**	**3**	**2**	**2**				**1**	**1**		**2**	**3**	**2**	

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Data Structure L-9 Hours

Introduction: Dynamic aspects of operations on data, Characteristics of data, Creation, Manipulation and Operations on data, Data Structure and its types, Abstract Data Types (ADTs), Analysis of algorithms and its Types, Asymptotic Notation. Arrays: Allocation, Operations and Storage with one-dimensional arrays and multidimensional arrays. Stacks: Operations on Stacks, Applications of Stacks, Queues: Operations and its types. Linked lists: Operations and Types of linked list (singly, doubly and circularly linked list), Implementation of Stack and Queue using linked list, Applications of Linked List.
Case Study: Tower of Hanoi, Sparse matrix.

Unit 2 Trees L-9 Hours

Introduction to Trees – Definitions and concepts, Representation of Binary Tree, Types of Binary tree, properties, structure and applications of binary tree, Binary Tree Traversal with Recursive and Non-Recursive - Expression Tree, Binary Search Trees – Definition, Properties and Operations of binary search tree. Priority Queue: Operations, Implementations- Heaps: properties and types of Heaps, Binary Heap: Representation, Declaration and Creation of Heap, Heapifying, Inserting and Deleting an element, Destroying Heap, Heap Sort. Case Study: Priority Queue in bandwidth management

Unit 3 Special Trees & Hashing L-9 Hours

AVL Tree: Properties, Declarations, Rotations, Insertion, Deletion. B-Tree: Properties, Insertion, Deletion –Trie: Insertion, Deletion, Searching. Hashing - Separate Chaining – Open Addressing – Linear Probing – Quadratic Probing – Double Hashing –Rehashing. Case Study: DNA sequence matching

Unit 4 Graphs L-9 Hours

Introduction to Graphs – Operations on graphs – Representation of Graph – Topological Sort - Graph Traversal - Depth first search – Breadth First Search – Minimum Spanning Tree – Prim's Algorithm- Kruskal's Algorithm – Disjoint subsets and Union-Find algorithms – Shortest Path Algorithms – Unweighted Shortest Paths –Dijkstra's Algorithm. Applications of Graphs. Case Study: Representing Google maps, Recommendations on e-commerce websites.

Unit 5 Sorting, Searching L-9 Hours

Searching Techniques: Linear Search, Binary Search.Sorting techniques: Insertion Sort,Selection sort, Merge sort, Quick Sort, Shell sort, Bubble sort, Counting sort, Bucket sort, Radix sort. Case Study: Tim Sort.

Total: 45 Hours

G. Learning Resources

i. Text Books:

1. M. A. Weiss, “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson Education, Reprinted edition 2013.[Unit 1,2,3]
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, “Fundamentals of Data Structure in C”, Universities Press,2017. [Unit 4,5]

ii. Reference Books:

1. V. Aho, J. E. Hopcroft, and J. D. Ullman, “Data Structures and Algorithms”, Pearson Education, First Edition, Reprint 2017.
2. R. F. Gilberg, B. A. Forouzan, “Data Structures”, Second Edition, Thomson India Edition, 2007.
3. Seymour Lipschutz, “Data Structures with C”, Scham’s outlines, Tata McGraw Hill, 2017.

iii. Online References:

1. “Introduction to Data Structures and Algorithms” 31.12.2009. Accessed on Apr. 20, [Online]. Available: https://nptel.ac.in/courses/106/102/106102064/.
2. “Data Structures and algorithms”. Accessed on: Apr. 15, 2021 [Online]. Available: https://www.coursera.org/specializations/data-structures-algorithms.
3. “Data structures Visualization” 2011. Accessed on: Apr. 15, 2021 [Online]. Available: https://www.cs.usfca.edu/~galles/visualization/Algorithms.html
4. “Data Structures Fundamentals” 2021, Accessed on: Apr. 20,2021 [Online]. Available: https://www.edx.org/course/data-structures-fundamentals

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS103	OPERATING SYSTEMS	3	0	0	3

A. Preamble

This course provides discussion about Operating systems kernel architecture, address spaces, system call interface, processes & threads, inter process communication, CPU scheduling deadlock, scheduling, main memory, virtual memory and file systems. This course aims to understand how Operating system makes computer system convenient to use in an efficient manner.

B. Prerequisite Course

10211CS102 - Data Structures

C. Course Objective

Learners are exposed to:

- Recognize operating Systems basic concepts, structures and System Calls.
- Apply process management concepts and Synchronization techniques.
- Learn different CPU scheduling algorithms and Deadlock Handling methods.
- Understand Various Memory and File management techniques.

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Describe the operating system structures, operations and system calls.	K2
CO2	Demonstrate process management concepts and process synchronization methods for real time problems.	K3
CO3	Illustrate CPU scheduling algorithms and deadlock handling methods for the given situation.	K2
CO4	Explain the concepts of various memory management techniques.	K2
CO5	Discussthe concepts of disk management and file system interface.	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	PSO1	PSO2	PSO3
CO1	3													
CO2	2	3	2	1								2		
CO3	1	3	3	1								2		
CO4	2	3	3									3		

CO5	**3**	**3**	**3**									**2**		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Structure and Overview of Operating Systems **L-8 Hours**

Operating system overview: Objectives – functions - Computer System Organization - Operating System Operations- System Calls, System Programs-Operating- System Structure: Traditional UNIX system structure-The Mac OS X structure - Architecture of Google's Android.

Unit 2 Process Management **L-10 Hours**

Processes: Process Concept – Threads - Process Scheduling - Operations on Processes – Inter process Communication - Communication in Client–Server Systems-Pipes (RPC, Pipes) - Process Synchronization: The Critical-Section Problem - Semaphores – Mutex Locks- Classic Problems of Synchronization – Monitors. Case Study: Windows Threads and Linux Threads

Unit 3 CPU Scheduling and Deadlock Management **L-9 Hours**

CPU Scheduling: Scheduling Criteria - Scheduling Algorithms. Deadlocks: Deadlock Characterization - Methods for Handling Deadlocks - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock. Case Study: Real Time CPU scheduling

Unit 4 Memory Management **L-9 Hours**

Main Memory: Swapping - Contiguous Memory Allocation, Segmentation, Paging - Structure of the Page Table - Virtual Memory: Demand Paging - Page Replacement - Allocation of Frames – Thrashing. Case study: Virtual machine

Unit 5 Storage Structure & File Systems **L-9 Hours**

Mass Storage Structure: Disk Structure - Disk Scheduling - Disk Management-Structure - File-System Interface: File Concepts -Directory Structure - File Sharing – Protection- File Allocation Methods-NFS. Case study: Recovery in Windows.

Total: 45 Hours

G. Learning Resources

i. Text Book:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2016.[Unit 1-5]

ii. Reference Books:

1. Andrew S. Tanenbaum, "Modern Operating Systems", 4th Edition, Prentice Hall, Wesley, 2014.
2. Operating Systems: Principles and Practice (2nd Edition), by Thomas Anderson and Michael Dahlin.

iii. Online Resources:

1. "Learn Operating System" Accessed on: April 21, 2021 [Online]. Available:https://www.tutorialspoint.com/operating_system/index.htm
2. Prof.Santanu Chattopadhyay, "Operating System Fundamentals" July 25,2019. Accessed on: April 21, 2021 [Online]. Available:https://nptel.ac.in/courses/106/105/106105214/

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS129	MODERN COMPUTER ARCHITECTURE	3	0	0	3

A. Preamble

This course specially focuses on the basic structure and functional units of a digital computer. It will explore the interaction of hardware and software and consider the efficient use of hardware to achieve high performance. Moreover, this course describes the analysis of different computer architectures and their applications. The topics of distributed computing architecture, High Performance Computing and CUDA Programming model are presented.

B. Prerequisite Course

10211CS201-Digital Electronics

C. Course Objectives

Learners are exposed to:

- Understand basic principles of Computer Systems.
- Explain various logic design techniques and their applications.
- Use high performance computing architecture.
- Implement CUDA Programming model for Parallel computing

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 organization of the Control unit, Arithmetic and Logical unit, Memory unit and the I/O unit.	**K2**
CO2	Analyse different computer architectures and applications.	**K3**
CO3	Explain modern design structures of Pipelined and Multiprocessors systems.	**K2**
CO4	Know distributed computing architecture and high-performance computing.	**K2**
CO5	Implement the CUDA Programming model for Parallel computing.	**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	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3			1						1		

CO2	3	3	2			1						1		
CO3	3	3				1								
CO4	3	3				1								
CO5	3	3	3	3	1	1								3

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Basic Structure of a Computer System **9 Hours**

Functional Units, Basic Operational Concepts, Instructions, Instruction's cycle, Memory reference instruction, I/O interruption, Adder and Subtractor circuits, Booth Multiplication Algorithm, Pipelining Review, control hazards and the motivation for caches, cache characteristics and superscalar architecture basics.

Unit 2 Multi Core Architecture **9 Hours**

Memory technologies, hierarchical memory systems, the locality principle and caching, direct- mapped caches, block size, cache conflicts, associative caches, write strategies, advanced optimisations, performance improvement techniques, DRAM – organization, access techniques, scheduling algorithms and signal systems. Tiled Chip Multicore Processors (TCMP), Network on Chips (NoC), NoC router – architecture, design, routing algorithms and flow control techniques, Advanced topics in NoC and storage – compression, prefetching, QoS.

Unit 3 Distributed Computing Systems and Concurrency **9 Hours**

Relation to Parallel Multiprocessors/multicomputer Systems, Distributed and Concurrent Programs, Message Passing vs. Shared Memory Systems, Synchronous vs. Asynchronous Executions, Design Issues and Challenges, Distributed Computing Technologies, Clocks and Synchronization, Coordination and Agreement Algorithms, Global State and Distributed Transactions.

Unit 4 High Performance Computing (HPC) **9Hours**

HPC Architecture, Parallel Processing, Parallel Memory Models, Data vs. Task Parallelism, High Throughput Computing, Vectorization, Multithreading.

Unit 5 High Performance Computing with CUDA **9 Hours**

CUDA programming model, Basic principles of CUDA programming, Concepts of threads and blocks, GPU and CPU data exchange.

Total: 45 Hours

G. Learning Resources

i. Text Books:

1. Hamacher,V.C., Vranesic, Z.G., and Zaky, S.G., "Computer Organization", 5/e. McGraw-Hill. 2014. [Unit- 1,2]
2. Patterson, D.A., and Hennessy, J.L. , "Computer Architecture : A Quantitative Approach ", Morgan Kaufmann Publishers, , Inc.2017.[Unit -3, 4,5]

ii. Reference Books:

1. Patterson, D.A., and Hennessy, J.L. , “Computer Organization and Design: The Hardware/Software Interface”, Morgan Kaufman Publishers, 5th Edition, Inc.2013
2. Stalling W, “Computer Organization and Architecture ”, Pearson Education India. 10th Edition, 2016
3. Parallel Computer Architecture: A Hardware/Software Approach David Culler and J.P. Singh with Anoop Gupta, Morgan Kaufmann, 1998.

iii. Online References:

1. Computer Architecture and Organisation” June, 8, 2017. Accessed on April, 20, 2021 [Online]. Available: https://nptel.ac.in/courses/106/105/106105163/
2. “Introduction to Computer Architecture “ January, 1, 2017. Accessed on June, 30, 2021 [Online]. Available: https://nptel.ac.in/courses/106/102/106102157/ https://onlinecourses.nptel.ac.in/noc20_cs41/preview
3. High-performance-computing[Online] Available: https://www.coursera.org/learn/introduction-high-performance-computing#syllabus
4. “GPU Architectures and Programming“ April, 17, 2020. Accessed on December, 14, 2022 Available: https://onlinecourses.nptel.ac.in/noc20_cs41/preview

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS105	COMPUTER NETWORKS	3	0	0	3

A. Preamble

This course is to provide students with an overview of the concepts and fundamentals of computer networks. Topics to be covered include: data communication concepts and techniques in a layered network architecture, communications switching and routing, types of communication, network congestion, network topologies, network configuration and management, network model components, layered network models (OSI reference model, TCP/IP networking architecture) and their protocols, various types of networks and their protocols.

B. Prerequisite Course

10210CS101 -Problem Solving Using C

C. Course Objectives

Learners are exposed to:

- Build an understanding of the fundamental concepts of computer networking, protocols, architectures, and applications.
- Understand the division of network functionalities into layers.
- Learn the flow control and error control mechanisms.
- Obtain the skills of subnetting and routing mechanisms.
- Explain the transport layer and application layer protocols.

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Discuss the basic fundamentals of networks for data communication and protocol Layering.	K2
CO2	Know the various techniques and standards of analog and digital data communication and its standards.	K2
CO3	Apply various error detection, correction and flow control techniques for efficient transmission of data.	K3
CO4	Interpret the functions and protocols of network and transport layer.	K2
CO5	Outline the various protocols of application layer.	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	PSO1	PSO2	PSO3
CO1	3	2		2								3		

CO2	**3**	**2**		**2**								**2**		
CO3	**3**	**3**		**2**								**2**		
CO4	**2**	**3**		**2**								**2**		
CO5	**3**	**2**										**3**		

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Introduction **L- 9 Hours**

Data Communication: system components (Passive and Active)-Topology-Network Models: -Physical and Logical Addressing- Data and Signals - Transmission Impairment - Data rate and Channel capacity-OSI-TCP /IP- Quality of Service.

Unit 2 Physical Layer **L- 9 Hours**

Transmission Media: Guided Media - Unguided Media -Digital Transmission - Digital-To -Digital Conversion - Analog Transmission - Digital-To-Analog Conversion - Wireless - Wired LANs: Ethernet - Token ring - Connecting Devices – Switching techniques – Bandwidth Metrics.

Unit 3 Data Link Layer **L-9 Hours**

Link Layer: Types of errors –Error detection- VRC, LRC, CRC andChecksum techniques - Data Forward and backward error correction - Hamming code. Flow control: stop and wait- sliding window protocol, Error control: Stop and wait ARQ- Go-Back-N ARQ- Selective Repeat ARQ Protocols-Asynchronous and Synchronous Protocol- Logical Link Control protocols: HDLC, ALOHA and FDDI.

Unit 4Network layer, Transport Layer **L-9 Hours**

Logical Addressing: Addressing Methods - IPV4 - IPV6 - Frame Format - IPV6 implementation scenarios and challenges – ARP– RARP - DHCP – ICMP - Unicast Routing Protocols – Intra and Interdomain Routing - Distance Vector Routing - Link State Routing-Transport Layer: Process-to-Process Delivery: UDP – TCP - Congestion Control Techniques - Techniques to Improve QoS.

Unit 5 Application Layer and Network Security **L-9 Hours**

Session Layer: Functions-Protocols: Winsock, Socket-Remote Procedure Call-Presentation Layer: Functions- Compression Techniques: Lossy and Lossless - Application layer protocols: REMOTE LOGGING - TELNET -EMAIL– DNS – FTP -HTTP – SDN-Introduction-Security Fundamentals.

Total: 45 Hours

G.Learning Resources

i. Text Books:

1. Behrouz Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 5th Edition,2021. (Reprinted) [Unit 1- 5]

ii. Reference Books:

1. Kurose and K.W. Ross, “Computer Networking: A Top-Down Approach Featuring the Internet”, Addison-Wesley,2017
2. Andrew S. Tanenbaum, David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2013.
3. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud,5th Edition,2017

iii. Online References:

1. “Computer Communication Specialization” Course Era [online] 2019.Available:https://www.coursera.org/specializations/computer-communications
2. “Introduction to Networking” edx [online]2020,Available: https://www.edx.org/course/introduction-to-networking
3. “Computer Networking”Udacity [online] 2020, Available: https://www.udacity.com/course/computer-networking--ud436
4. “Computer Networks and Internet Protocol” NPTEL [online] 2018, Available: https://nptel.ac.in/courses/106/105/106105183/

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS130	FUNDAMENTALS OF COMPUTER NETWORKS	3	0	0	3

A. Preamble

This course is to provide students with an overview of the concepts and fundamentals of computer networks. Topics to be covered include: data communication concepts and techniques in a layered network architecture, communications switching and routing, types of communication, network congestion, network topologies, network configuration and management, network model components, layered network models (OSI reference model, TCP/IP networking architecture) and their protocols, various types of networks and their protocols.

B. Prerequisite Courses

10210CS101-Problem Solving Using C

C. Course Objectives

Learners are exposed to

- Build an understanding of the fundamental concepts of computer networking, protocols, architectures, and applications.
- Understand the division of network functionalities into layers.
- Learn the flow control and error control mechanisms.
- Obtain the skills of subnetting and routing mechanisms.
- Explain the transport layer and application layer 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 basic fundamentals of networks and discuss the various techniques and standards of analog and digital data communication.	K2
CO2	Apply various error detection, correction and flow control techniques for efficient transmission of data.	K3
CO3	Interpret the functions and protocols of network layer.	K3
CO4	Explain the functions and protocols of transport layer.	K3
CO5	Understand the various protocols of application layer.	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	PSO1	PSO2	PSO3
CO1	3	2		2				2				2		
CO2	3	2		2				2				2		
CO3	3	3		2				2				3		
CO4	2	3		2				2				2		
CO5	3	2						2						

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction and Physical Layer **L-9 Hours**

ISO/OSI - TCP/IP Protocol suite, Data Communication-system components – Topology-Transmission ImpairmentTransmission Media: Guided Media - Unguided Media - Wireless - Wired LANs: Ethernet - Token ring - Connecting Devices – Switching techniques – Bandwidth Metrics.

Unit 2 Data Link Layer **L-9 Hours**

Types of errors –Error detectionand correction techniques, Flow control mechanism, Multiple access protocols, Link layer addressing. Media Access Control – frame format, types, cloning. IEEE 802.3 – frame format, types.

Unit 3 Network layer **L-9 Hours**

Logical Addressing: Addressing Methods –Classfull addressing - IPV4 – Public and private addressing.Classless addressing - IPV6 - Frame format –Subnetting -Supernetting, CIDR.Inter/Intra networks,ARP– DHCP – ICMP – IGMP - SNMP. Unicast Routing Protocols – Intra and Interdomain Routing - Distance Vector Routing - Link State Routing. RIP, OSPF.

Unit 4 Transport Layer **L-9 Hours**

Transport Layer: Process-to-Process Delivery: UDP – TCP - Congestion Control and Flow control Techniques - Quality of Service - Techniques to Improve QoS, merits and de-merits.

Unit 5 Application Layer **L-9 Hours**

Session Layer: Functions-Protocols: Winsock, Socket-Remote Procedure Call-Presentation Layer: Functions- Compression Techniques: Lossy and Lossless - Application layer protocols: REMOTE LOGGING – TELNET/SSH -EMAIL– DNS – FTP/TFTP– IPSec - HTTP/HTTPS – SDN.

Total: 45 Hours

G. Learning Resources

i.Text Books:

1. Behrouz Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 5th Edition,2021. (Reprinted) (Unit 1 to 5)

ii.Reference Books:

1.Kurose and K.W. Ross, “Computer Networking: A Top-Down Approach Featuring the Internet”, Addison-Wesley,2017

2. Andrew S. Tanenbaum, David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2013.

3. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud,5th Edition,2017

iii.Online References:

1.“Computer Communication Specialization” Course Era [online] 2019. Available:https://www.coursera.org/specializations/computer-communications

2.”Introduction to Networking” edx [online]2020,Available: https://www.edx.org/course/introduction-to-networking

3.“Computer Networking”Udacity [online] 2020, Available: https://www.udacity.com/course/computer-networking--ud436

4.“Computer Networks and Internet Protocol” NPTEL [online] 2018, Available: https://nptel.ac.in/courses/106/105/106105183/

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS106	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

10211CS101- Discrete Mathematics

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-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	PSO3
CO1	3	3	3		3							3		
CO2	3	3	3		3							3		
CO3	3	3	2	1	3							3		

CO4	**3**	**3**	**3**	**3**	**3**							**3**		
CO5	**3**	**3**	**2**	**2**								**3**		

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Formal Languages and Finite Automata L-10Hours

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 andHalting 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 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
10211CS107	COMPILER DESIGN	3	0	0	3

A.Preamble

This course introduces the basic concepts and mechanisms that are employed in language translators, with emphasis on compilers. It aims to provide the theory and practice of compilation, in particular, the lexical analysis, parsing, intermediate code generation, techniques of code optimization and approaches towards code generation.

B.Prerequisite Course

10211CS106 - Formal Languages and Automata Theory

C.Course Objectives

Learners are exposed to:

- Understand the structure of a compiler with the sequence of translation of input for each phase.
- Analyze the regular languages to describe the lexical elements of a programming language.
- Develop the syntactic structure of a programming language using the context free language and design the top-down and bottom-up parsers.
- Break down the statements and expressions to form and implement the intermediate code.
- Optimize the intermediate code of a program to machine-specific instructions to generate target code.

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 different phases of compilation with compile time error handling and design the lexical analyzer for a language.	K3
CO2	Develop appropriate top down and bottomup parser to produce parse tree representation of the input.	K3
CO3	Generate intermediate code for decision control and looping control statements in high level language.	K3
CO4	Apply various optimization techniques with basic blocks of the intermediate code through global data flow analysis.	K3
CO5	Design DAG representation for basic blocks and target low level language for high level language	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	PSO3
CO1	3	3	1		2							3		
CO2	3	2	1		1							3		
CO3	3	3										3		
CO4	3	3										3		
CO5	3	3	1									3		

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Compilers and Lexical Analysis **L-9 Hours**

Compilers – Interpreters – Analysis of the source program –Cousins of the Compiler – Grouping of Phases – Phases of a compiler – Compiler construction tools – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Recognition of Tokens – Specification of Tokens. Design of a Lexical Analyzer Generator.

Case Study: Lexical Analyzer for separating tokens, Counting whitespace, special characters and newline character, Pattern Matching of strings – use relevant tool.

Unit 2 Syntax Analysis and Parser **L-9 Hours**

Need and Role of the parser –Writing Grammars – Context-Free Grammars – Top Down parsing – Recursive Descent Parsing – Predictive Parsing – Bottom-up parsing – Shift Reduce Parsing – Operator Precedence Parsing – LR Parsers – SLR Parser – Canonical LR Parser – LALR Parser.

Case Study: Specification for desktop calculator, Error recovery of ambiguous arithmetic grammar, Syntax Analyzer for looping construct - use relevant tool.

Unit 3 Intermediate Code Generation **L-9 Hours**

Intermediate languages – Implementation of Three Address Code – Types and Declarations – Type Checking – Assignment Statements – Boolean Expressions – Switch Case Statements – Back patching – Procedure calls.

Case Study: Intermediate code for Array references with subscripts, Intermediate code for decision making and looping constructs of C, Intermediate code for Expression Parsing.

Unit 4 Code Optimization **L-9 Hours**

Principal Sources of Optimization – Introduction to Data Flow Analysis – Constant propagation – Loops in Flow Graphs – Runtime Environments – Source Language issues – Storage Organization – Storage Allocation – Access to Nonlocal data - Local optimization- Global optimization.

Case Study: Implement code optimization methods using relevant data structures.

Unit 5 Code Generation **L-9 Hours**

Issues in the design of code generator – The target machine – Register Allocation and Assignment- Basic Blocks and Flow Graphs – Optimization of basic Blocks – A Simple Code Generator – DAG representation of Basic Blocks – Code Generation from DAG - Heuristic Reordering - Labeling - Next-use Information – Peephole Optimization.

Case Study: Graph coloring application using Register Allocation, Generate Target code for Binary tree operations.

Total: 60 Hours (L)

G.Learning Resources

i. Text Books:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, and Jeffrey D. Ullman, Compilers –Principles Techniques and Tools, Pearson, Second Edition, 2013. [Unit 1-5].

ii. Reference Books:

1. Kenneth C. Louden, Compiler Construction –Principles and Practice, Cengage Learning Indian Edition, 2006.
2. Grune D, Bal H, Jacobs C, Langendoen K, Modern Compiler Design, Wiley, 2000
3. Cooper K, Torczon L, Engineering a Compiler, Morgan Kaufmann, Second Edition, 2011

iii. Online References:

1. "COMPILER DESIGN" Sep. 25, 2014. Accessed on: Feb. 16, 2021 [Online]. Available: https://nptel.ac.in/courses/106/105/106105190/
2. "LEX & YACC TUTORIAL by Tom Niemann" Oct. 24, 2013. Accessed on: Apr. 20, 2021 [Online]. Available: https://cse.iitkgp.ac.in/ ~bivasm/ notes/ LexAndYacc Tutorial.pdf
3. "Compiler Design", Nov. 2019. Accessed on: Apr. 20, 2021 [Online]. Available: https://www.udemy.com/course/compiler-design-n/

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS109	MICROPROCESSOR AND MICROCONTROLLER	2	0	0	2

A.Preamble

Microprocessors are a core course in the stream of Computer Science & Engineering. The objective of this course is to explore the concepts of hardware and software part of a microprocessor. It includes the architecture of 8086 Microprocessor and latest ARM processor architecture. This course covers ARM processor programming with interfacing techniques and equivalent assembly language code for high level language instructions like 'C'.

B.Prerequisite Course

10211CS201–Digital Electronics

C.Course Objective

Learners are exposed to:

D.Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Know the architecture of 8086 microprocessor and its basic configuration.	K2
CO2	Develop assembly language programs for the given problems using 8086 processor.	K3
CO3	Understand ARM processor architecture and the principle of its debug system.	K2
CO4	Develop programs for the problems specified using ARM processor instructions.	K3
CO5	Establish interfacing of I / O devices with ARM processor to develop 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	PSO1	PSO2	PSO3
CO1	3	3												
CO2	3	2			3							2		
CO3	3	2												
CO4	3	2			3							3		
CO5	3		3		3							3		

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Microprocessor Architecture – 8086 **L-6Hours**

Introduction – Types of computers – Evolution of Microprocessor – 8086 Microprocessor architecture – 8086 Programming method — program development tools – Interrupts and interrupt service procedures - 8086 signals – Basic configurations – System connections –Timing – Troubleshooting – Assembler directives - Introduction to OpenRISC Architecture.

Unit 2 Programming In 8086 **L-6Hours**

Assembly language programming – Addressing modes – Instruction set: Data transfer instructions – arithmetic and logical instructions – Branch instructions — Loop instructions – While – Do programs – Strings – Procedures – Macros.

Unit 3 Arm Processor Architecture **L-6Hours**

Cortex – M architecture – Block diagram –pipelined architecture – memory address map – bus system and bus matrix – memory and peripherals: memory endianness – bit banding – system stack architecture – debug system: AHB access port, FPB, DWT, ITM, ETM, TPIU – conditional execution – interrupts: exception and interrupt handling.

Unit 4 Arm Processor Programming **L-6Hours**

Addressing modes – ARM instruction sets: thumb instruction set – ADD and MOV data processing instructions – LDR and STR memory access instructions – data processing instructions – bitfield instructions – branch and control instructions – recursive functions If-Then conditional instructions – reset sequence – instruction encoding.

Unit 5Arm Processor Interfacing **L-6Hours**

TM4C123 microcontroller block diagram – GPIO features – peripherals on the memory map – GPIO pin configuration – LED and switch interfacing – keypad interfacing – I/O synchronization – polling – interrupt driven – processor interrupt configuration – interrupt based interfacing – Timer: timer as I/O device – external event counter – input capture device – general purpose timer modules – serial communication interface – I^2C interface – SPI interface – CAN interface.

Total: 30Hours (L)

G.Learning Resources

i. Text Books:

1. Doughlas V. Hall, “Microprocessors and Interfacing”, TMH, Revised second edition, 2005. [Unit 1-2]
2. Muhammad Tahir, Kashif Javed, “ARM Microprocessor Systems: Cortex-M Architecture, Programming, and Interfacing”, CRC Press, Taylor & Francis group, 2017. [Unit 3-5]

ii. Reference Books:

1. Andrew N. Sloss, “ARM system developer’s guide – Designing and optimizing system software”, ELSEVIER, 2004.
2. Charles M. Gilmore, “Microprocessors: Principles and applications”, TMH, Second edition, 1995.
3. Jonathan W. Valvano, “Embedded microcomputer systems: Real time interfacing”, CENGAGE Learning, Third edition, 2012.
4. Steve Furber, “ARM system-on-chip architecture”, Pearson education, Second edition, 2015.

iii. Online References:

1. “Microprocessor interfacing”, Accessed on Sep 20, 2022 [Online], Available: https://onlinecourses.nptel.ac.in/noc20_ee11/preview.
2. “Microprocessors and Digital systems”, Accessed on Sep 21, 2022 [Online], Available: https://archive.org/details/microprocessorsd0000hall/page/n3/mode/2up.
3. “ARM processor architecture”, Accessed on Sep 21, 2022 [Online], Available: https://www.cs.ccu.edu.tw/~pahsiung/courses/ese/notes/ESD_03_ARM_Architecture.pdf.

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS111	IMAGE PROCESSING	2	0	0	2

A.Preamble

Image processing is a core course in the stream of Computer Science & Engineering. This course provides an introduction to basic concepts, methodologies and algorithms of digital image processing focusing on the following two major problems concerned with digital images: (1) image enhancement and restoration for easier interpretation of images, and (2) image analysis and object recognition. Some advanced image processing techniques (e.g., wavelet and multiresolution processing) will also be studied in this course.

B.Pre-requisite course

10210MA101- Linear Algebra for Computing

C.Course Objectives

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 theoretical foundations for image processing techniques.	K2
CO2	Apply image transformations and enhancement techniques to improve the quality of real time images.	K3
CO3	Compare various filters for image restoration and construction techniques.	K2
CO4	Interpret the various image compression techniques.	K3
CO5	Use the image segmentation and representation techniques to detect object.	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	PSO3
CO1	3				1									1
CO2	3	3		3	2							3		1
CO3	3	3			1									1
CO4	2	3		3	1							3		1
CO5	3	2		2								2		

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Digital Image Fundamentals L-6 Hours

Need for Digital Image processing - Fundamentals steps in Digital Image Processing, Components of Image Processing Systems, Elements of visual perception - Light and Electromagnetic spectrum, Image sensing and acquisition, Simple image formation model, Image file formats, Image sampling and quantization, Basic relationship between pixels.

Case study: Basic operation on image

Unit 2 Image Transforms and Enhancement L- 6 Hours

Properties and Examples of 2D Orthogonal and Unitary Transforms, Hadamard Transform, Haar Transform, Fourier Transform, KL Transform, Discrete wavelet Transform- and its application in Compression, Image Enhancement in spatial and frequency domain: Histogram processing,Smoothing, Sharpening. Case study: Medical image diagnosis

Unit 3 Image Restoration and Reconstruction L-6 Hours

Image Restoration: Image Degradation and Observation Model, Unconstrained and constrained restorations, Detector and Recorder model noise model, Inverse filtering, Pseudo inverse filtering, Wiener Filtering, SVD , Blind Deconvolution, Image Reconstruction from Projections,Back projection operator- Projection Theorem, Principles of Computed Tomography, Projections and the Radon transform. Case study: Biometric analysis

Unit 4 Image Compression L-6 Hours

Image Compression: Need for data compression - Fundamentals, Compression Models, Loss Less and Lossy. Loss Less: Variable Length, LZW coding, Huffman, Lossy: Predictive Coding, Transform coding, Wavelet coding, JPEG Standard. Case study: Climatic data analysis

Unit5 Image Segmentation And Representation L-6 Hours

Fundamentals, Detection of Discontinuities, Point, link and line detection. Edge Linking and Boundary detection, Local and Global processing. Thresholding, Region based segmentation; Region growing, splitting and merging. Representation - Boundary descriptors, Simple Descriptors, Shape numbers, Regional descriptors, Simple and Topological Descriptors, Texture.

Part-1

Use Cases:

- ➞ To analyze the impact of image preprocessing techniques on real time data
- ➞ To analyze the effect of segmentation algorithms
- ➞ Analyze face image data through image processing techniques
- ➞ Plant crop detection using image segmentation
- ➞ Medical image analysis through morphological operations

Total: 30 Hours

G.Learning Resources

i. Text Books:

1. Rafael C Gonzalez, Richard E Woods, Digital Image Processing, Pearson Education, 4th edition, 2018. [Unit 1-5].

ii. Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,' Digital Image Processing using MATLAB', Pearson Education, Inc., 2004.
2. Rick Szelisk, “Computer Vision: Algorithms and Applications”, Springer 2011.
3. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, First Edition, PHI Learning Pvt. Ltd., 2011.

iii. Online References:

1. “Fundamentals of Digital Image and Video Processing”, 2016, Accessed on June 20, 2021. [Online]. Available: https://www.coursera.org/learn/digital.
2. “Digital Image Processing”, 2017, Accessed on June 20, 2021, https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee75/.

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS118	IMAGE PROCESSING TECHNIQUES	3	0	0	3

A.Preamble

Image processing is a core course in the stream of Computer Science & Engineering. This course provides an introduction to basic concepts, methodologies and algorithms of digital image processing focusing on the following two major problems concerned with digital images: (1) image enhancement and restoration for easier interpretation of images, and (2) image analysis and object recognition. Some advanced image processing techniques (e.g., wavelet and multiresolution processing) will also be studied in this course.

B.Pre-requisite course

10210MA101- Linear Algebra for Computing

C.Course Objectives

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 theoretical foundations for image processing techniques.	K2
CO2	Apply image transformations and enhancement techniques to improve the quality of real time images.	K3
CO3	Compare various filters for image restoration and construction techniques.	K2
CO4	Interpret the various image compression techniques.	K3
CO5	Use the image segmentation and representation techniques to detect object.	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	PSO3
CO1	3				1									1
CO2	3	3		3	2							3		1
CO3	3	3			1									1
CO4	2	3		3	1							3		1
CO5	3	2		2								2		

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Digital Image Fundamentals L-9 Hours

Need for Digital Image processing - Fundamentals steps in Digital Image Processing, Components of Image Processing Systems, Elements of visual perception - Light and Electromagnetic spectrum, Image sensing and acquisition, Simple image formation model, Image file formats, Image sampling and quantization, Basic relationship between pixels.

Case study: Basic operation on image

Unit 2 Image Transforms and Enhancement L- 9 Hours

Properties and Examples of 2D Orthogonal and Unitary Transforms, Hadamard Transform, Haar Transform, Fourier Transform, KL Transform, Discrete wavelet Transform- and its application in Compression, Image Enhancement in spatial and frequency domain: Histogram processing,Smoothing, Sharpening. Case study: Medical image diagnosis

Unit 3 Image Restoration and Reconstruction L-9 Hours

Image Restoration: Image Degradation and Observation Model, Unconstrained and constrained restorations, Detector and Recorder model noise model, Inverse filtering, Pseudo inverse filtering, Wiener Filtering, SVD , Blind Deconvolution, Image Reconstruction from Projections,Back projection operator- Projection Theorem, Principles of Computed Tomography, Projections and the Radon transform. Case study: Biometric analysis

Unit 4 Image Compression L-9 Hours

Image Compression: Need for data compression - Fundamentals, Compression Models, Loss Less and Lossy. Loss Less: Variable Length, LZW coding, Huffman, Lossy: Predictive Coding, Transform coding, Wavelet coding, JPEG Standard. Case study: Climatic data analysis

Unit5 Image Segmentation And Representation L-9 Hours

Fundamentals, Detection of Discontinuities, Point, link and line detection. Edge Linking and Boundary detection, Local and Global processing. Thresholding, Region based segmentation; Region growing, splitting and merging. Representation - Boundary descriptors, Simple Descriptors, Shape numbers, Regional descriptors, Simple and Topological Descriptors, Texture.

Part-1

Use Cases:

- ➞ To analyze the impact of image preprocessing techniques on real time data
- ➞ To analyze the effect of segmentation algorithms
- ➞ Analyze face image data through image processing techniques
- ➞ Plant crop detection using image segmentation
- ➞ Medical image analysis through morphological operations

Total: 45 Hours

G.Learning Resources

i. Text Books:

1. Rafael C Gonzalez, Richard E Woods, Digital Image Processing, Pearson Education, 4th edition, 2018. [Unit 1-5].

ii. Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,' Digital Image Processing using MATLAB', Pearson Education, Inc., 2004.
2. Rick Szelisk, “Computer Vision: Algorithms and Applications”, Springer 2011.
3. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, First Edition, PHI Learning Pvt. Ltd., 2011.

iii. Online References:

1. “Fundamentals of Digital Image and Video Processing”, 2016, Accessed on June 20, 2021. [Online]. Available: https://www.coursera.org/learn/digital.
2. “Digital Image Processing”, 2017, Accessed on June 20, 2021, https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee75/.

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS120	MACHINE LEARNING	3	0	0	3

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

Learners are exposed to:

- Apply the concepts of supervised and unsupervised learning algorithms for real time applications
- Experiment 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 data mining and machine learning concepts	K2
CO2	Apply pre-processing techniques and explore the using visualization techniques	K3
CO3	Implement various algorithms of Regression and Classification.	K3
CO4	Use the concept of neural networks for learning linear and non-linear activation functions	K3
CO5	Experiment various clustering algorithms to solve real time 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	PSO1	PSO2	PSO3
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			2	2	

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction **L-9 Hours**

Introduction to Data mining and Knowledge Discovery – Data – Data Mining Functionalities – Architecture of Typical Data Mining systems - Classification of Data Mining Systems – Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining. Mining Machine Learning -Types of machine learning– Model selection and generalization- Evaluation Metrics -Perspectives and Issues in Machine Learning – Concept Learning Task- FINDS-Candidate Algorithm – Applications of Data Mining and Machine Learning.

Unit 2 Data Preparation **L-9 Hours**

Data Pre-processing- Needs of Pre-processing - Data Cleaning, Data Integration and Transformation, Data Reduction – Exploratory Data Analysis - Dimensionality Reduction – Feature Extraction- Variable Selection- Variable ranking- Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis –Cross Validation –Resampling methods – Visualization of Data.

Unit 3 Association and Classification **L-9 Hours**

Linear Regression – Multiple Regression - Bayesian Classification –Support Vector Machines - Logistic Regression - Decision Trees – Univariate Tree – Multivariate Tree –ID3- Regression Trees - Random forest- Probability and Learning – Gaussian Mixture Models – Nearest Neighbour Methods.

Unit 4 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 – Application of MLP – Overview – Deriving Back-Propagation- Optimization- Hyper parameter tuning.

Unit 5 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 and Divisive Clustering -BIRCH - ROCK- Chameleon - Fuzzy Clustering- Fuzzy C-means algorithm.

Total:45 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

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS201	DIGITAL ELECTRONICS	2	0	2	3

A.Preamble

The primary aim of this course is to understand the fundamentals behind the digital logic design. From that student can gain the experience, to design any digital circuits and systems. The course includes fundamentals of Boolean algebra, combinational, sequential circuits and applications of digital electronics. Students can learn the basic programming concepts to implement digital circuits using hardware description language. The course outcome will be helpful to learn the concepts of computer architecture and organization.

B.Prerequisite Course

10210EE201 - Basic Electrical, Electronics & Measurement Engineering

C.Course Objectives

Learners are exposed to:

- Learn the basic Logic Gates
- Design of Combinational Circuits
- Apply Sequential Circuits Concepts
- Implement the Applications using sequential and combinational circuits

D.Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Apply the simplification of Boolean expressions using various mapping and mathematical methods.	K3/S3
CO2	Solve binary arithmetic operations using Combinational Circuits along with VHDL code using software tools.	K3/S3
CO3	Design synchronous counters and develop sequential circuit applications using flip flop and registers.	K3/S3
CO4	Demonstrate the variety of asynchronous sequential circuit design styles with respect to circuit properties.	K3/S3
CO5	Discuss the various applications of digital electronics.	K2/S3
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	PSO3
CO1	3	3			3							3		
CO2	3	3	3		3							3	1	
CO3	3	2	3		3									
CO4	3	3	3		3									
CO5	3	3			3								3	

High- 3; Medium-2; Low-1

F.Course Contents

Unit 1 Digital Fundamentals **L-6 Hours**

Introduction to Boolean algebra and Switching Functions; Basic Logic Gates, Binary and Digital number system - Boolean Minimization using K Map and Tabulation method.

Unit 2 Combinational Circuits and HDL **L-7 Hours**

Half adder – Full Adder – Half subtractor – Full subtractor –Multiplexer/ Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator-Introduction to Verilog / VHDL- Structural, Dataflow and Behavioral modeling. Structural, Dataflow and Behavioral modeling of combinational logic circuits (Multiplexer, Demultiplexer, decoder and encoder).

Unit 3 Memory Devices and Synchronous Sequential Circuits **L-7 Hours**

Flip Flops and Memory devices: RAM – Static and Dynamic, ROM, PROM, EPROM, EEPROM; Counters: Binary, BCD and programmable modulo counters - Shift register- Sequential circuit design: using Mealy and Moore model.

Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) – Implementation of combinational logic circuits using ROM, PLA, PAL.

Unit 4 Asynchronous Sequential Circuits **L-6 Hours**

Analysis Procedure - Design Procedure-Reduction of state and flow table-Race free state assignment-Hazards-ASM chart.

Unit 5 Applications of Digital Electronics **L-4 Hours**

Multiplexing displays - Frequency counters - Time measurements - ADC0804- microprocessor compatible A/D converters.

Total : 30 Hours

G. Laboratory Experiments **Total : 30 Hours**

Part - 1

Task 1 Realization of Boolean Logic using Logic Gates
Tools: Digital trainer kit, Integrated Circuits

Task 2 Design of Combinational Logic Circuits Half-Adder, Full-Adder, Half-Subtractor and Full-Subtractor.
Tools: Digital trainer kit, Integrated Circuits

Task 3 Verification of 4-Bit Magnitude Comparator Operations
Tools: Digital trainer kit, Integrated Circuits

Task4 Design of Decoders and encoders like BCD-Decimal decoder
Tools: Digital trainer kit, Integrated Circuits

Task5 Design of Code Converters (Binary to Gray)
Tools: Digital trainer kit, Integrated Circuits

Task6 Design of Multiplexers/De Multiplexers
Tools: Digital trainer kit, Integrated Circuits

Task7 Verification of Flip-Flop operation
Tools: Digital trainer kit, Integrated Circuits

Task8	Design of Shift register (To verify Serial to Parallel, Parallel to Serial,Serial to Serial and Parallel to Parallel Converters) using Flip-Flop **Tools**: Digital trainer kit, Integrated Circuits
Task9	Conversion of Flip-Flops (JK-T, JK-D) **Tools**: Digital trainer kit, Integrated Circuits
Task10	Design Synchronous and Asynchronous Counters **Tools**: Digital trainer kit, Integrated Circuits
Task11	Design a LED indicator system **Tools**: Digital trainer kit, Integrated Circuits
Task12	Design a counter using Programmable Array Logic **Tools**: Digital trainer kit, Integrated Circuits

Part-2

Use Cases:

Use case 1:

Design an Asynchronous sequential circuit using SR latch with two inputs A and B and one output y. B is the control input which, when equal to 1, transfers the input A to output y. when B is 0, the output does not change, for any change in input.

Use case 2:

The count has a repeated sequence of six states, with flip flops B and C repeating the binary count 00, 01, 10 while flip flop A alternates between 0 and 1 every three counts. Design with JK flipflop.

Use case 3:

Design a token number display system to drive the large LED display. This is used to display the three-digit token number on the display. These can be used in public places where people have to wait in lines like Banks, Hospitals, Airports, and Restaurants.

Use case 4:

This digital watch is used to display a 60sec time interval that counts from 0 – 59. This simple task is to design with an IC 555 & two counter ICs where 555 IC is used to generate the CLK signals and counter ICs carry the counting operation. Design a digital stopwatch.

Use case 5:

Use DTMF to control the appliances of home. This will overcome the limits of usual wall switches because these switches operate manually.The operation of this task can be done by dialing the selected number of specific loads on DTMF to control the home appliances. The operation of this system is very easy by using a mobile phone. The DTMF technology used in this system will get the commands from the mobile phone so that digital output can be generated. This output can make the relay driver ON to control the loads. The designing of this can be done using FFs, DTMF, and De-Multiplexer.

Total: Theory + Lab= 60 Hours

H.Learning Resources

i. Text Books:

1. M. Morris Mano, Digital Design, 6th Edition, Prentice Hall of India Pvt. Ltd., Pearson Education (Paperback) Pvt. Ltd., New Delhi, 2018. [Unit 1-3]
2. Thomas L. Floyd, Digital Fundamentals, 8th Edition, Pearson Education Inc, New Delhi, 2013 Donald D.Givone, Digital Principles and Design, TMH. [Unit 4-5]

ii. Reference Books:

1. John F.Wakerly, Digital Design, Fourth Edition, Pearson/PHI, 2016.
2. Donald. P.Leach, Digital principles and applications, 7th Edition, McGraw-Hill ,2012.
3. James Palmer and David Perlman, Introduction to Digital Systems, McGraw Hill, 1st Edition, 2020.

iii. Online References:

1. "Digital Electronics & Logic Design" Udemy[online] Available: https://www.udemy.com/course/digital-electronics-logic-design/
2. "Digital System Design " Nptel [online] 2021, Available: https://onlinecourses.nptel.ac.in/noc21_ee39/preview.

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS202	DESIGN AND ANALYSIS OF ALGORITHMS	3	0	2	4

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

10211CS102 – Data Structures

C.Course Objectives

Learners are exposed 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/S3
CO2	Implement solution for the given problems using Brute force and Divide and Conquer techniques.	K3/S3
CO3	Apply Dynamic programming and Greedy techniques to solve the problems.	K3/S3
CO4	Solve the problems using Backtracking and Branch & Bound techniques.	K3/S3
CO5	Interpret the computational efficiency using iterative approaches	K3/S3
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	PSO3
CO1	3	3	3	3				1	1		1	3	1	

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		

3- High; 2-Medium; 1-Low

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.)

Unit 2 Brute Force and Divide & Conquer 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 – Rod cutting problem - 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: Hill climbing, Comparison of knapsack problem with other design algorithms, 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: 45Hours (L)

G.Laboratory Experiments — Total: 30 Hours

Part – 1

Task 1: Algorithmic problem solving 1

Calculating the time complexities for the given algorithms and estimating the orders of growth

Ex 1:

```
int i, j, k = 0;
for (i = n / 2; i <= n; i++) {
   for (j = 2; j <= n; j = j * 2) {
      k = k + n / 2;
   } }
```

Ex 2:

```
function(int n) {
   if (n==1)
     return;
   for (int i=1; i<=n; i++)
   {
      for (int j=1; j<=n; j++)
      {
         printf("*");
         break;
      }    }
```

Task 2: Algorithmic problem solving 2

Ex 2.1: Sort all the functions below in increasing order of asymptotic (Big O) growth. If some have the same asymptotic growth, then be sure to indicate that. Note: log means base 2.

i) $5n$, ii) $4 \log n$, iii) $4 \log \log n$, iv) n^4, v) $n^{1/2} \log^4 n$, vi) $(\log n)^{5 \log n}$

vii) $n^{\log n}$, viii) 5^n, ix) 4^{n^4}, x) 4^{4^n} xi) 5^{5^n}, xii) 5^{5^n}, xiii) $n^{n^{1/5}}$, xiv) $n^{n/4}$, xv) $(n/4)^{n/4}$

Solution: $4 \log \log n < 4 \log n < n^{1/2} \log^4 n < 5n < n^4 < (\log n)^{5 \log n} < n^{\log n} < n^{n^{1/5}}$

$< 5^n < 5^{5^n} < (n/4)^{n/4} < n^{n/4} < 4^{n^4} < 4^{4^n} < 5^{5^n}$

Ex 2.2 Order the functions according to their growth from slowest to fastest growing

Ex2.3: $6n^3$, $n \log_6 n$, $4n$, $8n^2$, $\log_2 n$, $n \log_2 n$, $\log_8 n$, 64, 8^{2n}

Solution: 64, $\log_8 n$, $\log_2 n$, $4n$, $n \log_6 n$, $n \log_2 n$, $8n^2$, $6n^3$, 8^{2n}

Task 3: D&C – Quick Sort

Sort a given set of elements using the Quicksort method and determine the time requiredto sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.

Test Case 1: Choose random element as Pivot and analyze the time taken to execute the algorithm

Test Case 2: Assume that the list of elements is in ascending order and apply quick sort and find the time complexity

Task 4: D&C – Merge Sort

Implement a parallelized Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the

number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.

Test Case 1: Assume that the list of elements is in ascending order and apply merge sort and find the time complexity
Test Case 2: Assume the unsorted order of elements and apply merge sort and find its time complexity. Modify the algorithm to arrange the elements in descending order.

Task 5: Dynamic Programming – Warshall's & Floyd's algorithm

Compute the transitive closure of a given directed graph using Warshall's algorithm and for the same graph implement the all pairs shortest path problem using Floyd's algorithm.

Test Case 1: Assume the graph or a digraph with negative weights and check whether the Floyd's algorithm yields the correct result or not.
Test Case 2: Analyze that the time efficiency of Warshall's algorithm is cubic.

Task 6: Dynamic Programming – Knapsack algorithm

Implement 0/1 Knapsack problem using Dynamic Programming and find its complexity

Test Case 1: Show that a sequence of values in a row of the dynamic programming table for the knapsack problem is always non decreasing
Test Case 2: Show that a sequence of values in a column of the dynamic programming table for the knapsack problem is always non decreasing

Task 7: Greedy Technique – Prim's algorithm

Find Minimum Cost Spanning Tree of a undirected graph using Prim's algorithm

Test Case 1: Assume an undirected graph and find whether the graph is connected or not and then apply Prim's algorithm to find MST.

Test Case 2: Verify whether Prim's algorithm always work correctly on graphs with negative edge weights.

Task 8: Greedy Technique – Kruskal's algorithm

Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm

Test Case 1: Assume an input graph with more than one edge having a same weight, in such case which edge should be selected as the next visiting vertex by applying Kruskal's algorithm.
Test Case 2: Construct a Maximum Spanning tree for the input graph by applying Kruskal's algorithm.

Task 9: Greedy Technique – Dijkstra's algorithm

From a given vertex in a weighted connected graph find shortest paths to other vertices using Dijkstra's algorithm

Test Case 1: Show that the Dijkstra's Algorithm cannot work for a weighted connected graph with negative weights.
Test Case 2: Analyze the correctness of Dijkstra's algorithm for graphs with positive weights.

Task 10: Greedy Technique – Topological Sort

Obtain the Topological ordering of vertices in a digraph.

Test Case 1: Assume a Directed Acyclic Graph (DAG) as an input and check whether Topological sorting can be applied or not?
Test Case 2: Implement topological sorting using Breadth First Search (BFS)

Task 11: Backtracking - n-Queen's problem

Implement N Queen's problem using Backtracking

Test Case 1: Implement Rat in a Maze problem by applying the concept of backtracking.
Test Case 2: Modify the n-queens problem to handle the value of n in the range from 1 to 3.

Task 12: Backtracking - Subset problem

Find a subset of a given set S = {s1,s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions {1,2,6} and {1,8}.A suitable message is to be displayed if the given problem instance doesn't have a solution.

Test Case 1: Assume an instance of the subset sum problem and verify whether the backtracking algorithm work correctly if we use just one of the two inequalities to terminate a node as non-promising.
Test Case 2: Given a set of distinct integers and return all the possible subsets or power set

Task 13: Branch & Bound - Travelling Salesman problem

Implement any scheme to find the optimal solution for the Travelling Salesperson problem

Test Case 1: Derive the solution of TSP using B&B and prove that it is optimal when compared with Brute Force technique.
Test Case 2: Analyze that the Travelling Salesman Problem (TSP) is an NP hard problem.

Task 14: Branch & Bound – Knapsack algorithm

Implement 0/1 Knapsack problem using Branch & Bound techniques and find its complexity

Test Case 1: Derive the solution of Knapsack problem using B&B and prove that it is optimal when compared with Brute Force technique.

Test Case 2: Show that a sequence of values in a column of the dynamic programming table for the knapsack problem is always non decreasing

Task 15: Iterative Improvements

Apply Ford-Fulkerson algorithm to solve the computational problems of finding maximum flow in a network to determine how fast people can be evacuated from the given city.

TestCase 1: Apply Ford-Fulkerson algorithm and find whether the augmenting path exists or not in the graph.
TestCase 2: Apply Ford-Fulkerson algorithm and find the updated residual capacity of a graph.

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
10211CS204	OBJECT ORIENTED PROGRAMMING USING JAVA	2	0	2	3

A.Preamble

This course provides basic concepts about Object Oriented Programming, Java Packages, Exceptions, Database connectivity, Java Streams, JavaFX and Java Servlets, JSP, Spring and Hibernate. After successful completion of this course learners can able to develop software modules for real world problem.

B.Pre-requisite course

10210CS101 - Problem Solving using C

C.Course Objectives:

Learners are exposed to:

- Implement Basic OOP principles to solve problems
- Practice Java basic constructs
- Build efficient Programming practice in Java
- Web application development with DB servers
- Work on Frameworks such as Spring and Hibernate

D.Course Outcomes:

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

CO Nos	Course Outcomes	K - Level
CO1	Explain the fundamentals of Java and Object Oriented Programming (OOP) concepts to solve problems.	K2/S3
CO2	Apply the concepts of java inheritance and exception handling mechanisms for real world problem.	K3/S3
CO3	Solve the problems using Java Streams, Collections, UI Design and Threads	K3/S3
CO4	Develop simple web applications using JSP, Servlet with JDBC and Hibernate Framework	K3/S3
CO5	Build the web applications using Spring Framework.	K3/S3
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	PSO3
CO1	3	3	1											
CO2	1	3	3	1	1							2	1	
CO3	1	3	2	2	2							2	2	
CO4	1	3	3		2								3	
CO5	1	3	3		3								3	

3- High; 2-Medium; 1-Low

F.Course contents

Unit 1 Basics of OOP and JAVA **L-6 Hours**

Introduction to object-oriented programming - Features of Java - JVM- Keywords- Variables - Data types – Operators - Control statements -Command line arguments - Classes and Methods - Objects – Java Packages – Build-in packages - user-defined package -Access specifiers: private, protected, default, public - Constructors - Method Overloading - Type Casting - this keyword- Static – Arrays, Multi-dimensional Arrays.

Unit 2 Inheritance, Exception Handling andstring **L-6 Hours**

Basics of Inheritance - Forms of Inheritance - Super keyword – Final - Method Overriding –Abstraction: Abstract Classes - Interfaces. Exception Handling: Java Exception Hierarchy - Exception Types - Throwing and Catching exceptions -Declaring New Exception Types – custom exceptions. String class – Immutable String - String handling methods.

Unit 3 Java Streams, Collections, UI Design, Thread **L-6 Hours**

Java Streams: Features, methods – Generic Classes and Methods - Collections Frameworks: List, Queue, Set and Map.JavaFX: Architecture, Effects, Transformation, Animation, Layouts, UI Controls, Event Handling.Threads: Life cycle - Thread states - Thread priority– Thread Synchronization.

Unit 4 Server Programming, Hibernate Framework **L-6 Hours**

Introduction to Servlet and JSP, JDBC, Example Web applications with DB - Basics of Java Networking.Introduction to Java Frameworks - Basics of Hibernate – Hibernate Web application - Hibernate Mapping and types – HQL – Annotations – Caching. Integrating Hibernate and Spring.

Unit 5 Java Spring Framework **L-6 Hours**

Basics of Spring – Spring in IDE– Dependency Injection – Constructor Injection – Spring ORM: Spring with Hibernate – SPEL -Spring MVC – Spring Web – Spring JDBC – Spring with Angular – Spring Boot.

Total: 30 Hours (L)

G.Laboratory Experiments **Total: 30 Hours**

Part – 1

Task 1: Package creation and String.

- Simple Java application with class (Object), Methods
- Developing user defined packages in Java
- Apply String handling methods

Task 2: Inheritance and Interfaces

- To Implement Method overloading, constructor and Method Overriding.
- Use of this, super, static and final keywords
- Developing user-defined interfaces and implementation
- Use of predefined interfaces

Task 3: Exception Handling Mechanism in Java

- Handling pre-defined exceptions
- Handling user-defined exceptions

Task 4: Java Collections

- Handle list of elements using Collection classes (List, Queue, Set, Map)

Task 5: JavaFX

- To Create Different Layouts with JavaFX animation.

- To Design a web application with JavaFX event handling.

Task 6: Threading
- Creation of thread in Java applications
- Multithreading

Task 7: Java-JDBC
- To connect Oracle/ MySQL for Table creation and Data Manipulation.

Task 8: Servlet
- Write a Servlet program to to connect Oracle/MySQL for Table creation and Data Manipulation.

Task 9: JSP
- Write a JSP program to to connect Oracle/ MySQL for Table creation and Data Manipulation.

Task 10: Spring Standalone and web Application
- Standalone application with data manipulation
- Web application with data manipulation

Task 11: Hibernate Standalone and web Application
- Standalone application with data manipulation
- Web application with data manipulation

Part– 2

Use cases:

Use case1: Validated Login for Employee management JSP:
Company ABC planned to create a website for maintaining employee details. Login page need to be designed with username, password and captcha. Username is their mail-id and password should contain at-least 1-Uppercase alphabet, 1-special character, 1- lower alphabet. Design the page using front end and server scripting with client / server validation.
Use the technologies: HTML5, CSS5, Javascript, JSP.

Use case2: Event Registration for a University Spring:
In a University, they have planned to conduct national level symposium. Students are expected to come from various places from india. University has decided to maintain all participant details such as Participant_name, college name, branch, year, age, and phone.

And also generate unique participant ID using ID generator logic. Implement a java application for above scenario with rich user interface and database server.
Use the technologies: HTML5, CSS5, Spring framework, MySQL/Oracle.

Use case3: E – Applicant System for Student using Spring MVC:
E-Applicant system has been planned to implement by an institute. In that, student will be able to request any kind of Certificate like Transfer and Bonafiedetc by applying through this System.The student can check the status through his/her account. There are many users like Internal Staff, HOD, Dean, Registrar and Vice chancellor to verify and approve the request. Above application should be implemented using spring framework with MVC technology with suitable front end techniques and Database servers.
Use the technologies: HTML5, CSS5, Spring framework, MySQL/Oracle.

Use case4: Stock management with CRUD operations using hibernate:
A Pharma Agency decided to manage their business using software. Monitoring Stock entry, sales, shortage, offers, profit and expired medicines are the requirements from the client using the targeted software. Since inserting details, update the offer details and removing expired stock entries, CRUD supported implementation expected to build. Instead of using JDBC API, hibernate suggested to be used for making efficient CRUD operations with database servers.
Use the technologies: HTML5, CSS5, Hibernate framework, MySQL/Oracle.

H. Learning Resources

i. Text Books:

1. Herbert Schildt, “Java: the Complete Reference”, Eleventh edition, Tata Mc-Graw Hill, 2019.[Unit 1, 2, 3]
2. Jim Keogh, “J2EE: The complete Reference”, First Edition, Tata Mc-Graw Hill, 2017. [Unit 4]
3. K. Santosh Kumar, “Spring and Hibernate”, McGraw Hill Education, 2017. [Unit 4,5]

ii. Reference Books:

1. H.M. Deitel and P.J. Deitel,” Java How to Program”, Pearson Prentice Hall Seventh edition, 2018.
2. Balaguruswamy, “Programming in java”, Sixth Edition, Tata McGraw Hill, 2019.
3. Jason Hunter, William Crawford, “Java Servlet Programming”, Second Edition, O'Reilly-2018.

iii. Digital 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	COURSE TITLE	L	T	P	C
10211CS207	DATABASE MANAGEMENT SYSTEMS	3	0	2	4

A.Preamble

Databases form the backbone of all major applications today – tightly or loosely coupled, intranet or internet based, financial, social, administrative, and so on. Structured Database Management Systems (DBMS) based on relational and other models have long formed the basis for such databases. While DBMS differ in the details, they share a common set of models, design paradigms via a Structured Query Language (SQL) or NoSQL. More specifically, this course introduces relational data models; entity-relationship modeling, SQL, data normalization, database design and modern databases asd well lightweight databases.

B.Prerequisite Course

10210CS101 – Problem Solving using C

C.Course Objectives

Learners are exposed to:

- Design a database at basic level like Entity-Relationship modeling, Relational Modeling.
- Devise a database using Armstrong axioms, functional dependencies and views.
- Acquire knowledge of Query processing and concurrency transaction control.
- Learn an implementation issues with nontraditional databases.

D.Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Apply basic database designing methodologies	**K3/S3**
CO2	Design a database schema for a given problem	**K3/S3**
CO3	Apply normalization for the given database.	**K3/S3**
CO4	Use the properties of transaction and recovery management.	**K3/S3**
CO5	Implement CRUD operations in modern database.	**K3/S3**
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	PSO3
CO1	2	2	2									2		2
CO2		3	3	2	3							3	3	3
CO3		3	3		2							2	2	2
CO4		2	2											2
CO5		2		2	3								2	2

High- 3; Medium-2; Low-1

F.Course Contents

Unit 1 Introduction to DBMS L–9 Hours

Purpose of Database System – Database Schema and Instances- Views of data – Database Languages - Database System Architecture – Database users and Administrator –Distributed Databases-DDB System Architecture-Database models-Entity–Relationship model – E-R Diagrams - Introduction to relational databases –Structure of relational databases- Relational model-Basics- From E/R diagrams to Database Design- Hierarchical model-Tree-structure diagrams- data retrieval-update facility-virtual records-mapping of hierarchies to files-Network Model- Data-structure diagrams-DBTG model- data retrieval-Find-Get-Set processing-update facility-Mapping network to files. Case study: Conference Management system.

Unit 2 Database Design and Query Optimization L–9 Hours

Keys and Integrity Constraints - Relational Algebra – Relational Calculus-Tuple –Structured Query language(SQL) Basic and additional Operations –Database Languages Revisited –create-alter-update-insert-rename-truncate-drop-select query commands-grant-revoke-rollback-commit control commands-Operators-aggregate functions-string-indent-date functions-set-union-union all-aliasing-Nested Queries & Join Queries–Join-Natural-inner-equi-cross/cartesian-outer-left-right-full outer join-Common Table Expressions-limit function in statistics-summarizing-Embedded SQL- Indexes and Triggers –compound- Views Definitions -Materialized view-Assertions-Query Processing and Optimization-Heuristics and cost estimates in Query Optimization-Tuning. Case study: Restaurant chain for network model.

Unit 3 Functional Dependencies and Normalization L–9 Hours

Introduction and problem of data redundancy-Features of good Relational database design-Functional Dependencies - Normalization – First Normal Form-minimal cover-canonical cover-Decomposition- Second Normal Form- Third Normal Form –controversies with SQL in normalization-Advanced Normalization -Boyce/Codd Normal Form, Fourth Normal Form and Fifth Normal Form- Dependencies preservation-Denormalization-Case Studies of database system like Air-cargo services**.**

Unit 4 Transaction and Concurrency L–9 Hours

Transaction Concepts –Schedules- Transaction States - Concurrent Execution- Serializability- -Two Phase locking Protocol –Timestamp ordering Protocol-Validation Based Protocol-Multiple Granularity-Intention lock modes-Multiple granularity locking scheme-Replication in Distributed databases-Deadlock-Handling-Prevention-Wait-diescheme- wound-wait scheme- Detection-Wait-for graph-Phantom phenomenon-Distributed deadlock detection-Index locking-weak levels of concurrency- Concurrency in index structures- B+ Tree crabbing- -Types of Failure-Recoverability -Recovery and Prevention- Log based recovery-undo-redo-checkpoint-Recovery Algorithm-Transaction rollback with Logical undo- Recovery Algorithm with Logical Undo-ARIES Recovery Algorithm. Case study: Instances and Log recovery process in Oracle and Microsoft Access.

Unit 5 Storage and Modern Databases L–9 Hours

RAID storage -Modern databases-XML Databases- CAP Theorem-Datalog-Basic structure-Syntax-semantics-Relational operation in Datalog-Recursion in Datalog-Power of Recursion-Monotonicity-Non-monotonicity-NoSQL-Data models-Key value store, column families-Document Databases-MongoDB-Introduction to MongoDB- CRUD operations-Create-Insert-Update-Query-Removing documents-Sharding- Introduction to Mongoose-core concepts-extending models-CRUD operations with mongoose. Case study: Designing local library in Amazon using mongoose-SQLite-Building and Installing SQLite-DDL-DML-TCL-Select-compound select- alternate Join- JOIN..ON,

JOIN..USING-Database design-SQL functions and SQLite extensions-Virtual Tables and Modules.

Total: 45 Hours (L)

G.Laboratory Experiments — Total: 30 Hours

Part- 1

Task 1: Conceptual Design after FTR

Using basic database design methodology and ER modeler, design Entity Relationship Diagram by satisfying the following sub tasks:

1. a Identifying the entities.
1. b Identifying the attributes.
1. c Identification of relationships, cardinality, type of relationship.
1. d Reframing the relations with keys and constraints.

Task 2: Generating design of other traditional database model

Creating Hierarchical /Network model of the database by enhancing the sound abstract data by performing following tasks using forms of inheritance:

2. a Identify the specificity of each relationship, find and form surplus relations.
2.b Check is-a hierarchy/ has-a hierarchy and performs generalization and/or specialization relationship.
2. c Find the domain of the attribute and perform a check constraint to the applicable.
2. d Rename the relations.
2. e Perform SQL Relations using DDL, DCL commands.

Task 3: Using Clauses, Operators and Functions in queries

Perform the query processing on databases for different retrieval results of queries using DML, DRL operations using aggregate, date, string, indent functions, set clauses and operators.

Task 4: Using Functions in queries and writing subqueries:

Perform the advanced query processing and test its heuristics using the designing of optimal correlated and nested subqueries such as finding summary statistics.

Task 5: Writing Join Queries, equivalent, and/or recursive queries

Perform the advanced query processing and test its heuristics using the designing of optimizing complex queries and their equivalence queries

TASK 6: Procedures, Function and Loops:

Programming using PL/SQL Procedures, Functions and loops on Number theory and business scenarios like.

TASK 7: **Triggers, Views and Exceptions**

Conduct events, views, exceptions on CRUD operations for restricting phenomenon.

TASK 8: **CRUD operations in Document databases**

Perform Mongoose using NPM design on MongoDB designing document database and performing CRUD operations like creating, inserting, querying, finding, removing operations.

TASK 9: CRUD operations in Graph databases

Perform GraphQL/Neo4jgraph space design for recommendation engines. Also perform CRUD operations like creating, inserting, querying, finding, deleting operations on graph spaces.

Task 10: **Normalizing databases using functional dependencies up to BCNF**

Upon relational tables created in task-2, perform normalization up to BCNF based on given Dependencies as following for the assumed relations specified below.

10. a Apply the functional dependency, normalize to 1NF
10. b Normalize the relations using FD+ and α+
10. c Find the minimal cover, canonical cover.
10. d Normalize to 2NF, add/alter constraints if necessary.
10. e Normalize to BCNF, add/alter constraints if necessary.
10. f Normalize to 3NF, add/alter constraints if necessary.

Task 11: Menus, Forms and Reports:

For an application, creating and debugging Menus, Forms and reports using Oracle Forms and Report Builder or SQL server management studio or SQLite or NetBeans

.

Task 12: Micro Project:
Develop micro projects based on business scenarios and use cases.

Part-II
Use cases:

Use Case-1: Building a Cart analysis for Myph
Myph has just launched their brand new phone range to the eager reception of the consumer market cart analysis. The product's data model has a unique menu that identifies the product, title, description, a stock quantity, and pricing information about the item. All products have categories. To be able to provide a list of all the products in a category, amend the data model with a collection of documents for each category and contain the path for that category in the category tree. Use cart analysis in developing different consumer selection options. Would this answer outlier selection in cart i.e., surplus selections? Is Relational database application can answer these transactions? How recovery is made through carting and commerce?

Use Case-2: Indexing various devices in IoT platform
A generic IoT platform required support for data from a wide range of devices, some of which could not be envisaged while developing the platform. The proficient work necessitated a data storage mechanism that could handle data from different types of devices. Indexing support makes it easy to pull data using a single index or multiple indexes such as device id with location id. Records for a particular device in different locations are easily accessed. Common parameters like temperature from different types of

devices and their records are retrieved fast through these indexes. How the application could lead to the choice of JSON-based document database, MongoDB? Assume or create JSON script in support of this.

Use Case-3: A gift coupon application handles offers payment-related Information.
Choose the database system, a relational database, for its capability to scale horizontally while keeping the ACID property. The last was particularly important because transactional data was being handled. Eventual consistency as offered by other databases was not suitable. Going with DB and cluster gives the opportunity to scale horizontally for a large number ofwrites and reads without compromising the ACID and transactional capability required by the application. Will it transact and lead to no deadlock, keeping all relational tables normalized? If so till what normal form do they sustain to offer a gift coupon application?

Use case- 4: Army Supply chain, Bill of Materials and Maintenance Cost Management
The nation's armed forces, the support for more than one million soldiers and about 200,000 civilian staff. Each of these staff members relies on multiple pieces of equipment, from helicopters and armoured vehicles to small arms and radios, to complete their missions. With maintenance, operation and support costs of equipment representing as much as 80% of total lifecycle costs, it's imperative that the Defence ministry track and analyse equipment maintenance costs including changing historical data sources Dimension with more flexibility like graph databases and to be given richer analysis like forecast replacement parts with the location and climate, mean time to failure rates, logistics and requirement processes. Is answerable the vital "what-if" questions such as the cost of deploying certain forces and supporting equipment to a new war zone? Could the model perform multi-dimensional cost comparison and trend analysis? Will the solution promises how the data management in unpredictable maintenance costs?

H.Learning Resources

i. Text Books:

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2019.[Unit1-5]

2. Shannon Bradshaw, E Brazil, Kristina Chodorow, "MongoDB: The Definitive Guide - Powerful and Scalable Data Storage", Third Edition, Shroff/O'Reilly Inc., January 2020.[Unit-5]
3. AgusKurniawin, "Python and SQLite Development", First Edition, PE Press, January 2021. [Unit-5]

ii. Reference Books:

1. Raghu Ramakrishnan et al, "Database Management Systems", Third Edition, McGraw Hill, 2014.
2. Elmasri Ramez, Navathe S, "Fundamentals of Database System", Seventh Edition, Pearson, 2017.
3. J.D.Ullmann et al, "Database Systems: The Complete Book", Second Edition, Pearson Ed, Inc, 2009.

iii. Online References:

1. "Database Management System Part-1&11" Mar.25, 2019. Accessed on Feb.20, 2021[Online].Available:https://infytq.onwingspan.com/en/viewer/web_module/lex_auth_013054273657380864100 6_shared?collectionId=lex_auth_01275806667282022456_shared&collectionType=Course.
2. "Database Design", Dec 31, 2009. Accessed on May05,2021[Online]. Available: https://nptel.ac.in/courses/106/106/106106093/.
3. "Designing local library models", Accessed on: May 05, 2021[online]. Available: https://developer.mozilla.org/en-US/docs/Learn/Server-side/Express_Nodejs/mongoose.

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS208	SOFTWARE ENGINEERING	2	0	2	3

A.Preamble

Software Engineering is an engineering branch that relates to the evolution of software product using well-defined scientific principles, techniques, and procedures. This course is being offered in order to train the students to presents the concepts, methods and techniques necessary to efficiently capture software requirements, to plan the project with appropriate estimations, and to bring it to completion.

B.Prerequisite Courses

10211CS204– Object Oriented Programming using Java/ 10210CS101- Problem solving using C

C.Course Objectives

Learners are exposed to:

- Understand the best practices in software engineering.
- Develop the necessary skills to handle software projects in a principled way.
- Provide an in depth knowledge on the different phases of the software life cycle.
- Perform requirements analysis, estimation design and testing for applications.

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 suitable process model for software development.	K3/S3
CO2	Prepare the SRS document with projectestimation and plan.	K3/S3
CO3	Design the UML Diagrams to develop a software application.	K3/S3
CO4	Apply the software design heuristics for quality improvement	K3/S3
CO5	Build Test cases using various testing strategies.	K3/S3
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	PSO3
CO1	2	3										1	3	

CO2	2	3	3		1							2	3	
CO3	1	3	3		3								3	3
CO4	1	3	3		3	2							3	
CO5	3	3	3			1						1	3	

3- High; 2-Medium; 1-Low

F.Course Content

Unit 1 Software Development Process Models L–6 Hours

Introduction to Software Engineering - Software Development process models – Waterfall Model, Incremental Model, Spiral Model, V Model – Agile Development- Agile Methodologies- Agile Principles- SCRUM and XP - Project management- Stages of Project management- 4 P's of project management - Process & Project metrics. Case Study: The Railways tracking - Arrival Time Prediction System

Unit 2 System Requirements Specification, Planning & Scheduling L–6 Hours

Software Requirements Specification - Software project planning - Software Estimation - Empirical Estimation Models – Software Project Scheduling- Risk Management - Software risks – Risk identification – Risk projection – Risk refinement - Defect Prevention. Case Study: Preparation of SRS for the camera motion sensor system for home automation.

Unit 3 Analysis Using UML L–6 Hours

Analysis Modeling - Data Modeling - Functional Modeling & Information Flow - Behavioral Modeling- Structured Analysis - Object Oriented Analysis - Domain Analysis- Object Relationship Model - Object Behavior Model, Design modelling with UML- Design modelling with UML. Case Study: UML diagrams for Stock Trading Application using the online Creatly platform.

Unit 4 Design Principles and Heuristics L–6 Hours

Design Principles - Design Process - Design Elements- Design Concepts - Modular Design-top-down and bottom-up, Abstraction, step-wise refinement, coupling and cohesion, Refactoring, Architecture- Introduction to Software Architecture - Data Design - Transform Mapping - Transaction Mapping - Design Patterns. Case Study: Architecture diagram and design for the Safe Home security system.

Unit 5 Testing, Maintenance and Reengineering L–6 Hours

Testing approaches -Top-Down, Bottom-Up, Big Bang and Sandwich, object oriented product Implementation & Integration- Software Testing methods- White Box- Black Box - Unit Testing - Integration testing - Validation & System testing – Software Maintenance & Reengineering. Case study: Login module of Ecommerce application - Test cases and Best Practices.

Total: 30 Hours (L)

G.Laboratory Experiments Total: 30 Hours

Part - 1

Task 1 Design of problem statement, perform a detailed feasibility study and finalize the process model to be used.

Tools: Microsoft Word

Task 2 To Prepare the Software Requirement Specification Document in the given template to include the functional and Non-functional requirements.

Tools: Perforce Helix RM and Microsoft Word.

Task 3 To Prepare a detailed estimate using the FP and COCOMO Model. Also prepare a detailed schedule of the project.
Tools: GanttPRO or Lucid Chart and Microsoft Word.

Task4 Identify Use Cases and develop the Use Case model for the given scenario Draw the relevant Entity Relationship Diagram and class diagram.
Tools: Creately, Rational Ross or any CASE Tools

Task5 Using the identified scenarios, find the interaction between objects and represent them using UML Sequence & Communication diagrams.
Tools: Creately, Rational Ross or any CASE Tools

Task6 To implement behavioural modelling using User Interface diagrams, state transition diagram and activity diagrams for the given scenario.
Tools: Creately, Rational Ross or any CASE Tools

Task7 To implement partial layered, Object Oriented and logical software architecture diagram to visualize the high level design.
Tools: Rational Ross or any CASE Tools

Task8 To Implement the data Flow Diagrams to perform the data modelling with Level 0, Level 1 and Level 2 analysis.
Tools: Creately, Rational Ross or any CASE Tools

Task9 To Develop test cases for various Testing methodologies. Write the test cases for both Black box Testing and White Box Test Testing.
Tools: TestopiaTools and Microsoft Word.

Task10 To Develop a prototype of the project with database management system and deploy the project.
Tools: Rational Ross or any CASE Tools

Part-2

Use Cases:

Use Case 1: Analyze and implement the Employee management and Payroll Processing application.
Use Case 2: Build the Library Management system application with project plans, schedule, estimation and design.

Use Case 3: Design,Analyze and implement the Passport Automation System application.

Use Case 4: Identify, plan, analyze and implement the E Voting System application.

H.Learning Resources

i. Text Books:

1. Roger. S. Pressman and Bruce R. Maxim, “Software Engineering – A Practitioner’s Approach”, 9th Edition, McGraw Hill, 2020. [Unit 1,2,4,5]
2. Ian Somerville, “Software Engineering”, 10th Edition, Pearson Education, New Delhi, 2017. [Unit 3]

ii. Reference Books:

1. Fairley R, “Software Engineering Concepts”, Indian edition, Tata McGraw Hill, New Delhi, 2017.

iii. Online References:

1. Software Development Lifecycle, Accessed on: Apr. 20, 2021 [Online], Available: https://www.coursera.org/specializations/software-development-lifecycle
2. Writing Test Cases, Accessed on: Apr. 20, 2021 [Online], Available: https://www.softwaretestinggenius.com/a-simplistic-approach-to-writing-test-cases-the-black-box-way/
3. Introduction to Software Engineering, Accessed on: Apr. 20, 2021 [Online], Available: https://www.coursera.org/learn/introduction-software-testing

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS212	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 Front End 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

10211CS204- Object Oriented 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/S3
CO2	Build the interactive and dynamic web page using Java Script Technology.	K3/S3
CO3	Implement the server-side business logic to handle client request using NodeJS and PHP.	K3/S3
CO4	Make use of MVC framework for integrating the window controls and its corresponding actions through event handlers.	K3/S3
CO5	Transform the function as Microservice components to enhance the Reusability concept.	K3/S3
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	PSO3
CO1		2	3		3	1							3	
CO2		3	3	1	2	1							3	

CO3		3	2		3	2						2	2
CO4		3	3		3	2						3	3
CO5		3	3		3	2						3	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), **CCS3:** 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 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

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 Total: 30 Hours

Part – 1

Task 1 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 taxiswe 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 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

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-toangular-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
10211CS213		PYTHON PROGRAMI

A.Preamble

The objective of this course is to provide learners an insight into Python programming, and develop programming skills to manage the development of software systems. It covers programming structures, important instructions, data representations, file handling, Exception handling, String handling, regular expressions and file data processing. This course also lays the foundation to data processing, UI design and gaming.

B.Prerequisite Course

Nil

C.Course Objectives

Learners are exposed to:

- Understand the basic program structure and elements of Python Language.
- Know the concept of file manipulation, string manipulation and regular expression.
- Learn the exception handling and multithreading concepts using python.
- Use the python modules for data analysis.
- Apply the python modules for gaming and UI design.

D.Course Outcomes

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

CO No's	Course Outcomes	K – Level
CO1	Experiment with data types, operators, statements and functions in python.	**K3/S3**
CO2	Construct the file handling, string handling and regular expression functions in python	**K3/S3**
CO3	Make use of the Exception handling to handle errors and multithreading mechanism for parallel execution.	**K3/S3**
CO4	Demonstrate the use of python libraries for data analysis.	**K3/S3**
CO5	Apply python modules for Graphical User Interface and game design	**K3/S3**
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create S3- Apply		

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	PSO3
CO1	3	1	3									3	1	
CO2	3	1	3	3	1							1	3	1
CO3	3	3	3	2									2	

CO4	3	3	3		3				1		1	3	3	3
CO5			3		3	3		3			3	3	3	3

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Introduction **L-3Hours**

Python Basics:variables-data types-operators and expressions-control statements-comments in the program-python collections (List,Tuple,Set,Dictionary)-modules-packages and composition. Python functions-built-in functions-Lambda functions-python iterator and generator.

Case Study: Shuffling a Deck of Card

Unit 2 File Manipulation, String Handling and Regular Express **L-3Hours**

Manipulating files and directories, os and sys modules; text files: reading/writing text and binary files; creating and reading a formatted file (csv or tab-separated); String manipulations: indexing, slicing a string-string operations-number system-Regular expressions- match and search functions; modifiers and patterns-python Decorators.

Case Studies: Creating a Hash File (or a message digest of a file) and pattern recognition

Unit 3 Exception Handling and Multi-Threading in python **L-3 Hours**

Exception handling: try, except and finally block, handling multiple exceptions, raise an exception, User defined exception- python multithreading- thread and threading module-Synchronizing Threads in Python.

Case Study: Development of student performance evaluation report

Unit 4 Data Analysis using Python libraries **L-3Hours**

NumPy: Introduction, NdArray object, Data Types, Array Attributes, Indexing and Slicing, Array manipulation, mathematical functions, Matplotlib; Pandas: Introduction to pandas data structures-series-Data Frame-Panel-basic functions-descriptive statistics function-iterating data frames-statistical functions-aggregations-visualization- plotting graphs using plotly Library.

Case Study: Sales Forecasting

Unit 5UI and Game design using Python libraries **L-3 Hours**

Tkinter module: introduction, widgets, standard attributes, Geometry management, Tkinter Event Handling; Database connectivity with MySQL. PyGame Module - PyGame Concepts- Basic Game Design-Sprites-Sprite Groups-Custom Events-Collision Detection-Sprite Images-Game Speed-Sound Effects.

Case Study: Angry bird game and UI design

Total: 30 Hours (L)

G.Laboratory Experiments **Total: 30 Hours**

Part 1

Task 1 Running Python Script and various expressions in an interactive interpreter
Tools:IDLE,pycharm

Task 2 Implement conditional, control and looping statements.
Tools:Python Tutor (or) pycharm (or) IDLE

Task 3 Importing Python modules and packages in python programming.
Tools:**Jupyter,pandas, numpy,scipy**

Task4 Use various data types, List, Tuples and Dictionary in python programming
Tools: Python Tutor (or) pycharm (or) IDLE

Task5	Implement various Searching and Sorting Operations in python programming **Tools: Python Tutor (or) pycharm (or) IDLE**
Task6	Implement various text file operations. **Tools: Python Tutor (or) pycharm (or) IDLE**
Task7	Utilizing 'Functions' concepts in Python Programming. **Tools: Python Tutor (or) pycharm (or) IDLE**
Task8	Implement python generator and decorators. **Tools: Python Tutor (or) pycharm (or) IDLE**
Task9	Implement Exceptions and Exceptional handling in Python. **Tools: Python Tutor (or) pycharm (or) IDLE**
Task10	Use the Matplotlib module for plotting in python. **Tools:matplotlib**
Task11	Use the Tkinter module for UI design. **Tools:Tkinter, jupyter**
Task12	Simulate Gaming concepts using Pygame **Tools:Pygame**

Part 2

Use Cases:

Use Case 1: Finding the Winning Strategy in a Card Game using python
Use Case 2: Develop an application to perform Plotting Probabilities Using Matplotlib
Use Case 3: Design an application for Simulating Random Coin-Flips and Dice-Rolls Using NumPy

H.Learning Resources

i. Text Books:

1. Guido van Rossum, Learning Python: Crash Course Tutorial, The Python development team publishers, 2020. [Unit-1,2,3]
2. Bharti Motwani, "Data Analytics using Python", paperback edition, Wiley Publishing Ltd, 2020. [Unit-4]
3. James R. Parker, "Game Development Using Python", 2nd edition, Mercury Learning and Information publishers, 2021. [Unit-5]

ii. Reference Books:

1. David M.Baezly , "Python Essential Reference", Addison-Wesley Professional; 5th edition, 2021.
2. John Shovic, Alan Simpson, "Python for dummies", John Wiley & Sons, 2020.

iii. Online References:

1. Programming for Everybody (Getting Started with Python), Accessed on 02, April 2021 [Online] Available: https://www.coursera.org/learn/python
2. Learn Python, Accessed on 02, April 2021 [Online] Available: https://www.udemy.com/course/python-the-complete-python-developer-course
3. Introduction to Python Programming, Accessed on 02, April 2021 [Online] Available: https://www.edx.org/professional-certificate/introduction-to-python-programming
4. The Python Standard Library, Accessed on 02, April 2021 [Online] Available: https://docs.python.org/3/library/

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS223	MACHINE LEARNING TECHNIQUES	2	0	2	3

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

Learners are exposed to:

- Apply the concepts of supervised and unsupervised learning algorithms for real time applications
- Experiment 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 data mining and machine learning concepts	K2/S3
CO2	Design and evaluate the dimensionality reduction algorithms using real world datasets.	K3/S3
CO3	Apply various algorithms of Classification and Association.	K3/S3
CO4	Demonstrate experiments to evaluate and compare different unsupervised learning algorithms	K3/S3
CO5	Use the concept of neural networks for learning linear and non-linear activation functions	K3/S3
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	PO9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	2	3	3									3	3	
CO2	3	3	3	3	2	1		1	1			3	3	
CO3	3	3	3	3	2	1		1	1			3	3	
CO4	3	3	3	3	3	1		1	1			3	3	

CO5	3	3	3	3	2	1		1	1			3	3	

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Data mining and Machine Learning L-6 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 Data Preprocessing L-6 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-6 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 Neighbour Methods

Unit 4 Clustering Techniques L-6 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-6 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:30Hours

Laboratory Experiments **Total:30Hours**

Part-1

Task No	Task	CO/Skill Level
Task 1	i. Implement the Find-S algorithm to learn the most specific hypothesis from a dataset. ii. Implement the Candidate Elimination algorithm to compute the version space for a concept. iii. Compare the outputs of Find-S and Candidate Elimination on the same dataset. iv. Understand how these algorithms behave with noisy or incomplete data.	CO1/S3

	Platform: Orange, Google co-lab, Anaconda navigator, Language: Python	
Task 2	i. Perform Data Pre-processing, Data Analysis and Visualization for a given dataset. Platform: Orange, Language: Python.	CO2/S3
Task 3	i. Implement Principal Component Analysis (PCA) on a high-dimensional dataset. ii. Compare results of PCA with Linear Discriminant Analysis (LDA). **Platform: Orange, Google co-lab, Anaconda navigator, Language: Python**	CO2/S3
Task 4	i. Use Apriori and FP-growth algorithm to find all frequent item sets for the chosen datasetand also generate Association Rules. ii. Analyze and interpret generated rules. **Platform: Rapidminer, Language: Python**	CO3/S3
Task 5	Build a model using any of the classification algorithms that can effectively analyze and classify a new sample. Calculate the classification rate, accuracy, precision, recall, F1-score and confusion matrix for your data set. **Platform: Orange, Google co-lab, Anaconda navigator, Language: Python**	CO3/S3
Task 6	i. Build a simple linear regression model. Evaluate the model's performance using appropriate metrics like R-squared and Mean Squared Error. Use the model to predict the target variable for a given value of the predictor. ii. Perform exploratory data analysis (EDA) to identify correlations between variables. Fit a multiple regression model using all the independent variables. Check for multicollinearity among predictors and address it if necessary. iii. Build a logistic regression model. What is the equation for the log-odds (logit function)? Interpret the coefficients of the predictors. How do they influence the probability of the binary outcome? Evaluate the model using metrics such as accuracy, precision, recall, F1-score, and ROC-AUC. Create a confusion matrix. **Platform: Google co-lab, Language: Python**	CO3/S3
Task 7	Apply partitioning and hierarchal clustering algorithms for a given dataset. Compare the results and comment on the quality of clustering using evaluation metrics **Platform: Google co-lab, Language: Python**	CO4/S3
Task 8	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. **Platform: Google co-lab Language: Python**	CO5/S3
Task 9	**Perceptron** Implement a perceptron to solve a linearly separable problem. i. Demonstrate logical gate implementation using perceptron ii. Implement an MLP from scratch using Python/NumPy for a classification task. iii. Train the MLP using the backpropagation algorithm and evaluate its performance. **Platform: Google co-lab, Language: Python**	CO5/S3
Task 10	**Hyperparameter Tuning**:	CO5/S3

	i. Use grid search or random search to optimize hyperparameters for an MLP. ii. Compare results before and after tuning. **Platform: Google co-lab, Language: Python**	

Part-2
Use Cases:

Use Case No	Use Case	CO/Skill Level
1	How can a machine learning system be developed to monitor student performance in an online education platform by incorporating **data preprocessing** (e.g., handling missing grades, normalizing time spent on activities), **classification** (e.g., predicting if a student will pass or fail a course), **clustering** (e.g., grouping students based on learning patterns or engagement levels), **perceptron** (e.g., using a simple neural network to classify students into high-risk or low-risk categories for dropout), **hyperparameter tuning** (e.g., optimizing the classification and clustering models), with **inference** (e.g., identifying underperforming students early) and **visualization** (e.g., generating dashboards showing clusters, classification probabilities, and risk levels)?	**CO1-CO5/S3**
2	How can a machine learning solution be developed for a retail store to analyze customer purchasing behavior, involving **data preprocessing** (e.g., cleaning and normalizing transaction data), **classification** (e.g., predicting whether a customer will buy a particular product), **clustering** (e.g., segmenting customers into groups based on their purchase patterns), **perceptron** (e.g., using it to build a simple binary model for predicting high-value customers), and **hyperparameter tuning** (e.g., optimizing the classification and clustering algorithms for better performance)?	**CO1-CO5/S3**
3	How can a machine learning system be designed to optimize vehicle maintenance schedules for a logistics company by using **data preprocessing** (e.g., cleaning sensor data, imputing missing values, and scaling usage metrics), **classification** (e.g., predicting whether a vehicle is likely to require maintenance soon), **clustering** (e.g., grouping vehicles based on usage patterns and wear-and-tear factors), **perceptron** (e.g., using a simple neural network to classify vehicles into "maintenance required" or "maintenance not required"), **hyperparameter tuning** (e.g., optimizing the classification and clustering algorithms), with **inference** (e.g., identifying high-risk vehicles in real time) and **visualization** (e.g., generating heatmaps and timelines of maintenance predictions and vehicle clusters)?	**CO1-CO5/S3**
4	How can a machine learning system be implemented to detect fraud in online financial transactions by incorporating **data preprocessing** (e.g., removing duplicates, handling missing values, and normalizing transaction amounts), **classification** (e.g., predicting whether a transaction is fraudulent or legitimate), **clustering** (e.g., grouping transactions to identify anomalous behavior patterns), **perceptron** (e.g., applying a basic neural network for binary fraud detection), **hyperparameter tuning** (e.g., fine-tuning the model to improve precision and recall), with **inference** (e.g., flagging suspicious transactions in real time) and **visualization** (e.g., creating dashboards to display fraud patterns and cluster distributions)?	**CO1-CO5/S3**

Total: 30 Hours
Total:60 Hours

G. 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. Han, J., Pei, J., &Kamber, M. *Data mining: Concepts and techniques* (3rd ed.). Morgan Kaufmann., reprint, 2019
2. Oliver Theobald, “Machine Learning for Absolute Beginners", Scatterplot Press, third edition, 2020
3. Beattie, Guy, “Machine Learning: Start with Machine Learning with all new tipstricks2020.Understand how machine learning can help”, 2020

iii. Online References:

1. Machine Learning, accessed online April 20, 2021 [online] 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
3. Data mining, Stanford University, Accessed on 19th June 2021, [Online] http://statweb.stanford.edu/~lpekelis/13_datafest_cart/WekaManual-3-7-8.pdf
4. Data Warehouse: Edgewood Solutions, Accessed on 28th June 2021, [Online] https://www.mssqltips.com/sqlservertip/5690/create-a-star-schema-data-model-in-sql-server-using-the-microsoft-toolset/
5. Data mining, University of Waikato, Accessed on 19th June 2021, [Online] Available :https://waikato.github.io/weka-wiki/downloading_weka/

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS302	DATA STRUCTURES LABORATORY	0	0	2	1

A. Preamble

This course is designed to develop skills to design and analyze linear and nonlinear data structures. This laboratory gives a way for students to get hands-on experience in identifying and applying the suitable data structure for the given real-world problem. It enables them to gain knowledge in practical applications of data structures.

B. Prerequisite Course

10210CS101 - Problem Solving using C

C. Corequisite Course

10211CS102- Data Structures

D. Course Objectives

Learners are exposed to:

- Introduce various techniques for representation of the data in the real world.
- Design and implement various data structure algorithms through ADT including List, Stack, Queues.
- Get familiarize and implement nonlinear data structures including Trees and Graphs.
- Implement various techniques of sorting and searching algorithms.

E. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Design and implement basic array and various linear data structure operations.	S3
CO2	Develop an appropriate algorithm using tree data structure to specified problem definition.	S3
CO3	Utilize appropriate hashing techniques and develop solutions for a range of problems.	S3
CO4	Apply Graph data structure and implement appropriate algorithm for given problem.	S3
CO5	Implement appropriate sorting and searching techniques for solving the problem.	S3
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 Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2							3	3	3	
CO2	3	3	3	3							3	3	1	
CO3	3	3	3	3							3	3	1	
CO4	3	3	3	3							3	3	1	
CO5	3	3	3	3							3	3	3	

3- High; 2-Medium; 1-Low

G. Course Contents

Part -1

Task 1: Array ADT

Using Array ADT perform the following:

i) Basic Operations in ADT: Creating an array, displaying of array elements, Inserting an element

ii) Problems related to: Finding duplicates, missing element, minimumdifference and rotations.

Task 2: Linked List

Design, Develop and Implement the following tasks using LinkedList ADT.

i) Singly Linked List: Operations in Ascending Order

ii) Doubly Linked List: Get reversed in from the given order

iii) Circular Linked List: Choose the place in the end of the circle so that you arethe last one.

Task 3: Stack ADT

Develop and implement the following tasks using Stack ADT:

i) Stack using Array

ii) Find all elements greater than their Right element

iii) Infix To Postfix Conversion

iv) Balanced Parenthesis

v) Tower of Hanoi

Task 4: Queue ADT

Using Queue ADT perform the following:

i) Basic Operations of Queue ADT Using Array

ii) Queue Implementation using Stack

iii) Circular Queue of Characters

Task 5: Binary search Tree

Design, Develop and Implement the following tasks using Binary search Tree.

i) Basic Operations of BST

ii) Tree Traversal with Recursion

iii) Tree Traversal without Recursion

iv) Find the Depth and Height of the tree

v) Find the MIN and MAX element of the tree.

Task 6: Hashing

Using Hashing Technique perform the following:

i) Basic Hashing Technique

ii) Linear Probing

iii) Separate Chaining

iv) Character Frequency Counting

v) Number Frequency Counting

Task 7: Graph

Design, Develop and Implement the following tasks using Graph Concept.

i) Read the adjacent Vertices from given Matrices

ii) Find the Shortest Path using Dijkstra's Algorithm

iii) Find Minimum Spanning Tree using Prim's algorithm (based on PriorityQueue)

iv) Find Minimum Spanning Tree using Kruskal's algorithm - using Disjointsubsets and Union find algorithm

v) Topological Sorting

vi) Graph Traversal using Depth First Search

vii) Graph Traversal using Breadth First Search

Task 8: Sorting

Develop and implement the following sorting algorithms:

i) Insertion Sort

ii) Merge sort

iii) Quick Sort

iv) Bubble sort

v) Radix sort.

Task 9: Searching

i) Implementation of Linear Search

ii) Implementation of Binary Search

Part II

Use Cases

Use Case 1: Railroad Car

Imagine a railroad switching circuit such as the one below. Railroad cars are givenunique numbers, from 1 onwards. Cars come in from the right in a random order, and thegoal is to assemble the cars in numeric order on the left.For example, to assemble the cars in the sequence shown (2, 1, 3) the car numbered 2would be switched on to the siding. Then car numbered 1 would be moved on to thesiding and then to the left. Next car numbered 2 would be moved up from the siding andassembled behind car 1. Finally, car numbered 3 would be moved from the right to theleft, via the siding. Notice that the cars in the siding work as a stack, since if a car ismoved on to a nonempty siding the existing cars cannot be accessed until the new car isremoved.Develop and implement an algorithm that will rearrange the cars in sequential

order regardless of the order in which they appear on the left. Use the Linear data structure ADT for implementing the use case.

Use Case 2: Card Shuffling

A new casino has recently opened in ChefTown - the capital of Chef Land. Amongst a lot of games, there are also a few games that are played with a pile of cards. In total, there are N cards in the pile. Let us enumerate them by positive integers 1, 2, ..., N in order they appear in the pile from top to bottom. Obviously, the cards must be shuffled before the game. Our protagonist Alex, being a mathematician wants to analyze this process. According to Alex, the card shuffling process in the casino is quite similar to how we do in the real life. Namely, it consists of the following: The croupier takes a consecutive ""sub-pile"" of cards, starting from the L1-th card from the top and ending at the R1-th card from the top (both inclusive) and moves this sub-pile from the middle of the pile to the very top, not changing the order of the cards in the taken sub-pile. Then she takes a sub-pile, starting at the L2-th card and ending this one at the R2-th one from the top of the current pile and moves it to the top, and so on. At last, she takes a sub-pile, starting at the LM-th card and ending this one at the RM-th one from the top of the current pile and moves it to the top. The process, described above, repeats Q times. Alex wants to collect some data in order to be able to predict the order in which thecards will be lying in the pile after the shuffling, but he is not really good at working with big piles and large repetitions. Design, Develop and implement an algorithm to do the following:

i) For a given set of segments ([L1, R1], [L2, R2], ..., [LM, RM]) and a given permutation, Find the minimum Q such that after Q repetitions of the first step in the algorithm above, the permutation will look like this. It is given that this number won't ever be bigger than 1012.

ii) For a given set of segments ([L1, R1], [L2, R2], ..., [LM, RM]) and a given Q, Determine the order of the cards after the shuffling algorithm above.

Use Case 3: Multiuser Environment

Linux is designing a new OS to operate in a multiuser environment. All the users would be connected to a central machine. This central machine can allocate or de-allocate resources to the connected users in order to maximize overall performance.
The OS has a limitation. If a particular program is running on more than 2 computers the central machine terminates this program on all the machines running it. To do this, the central machine assigns a unique identification number Z to each of the programs. The central machine runs a periodic check in which it obtains a list from each of users stating identification number of all the programs running on their systems. If the central machine finds that a particular program is running on more than 2 machines it terminates it on all machines.

This task of periodic checks and obtaining the lists has been implemented in the OS. In order to terminate the programs, the OS need to know in advance the exact number of programs it is going to terminate. So given these lists, design a program which can tell the OS the number of programs it is going to terminate.

Note: You need to specify only the number of ‘programs’ it is going to terminate and not the number of machines on which that program is running. For e.g. If a program is running on 4 computers, for the OS this counts as a single program which it needs to terminate.

Use Case 4: Delivery Vehicles

A computer company in the Silicon Valley area (see Figure) needs to route delivery vehicles between cities on the shortest route. Recognize the appropriate algorithm and demonstrate the following tasks:

a. Modify the graph ADT to store weights in the arc nodes.

b. Implement a program, when given the start and destination and display the shortestroute between them.

Total: 30 Hours

H. Learning Resources

i. Text Books:

1. Narasimha Karumanchi," Data Structures and Algorithms made Easy"5th Edition, Career Monk Publication, Print Replica, 2020.
2. Seymour Lipschutz, "Data Structures with C", Scham's outlines, Tata McGraw Hill, 2017.

ii. Reference Books:

1. V. Aho, J. E. Hopcroft, and J. D. Ullman, "Data Structures and Algorithms", Pearson Education, First Edition, Reprint 2017.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, "Fundamentals of DataStructure in C", Universities Press,2017.

iii. Online References:

1. "Data Structures using C" 2003- 2021. Accessed on: Apr. 15, 2021 [Online]. Available: http://www.academictutorials.com/data-structure/
2. "Linked List" 2015, Accessed on: Apr. 15,2021 [Online]. Available: http://www.c4learn.com/mcq/data-structure-mcq/linked-list-mcq-general-questions/
3. "Advanced Data Structures" 1999 – 2021. Accessed on: Apr. 15,2021 [Online]. Available: http://randu.org/tutorials/c/ads.php
4. "C Data Structure Fundamentals" 2021. Accessed on Apr.15,2021 [Online]. Available: http://www.zentut.com/c-tutorial/

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS303	COMPUTER NETWORKS LABORATORY	0	0	2	1

A.Preamble

This course provides students with hands on training regarding the design, troubleshooting, modeling and evaluation of computer networks. In this course, students are going to experiment in a passive cable connectivity, and learn about network design and troubleshooting topics such as: frame analysis, routing and routing table updating, route discovery, Switch Trunk Port Issues and many others.

B.Prerequisite Course

10210CS101 -Problem Solving using C

C. Corequisite Course

10211CS105 - Computer Networks

D.Course Objectives

Learners are exposed to:

- Understand the working difference between straight cable and cross over cable.
- Gain core knowledge of Network layer routing protocols and IP addressing
- Learn about basic security configuration and troubleshooting

E. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Choose the different types of transmission media for real time applications.	S3
CO2	Identify data flow between peer to peer in an IP network.	S3
CO3	Demonstrate the configuration of switches and routers.	S3
CO4	Implement the routing protocols to route the packet in a given network.	S3
CO5	Implement file transfer mechanisms using Socket programming with security configurations.	S3
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 Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

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**

3- High; 2-Medium; 1-Low

G.Course Contents

Part-1

Physical Layer:

Task 1: **Passive cable connectivity**:

Using raw Un Twisted Pair Cable (UTP) cables and connectors create Cross-over /straight-through cables as per the network requirements to fulfil the hybrid topology creation.

Data Link Layer:

Task 2:Frame Analysis:

A) Using PCAP tool capture the real time frame and analyses the all-header fields of the same.
B) Configure a layer 2 switch to send a packet from one LAN (Local Area Network) to another LAN by Link Layer Address.

Task 3: **Layer 2 Route Discovery:**

Create and implement the following

Execute the ping command from ‘PC2’ to ‘PC5’ successfully

Network Layer:

Task 4: Layer 3 Routing:

A) Consider networks A, B and C consist of 4 computers in each network are directly connected with Router ’R’.

Condition: I) network A and C can only communicate each other

II) Portion of Network B can communicate with Network A

Configure the above scenario using Cisco packet tracer or equivalent opensource tool

B) Using a wireless router configure the following

I) Device ID / name II) Device Password III) SSID IV) Wi-Fi Password

V) DHCP (Dynamic Host Configuration Protocol) Address range VI) MAC Binding

Task 5:Routing Table Update:

Implement to update routing table IPV4 and IPV6 addressing table before and after route 2(R2) has been removed from network communication for the given network.

Task 6: **Subnetting:**

Calculate the range of network and host addresses and subnet mask for the given IP addresses (ex. 172.17.1.5/24) and construct a network for the same using packet tracer/NS2/NS3.

Task 7: Protocol Performance:

Implement Distance Vector and Link State Routing Protocol using packet tracer with at least 4 routers. Justify the performance.

Transport Layer:

Task 8: Socket Programming:

Using TCP/IP sockets, create a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present.

Task 9: **Basic Security Configurations:**

Configure basic security consideration in a computer, Switch, Router and Firewall devices.

Task 10: Troubleshooting:

Study and Devise Solutions with appropriate commands to trouble shoot

i) Missing VLANs ii) Switch Trunk Port Issues iii) Switch Access Port Issues iv) Router Configuration Issues v) Remote management issue vi) restoring a managed switch with earlier configuration

Application Layer:

Task 11: Remote Login:

Access the server's FTP service from the PC, capture the packet and analyze it.

Part-2

Use Cases

Use Case1: Designing LAN for an Operating Centre

Design an operational LAN network-1 with departments A, B are having 2 computers each, accessing the switch-1 located in Building 'B1' and the same part of departments which is operational at Building 'B2' are accessing the switch-2. Both switches are connected with Router 'R1' and the router ‘R1’ is serially connected with router 'R2'. R2 is directly connected with a PC ("stu VTU number")' using a Switch-3.

A Laptop 'Admin-PC' with Wireless connectivity to manage all network devices remotely and an application server 'Server-S1' is located in a network operating Centre connected with Router 'R1' via Switch-4 and is accessible to all departments.

Connectivity:

All Network devices are connected to each other through FOC

In-case of any additional devices required can be added

Department C shall not communicate with Department A& B but can communicate with Server

All not used Ports shall by Disabled and All switch requires login Password facility for remote users

from laptop all switches need to be configured/Access for remote management

Use Case 2:

Create a Lan Network with 5 Wi-Fi device and 5 CCTV camera under a switch. Both traffic channels shall be separated and Only CCTV cameras need to be accessed from remote network beyond router. For that student may configure Port forwarding method.

Total: 30 Hours

G.Learning Resources

i. Text Books:

1. Behrouz Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 5th Edition,2021.
2. Andrew S. Tanenbaum, David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2016.

ii. Reference Books:

1. Kurose and K.W. Ross, “Computer Networking: A Top-Down Approach Featuring the Internet”, Addison-Wesley,2013
2. W. Stallings, “Data and Computer Communication”, PHI, 10th Edition,2017.
3. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud,5th Edition,2015

iii. Online References:

1. “Networking Fundamentals” CISCO [online] 2019, https://www.cisco.com/c/dam/global/fi_fi/assets/docs/SMB_University_120307_Networking_Fundamentals.pdf
2. “Software Testing Help” [Online] 2020, https://www.softwaretestinghelp.com/router-setup-configuration/
3. “Cisco ICND1 Foundation Learning Guide: LANs and Ethernet” CISCO [online]2013, https://www.udacity.com/course/computer-networking--ud436.
4. “Fundamentals of Network Communication” Course Era [Online] 2021, https://www.coursera.org/learn/fundamentals-network-communications.
5. “Introduction to packet tracer” CISCO[online]2019, https://www.netacad.com/courses/packet-tracer/introduction-packet-tracer

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS312	FUNDAMENTALS OF COMPUTER NETWORKS LABORATORY	0	0	2	1

A. Preamble

This course provides students with hands on training regarding the design, troubleshooting, modelling and evaluation of computer networks. In this course, students are going to experiment in a passive cable connectivity, and learn about network design and troubleshooting topics such as: frame analysis, routing and routing table updating, route discovery, Switch Trunk Port Issues and many others.

B.Prerequisite Courses

10210CS101 - Problem Solving using C

C.Course Objectives

Learners are exposed to

- Understand the working difference between straight cable and cross over cable.
- Gain core knowledge of Network layer routing protocols and IP addressing
- Learn about basic security configuration and troubleshooting

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 network using network components	S3
CO2	Examine the frame analysis and routing in layer2 network.	S3
CO3	Apply the routing techniqueand create the subnetting in layer3 network.	S3
CO4	Demonstrate the Socket programming and datagram approaches.	S3
CO5	Explain the application layer protocols for a given real-time scenario.	S3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create S3 – Skill Level, Precision		

E.Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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

3- High; 2-Medium; 1-Low

F.Course Contents

Part 1

Physical Layer:

Task 1: Implement Peer-to-Peer network using network components: **CO1, K3**

Using raw Un Twisted Pair Cable (UTP) cables and connectors create Cross-over /straight-through cables as per the network requirements to fulfil the hybrid topology creation.

Task 2: Implement a client-server architecture using wireless medium. **CO1, K3**

Data Link Layer:

Task 3: Frame Analysis**:** **CO2, K3**

A) Using PCAP tool capture the real time frame and analyses the all-header fields of the same.

B) Configure a layer 2 switch to send a packet from one LAN (Local Area Network) to another LAN by Link Layer Address.

Task 4: Examine the MAC table using ARP **CO2, K3**

Task 5: Layer 2 Route Discovery**:** **CO2, K3**

Configure a layer 2 switch to send a packet from one LAN (Local Area Network) to another LAN by Link Layer Address.

Execute the ping command from ‘PC2’ to ‘PC5’ successfully.

Network Layer:

Task 6: Subnetting **CO3, K3**

Calculate the range of network and host addresses and subnet mask for the given IP addresses (ex. 172.17.1.5/24) and construct a network for the same using packet tracer/NS2/N S3.

Task 7: Layer 3 Routing**:** **CO3, K3**

A) Consider networks A, B and C consist of 4 computers in each network are directly connected with Router ’R’.

Condition: I) network A and C can only communicate each other

II) Portion of Network B can communicate with Network A

Configure the above scenario using Cisco packet tracer or equivalent opensource tool

B) Using a wireless router configure the following

I) Device ID / name II) Device Password III) SSID IV) Wi-Fi Password

V) DHCP (Dynamic Host Configuration Protocol) Address range VI) MAC Binding.

Task 8: Configuring RIP: **CO3, K3**

Implement to update routing information protocol table for the given network.

Task 9: Routing Table Update**:** **CO3, K3**
Implement to update routing table IPV4 and IPV6 addressing table before and after route 2(R2) has been removed from network communication for the given network.

Task 10: Protocol Performance**:** **CO3, K3**

Implement Distance Vector and Link State Routing Protocol using packet tracer with at least 4 routers. Justify the performance.

Transport Layer:
Task 11: Socket Programming**:** **CO4, K3**
Using TCP/IP sockets, create a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present.

Task 12: Implement the datagram approaches. **CO4, K3**

Task 13: **Basic Security Configurations:** **CO4, K3**
Configure basic security consideration in a computer, Switch, Router and Firewall devices.

Task 14: Troubleshooting: **CO3, CO4, K3**
Study and Devise Solutions with appropriate commands to trouble shoot
i) Missing VLANs ii) Switch Trunk Port Issues iii) Switch Access Port Issues iv) Router Configuration Issues v) Remote management issue vi) restoring a managed switch with earlier configuration.

Application Layer:
Task 15: Remote Login: **CO5, K3**
Access the server's FTP service from the PC, capture the packet and analyze it.

Task 16: Implement the DNS services. **CO5, K3**
Task 17: Implement the web services using HTTP/HTTPS. **CO5, K3**
Task 18: Implement the mail service using SMTP, POP3, and IMAP. **CO5, K3**

Part 2
Use Case1: Designing LAN for an Operating Centre
Design an operational LAN network-1 with departments A, B are having 2 computers each, accessing the switch-1 located in Building 'B1' and the same part of departments which is operational at Building 'B2' are accessing the switch-2. Both switches are connected with Router 'R1' and the router 'R1' is serially connected with router 'R2'. R2 is directly connected with a PC ("stu VTU number")' using a Switch-3.

A Laptop 'Admin-PC' with Wireless connectivity to manage all network devices remotely and an application server 'Server-S1' is located in a network operating Centre connected with Router 'R1' via Switch-4 and is accessible to all departments.

Connectivity:
All Network devices are connected to each other through FOC
In-case of any additional devices required can be added
Department C shall not communicate with Department A& B but can communicate with Server
All not used Ports shall by Disabled and All switch requires login Password facility for remote users
from laptop all switches need to be configured/Access for remote management

Use Case 2:
Create a Lan Network with 5 Wi-Fi device and 5 CCTV camera under a switch. Both traffic channels shall be separated and Only CCTV cameras need to be accessed from remote network beyond router. For that student may configure Port forwarding method.

Total: 30 Hours

F.Learning Resources

i.Text Books:

1. Behrouz Forouzan, "Data Communications and Networking", Tata McGraw Hill, 5th Edition,2021.

2. Andrew S. Tanenbaum, David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2016.

ii.Reference Books:

1.Kurose and K.W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Addison-Wesley,2013

2. W. Stallings, "Data and Computer Communication", PHI, 10th Edition,2017.

3. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud,5th Edition,2015

iii.Online References:

1."Networking Fundamentals" CISCO [online] 2019, https://www.cisco.com/c/dam/global/fi_fi/assets/docs/SMB_University_120307_Networking_Fundamentals.pdf

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS304	OPERATING SYSTEMS LABORATORY	0	0	2	1

A.Preamble

The Operating System Laboratory is a course that will teach students about practicing Unix commands, Shell programming, System calls, working with process management, different CPU scheduling algorithms, Deadlock handling methods and apply Memory management techniques.

B.Prerequisite Course

10211CS102 - Data Structures

C. Corequisite Course

10211CS103 - Operating Systems

D.Course Objectives

Learners are exposed to:

- Practice on Unix commands and Shell programming.
- Illustrate System calls implementation and process management techniques.
- Demonstrate different CPU scheduling algorithms and Deadlock Handling methods
- Apply Various Memory and Disk scheduling techniques.

E.Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Develop Shell scripts& system calls	S3
CO2	Apply the process management techniques and scheduling algorithms for the given problem.	S3
CO3	Make use of Banker's algorithm to detect and avoid dead lock	S3
CO4	Implement various memory management strategies and page replacement algorithm.	S3
CO5	Implement the various disk scheduling algorithms	S3
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 Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1												
CO2	3	3	3	1								3		1
CO3	3	3	3	3								3		
CO4	3	3	3									3		
CO5	3	3	3									3		3

3- High; 2-Medium; 1-Low

G.Laboratory Experiments: **Total:30Hours**

Part-1

Task 1. Practice on **UNIX Commands**

- For the given task find out the correct command and produce the output
- Ex: create 100 directories named from 1 to 100

Task 2. Interpret **Shell programming**

- For the given problem statement, write shell program.
- Find out the appropriate shell script to get the output.
- Implement the shell program to perform I/O operations on file.

Task 3. Illustrate **System calls** of UNIX operating system: fork, exec, getpid, exit, wait, close.

- Implement the appropriate program to implement the given system calls.
- Files created automatically by using system call implementation.
- Use relevant system calls in the implementation.

Task 4. Interpret **I/O System calls** of UNIX operating system (open, read, write, etc).

- Create the file by using appropriate system call in C program
- Perform read operation in the mentioned file and print it on screen
- Read input from user and write the same to the file.
- Copy content from one file, write into another file and display the content of destination file in display.

Task 5. Demonstrate **Inter-Process Communication** (**using shared memory**, pipes or message queues).

- Create number of processes and pass information between them.
- Pass information between parent and child process using pipes.
- Use shared memory concept, perform read and write operation by the process to communicate between them.

Task 6. Use of **semaphores** (using UNIX system calls)

Write program to ,

- Implement producer-consumer environment using common buffer.
- Implement readers-writers problem.
- Use appropriate semaphore variable for the given problem statement to avoid synchronization problems.

Task 7. Practice on CPU Scheduling algorithms: **FCFS, SJF, PRIORITY, ROUND ROBIN**

For the given scenario write C program to,

- Find out the waiting time for each process.
- Find out the Turn around time of each process.

- Display the table which contains process names, burst time, arrival time, waiting time and turnaround time.
- Display average waiting time and Average turnaround time.

Task 8. Apply **Bankers Algorithm** to avoid Deadlock.

For the given scenario write C program to,

- Calculate need matrix.
- Find out sequence of execution of process.
- Print the Sequence of execution and conclude the system in safe state or not.

Task 9. Interpret Memory allocation schemes like **First fit, Best fit and Worst fit.**

Write a C program to,

- Simulate contiguous memory allocation techniques.
- Each allocation Techniques, find out the mapping of process with corresponding frames.
- Display mapping details .

Task 10. Illustrate **page Replacement algorithms: FIFO, LRU, OPTIMAL**

Write a C program to,

- Implement different Page replacement algorithms, for each Algorithm,
- Show the contents of frames for each reference of a page.
- If page hit, display "No page Fault"
- Display the number of page faults at the end.

Task 11. Apply Disk scheduling algorithms:**FCFS, SSTF, SCAN,C-SCAN**

Write a C program to simulate Disk Scheduling techniques and for each algorithm

- Display the order of servicing the request.
- Calculate the number of read / write head movements.
- Display the number of movements.

Part-2

Use Cases

Use Case 1:

Illustrate the given scenario by a program to implement

a) create a file "input.txt"
   [one
   Two
   Three
   Four
   Five]
b) Copy "input.txt" to "output.txt"
c) Append to "output.txt"
   [Six
   Seven
   Eight]

d) Delete “input.txt” file

Use Case 2:

a) Demonstrate a program in C that creates a child process, waits for the terminationof the child and lists its PID

b) Create a file named my file.txt that contains the following four lines :

Child 1 reads this line

Child 2 reads this line

Child 3 reads this line

Child 4 reads this line

Write a C program that forks four other processes. After forking the parent process goes into wait state and waits for the children to finish their execution. Each child process reads a line from the file my file.txt (Child 1 reads line 1, child 2 reads line 2, child 3 reads line 3 and child 4 reads line 4) and each prints the respective line. The lines can be printed in any order.

Use Case 3:

Illustrate a program to coordinate the barber and the customers..A barbershop consists of a waiting room with n chairs, and the barber room containing the barber chair. If there are no customers to be served, the barber goes to sleep. If a customer enters the barbershop and all chairs are occupied, then the customer leaves the shop. If the barber is busy, but chairs are available, then the customer sits in one of the free chairs. If the barber is asleep, the customer wakes up the barber. Write a program to coordinate the barber and the customers.

Usecase 4.

A computer processor is given N tasks to perform ($1 \leq N \leq 50,000$). The i-th task requires T_i seconds of processing time ($1 \leq T_i \leq 1,000,000,000$). The processor runs the tasks as follows: each task is run in order, from 1 to N, for 1 second, and then the processor repeats this again starting from task 1. Once a task has been completed, it will not be run in later iterations. Determine, for each task, the total running time elapsed once the task has been completed.

Input

The first line of the input contains the integer N, and the next N lines contain the integers T_1 through T_N.

Output

Output N lines, the i-th of which contains an integer representing the time elapsed when task i has been processed.

Example

> **Input:**
>
> 5
>
> 8
>
> 1

3

3

8

Output:

22

2

11

12

23

The second task is completed during the first iteration, finishing 2 seconds in. On the third iteration, the third and fourth tasks complete at 11 seconds and 12 seconds, respectively. Finally, on the eighth iteration, the first and last tasks complete at 22 seconds and 23 seconds, respectively.

Usecase 5.

A single processor system has three resource types HDD, Printer and USB , which are shared by three processes. There are 5 units of each resource type. Consider the following scenario, where the column alloc denotes the number of units of each resource type allocated to each process, and the column request denotes the number of units of each resource type requested by a process in order to complete execution. Which of these processes will finish LAST? Develop a program to solve this.

0. P0
1. P1
2. P2

None of the above since the system is in a deadlock

	Alloc			**Request**		
	HDD	**Printer**	**USB**	**HDD**	**Printer**	**USB**
P0	1	2	1	1	0	3
P1	2	0	1	0	1	2
P2	2	2	1	1	2	0

Usecase 6.

Interpret a C program to simulate page replacement algorithms

a) FIFO b) LRU c) LFU

A system uses 3 page frames for storing process pages in main memory. Assume that all the page

frames are initially empty. What is the total number of page faults that will occur while processing the page reference string given below-Apply all replacement algorithms

1,2,3,4,2,1,5,6,2,1,2,3,7,6,3,2,1,2,3,6

Also calculate the hit ratio and miss ratio.

Usecase 7:

Demonstrate a C program to simulate the following contiguous memory allocation techniques. Consider six memory partitions of size 200 KB, 400 KB, 600 KB, 500 KB,

300 KB and 250 KB. These partitions need to be allocated to four processes of sizes 357 KB, 210 KB, 468 KB and 491 KB in that order.

Perform the allocation of processes using-

1. First Fit Algorithm
2. Best Fit Algorithm
3. Worst Fit Algorithm

Usecase 8:

Implement a C program to simulate the following Disk Scheduling techniques

Input:

Suppose the order of request is- (82,170,43,140,24,16,190) print the order of visit and

Seek time and current position of Read/Write head is : 50

a) FCFS b) SSTF

H.Learning Resources

i. Text Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, 9th Edition, John Wiley and Sons Inc., 2016.

ii. Reference Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating SystemConcepts”, 9th Edition, John Wiley and Sons Inc., 2016.
2. Richard Petersen, “Linux: The Complete Reference”, 6th Edition McGrawHill Education 2017.

iii. Online Resources:

1. “Learn Unix” Accessed on: May 25, 2021 [Online]. Available: https://www.tutorialspoint.com/unix/index.htm
2. “Linux programming and scipting” June 18,2015. Accessed on: May 25, 2021 [Online]. Available: https://nptel.ac.in/courses/117/106/117106113/

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS305	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	0	0	2	1

A. Preamble

This laboratory course motivates the students to understand and develop assembly language programming skill by learning simple arithmetic, conditional programs. It teaches the students to realize the difference between microprocessor and microcontroller. Students are also exposed about interfacing techniques which has been the pathway for developing real time applications.

B.Prerequisite Course

10211CS201 – Digital Electronics

C. Corequisite Course

10211CS109 - Microprocessor and Microcontroller

D.Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Develop programming skill using 8086 assembly language instructions.	S3
CO2	Identify the list of ARM processor related instructions and develop simple programs using it.	S3
CO3	Establish ARM processor interfacing with keyboard and display unit using embedded C programs.	S3
CO4	Realize UART data transmission between two ARM processor boards.	S3
CO5	Measure the temperature of an object using ARM processor.	S3
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	PSO3
CO1	3	3											2	
CO2	3	3			3								3	
CO3	3	3	3		3								3	
CO4	3	3	3		3								3	
CO5	3	3	3		3								3	3

High - 3, Medium - 2, Low – 1

F. Course Content

Part – 1

Task 1: 16bit arithmetic and logical operations using 8086 instruction set.

Construct assembly language programs for addition, subtraction, multiplication and division.

Task 2: String operations using 8086 instruction set

Develop programs for string concatenation and conversion of uppercase letters into lowercase letters and vice versa.

Task 3: Smallest and largest number using 8086 instruction set
Realize a program that is able to identify the smallest and largest number from the given set of data.

Task 4: Ascending and descending order using 8086 instruction set
Write assembly language program to arrange the given number from smallest to largest and vice versa.

Task 5: Data transfer using ARM processor
Employ an assembly language program which is able to transfer data from ARM processor register to memory or memory to ARM processor.

Task 6: Count of negative numbers in an array using ARM processor instructions
Formulate a logic to identify the list of negative numbers from the given numbers and develop the program using ARM processor instruction set.

Task 7: Factorial of positive integer N using ARM processor instructions
Calculate the factorial of a given numbers using ARM processor instructions.

Task 8: GCD algorithm using ARM processor instructions
Identify the greatest common divisor of given numbers by executing program developed using ARM processor instructions.

Task 9: Seven segment LED display
Control the display of an LED through an ARM processor.

Task 10: Key board and display interfacing using ARM processor kit development board
Realize the display of the information typed using a keyboard and processed by an ARM processor.

Task 11: UART device driver for data transmission
Experiment the process of data transfer that can be established between two ARM processor boards.

Task 12: Temperature measurement using ARM processor kit development board
Construct a data acquisition mechanism of any physical parameter like temperature using an ADC which is in-built in an ARM processor.

Part-2Use Cases:

Use Case 1:

Develop an application which counts the number of customers entering into a supermarket for purchasing using 8086 microprocessor. IR sensor shall be used to identify the customerentering into the supermarket. 8086 Processor recognizes the output of IR sensor as a digital input and a suitable ALP is able to initiates the count as and when it receives a logic ‘1’.

Use Case 2 :

Implement a scheme to measure the distance between two cars that helps to avoid collision due to over speed. GP2D120 sensor can be used to measure the distance between two objects. Output of the sensor is analog signal. A/D converter in an ARM CORTEX processor recognizes this output as an input to it. Suitable Keil ‘C, coding implemented in the ARM processor converts the analog signal into digital and displays the result through LCD display.

Use Case 3 :

Interpret the given digital signal, develop a Keil ‘C’ program to implement in an ARM CORTEX processor for identifing the frequency of the signal and display its value in an LCD.

Use Case 4 :

Design a Keil ‘C’ program to generate a PWM signal based on the input value given by the user. The program must be implemented in an ARM CORTEX processor and the output shall be displayed by

changing the ON / OFF condition of an LED. Timer in the ARM processor can change the width of the pulse depending the input applied to it. Frequency of the timer is the frequency of the ARM processor.

Total: 30 Hours

H. Learning Resources

i. Text Books:

1. Doughlas V. Hall, “Microprocessors and Interfacing”, TMH, Revised second edition, 2005.
2. Muhammad Tahir, Kashif Javed, “ARM Microprocessor Systems: Cortex-M Architecture, Programming, and Interfacing”, CRC Press, Taylor & Francis group, 2017.

ii. Reference Books:

1. Andrew N. Sloss, “ARM system developer’s guide – Designing and optimizing system software”, ELSEVIER, 2004.
2. Charles M. Gilmore, “Microprocessors: Principles and applications”, TMH, Second edition, 1995.
3. Jonathan W. Valvano, “Embedded microcomputer systems: Real time interfacing”, CENGAGE Learning, Third edition, 2012.
4. Steve Furber, “ARM system-on-chip architecture”, Pearson education, Second edition, 2015.

iii. Online References:

1. “Microprocessor interfacing”, Accessed on Sep 20, 2022 [Online], Available: https://onlinecourses.nptel.ac.in/noc20_ee11/preview.
2. “Microprocessors and Digital systems”, Accessed on Sep 21, 2022 [Online], Available: https://archive.org/details/microprocessorsd0000hall/page/n3/mode/2up.
3. “ARM processor architecture”, Accessed on Sep 21, 2022 [Online], Available: https://www.cs.ccu.edu.tw/~pahsiung/courses/ese/notes/ESD_03_ARM_Architecture.pdf.

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS306	COMPETITIVE CODING - I	0	0	2	1

A.Preamble

This course provides the way to trace the code using pen and paper handy. Students are expected to understand the notions of syntax and semantics of programming languages. Also, the students are expected to carry out the tasks which in turn helps them to develop their logic and problem-solving skills using learning-by-doing approach

B.Prerequisite Courses

10210CS101 - Problem solving Using C

C.Course Objectives

Learners are exposed to:

- Understand in depth knowledge in tracing the code.
- Identify the syntax and semantic errors and to debug the program.
- Solve programming problems using basic number theory concepts
- Implement the concepts of linear and Nonlinear data structures for the real-world problem

D.Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Trace and debug the program / code segment which includes syntax and semantic errors.	S3
CO2	Analyze the functional, logic and programming paradigm.	S3
CO3	Apply number theory and mathematical concepts to solve the computational problem.	S3
CO4	Implement algorithm for real word problems using elementary data structures.	S3
CO5	Analyze the given partial code / Pseudocode and find correct solution.	S3
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	PSO3
CO1	3	3	3	3							3	3		
CO2	3	3	1	1							3	3		
CO3	3	3	3	3							3	3	3	
CO4	3	3	3	3							3	3	3	
CO5	3	3	3	1							3	3		

3- High; 2-Medium; 1-Low

F.Course Contents

The coursedescribes how programs work and how data is stored- Point out the Syntax and Semantic errors - Conceptual Questions in Programming- Solve programming problems implementing loops- Basic Number Theory 1, Basic Number Theory 2- Primality Tests- Data structure algorithms and finding complexity- Code Optimization -Partial Code Completion -Techniques for readability and ease of maintenance. -Concepts behind compiling, linking, OS, Hardware-Practice Problems for Placement Preparation

The above contents are covered under the following tasks:

Task 1: Point out the Syntax and Semantic errors in the code snippet, and debug

[Ref: T1 – Pg.no: 18,32,33,141-143,159-161,191-192,248,320-321,401,402, Appendix C]

Task 2: Conceptual Questions in Programming

[Ref: T1 – Pg.no:34,35,140,141,171,172,190,191,211,212,247-248,269-271,319,320,400,401]

Task 3: Solve programming problems implementing necessary loops

[Ref: T1 – Pg.no:48-53,66-72,84-86,102-106,120-124]

Task 4: Basic Number Theory 1

To solve programming problems which includes the following topics:

1. **Modular arithmetic:** Properties with example
2. **Modular exponentiation**
    a. Basic method and its time complexity with example
    b. Optimized method and its time complexity with example

Task 5: Basic Number Theory 1

To solve programming problems which includes the following topics:

1. **Greatest Common Divisor (GCD)**
    a. Naïve Approach and its time complexity with example
    b. Euclid Algorithm and its time complexity with example

2. **Extended Euclidean algorithm:** Basic method and its time complexity

3. **Modular multiplicative inverse**

    a. Naïve Approach and its time complexity with example
    b. Extended Euclidean algorithm
    c. Fermat's Little Theorem and its time complexity with example

Task 6: Basic Number Theory 2

To solve programming problems which includes the concept of Prime numbers and its related properties.

a. **Naive Approach** and its time complexity with example
b. **Sieve of Eratosthenes** and its time complexity with example

Task 7: Primality Tests

To solve programming problems which includes the concept of Prime numbers and its related properties.

a. **Sieve of Eratosthenes** with example
b. **Fermat's Primality Testing** with example
c. **Miller-Rabin Primality** Testing with example

Task 8: Arrays -Introduction, memory allocation (with row/column major), operations (insert, delete, search) sorted and unsorted array, suffix array, subsequence and subarray.

Practice Problems:

i) Two Sum : -https://leetcode.com/problems/two-sum/
ii) Rotate Array :- https://leetcode.com/problems/rotate-array/
iii) Maximum Subarray :- https://leetcode.com/problems/maximum-subarray/
iv) Best Time to Buy and Sell Stock :-https://leetcode.com/problems/best-time-to-buy-and-sell-stock/
v) Container with most water:-https://leetcode.com/problems/container-with-most-water/

Additional Problems:

i) Contiguous array:-https://leetcode.com/problems/contiguous-array/
ii) Maximum product subarray:-https://leetcode.com/problems/maximum-product-subarray/
iii) Find the Duplicate Number:-https://leetcode.com/problems/find-the-duplicate-number/
iv) First Missing Positive:-https://leetcode.com/problems/first-missing-positive/

Task 9: String Processing- Basics, String functions (based on different language), String operations, Two algorithms for string pattern matching - Naïve approach and Robin karp approach

Practice Problems:

i) Reverse words in a string:-https://leetcode.com/problems/reverse-words-in-a-string/
ii) Valid Palindrome:-https://leetcode.com/problems/valid-palindrome-ii/
iii) Longest Palindromic Sunstring:-https://leetcode.com/problems/longest-palindromic-substring/
iv) Palindromic Substrings:-https://leetcode.com/problems/palindromic-substrings/
v) Subsequence Matching:-https://practice.geeksforgeeks.org/problems/subsequence-matching/0

Additional Problems:

i) Reverse String:-https://leetcode.com/problems/reverse-string/
ii) Reverse words in a string-III:-https://leetcode.com/problems/reverse-words-in-a-string-iii/
iii) Roman to Integer:-https://leetcode.com/problems/roman-to-integer/
iv) Good Substrings:-http://codeforces.com/problemset/problem/271/D
v) Pattern Finding:-https://www.spoj.com/problems/NAJPF/

Task 10: Bit Map-Introduction, XOR, AND, OR, right shift, left shift.

Practice Problems:

i) Reverse Bits: https://leetcode.com/problems/reverse-bits/
ii) Number of 1 bits: https://leetcode.com/problems/number-of-1-bits/
iii) Hamming Distance: https://leetcode.com/problems/hamming-distance/
iv) Single Number: https://leetcode.com/problems/single-number/
v) Single number II: https://leetcode.com/problems/single-number-ii/

Additional Problems:

i) Total Hamming Distance: https://leetcode.com/problems/total-hamming-distance/
ii) Counting Bits: https://leetcode.com/problems/counting-bits/
iii) Single Number III: https://leetcode.com/problems/single-number-iii/

Task 11: Recursion and its concepts

Practice Problems:

i) Fibonacci Number: https://leetcode.com/problems/fibonacci-number/
ii) Nth Tribonacci number: https://leetcode.com/problems/n-th-tribonacci-number/
iii) K equal sum subsets:https://leetcode.com/problems/partition-to-k-equal-sum-subsets/
iv) Permutations of string:https://practice.geeksforgeeks.org/problems/permutations-of-a-given-string/0
v) Counting Bits: https://leetcode.com/problems/counting-bits/

Additional Problems:

i) Total Hamming Distance: https://leetcode.com/problems/total-hamming-distance/
ii) Single number II: https://leetcode.com/problems/single-number-ii/

iii) Single Number III: https://leetcode.com/problems/single-number-iii/

Task 12: Elementary data structure algorithms-based Questions and finding complexity

S.No.	Data Structure Algorithms	Reference no- T2
12.1	Linked List	Problem no:2,3,11, 14,15,16,17,23,24,29
12.2	Stack	Problem no: 2, 3, 22, 23, 24, 25
12.3	Queue	Problem no: 1 to 6
12.4	Binary Tree	Problem no: 8, 10, 17, 18, 24, 27, 28
12.5	Binary Search Tree	Problem no: 49, 50, 51, 52, 56, 59
12.6	Sorting	Page no :246-255 Performance analysis and Comparison
12.7	Searching	Problem no: 1, 2, 36, 58, 59, 64, 67, 69

Task 13: Partial Code Completion [Ref: Online references]

Task 14: Practice Problems for Coding Preparation [Ref: T1 – Pgno:406-424]

Total: 30 Hours

G.Learning Resources

i. Text Books:

1. Yeshwant P. Kanetkar," Let us C: Authentic Guide to C Programming Language",17th Edition, 2020, BPB Publications.
2. Narasimha Karumanchi," Data Structures and Algorithms made Easy"5th Edition, Career Monk Publication, Print Replica, 2020.

ii. Reference Books:

1. Marty Erickson, Anthony Vazzana, David Garth,"Introduction to Number Theory", Chapman and Hall, CRC; Copyright year 2016.

2. Thomas H.Cormen," Introduction to Algorithms",3rd Edition,2009, MIT Press Cambridge.

iii. Online References:

1. "Number Theory", Accessed on Apr.20, 2021 [Online]. Available: https://www.hackerearth.com/practice/math/number-theory/
2. "All Problem sets from Leet code", Accessed on Apr.20, 2021 [Online]. Available: https://leetcode.com/problemset/all/

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS307	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

10211CS306 – 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	**S3**
CO2	Demonstrate stack, queue and sorting algorithms to solve the problems.	**S3**
CO3	Implement classical algorithms for trees and graphs with backtracking concepts, being aware of their trade-offs in terms of complexity in time/space	**S3**
CO4	Analyse and implement efficient algorithms for challenging computational problems on advanced data structures, in practice, quickly and correctly.	**S3**
CO5	Solve complex problems using dynamic programming and greedy algorithm.	**S3**

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	PSO3
CO1	3	3	3	3							3	3	2	
CO2	3	3	3	3							3	3	2	
CO3	3	3	3	3							3	3	2	
CO4	3	3	3	1							3	3	2	
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 repeatingcharacters: 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) Firstnonrepeating 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) DescendingWeights : 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) Lettercombination: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 od Data :https://www.hackerearth.com/practice/data-structures/advanced-data-structures/trie-keyword-tree/practice-problems/algorithm/cost-of-data-11/Random Generator : 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:
Lemonade change:https://leetcode.com/problems/lemonade-change/

i) Water bottles:https://leetcode.com/problems/water-bottles/
ii) Best time to buy and sell stock:https://leetcode.com/problems/best-time-to-buy-and-sell-stock-with-transaction-fee/
iii) Couples holding hands:https://leetcode.com/problems/couples-holding-hands/
iv) 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

F.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 Resources:

1. "Number Theory", Accessed on Apr.20, 2021 [Online]. Available: https://www.hackerearth.com/practice/math/number-theory/
2. "All Problem sets from Leet code", Accessed on Apr.20, 2021 [Online]. Available: https://leetcode.com/problemset/all/

COURSE CODE	COURSE TITLE	L	T	P	C
10211CS313	MACHINE LEARNING LABORATORY	0	0	2	1

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. Corequisite Course

10211CS120–Machine Learning

D. Course Objectives

Learners are exposed to:

- Implement the Machine Learning concepts for real time applications
- Experiment 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 neural networks for real scenario.

E.Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Apply data mining algorithms and concept learning algorithms	S3
CO2	Experiment pre-processing techniques and dimensionality reduction techniques in real time problems	S3
CO3	Use the concept of various regression and classification algorithms	S3
CO4	Implement artificial neural networks concepts to solve complex problems	S3
CO5	Model various clustering algorithms to solve real time problems	S3
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 Programme Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PSO 1	PSO 2	PSO 3
CO1	2	2										3		
CO2	3	3	3	2	3							3	2	2

CO3	3	3	3	2	3						3	2	2
CO4	3	3	3	2	2						3	2	2
CO5	3	2	2	2	2						3	2	2

3- High; 2-Medium; 1-Low

G.Course Contents

Part-1

TASK 1 Implement Apriori and FP-growth algorithm to find all frequent item sets for the chosen dataset and also generate Association Rules.
Platform: Rapidminer, Language: Python

TASK 2 Demonstrate the FIND-S algorithm to find a most specific hypothesis and Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
Platform: Orange, Google co-lab, Anaconda navigator, Language: Python

TASK 3 Perform Data Pre-processing, Data Analysis and Visualization for a given dataset. **Platform: Orange, Language: Python**

TASK 4 Apply PCA and LDA algorithm to select the appropriate features from the given data set.
Platform: Orange, Google co-lab, Anaconda navigator, Language: Python

TASK 5 Build a model using any of the classification algorithms that can effectively analyze and classify a new sample. Calculate the classification rate, accuracy, precision, and recall for your data set.
Platform: Alteryx Google co-lab, Language: Python

TASK 6 Implement parametric and non-parametric Regression algorithm in order to fit data points. Select appropriate dataset, visualize the output and Interpret the results.
Platform: Google co-lab, Language: Python

TASK 7 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.
Platform: Google co-lab Language: Python

TASK 8 Create a perceptron with appropriate number of inputs and outputs using Medical data. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights.
Platform: Google co-lab, Language: Python

TASK 9 Apply partitioning clustering algorithms for a given dataset. Compare the results and comment on the quality of clustering using evaluation metrics.
Platform: Google co-lab, Language: Python

TASK 10 Apply hierarchal clustering algorithms for a given dataset. Compare the results and comment on the quality of clustering using evaluation metrics.
Platform: Google co-lab, Language: Python

Part-2

Use Cases:

1. Predicting Illness
2. Recommendation System
3. Email monitoring
4. Product Classifier
5. Marketing Analysis
6. Ranking of Posts on Social Media

Total: 30 Hours

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, third edition, 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

PROGRAM ELECTIVE

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS110	OPTIMIZATION TECHNIQUES	3	0	0	3

A.Preamble

This course offers a holistic and hands-on introduction to the fundamentals of mathematical optimization for machine learning and deep learning. The course also explores about the fundamental optimization algorithms for popular machine learning / deep learning models including: least squares linear and nonlinear regression, logistic regression, support vector machines, feedforward neural networks, convolutional networks, gradient boosting, K-Means, Principal Component Analysis, and Recommender Systems.

B.Pre-requisite course

10210MA103 - Probability, Statistics and Queuing Theory

C.Course Objectives:

Learners are exposed to:

- Mathematically characterize optimal solutions for nonlinear optimization models
- Know the fundamental algorithms for unconstrained optimization
- Know how to specialize these algorithms for data science problems

D.Course Outcomes:

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

CO No's	Course Outcomes	K - Level
CO1	Develop optimization thinking and problem solving methods for solving different types of problems.	K3
CO2	Examine the optimization principle and its application in formulation of engineering optimization problems.	K3
CO3	Optimize the mathematical problems using nature based algorithms	K3
CO4	Solve various constrained and unconstrained problems in Single variable as well as multivariable.	K3
CO5	Apply the modern optimization methods for real world 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	PSO 1	PSO 2
CO1	3	3	2	2	2		2			2		3	
CO2	3	3	3	3	3		3					3	
CO3	3	3	3	2	2		2			2		3	
CO4	3	3	3		2								
CO5	3	3	3	3	3		3			3		3	2

High- 3; Medium-2; Low-1

F.Course contents

Unit 1 Mathematical Optimization for ML and DL **L-9 hours**

Supervised learning and unconstrained optimization: deep nets, trees, and kernels; The tools in the warchest: first and second order methods; Deep learning and engineering-focused first order methods; Dimension reduction, clustering, and constrained optimization Dealing with discontinuities via heuristic methods.

Unit 2 Fundamental mathematical and computational tools **L-9 hours**

Review of Linear Algebra, probability and statistics; Calculus of multivariate functions, Taylor series and local function approximation; Optimality conditions for unconstrained / constrained optimization; Numerical methods for computing derivatives, automatic differentiation, Numerical computation of eigen values / singular values.

Unit 3 Unconstrained optimization via local search **L-9 hours**

Local search as a general optimization paradigm; Random local search and the curse of dimensionality; Step length rules and intuition; Formal principles of random local search; Gradient descent - normalized and unnormalized versions; Step size selection and convergence; Conservative theoretical guarantees and line search; Steepest descent - norm generalization; Batch / Stochastic gradient descent; Variations on normalized stochastic gradient descent.

Unit 4 Second order methods **L-9 hours**

Newton's method basics - normalized and unnormalized versions; Newton's method stepsize, and backtracking linesearch - Honest adjustments for non-convex functions; Scaling issues with Newton's method; Newton and secant method as zero-finding algorithm; Quasi-Newton Methods.

Unit 5 Modern Methods of Optimization **L-9 hours**

Genetic Algorithms - Representation of Design Variables- Representation of Objective Function and Constraints- Genetic Operators; Simulated Annealing- Procedure- Algorithm- Features of the Method; Particle Swarm Optimization- Computational Implementation of PSO- Improvement in PSO- PSO Constrained Optimization Problem; Ant Colony Optimization- Ant Searching Behavior- Path Retracing and Pheromone Updating- Pheromone Trail Evaporation

Total: 60 Hours

G.Learning Resources

i. Text Books:

1. Watt, Jeremy, Reza Borhani, and Aggelos K. Katsaggelos. Machine learning refined: Foundations, algorithms, and applications. Cambridge University Press, 2020.
2. Sra, Suvrit, Sebastian Nowozin, and Stephen J. Wright, eds. Optimization for machine learning. Mit Press, 2012. (ISBN: 9780262016469)

ii. ReferenceBooks

1. Battiti, Roberto, and Mauro Brunato. "The LION way." Machine Learning plus Intelligent Optimization. LIONlab, University of Trento, Italy 94 (2014).
2. S. Bubeck, Convex Optimization: Algorithms and Complexity, Foundations and Trends in MachineLearning, 8(3-4): 231-357, 2015.
3. T. Hastie, R. Tibshirani and M. J. Wainwright, Statistical Learning with Sparsity: the Lasso andGeneralizations, Chapman and Hall/CRC Press, 2015.

iii. OnlineResource

1. http://web.stanford.edu/~hastie/StatLearnSparsity/
2. http://simons.berkeley.edu/talks/peter-richtarik-2013-10-23

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS113	REINFORCEMENT LEARNING	3	0	0	3

A. Preamble

This course provides the overview of reinforcement learning paradigm that aims to model the trial-and-error learning process. It is a core area of research in artificial intelligence and machine learning, and today provides one of the most powerful approaches to solving Decision problems

B. Prerequisite Course

10210MA103- Probability, Statistics and Queuing theory

C. Course Objectives

Learners are exposed to:

- Knowledge of basic and advanced reinforcement learning techniques.
- Identification of suitable learning tasks to which these learning techniques can be applied.
- Appreciation of some of the current limitations of reinforcement learning techniques.

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 fundamental knowledge on reinforcement learning	K2
CO2	Interpret the tabular solution methods for reinforcement learning	K2
CO3	Examine the policy gradient methods to provide the solution for real use cases	K2
CO4	Identify e the model-based learning approaches in RL environment	K2
CO5	Summarize the prototype and implement RL algorithm for real world application use cases	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	PSO1	PSO2	PSO3
CO1	3	3	3									2	2	
CO2	3	3	3	2								2	2	
CO3	3	3	3	2								2	2	
CO4	3	3	3	2								2	2	
CO5	3	3	3	2								2	2	

3-High; 2-Medium; 1-Low

E. Course Contents

Unit 1 Introduction to Reinforcement Learning **L-9Hours**

Introduction and Basics of RL- Defining RL Framework- Elements and History of RL- Markov Decision Process- Polices, Value Functions and Bellman Equations- Exploration vs. Exploitation

Unit 2 Tabular Solution Methods **L-9Hours**

Dynamic Programming- Policy Evaluation- Policy Improvement-Policy Iteration- Value Iteration- Generalized Policy Iteration- Monte Carlo- Predictions- Control- Incremental implementation- Off policy- Temporal-Difference learning methods -TD(0)- SARSA- Deep Q-networks – DQN- DDQN- Dueling DQN- Prioritized Experience Replay

Unit 3 Policy Gradient Methods **L-9 Hours**

Introduction to policy-based methods- Vanilla Policy Gradient- REINFORCE algorithm and stochastic policy search- Actor-critic methods - A2C- A3C- Advanced policy gradient–PPO-TRPO-DDPG- Function Approximation- Value prediction and control- Gradient Descent Methods-Linear methods planning- prioritized sweeping-Heuristic search

Unit 4 Model Based Rl And Classical Conditioning **L-9Hours**

Model Based RL- Bayesian Approaches to Reinforcement Learning- Data-efficient Reinforcement Learning- Learning with off-line data- Learning with incompletely specified models- RL and planning- Classical Conditioning : Blocking and Higher-order Conditioning -The Rescorla - Wagner Model - TD Model -Simulations - Instrumental Conditioning – Delayed Reinforcement- Cognitive Maps.

Unit 5 Applications **L-9Hours**

Meta-learning-Multi-Agent Reinforcement Learning- TD-GammonSamuel's Checkers Player Watson's Daily-Double Wagering-Mastering the Game of Go- AlphaGo-AlphaGo Zero- Ethics in RL- Applying RL for real-world problems - Optimizing Memory Control- Human-level Video Game Play- Autonomous UAV Navigation and path planning -Drones for Field Coverage

Total: 45 Hours

G. Learning Resources

i. Text Books:

1. Richard S. Sutton and Andrew G. Barto. Introduction to Reinforcement Learning, 2nd Edition, MIT Press. 2018.[Unit 1,2,3, and 4]
2. Csaba Szepesvári, Algorithms for Reinforcement. Morgan & Claypool. 2010. [Unit 4 and 5]

ii. Reference books:

1. D.P.Bertsekas, Dynamic Programming and Optimal Control, Vol. I, Athena Scientific, 2017
2. Sudharsan Ravichandiran, Hands-On Reinforcement Learning with Python-Master Reinforcement and Deep Reinforcement Learning Using OpenAI Gym and TensorFlow, Packt Publishing ISBN-9781788836913, 178883691X, 2018.

iii. Online References:

1. https://web.mst.edu/~gosavia/rl_website.html
2. https://link.springer.com/referenceworkentry/10.1007%2F978-0-387-30164-8_714
3. https://onlinecourses.nptel.ac.in/noc19_cs55/preview

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS119	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

10211CS105 - 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	PSO1	PSO2	PSO3
CO1	3	3										2		
CO2	3	2		3		2						3		
CO3	3	2		3		2						2		
CO4	2				1	3						3		
CO5	2	3		2	2	2								

High- 3; Medium-2; Low-1

F.Course contents

Unit 1 Introduction to Cryptography L-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 **L-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 **L-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 **L-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 **L-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. 1AtulKahate, ―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
4.

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS121	HIGH PERFORMANCE COMPUTING	3	0	0	3

A.Preamble:

This course introduces high performance computing foundations for developing, analyzing, and implementing parallel and distributed algorithms. This course focuses on modern HPC systems, such as OpenMP on shared memory nodes, CUDA for graphics co-processors (GPUs), and MPI models for distributed memory systems.

B.Prerequisite Course

10211CS104 - Computer Organization and Architecture

C.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 used in modern processors for increasing the performance	K2
CO2	Recite the knowledge on optimization techniques for serial code	K2
CO3	Illustrate the concept of Parallel Computing paradigms	K2
CO4	Infer the distributed parallel programming concepts with efficient MPI programming	K2
CO5	Interpret the shared memory parallel programming with OpenMP and CUDA	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	PSO1	PSO2	PSO3
CO1	2	3		1	1	1						2		
CO2	3	3	2	1		1						3		
CO3	3	3	3	2	2							3	1	
CO4	3	2	3	2	3							3	2	
CO5	3	2	3	2	3							3	2	

3- High; 2-Medium; 1-Low

E.Course Contents:

Unit 1 Modern Processors 9 Hours

Modern Processors : Stored Program Computer Architecture- General purpose cache- based microprocessor-Performance based metrics and benchmarks- Moore's Law- Pipelining- Super scalarity-SIMD- Memory Hierarchies Cache- mapping- prefetch- Multicore processors- Mutithreaded processors- Vector Processors- Design Principles- Maximum performance estimates- Programming for vector architecture**.**

Unit 2 Optimization Techniques for Serial Code 9 Hours

Basic optimization techniques for serial code : scalar profiling- function and line based runtime profiling- hardware performance counters- common sense optimizations- simple measures, large impact- elimination of common sub expressions- avoiding branches- using SIMD instruction sets- the role of compilers - general optimization options- inlining - aliasing- computational accuracy- register

optimizations- temporaries- dynamic memory management- loop kernels and iterators data access optimization: balance analysis and light speed estimates- storage order.
case study: jacobi algorithm and dense matrix transpose.

Unit 3 Parallel Computers **9 Hours**

Parallel Computers : Taxonomy of parallel computing paradigms- Shared memory computers- Cache coherance- UMA - ccNUMA- Distributed-memory computers- Hierarchical systems- Networks- Basic performance characteristics- Buses- Switched and fat- tree networks- Mesh networks- Hybrids - Basics of parallelization - Why parallelize - Data Parallelism - Function Parallelism- Parallel Scalability- Factors that limit parallel execution- Scalability metrics- Simple scalability laws- parallel efficiency - serial performance Vs Strong scalability- Refined performance models- Choosing the right scaling baseline

Case Study: Can slow processors compute faster- Load balance

Unit 4 Distributed Memory Parallel Programming with MPI **9Hours**

Message passing - Introduction to MPI – example - messages and point-to-point communication - collective communication – nonblocking point-to-point communication- virtual topologies - MPI parallelization of Jacobi solver- MPI implementation - performance properties . Efficient MPI programming : MPI performance tools- communication parameters- Synchronization, serialization, contention- Reducing communication overhead- optimal domain decomposition- Aggregating messages – Nonblocking Vs Asynchronous communication- Collective communication- Understanding intra-node point-to-point communication.

Unit 5 Shared Memory Parallel Programming with OPENMP and CUDA **9Hours**

Introduction to OpenMp - parallel execution - data scoping- OpenMp work sharing for loops- synchronization - reductions - loop scheduling - tasking - case study: OpenMp- parallel jacobi algorithm- advanced OpenMp wavefront parallelization- Efficient OpenMP programming: Profiling OpenMP programs - Performance pitfalls, Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplicationin CUDA , CUDA Memory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features - Case study: Parallel Sparse matrix-vector multiply

Total: 45 Hours

H.Learning Resources

i.Text Book:

1. Georg Hager, Gerhard Wellein, “Introduction to High Performance Computing for Scientists and Engineers”, Chapman & Hall / CRC Computational Science series, reprint 2010 .[Unit 1-5].

ii.Reference Book(s):

1. Victor Eijkhout, Edmond Chow, Robert van de Geijn, “Introduction to High Performance Scientific Computing”, 2nd edition, revision 2016
2. Zbigniew J. Czech, “Introduction to parallel computing”, 2nd edition, Cambridge University Press,2016

iii.Online Reference(s):

1. Introduction to High Performance Computing for Scientists and Engineers, https://cds.cern.ch/record/1338418/files/9781439811924_TOC.pdf
2. Charles Severance, Kevin Dowd, High Performance Computing http://cnx.org/content/col11136/1.5/

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS128	FINANCIAL ACCOUNTING	3	0	0	3

A.Preamble

To learn the basic Business types, impact of the Economy on Business and Firms specifically. To analyze the Business from the Financial Perspective. Student will be able to read the three most common financial statements: the income statement, balance sheet, and statement of cash flows

B.Prerequisite Course

10210MA103 - Probability, Statistics and Queuing Theory

C.Course Objectives

Learners are exposed to

- This course will enable the students to combine practice and theoretical knowledge of financial accounting.
- The students of this course will be active learners and develop awareness of emerging trends in financial accounting,
- The course will provide decision making skills to the students in the financial analysis context.

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 financial accounting, investments and Indian Accounting standards.	K2
CO2	Summarize the overview on accounting system, transactions and statements	K2
CO3	Outline on depreciation and various inventory evaluation methods	K2
CO4	Explain the methods of cash flow statements and accounting rules	K2
CO5	Explore the inventory evaluation methods and errors	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 Program Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1										3				
CO2	2									2		2		
CO3	2									2		2		
CO4	2									2				
CO5	2									2		2		

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Basics of Financial Accounting L-9 Hours

Introduction-Accounting information system- Users -Needs- Qualitative characteristics- Advantages and limitations of accounting- Branches of accounting- Financial accounting principles –Capital Receipts- Revenue and Capital Expenditure- Deferred Revenue expenditure- Indian Accounting Standards –AS-1, AS-2, AS-7, AS-9, AS-6, AS-10 and GAAP.

Unit 2 Accounting Process **L-9 Hours**

Double-entry accounting system- Debits and Credits- Accounting rules and procedures- Terms: Transaction, Capital, Drawings- Liabilities- Assets- Fixed assets, Expenditure-Expense, Income, Profit, Gain, Loss, Purchase, Sales, Goods, Stock, Debtor, Creditor, Voucher, Discount -Trade discount and Cash Discount- Analyzing and journalizing transactions- Posting transactions to ledger- Accounting Rules-Preparing the trail balance- Effects of errors.

Unit 3 Depreciation **L-9 Hours**

Depreciation, Provisions and Reserves- Depreciation: Concept, Features, Causes, factors - Other similar terms: Depletion and Amortization - Methods of Depreciation-Straight Line Method (SLM) -Written Down Value Method (WDV)- Inventories: Meaning. Significance of inventory valuation- Inventory Record Systems: periodic and perpetual- Methods: FIFO, LIFO and Weighted Average.

Unit 4 Cash Flows **L-9 Hours**

Overview the cash flow statement- Preparing the clash flow statement- Types of cash flow activities- inflows and outflows of cash flows-Cash flow statement and balance sheet- Examples of cash flow statements- Methods of preparing cash flow statements- Accounting rules- Importance of cash flow statements.

Unit 5 Mining Data Streams **L-9 Hours**

Adjustments in preparation of financial statements with respect to closing stock- outstanding expenses- Prepaid expenses- Accrued income- Income received in advance- Depreciation- Bad debts- Doubtful debts- Provision for discount on debtors- Abnormal loss- Goods taken for personal use/staff welfare- Interest on capital and managers commission-Preparation of Trading, Profit and Loss account - Balance Sheet of a profit-oriented organization-Single entry system.

Total: 45 Hours

G.Learning Resources

i.Text Books:

1. Horngren, Sundem, Elliott and Philbrick, “Introduction to Financial Accounting”, Pearson Education India Ltd., 11th edition, 2017.

ii.Reference Books:

1. Libby, Robert., Libby, Short, “Financial Accounting”, Tata McGraw-Hill., 7th edition, 2016
2. R Narayanaswamy, Financial Accounting: A managerial perspectives, 6th edition, PHI 2017

iii.Online References:

1.http://www.xn--klker-kva.hu/wp-content/uploads/2013/03/30459588-Principles-of-Managerial-Finance-by-Gitman.pdf

2.http://www.mim.ac.mw/books/Principles-of-Managerial-Finance-13th Edition_Full.pdf.9Ukgy8w1RYp7U1dls6CxRLDn1i8aezIq

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS210	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

10211CS207 -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/S3**
CO2	Design Job Execution procedures in Map Reduce and Apache SparkParadigm .	**K3/S3**
CO3	Design memory efficient solutions for Big Data Applications	**K3/S3**
CO4	Build Big Data Solutions for social media network applications	**K3/S3**
CO5	Apply cloud and optimization techniques to develop the solutions for real time scenarios	**K3/S3**
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	PSO3
CO1	3		3	3									3	
CO2		2	2	2	3								3	3
CO3	2		3		3	2						2	2	2
CO4	2	3		3	3	3						3	3	1
CO5	2	2		3		3						3	3	

3- High; 2-Medium; 1-Low

F.Course Content

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, CURD Operations. Apache Kafka- Fundamentals, Cluster Architecture, Work Flow, Basic Operations, Producer and Consumer Example.

Unit 4Big 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 **Total : 30 Hours**

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**
Task4	Implement matrix multiplication with Map Reduce. **Tools:LINUX**
Task5	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
Task8	i. Implement basis commands in HIVE. ii. Use Hive to create, alter, and drop databases, tables, views, functions, and indexes**Tools: HIVE , LINUX**
Task9	Write Pig Latin scripts sort, group, join, project, and filter the data **Tools: Pig, LINUX**
Task10	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**
Task11	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**
Task12	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
UseCases:

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:75 Hours

H. Learning Resources

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. G. SudhaSadasivam& R. Thirumahal, “Big Data Analytics”, First Edition, Oxford University Press, 2020
2. Capriolo, E., Wampler, D., & Rutherglen, J., “Programming Hive”, O’Reilly Media, Inc.”,2012

iii. Web 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
10212CS211	ARTIFICIAL INTELLIGENCE TECHNIQUES	3	0	2	4

A. Preamble

The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence. In this course students can explore the various Search techniques like basic, advanced and heuristic approach are universal problem-solving methods to solve a specific problem and provide the best result. Evolutionary algorithms are used to optimize the AI applications. Goal and constraint-based approach, Knowledge reasoning and inference helps the students to develop the decisions making strategies in intelligent agents and expert systems.

B. Prerequisite Course

10210CS101 - Problem Solving using C

C. Course Objectives

Learners are exposed to:

- Understand and apply the basic principles of artificial intelligence concepts towards problem solving, knowledge representation, reasoning, inference and learning.
- Explore the artificial intelligence techniques in intelligent agents, expert systems, artificial neural networks, Genetic algorithms, Heuristics approaches and Evolutionary algorithms models.

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 problem-solving techniques by using State Space search and heuristic search approach	K3/S3
CO2	Use evolutionary and advanced search techniques to provide optimized solution.	K3/S3
CO3	Solve unified planning approach and Constraint-satisfaction problems.	K3/S3
CO4	Apply Logical knowledge representation for rules and fact-based approach.	K3/S3
CO5	Build the logic of Uncertainty and Reasoning using resolution methods.	K3/S3
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	PSO3
CO1	3	3		1	1			1	1		1	2		3
CO2	3	3	3	1	1			1	1		1	2		3
CO3	3	3	3	1	1			1	1		1	2		3
CO4	3	3	2	1	2			1	1		1	1		3
CO5	3	3	3	1	2			1	1		1	2		3

High - 3, Medium - 2, Low – 1

F. Course Contents

Unit 1 Basic and Heuristic Search Techniques L-9 Hours

Artificial Intelligence – Introduction - Evolution of AI- State Space Search: Generate and Test- Simple Search- Depth First Search- Breadth First Search- Comparison of BFS and DFS- - Depth Bounded DFS- Depth First Iterative Deepening. Heuristic Search: Heuristic Functions- Best First Search- Hill Climbing- N-Puzzle Problem- Block-world Problem Local Maxima- Variable Neighborhood Descent- Beam Search- Tabu Search- Case Studies – Stock Market prediction, Weather Forecasting.

Unit 2 Evolutionary and Advanced Search Techniques L-9 Hours

Randomized Search and Emergent Systems: stochastic and evolutionary search algorithms- Simulated Annealing- - Emergent Systems- Ant Colony Optimization- Finding Optimal Paths: The Travelling Salesman Problem- Dynamic Programming- Algorithm A*- Iterative Deepening A* - Min-Max- Alpha-Beta Tree search – Monte Carlo Tree Search - Case Studies – Vehicle Routing and Map Navigation.

Unit 3 Planning and Strategies L-9 Hours

Planning: planning as search, partial order planning - A Unified Planning Framework-Forward and Backwards State Space Planning- Goal Stack Planning- Plan Space Planning- The STRIPS Domain- Constraint Satisfaction Problem: N-Queens-Cryptarithmetic- Graph Coloring- Constraint Propagation- Scene Labeling- Higher Order and Directional Consistency- Algorithm Backtracking: Graph Coloring - Case Studies – Robot traversal- Object recognition- Game Playing.

Unit 4 Knowledge Representation L-9 Hours

Ontologies, foundations of knowledge representation- Logical representation -The Scheme- Frames- Semantic Net- Production rules -Scripts - Inheritance in Taxonomies- Description Logics- Formal Concept Analysis- Conceptual Graphs Knowledge reasoning - Reasoning about objects- relations – events- actions- time and space-reasoning with defaults- Reasoning about knowledge Case studies – chatbot system- recommendation system.

Unit 5 Knowledge Facets and Logic Inferences L-9 Hours

Knowledge Facets: Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents- The Wumpus World. Logic and Inferences: Formal Logic- Resolution Method in Propositional Logic- Resolution method in First Order Logic- Deductive Retrieval – Horn Clauses – Forward Chaining- Backward Chaining- Uncertain Knowledge- Probabilistic Reasoning- connection to logic- independence- Bayes rule- Bayesian networks- probabilistic inference, Case studies – Multi- Agent Decision Making System- Human Computer Interaction.

Total: 45 Hours

G.Laboratory Experiments **Total: 30 Hours**

Part - 1

Task 1 Implementation of Graph search algorithms (Breadth first search and Depth First Search) using following constraints.

BFS: Pick any node, visit the adjacent unvisited vertex, mark it as visited, display it, and insert it in a queue. If there are no remaining adjacent vertices left, remove the first vertex from the queue. Apply recursion concept to follow the above steps until the queue is empty or the desired node is found.

DFS: Pick any node. If it is unvisited, mark it as visited and recur on all its adjacent nodes. Repeat until all the nodes are visited, or the node to be searched is found.

Tools- Prolog

Task 2 Implementation of Hill climbing algorithm for Heuristic search approach using following constraints in python.

i. Create a function generating all neighbours of a solution

ii. Create a function calculating the length of a route
iii. Create a random solution generator
iv. Create a Travelling salesman problem

Tools- Python, Online Simulator - https://graphonline.ru/en/

Task 3 Implementation of A * Algorithm to find the optimal path using Python by following constraints.

- The goal of the A* algorithm is to find the shortest path from the starting point to the goal point as fast as possible.
- The full path cost (f) for each node is calculated as the distance to the starting node (g) plus the distance to the goal node (h).
- Distances is calculated as the manhattan distance (taxicab geometry) between nodes.

Tools- Python, Online Simulator - https://graphonline.ru/en/

Task 4 Implementation of Mini-Max algorithm uses recursion to search through the game-tree using python by applying following constraints.

- In this algorithm two players play the checker's game; one is called MAX and other is called MIN.
- Both the players fight it as the opponent player gets the minimum benefit while they get the maximum benefit.
- Both Players of the game are opponent of each other, where MAX will select the maximized value and MIN will select the minimized value.
- The minimax algorithm performs a depth-first search algorithm for the exploration of the complete game tree.
- The minimax algorithm proceeds all the way down to the terminal node of the tree, then backtrack the tree as the recursion.

Tools : Python

Task 5 Implementation of Ant Colony Optimization to Optimize Ride-Sharing Trip Duration using Python by following constraints.

- To forecast travel times between every pair of pick-up and drop-off locations.
- To find the shortest route that visits a set of locations.
- To implement optimization techniques are required to intelligently search the solution space and find near-optimal solutions.

Tools: Python

Task 6 Solve a Map Coloring problem using constraint satisfaction approach by applying following constraints

- Assign each territory a color such that no two adjacent territories have the same color by considering following parameters: Domains, Variables and Constraints
- Apply Basic Greedy Coloring Algorithm: Color first vertex with first color, do following for remaining V-1 vertices.
- Consider the currently picked vertex and color it with the lowest numbered color that has not been used on any previously colored vertices adjacent to it. If all previously used colors appear on vertices adjacent to v, assign a new color to it.

Tools- Python, Online Simulator - https://graphonline.ru/en/

Task 7 Implementation of Monkey Banana Problem in Goal Stack planning using prolog by applying following constraints.

Imagine a room containing a monkey, chair and some bananas. That have been hanged from the centre of ceiling. If the monkey is clever enough, he can reach the bananas by placing the chair directly below the bananas and climb on the chair. The problem is to prove the monkey can reach the bananas.The monkey wants it, but cannot jump high enough from the floor. At the window of the room there is a box that the monkey can use. The monkey can perform the

Following actions: -

1) Walk on the floor.
2) Climb the box.

3) Push the box around (if it is beside the box).
4) Grasp the banana if it is standing on the box directly under the banana.
Tools: Prolog

Task 8 Implementation of N-queen problem using backtracking algorithm using prolog
In the 4 Queens problem the object is to place 4 queens on a chessboard in such a way that no queens can capture a piece. This means that no two queens may be placed on the same row, column, or diagonal.

Tools:Prolog

Task 9 To Build an Intelligent Chatbot system with Python and Dialog-flow using Interactive Text Mining Framework for Exploration of Semantic Flows in Large Corpus of Text.

- To integrate with Google Cloud Speech-to-Text and third-party services such as Google Assistant, Amazon Alexa, and Facebook Messenger.
- Configure Dialogflow to manage your data across GCP services and let you optionally integrate Google Assistant.

Tools- Python, Dialog-flow Framework

Task 10 Implement simple fact for following:
a. Ram likes mango.
b. Seema is a girl.
c. Bill likes Cindy.
d. Rose is red.
e. John owns gold.
Tools-Prolog

Part-2

Use Cases:

Use Case – 1: Implementation of Map navigation using Heuristic search approach in python.
Use Case – 2: Develop a simple neural network for simulating logic gate operations.
Use Case – 3: Solve Multiple criteria production scheduling problem using Genetic algorithm
Use Case – 4: Implementation of Text Lemmatization using NLTK Python Package.
Use Case – 5: Implementation of Intelligent Chat-Bot system using Python and Dialogflow
Use Case – 6: Implementation of Block world problem using STRIPS domain precondition rules in prolog.

Total:75 Hours

G. Learning Resources

i.Text Books:

1. Stuart. J. Russell, et al. “Artificial Intelligence by Pearson: A Modern Approach” 4th Ed, 2020.

ii.Reference Books:

1. Rich and K. Knight,” Artificial Intelligence”, Mc Graw Hill Publishers Inc, 3rd Edition, 2017.
2. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill Education, 2013.

iii.Online References:

1. “Artificial Intelligence :Search Methods for Problem Solving”, May. 06, 2014 [Online]. Available: https://nptel.ac.in/courses/106/106/106106126/
2. “Artificial Intelligence: Knowledge representation and reasoning” Jan. 19, 2016 [online] Available : https://nptel.ac.in/courses/106/106/106106140/

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS214	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

10211CS207-Database Management Systems

C.Course Objectives

Learners are exposed to:

- Employ best practices in data visualization to develop charts, maps, tables, and other visual representations of data.
- Use visualization tools to conduct data analysis, especially exploration of a large dataset.

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 visualization process and identify the type of data	K2S3
CO2	Apply various visualization techniques for Exploratory Data Analysis	K3/S3
CO3	Explore visualization techniques Trees, Graphs, Networks, Text and documents	K3/S3
CO4	Utilize various visualization techniques for spatial and Geospatial data	K3/S3
CO5	Make use of different visualization tools for various applications	K3/S3
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	PSO 1	PSO2	PSO 3
CO1	3	3	2		1			1				2		
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			2	3	2
CO5	3	3	3	3	3	3		1	3			3	3	2

3- High; 2-Medium; 1-Low

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 data **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 **Total:30 Hours**

Part- 1

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, Language :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, Language: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, Language:Python

Task 5: To design and perform visualization for Trees

- TreeMap, Sun Burst Display

Tools: Tableau, Language:Python

Task 6: To design and perform visualization for Graphs and Networks

- Force based Layout

Tools: Tableau, Language:Python

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, QGIS, Language:Python

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, Language :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:75 Hours

H.Learning Resources

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 References:

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

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS215	DEEP LEARNING	3	0	2	4

A.Preamble

In this course students will be gain knowledge on how to build and train neural network architectures such as Convolutional Neural Networks, Recurrent Neural Networks, LSTMs, and Autoencoders. Understand the capabilities, challenges, and consequences of deep learning compared to Machine learning and prepare students in the development of leading-edge AI technology.

B.Prerequisite Course

10212CS223 - Machine Learning Techniques

C.Course Objectives

Students are able to

- •Understand basic concepts of deep learning Framework
- •Understand CNN, RNN and GAN architecture models
- •Perform model optimization and deployment

D.Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Explore data processing techniques using various deep learning frameworks for classification.	K3/S3
CO2	Build and train Convolutional Neural Network (CNN) model for real time applications.	K3/S3
CO3	Use various Convolutional Neural Network architectures for model building.	K3/S3
CO4	Demonstrate Recurrent Neural Networks and LSTM Networks	K3/S3
CO5	Choose the appropriate optimization technique to improve the accuracy of a model.	K3/S3
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	PSO3
CO1	3	3	3	3		2						3		
CO2	3	2	2	2	2	2						3	2	
CO3	3	3	3	3	2	2						3	2	
CO4	3	3	3	3	2	2						2	2	
CO5	3	3	3	3	3	2						2	2	

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1- Data Processing and Deep Learning Framework L-9Hours

Introduction to Data Handling – Data processing and Normalization using Deep Learning libraries and Data Augmentation Techniques.Deep Learning Frameworks – PyTorch, TensorFlow and Keras. Deep Learning Parameters – Epoch, Learning rate, Batch size, Open-source deep learning tools.

Unit 2 – DeepConvolutional Neural Networks (CNN) L-9Hours

Deep learning Layers – Convolutional Layer- Convolutional Properties and operations, Pooling Layer – Role and its types. Activation Layer – Significance and its types. Optimizers – Stochastic gradient, RMSProp, Ada Delta and Adam optimizers. Loss Function – Mean Square Error (MSE), Binary Cross Entropy, Categorical cross Entropy and Sparse Categorical cross Entropy.

Unit 3- Convnet Architecture and Transfer Learning L-9Hours

Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization, Addressing Overfitting and Underfitting issues.Interpretation of CNN – Localization Maps - Heat Maps - GradCAM. Transfer Learning, Advance architectures – Generative Adversarial Networks (GANs), Autoencoders, One shot learning, Siamese Networks and Capsule networks.

Unit 4 – Recurrent Neural Networks (RNN) L-9 Hours

Introduction toRecurrent Neural Networks (RNN)–RNN architecture, Building RNN step by step, Gated Recurrent Unit (GRU), Long-Short Term Memory (LSTM), LSTM architecture, Bi-LSTM.Language Models- Word embedding, Word-Level RNNs. Advance Networks – GPT3, BERT and Transformer models.

Unit 5- Optimization Techniques L-9Hours

Optimization in deep learning – Model Optimization, Non-convex optimization for deep networks- Stochastic Optimization.Generalization in neural networks- Spatial Transformer Networks.

Total: 45 Hours

G.LaboratoryExperiments: Total:30 Hours

Part - 1

Task 1	Implementation of a Binary classification model for grey-scale image **(Framework: PyTorch).**
Task 2	Implementation of a Convolutional Neural Network(CNN) classification model. **(Framework: PyTorch).**
Task 3	Construct a Convnet model for image classification. **(Framework: PyTorch).**
Task4	Application of Transfer Learning to build an image classification model **(Framework: PyTorch).**
Task5	Implement a simple Generative Adversarial Network (GAN) **(Framework: PyTorch).**
Task6	Implementation of word embedding using RNN **(Framework: PyTorch).**

Task7	Implementation of Autoencoders **(Framework: PyTorch).**
Task8	Implementation of prediction using LSTM networks **(Framework: PyTorch).**
Task9	Implementation of object detection and localization **(Tool: OpenCV).**
Task10	Apply optimization techniques to improve model performance. **(Framework: PyTorch).**

Part-2

Use Cases:

Use Case1: MNIST data classification

Use Case2:Dog vs Cat image classification

Use Case3:Synthetic image generation

Use Case4:Synthetic music generation using Autoencoder

Use Case5:Time series forecasting

Use Case6:Car detection using YOLO

Use Case7:Model optimization for Fruit data classification

[All experiments can be executed using standard dataset from Kaggle or ImageNet]

Total:75 Hours

H.Learning Resources

i. Text Books:

1. I Goodfellow, Y Bengio and A Courville, "Deep Learning",1st Edition MIT Press, 2017. [Unit 1-5]

ii. Reference Books:

1. Venkatesan, Ragav, and Baoxin Li. “Convolutional neural networks in visual computing: a concise guide”. CRC Press, 2017.[Unit-2,3]
2. Nikhil Buduma.,“Fundamentals of Deep Learning”, O'Reilly Media, 2017. [Unit-4,5]

iii. Online References:

1. “Deep Learning Specialization”. Accessed on: April 20, 2021 [Online]. https://www.coursera.org/specializations/deep-learning.
2. “Deep Learning Nanodegree”, Accessed on: April. 16, 2021 [Online]. Available: https://www.udacity.com/course/deep-learning-nanodegree--nd101

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS216	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

10211CS102-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/S3**
CO2	Use the concept of Probabilistic model of defining language and POS tagging for NLP applications	**K3/S3**
CO3	Develop the Syntactic parser and Semantic Parser for Translation for word forms	**K3/S3**
CO4	Interpret the concept of text analysis, summarization and extractions for Information Extraction.	**K3/S3**
CO5	Apply the concepts of machine translation and deep learning for NLTK Modelling.	**K3/S3**
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	PSO 1	PSO 2	PSO 3
CO1	3	3	3	1	3						2	3		
CO2	3	3	3	2	3						1	3		
CO3	3	3	2	3	3	3					2	3		
CO4	3	3	2	3	3	3					2	3	2	2
CO5	3	3	3	3	3	3					3	3	3	3

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Introduction o 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 **Total : 30 Hours**

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:75 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

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS217	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	Explain the life cycle of data science process for building real world applications	K2/S3
CO2	Understand different types of data description for data science process	K2/S3
CO3	Gain knowledge on relationships between data	K2/S3
CO4	Use the Python Libraries for Data Wrangling	K3/S3
CO5	Apply visualization Libraries in Python to interpret and explore data	K3/S3
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 1	PSO2 2	PSO3 3
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 –Univariateanalysis – Bivariateanalysis – Multivariateanalysis-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 –regression line – 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 Python Libraries 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 datatypes - 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 - overfitting low bias and low variance –-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

Laboratory Experiments **Total: 30 Hours**

Part – I

Task 1: Explore python modules for data collection and preparation

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, piechart 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: Write a program to build, evaluate the model using ridge and lasso regressions for a sample dataset.

Task 9: Write a program to build, evaluate the model using binary classification for a sample dataset. Evaluate the performance of classifier.

Task 10: Write a program to build, evaluate the model using Decision Tree for a sample dataset. 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, SalePercent] of five different companies. Storeat 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 guineapigs (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
10212CS218	MODELING 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/S3
CO2	Perform least square procedure to find the best fit for set of data points	K3/S3
CO3	Build interference in Linear regression to fit a linear equation to observed data	K3/S3
CO4	Analyze the linear regression and predict the data through R studio	K3/S3
CO5	Apply the Regression analysis and investigate the assumptions made about the data and the model	K3/S3
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	PSO 1	PSO 2	PSO 3
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 **Total: 30 Hours**

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: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
10212CS219	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 courses

10211CS130–Fundamentals ofComputer 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/S3**
CO2	Interpret the attacks, security issues, and management standards in wireless devices.	**K2/S3**
CO3	Apply the tools and methods to detect cyber attacks	**K3/S3**
CO4	Identify the phishing techniques and associated vulnerabilities.	**K3/S3**
CO5	Utilize the preventive measures for cyber security safeguards.	**K3/S3**
	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	PO 11	PSO 1	PS O2	PS O3
CO1	2	2				2	2	1						
CO2	2	3		3		2	2	1						
CO3	1	2		2	3	2	2	2						3
CO4	1	3			3	2	2	2						3
CO5	2		3	2	3	2	2	2						3

High- 3; Medium-2; Low-1

F.Course contents

Unit 1 Introduction L-9Hours

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, Anti-keylogger, 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 **Total: 30 Hours**

Part – 1

Task 1	Installations 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 analysis 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: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
10212CS244	COMPUTER GRAPHICS	3	0	2	4

A. Preamble

Computer graphics courses enable students to create 2D and 3D designs, use multimedia techniques and study advances in the field.

B. Prerequisite Courses

1150MA101-Linear algebra for Computing

C. Course Objectives

Students are able to understand

- An understanding of the physical and geometrical principles used in computer graphics
- An understanding of rendering algorithms, and the relationship between illumination models and the algorithms used to render them
- An understanding of the basic techniques used to model three dimensional objects, both as surfaces and as volumes
- An acquaintance with the principles of interaction and of user interfaces

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Apply various algorithms for 2D primitives and Transformations	**K3/S3**
CO2	Use the basics concepts of Illumination and various projection techniques	**K3/S3**
CO3	Experiment with Illumination model and basic representation of image	**K3/S3**
CO4	Explore the abstractions of models for specifying complex objects and introduction to Multimedia.	**K3/S3**
CO5	Illustrate about the types of compression and advanced multimedia environments	**K3/S3**
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:

CO Nos.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO3
CO1	2	3			2							2		
CO2	2	2			2							2		
CO3	2	3			2							2		
CO4	2	2			2							2		
CO5	2	2			2							2		

High-3; Medium-2; Low-1

F. Course contents

Unit 1 Review of Graphics Fundamentals **L-9 Hours**

Basic raster graphical algorithm for 2D primitives, Line drawing algorithm: Bresehem's algorithm, Midpoint line algorithm, DDA algorithm, Circle drawing algorithm: Breseham's algorithm, Midpoint circle algorithm, Ellipse drawing algorithm.

Unit 2 Transformation and Projection **L-9 Hours**

2D,3D transformations: Window to Viewport transformations, Clipping algorithm, Bezier curve, b-spline curve, surfaces and Solid modeling.Parallel projection-Perspective projection,Visible surface determination techniques for visible line determination, Z-buffer algorithm, scanline algorithm, visible surfaces ray-tracing and recursive ray tracing, radiosity methods.

Unit 3 Shading and Representation **L-9 Hours**

Illumination model, Specular reflection model, Shading models: Transparency, Shadows, Object reflection, Gouraud & Phong shading, Recursive ray tracing and path tracing. Light Sources – RGB,CMYK and HLS Color Models,Image representation and manipulation, Enlarging and Shrinking images, Texture mapping.

Unit 4 Advance Modellingand Multimedia **L-9 Hours**

Procedural models, fractals models, Grammar-based models, multi-particle system, volume rendering, vsoftware applications and software environments – Media types – Analog and digital video, digital audio and animation - Memory storage – Basic tools – Authoring tools.

Unit 5 Elements in Multimedia **L-9 Hours**

Building blocks text - hypertext - sound - sound cards - standards - image - image types – imagecompression - fractal and wavelet compressions - image file types - animation -capture and playback techniques. Multimedia environments, multimedia programming, advancedmultimedia moving pictures - techniques realistic image synthesis, virtual reality - full motion digital video – video capture techniques – multimedia networks

Total: 45 Hours

G. Laboratory Experiments

Part - 1

TASK 1	Using of Bresenham's algorithm to draw a line using Bresenham's algorithm. **Tools: Code Block**
TASK 2	Draw a rectangle using line drawing algorithm with C/C++ program. **Tools: Code Block**
TASK 3	Implementation of Circle drawing algorithms in C/Java: Bresenham's Algorithm, Mid-Point Algorithm **Tools: Code Block**
TASK4	Develop a C/C++ program to draw a two-dimensional object and perform translation, rotation, and scaling transformations. **Tools: Code Block**
TASK5	Write a program to perform 2D Transformation on a line.
TASK6	Write a program to perform shear transformation on a rectangle.
TASK7	Write a program to draw a car using in build graphics function and translate it from bottom left corner to right bottom corner of screen.

TASK8	Write a program to draw a cube using in build library function and perform 3D transformations i) Translations in x, y, z directions ii) Rotation by angle 450 about z axis, rotation by 600 about y-axis in succession. iii) Scaling in x-direction by a factor of 2, scaling in y- direction by a factor of 3
TASK9	Write a C/C++ program to draw a cube using in build library function and perform 3D transformations **Tools: Code Block**
TASK10	To Implementa C/C++ program for implementation of Visualizing Projections of 3d Images. **Tools: Code Block**
TASK11	Implement the following fundamental operation on the given input image, such as i) How to read and write the image. ii) Convert the given image into binary image. iii) Convert the RGB image into gray scale image. iv) Resize the given image into particular different pixel size. v) Display pixel intensity values of the given image. **Tools: Matlab, Open CV**
TASK12	Implement a MATLAB program for Morphological Operations on Binary Images. **Tools: Matlab, Open CV**

Part-2

Use Cases:

Use case 1: To create a primitives object and apply any transformation.
Use case 2: Using Flash/Maya perform different operations (rotation, scaling move etc..) on objects
Use case 3: Design and develop simple graphics programs using basic graphics functions defined in "graphics.h"
Use case 4: To Study various in build graphics functions in C library.
Use case 5: Design and implement game / animation clip / Graphics Editor using open source graphics library. Make use of maximum features of Object Oriented Programming.

Total:75 Hours

H.Learning Resources

i. Text Books:

1. David J.Eck, Hobart and William Smith, "Introduction to Computer Graphics", Version 1.2, 2018. (Unit 1)
2. Hearn & Baker, "Computer Graphics C Version", 2nd ed. Pearson Education, 2012.(Unit 2-3)
3. Foley, Van Dam, Feiner, and Hughes, "Introduction to Multimedia": Principles and Practice, 2nd edition in C, Addison-Wesley(Unit 4-5).

ii. Reference Books:

1. DaveShreiner, Graham Sellers, John M. Kessenich, Bill M. Licea-Kane ,"OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.3", 8th Edition, ARB working group.
2. Hearn and Baker, "Computer Graphics using open GL", 3rd edition, Pearson Education, 2009.

iii. Online References:

1. "Computer Graphics", Co-ordinated by IIT Guwahati Available from 6th May 2020 [Online]. Available: https://nptel.ac.in/courses/106/103/106103224/
2. "Fundamentals of Graphic Design", Offered by CALARTS, Available from 22nd April 2021 [Online]. Available: https://www.coursera.org/learn/fundamentals-of-graphic-design
3. "Computer Graphics", Available from Aug. 27, 2017 [Online]. Available: https://www.slideshare.net/smrutisarangi2/computer-graphics-notes-79192682

Course Code	Course Title	L	T	P	C
10212CS220	ANIMATION ENGINEERING	3	0	2	4

A. Preamble

The objective of the course is to provide the students an insight into the basics and the more advanced skills to masterfully navigate and create their own works of animation. At the end of the course, students will be able to create their own characters and animation scenes. Students able to acquire knowledge to create, develop, and execute animation sequences.

B.Prerequisite Course

10212CS244 –Computer Graphics

C.Course Objectives

Learners are exposed to:

- To familiarize the students with various approaches, methods, styles and techniques of animation technology, and how to apply.
- To enable students to manage Animation Projects from its Conceptual Stage to the final Product creation.
- To develop competencies and skills needed for becoming an effective Animator.
- Enriching the student skill set to meet professional expectations necessary for a career in the expanding industry of entertainment.

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 history of animation films and different types of animationtechniques	K2/S3
CO2	Apply the design principles, styles and theories to animation production	K3/S3
CO3	Create a 2D animation starting from developing a script to final output	K3/S3
CO4	Develop 3D animation content by using 3D animation concepts	K3/S3
CO5	Use required software and hardware tolls for Animation making	K3/S3
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	PSO1	PSO2	PSO3
CO1	3		2		1			1	1				1	
CO2	3		3		2			2	1				2	
CO3	2		3		3			1	1				2	2
CO4	3		3		3			1	1				2	2
CO5	3		2		2			1	1				2	2

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Introduction to Animation **L-9 Hours**

Introduction to graphics and animation – History of animation– Disney's 12 Principles of Animation – Application of Graphics and Animation – Different types of Animation – Animation Techniques – Future trends of computer animation.

Unit 2 Styles in Animation **L-9 Hours**

Introduction to the equipment required for animators: The animator's drawing tools – the animation table – Perspective in animation – Styles in Animation –Animation Making Process –Pre–production phase – Production Phase – Post Production Phase.

Unit 3 2D Animation **L-9 Hours**

Introduction to 2D animation–Pre visualization–Developing the idea–Writing the script – Storyboarding–2D animationTechniques–CelAnimation –Traditional 2D Animation –Digital 2D animation – Voiceover and music clips

Unit 4 3D Animation **L-9 Hours**

Introduction to 3D animation – Modeling:3D Modeling basics – Types of 3D Modeling – Introduction to Modeling Techniques–Texturing: Texture Mapping –Texture making– Lighting: Types of Lights – Lights attributes – Rigging and Animation –Composition –Rendering.

Unit 5 Hardware and Software Tools and Industry Trends **L-9 Hours**

Choosing a Computer – Using Monitors/Displays– Using 3D Scanners– Finding Data Storage Solutions – Choosing Software – Comprehensive 3D Animation Packages – CAD – Adobe Photoshop – Blender – 3Ds Max – Maya – Adobe Animate–Using Motion Capture–Creating Stereoscopic 3D – Integrating Point–Cloud Data – Providing Real–Time Capabilities – Working in Virtual Studios.

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 environment, objects, and Characters
c) Design an External and Interior Background

Tool: Adobe Photoshop

Task 2

a) Create animation that showcases Weighted object lifting
b) Create an Animation involving basic principle like Bouncing Ball
c) Create an Animation involving basic principle like ball rolling on wooden ramp.

Tool: Blender/Pencil 2D

Task 3

a) Animate a Greeting Card, Create an animated advertisement.
b) E– content Creation : Use animation to explain a concept
c) Design an Interactive Presentation, Animation Portfolio

Tool: Blender

Task4 For the given 3D animation conceptperform the following operation,

a) Create a suitable 3D model from primitive objects.
b) Apply various transformations to the 3D model.
c) Apply modifiers to bring realistic 3D model.

Tool: Blender

Task5 For the developed 3D model perform the following operation,

a) Create an image texture to apply on the 3D model

b) Import the texture to the 3D animation tool
c) Apply texture on the 3D model

Tool: Blender

Task 6 Animate the objects in following way:
Moving as a whole object
a) Changing their position,
b) Orientation or size in time
c) 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

Task8 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 model/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) Combine multiple video channels and add effects to them
b) Add audio and synchronize the timing of the video sequence to match it–Video Sequencer
c) Display result of rendering Sequencer timeline–Sequencer preview

Tool: Blender

Part–2

Use Cases:

Case 1: Make use 2D animation to display aProduct demo

Case 2: Develop an explainer video for public awareness about a product or a service

Case1: **Building an Interactive 3D Animation System**

Develop a 3D animated video to illustrate the Basics of Computer Network

Case 2: **3D animation as an educational tool**

Use 3D animation to explain a complex subject that requires deep understanding.

H. Learning Resources

i. Text Books:

1. Richard Williams, “The Animators Survival Kit”, Barnes & Noble
2. Ande Beane, “3D Animation Essentials”, John Willey & Sons 2012
3. King R. “3D Animation for the Raw Beginner Using Autodesk Maya 2e”. CRC Press; 2019

ii. Reference Books:

1. Tinwell A. The uncanny valley in games and animation. AK Peters/CRC Press; 2014

iii. Online References:

1. “Beginning 2D Animation: The Absolute Beginner's Entry” Last updated 9/2018, [Online]. Available: https://www.udemy.com/course/absolute-beginners-entry-into-animation/
2. “2D Animation” [Online]. Available: https://www.animatorisland.com/courses/2d-animation
3. 3D Animation, [Online]. Available: https://www.mooc–list.com/tags/3d–animation
   Getting started in 3D Animation: [Online]. Available: https://www.udemy.com/course/learn–3d–animation–in–just–2–weeks/
4. Introduction to 3d Animation Software, [Online]. Available: https://www.educba.com/3d–animation–software/

Course Code	Course Title	L	T	P	C
10212CS221	GAME DESIGN	3	0	2	4

A.Preamble

Game design is a field with a broad focus. This course is an introduction to the primary concepts of gaming, and an exploration of how these basic concepts affect the way gamers interact with games. In this course students will understand game design concepts, the mechanics, and rules behind different types of games. Students will be able to design and develop various games.

B.Prerequisite Course

10211CS102- Data Structures.

C.Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Understand the stages of the game design process	**K2/S3**
CO2	Develop the Game environment, Game objects, and Characters	**K3/S3**
CO3	Identify the various genres of games	**K3/S3**
CO4	Use Game Engines to develop Game User Interface	**K3/S3**
CO5	Build the Game from game engine based on the target platform	**K3/S3**
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	PSO1	PSO2	PSO3
CO1	3		2		2			1	1				1	
CO2	3	2	2		2			2	1				2	
CO3	3	2	3		3			2	1				3	
CO4	3	2	3		3			2	1				3	2
CO5	3	2	3		3			2	1				3	2

High-3; Medium-2; Low-1

E.Course Contents

Unit 1 Introduction to Game Design L- 9 Hours

History of Game - Conventional Games Versus Video Games - The Key Components of Video Games - The Structure of a Video Game - The Stages of the Design Process - The Game Design Team Roles - The Anatomy of a Game Designer - Getting an Idea - From Idea to Game Concept - The Player's Role - Choosing a Genre - Defining Your Target Audience and Target Platform.

Unit 2 Game World and Character Design L-9 Hours

Introduction toGame World - The Purposes of a Game World - The Dimensions of a Game World - Self-Defining Play - Creative Play - Storytelling Play - Game Modifications - The Goals of Character Design - The Relationship Between Player and Avatar - Visual Appearances - Character Depth - Audio Design

Unit 3 Level Designand Genres of Game **L-9 Hours**

Game Balancing - General Principles of Level Design - Key Design Principles - Layouts - The Level Design Process - Pitfalls of Level Design - THE GENRES OF GAMES: Action Games - Strategy Games - Role-Playing Games - Sports Games - Vehicle Simulations - Adventure Games - Construction and Management Simulations - Artificial Life and Puzzle Games

Unit 4 User Interfaces design and Interaction Models **L-9 Hours**

User Interface- Player-Centric Interface Design - The Design Process - Managing Complexity - Interaction Models - Camera Models - Visual Elements- Audio Elements - Input Devices - Navigation Mechanisms Gameplay: Making Games Fun - The Hierarchy of Challenges - Skill, Stress, and Absolute Difficulty - Commonly Used Challenges

Unit 5 Game Development and Testing **L-9 Hours**

Working with audio – Saving player details and progress – 2d Vs. 3D game development – Single player Vs. Multiplayer games –Testing and refining – Game build – Target Platform – Future Trends: Cloud Gaming and Streaming - Next-Generation Consoles – VR and AR games – Mixed Reality Games.

Total: 45 Hours

G. Laboratory Experiments **Total:30 Hours**

Part-1

Task 1 **Conceptualizing and creating the storyboard:**

- Develop a storyboard for a given game concept.

Task 2 For the given game concept,

- Identify the Game environment, Game objects, and Characters
- Identify Target Platform, End Users, Types of game, Genre of Game, and Target Audients

Task 3 For the given game concept,

- Model the Game environment, Game objects, and Characters
- Integration of Game world with Game Engine

Tool: Blender, Unity 3D

Task 4

- Levels design – number of Levels
- Core Mechanics Implementation

Tool: Unity 3D, Visual Studio

Task 5 Perform the following operations to implement the Scene Management

- Create multiple scenes
- Switching between the scenes – Using scene name and scene number

Tool: Unity 3D, Visual Studio

Task 6 Perform the following operations

- User Interface Design – Panels, Text, Buttons etc.,

Tool: Unity 3D, Visual Studio

Task 7 Audio Design – Sounds and Music

- Apply Suitable Audioto all the scene

Tool: Unity 3D, Visual Studio

Task 8 Saving player details and player's progress

- Save Player's information such as name, Id, Gender etc.,
- Save Player's progress such as score, high score, level cleared etc.,

Tool: Unity 3D, Visual Studio

Task 9 For the rendered 3D model/character perform the following operations.

- Testing and debugging

Tool: Unity 3D, Visual Studio

Task 10 Conversion of game into Build (Android/IOS/Windows)
Tool: Unity 3D

Part-2

Use Cases:

Use Case 1: Design and Develop a puzzle game to improve communication skill of children

Use Case 2: Design and Develop a computer game for a given requirement

The basic idea behind the game "Bouncy Ball" is that the main screen displays a ball and the player has to click the ball which changes its position randomly. There are three lives given to the player. For every wrong click a life is reduced. As soon as the three lives are over the game gets over and the final score is displayed. There are three stages in the game that are Easy, Normal and Hard. On every stage the ball's appearing speed increases thus increases the difficulty level.

Total:75 Hours

H.Learning Resources

i.Text Books:

1. Jesse Schell - The Art of Game Design: A Book of Lenses, CRC Press, Third edition, 2020
2. Joshua Bycer - Game Design Deep Dive into Platformers, CRC Press, First edition 2020

ii.Reference 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:

1. Beginner Design: Unity Game Development Course, Offered By Plural sight Company,https://learn.unity.com/course/beginner-design-unity-game-development-course

Course Code	Course Title	L	T	P	C
10212CS222	VIRTUAL AND AUGMENTED REALITY	2	0	2	3

A. Preamble

This course creates a foundational understanding of the differences between AR and VR. It provides the students with a broad overview of the rapidly evolving space and the tools to characterize future VR&AR developments and assess their potential and limitations. It establishes key concepts and dives into the device landscape, helping learners to differentiate current and future platforms and devices as well as critique the use of VR or AR in applications.

B.Prerequisite Course

10211CS111/10211CS118- Image Processing/ Image Processing Techniques

C.Course Objectives

Students are able to

- To introduce the relevance of this course to the existing technology through demonstrations, and applications with a futuristic vision along with socio-economic impact and issues.
- To understand virtual reality, augmented reality and using them to build applications/simulations.

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 components of the Virtual Reality System	**K2/S3**
CO2	Construct the Geometrical Transformations and Understand Motion & Tracking of VR	**K3/S3**
CO3	Utilize the Augmented Reality and its components of the Augmented Reality System	**K3/S3**
CO4	Make use of Game Engines to develop various VR/AR Applications	**K3/S3**
CO5	Identify the usage of VR/AR Technology in various fields	**K3/S3**

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	PSO 1	PSO 2	PSO3
CO1	3	1	2		2			2	1					
CO2	3	2	3		3			2	1			2		
CO3	2	2	3		3			2	1			2		
CO4	2	1	3		3			2	1			2		
CO5	3	1	3		3			2	1			2		

High-3; Medium-2; Low-1

F.Course Contents

Unit 1 Introduction to Virtual Reality **L-6 Hours**

Defining Virtual Reality - Human Physiology and Perception - Key Elements of Virtual Reality Experience - Virtual Reality System - Interface to the Virtual World - Input & output - Visual, Aural & Haptic Displays - Types of Virtual Reality - Components of Virtual Reality -Applications of Virtual Reality - challenges in VR.

Unit 2 The Geometry of Virtual Worlds, Motion & Tracking **L-6 Hours**

3D Computer Graphics - Geometric Models - Changing Position and Orientation - Axis-Angle Representations of Rotation - Viewing Transformations - Chaining the Transformations - Motion in Real and Virtual Worlds - Physics in the Virtual World - Tracking Position and Orientation - Collision detection**.**

Unit 3 Introduction to Augmented Reality **L-6 Hours**

Technology and features of augmented reality - difference between AR and VR - AR systems and functionality - Input & output - Visualization techniques for augmented reality - Types of augmented reality - Interaction for AR - Tracking for AR - AR challenges.

Unit 4 Development Tools And Frameworks In VR/AR **L-6 Hours**

Frameworks of Software Development Tools in VR/AR- Game Engines (Unity and Unreal) - Steam VR, Oculus VR, AR Core, Vuforia - UI/UX Design - Virtual Environment Design, Choosing low polygonal 3d models for simulations - Choosing Target Platform - Testing and refining.

Unit 5 Applications and Future of VR/AR **L-6 Hours**

APPLICATIONS OF VR/AR - Medical Applications, Education, Arts and Entertainment, Military, Manufacturing, Industrial Training, VR/AR application development – 3D modeling, C# Scripting Emerging Applications of VR/AR - AR in Shopping & Retail, Mobile VR/AR, VR/AR Games.

Total: 30 Hours

G.Laboratory Experiments

Part - 1

Task 1 Create a virtual environment and objects using Unity 3D Game Engine

Tools: Unity 3D

Task 2 Create 3D models using Unity 3d Game Engine

Tool: Unity 3D

Task 3 Develop a scene to implement transformations

Tool: Unity 3D, Visual Studio

Task4 Develop a scene to implement Colliders, Object movement

Tool: Unity 3D, Visual Studio

Task5 Apply Suitable Audio/Video to the created scene.

Tool: Unity 3D, Visual Studio

Task6 Moving in the Virtual Environment (Teleportation), grabbing game objects

Tool: Unity 3D, Visual Studio

Task7 Add multimedia content (text, image, video, animation) to the scene

Tool: Unity 3D, Visual Studio

Task8 Developing different targets (Image, Model, Area) for AR application

Tool: Unity 3D, Visual Studio

Task9 Testing and refining the project – Scenario-based Testing

Tool: Unity 3D, Visual Studio

Task10 Conversion of VR/AR project into the application

Tool: Unity 3D,Visual Studio

Part-2

Use Cases:

Use Case 1: Implement Virtual tour of campus using Unity 3D

Use Case 2: Develop an AR Application to showcase Human Anatomy

Total:30 Hours

H.Learning Resources

i.Text Books:

1. Steven M. LaValle - Virtual Reality, Cambridge University Press, 2020. [Unit 1&2]
2. Linda Daniela - New Perspectives on Virtual and Augmented Reality, Routledge, 2020[Unit 3,4,5]

ii.Reference Books:

1. Philipp A. Rauschnabel- Augmented Reality and Virtual Reality Changing Realities in a Dynamic World, Springer International Publishing, 2020
2. Erin Pangilinan, Steve Lukas, Vasanth Mohan - Creating Augmented and Virtual Realities: Theory and Practice for Next-Generation Spatial Computing, O'Reilly Media, First Edition, 2019

iii.Online References:

1. Introduction to XR: VR, AR, and MR Foundations, Offered By Unity Technologies, [Online]. Available: https://learn.unity.com/course/introduction-to-xr-vr-ar-and-mr-foundations

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS224	COMPUTER VISION	3	0	2	4

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

10211CS120/Machine Learning/ 10211CS223 –Machine Learning Techniques Machine

C.Course Objective

Learners are exposed to

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/S3**
CO2	Use hough transform for line and object detection	**K3/S3**
CO3	Perform various segmentation techniques on images	**K3/S3**
CO4	Implement known methods to process 2D images to obtain 3D representations.	**K3/S3**
CO5	Explore state-of-the-art techniques for digital video processing	**K3/S3**
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	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
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 Imaging Geometry – 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 Epipolar Constraint

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 - The Watershed Algorithm - Segmentation Using K-means - Encoding Layout with GIST Features - Summarizing Images with Visual Words - The Spatial Pyramid Kernel - Classifying images of single 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

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.

G.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-Verlag London Limited, 2011
2. Simon J. D. Prince, "*Computer Vision - Models, Learning, and Inference*", Cambridge University 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
10212CS225	ETHICAL HACKING	3	0	2	4

A.Preamble

This course provides the skills in hacking techniques, methodologies, tools, tricks, and security measures to secure an organization's IT systems. It is a course that has become especially important in the present-day context and can help individuals and organizations to adopt safe practices and usage of their IT infrastructure. Starting from basic topics like 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 be helpful to the students.

B.Prerequisite Courses

10211CS105–Computer Networks

C.Course Objectives

Students undergoing this course are expected to

- Understand the concepts of ethical hacking with terminologies and the laws criticizing those.
- 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.

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 various types of cyber-attacks and apply the security policies to protect against it.	**K3/S3**
CO2	Apply knowledge gained from reconnaissance and scanning to create a comprehensive network map.	**K3/S3**
CO3	Apply Windows and Linux operating systems specific enumeration techniques to find vulnerabilities.	**K3/S3**
CO4	Demonstrate various attacks on web application vulnerabilities and wireless networks.	**K3/S3**
CO5	Interpret the cyber laws and write the report of vulnerabilities present in assets, data, network and applications.	**K3/S3**
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		2		2	3		3						
CO2	2	3		3	3		3						
CO3	2	2		3	3		3						
CO4	3	3		3	3		3						
CO5	3	3		3	3		3					2	

3- High; 2-Medium; 1-Low

F. Course Contents

UNIT – 1 Ethical Hacking Overview **L-9 Hours**

Introduction to Ethical Hacking– TCP/IP concepts - Essential Terminologies – Penetration Testing - Malicious Software – Protection against malware attacks – Physical Security – Security Policies and Procedures

UNIT – 2 Reconnaissance and Scanning **L-9 Hours**

Reconnaissance and Footprinting – Active and Passive – Google Hacking - Social Engineering – Port Scanning – Types of Port Scanning – Port Scanning tools – Ping Sweeps – Scripting for vulnerability scan

UNIT – 3 Enumeration and System Hacking **L-9 Hours**

Introduction to Enumeration – DNS Attacks -DNS Zone Transfers – NetBIOS Enumeration Tools-Windows and Linux Operating System Vulnerabilities – Metasploit framework- System Hacking – Malware Creation – Evading IDS, Firewall and Honeypot - Maintaining Access and Clearing Tracks.

UNIT – 4 Web Application and Wireless Hacking **L-9 Hours**

Understanding Web Application – Web Application vulnerabilities – OWASP Top 10 Vulnerabilities – Session Hijacking - Code injection, SQL injection, cross-site scripting – Denial of service attacks - Wireless Technology – Wireless attacks – WEP/WPA vulnerabilities – Wifi Hacking.

UNIT – 5 Reporting and Cyber Law **L-9 Hours**

Skills required for an ethical hacker – Incident Handling - CVE and CVSS – Report Writing – Laws of Land – Ethics Vs Law – Indian IT Policy 2000 – Compliance and Risk Assessment - Case Studies (Ransomware Attacks/Stuxnet/DataBreach/Pegasus).

Total: 45 Hours

G. Laboratory Experiments **Total: 30 Hours**

Part - 1

TASK 1	Installation of VM work station and Kali Linux/Parrot Operating System.
TASK 2	OSINT Framework for gathering of information about the target system, network and human factors.
TASK 3	Gather the information about the network or webserver by using nslookup, whois lookup, Google dorks **Tools: NSLookup, Whois, Google dorks**
TASK 4	Scan and identify the network range, different types of ports open and vulnerabilities exist using Nmap Tool **Tools: Nmap**
TASK 5	Perform the vulnerability scan and identify the different types of vulnerabilities present in the network. **Tool: Nessus**
TASK6	Demonstrate proxy, intruder attack and Session Hijacking attack **Tools: Burpsuite**
TASK7	Perform Cross site scripting, and Injection attacks **Tools: DVWA**
TASK8	Perform the automated SQL injection attack for the given target. **Tools: SQLMap**
TASK9	Perform Windows and Linux System Hacking **Tools: Metasploit**

TASK10	Malware Creation **Tools: Msfvenom**

Part-2

Use Cases:

Use Case 1: A company wants to assess the security of its network infrastructure. As an ethical hacker, perform network reconnaissance to identify live hosts, open ports, and services using tools like Nmap. Provide a detailed report on the discovered information.

Use Case 2: A financial institution has an online banking portal. Conduct a penetration test on the web application to identify and exploit vulnerabilities such as SQL injection or cross-site scripting. Report on potential risks and recommend mitigation strategies.

Use Case 3: An organization is concerned about its employees falling victim to social engineering attacks. Conduct a simulated phishing campaign to assess the susceptibility of employees. Provide recommendations for improving awareness and training.

Use Case 4: A popular e-commerce website is vulnerable to Cross-Site Scripting attacks. Ethically hack the website to demonstrate how an attacker could inject malicious scripts into web pages, potentially stealing user credentials. Propose measures to mitigate XSS vulnerabilities.

Total: 75 Hours

H. Learning Resources

i.Text Books: Michael T. Simpson, Kent Backman, James Corley - Hands-On Ethical Hacking and Network Defense, Cengage Learning, Second Edition, 2012 (Unit I-III,V)

1. "Ethical Hacking and Countermeasures", EC-Council, Publisher: Course Technology; 2nd edition, 2016. (UNIT-IV)

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: Apr. 20, 2021 [Online]. Available: https://www.greycampus.com/opencampus/ethical-hacking

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS228	BLOCKCHAIN TECHNOLOGY	2	0	2	3

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

10211CS109–Computer Networks

C.Course Objectives

Students undergoing this course are expected to

- Understand the concepts of ethical hacking with terminologies and the laws criticizing those.
- 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.

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/S3**
CO2	Illustrate the concepts of Cryptocurrency and Smart Contracts to build blockchain	**K3/S3**
CO3	Construct Public, Private and ConsortiumBlockchain System for real time implementation	**K3/S3**
CO4	Use Initial Coin Offering, securityand privacy in blockchain with Hyperledger Fabric	**K3/S3**
CO5	Implement Blockchain applications in real time using solidity.	**K3/S3**
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

me Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO2	PSO3
CO1	2												
CO2	3	3									2		
CO3		3											
CO4					3								
CO5			3		3							3	

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Introduction to Blockchain, Types and Consensus Mechanism L-6 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 **L-6 Hours**

Cryptocurrency – Bitcoin, Altcoin and Token -Bitcoin and the Cryptocurrency - Cryptocurrency Basics - Types of Cryptocurrencies - Cryptocurrency Usage

Smart Contracts - Characteristics of a Smart Contract - Types of Smart Contracts -Types of Oracles - Smart Contracts in Ethereum - Smart Contracts in Industry

Unit 3 Types of Blockchain **L-6 Hours**

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 Consortium Blockchain - Hyperledger Platform -Overview of Ripple - Overview of Corda

Unit 4 Security and Application of Blockchain **L-6 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

Security 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 **L-6 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 :30 Hours

G.Laboratory Experiments

Part - 1

TASK 1 Creating MetaMask wallet and crypto

- Meta Mask Setup
- Deposit the Crypto
- Make a Transaction and Extracting the transaction details
- Ethereum Transaction

Tool: MetaMask

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 Hyperledger Fabric using solidity

- Create the Fabric Test Network
- ringing up the test network
- Creating a channel
- Starting a chaincode 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

Total: 60 Hours

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 (Unit 1&2)

ii.Reference Book(s):

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

10212CS229	IOT AND CLOUD COMPUTING	3	0	2	4

A. Preamble

This course provides an overview of the Internet of Things (IoT) and Cloud Computing concepts, infrastructures and capabilities. This will help students gain the necessary knowledge to construct IoT systems and use cloud services for processing and storage of the data produced by the IoT devices. Emphasis will be placed on the architecture and design of IoT systems, the different technologies governing system implementation and the migration of the data to the Cloud for processing.

B. Prerequisite Course:

10211CS129–Modern Computer Architecture

C. Course Objectives

Students are able to

- Know the IoT architecture stack.
- Understand the different IoT platforms
- Analyze the different IoT Protocols
- Learn the cloud computing basics
- Summarize role of Cloud Computing in IoT

D. Course Outcomes:

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

CO Nos.	Course Outcomes	K-Level
CO1	Understand the various concepts of IoT and their technologies	K2/S3
CO2	Choose appropriate physical devices to develop IoT applications.	K3/S3
CO3	Use various protocols in IoT applications	K3/S3
CO4	Demonstrate the use of cloud technology in IoT applications.	K3/S3
CO5	Develop a smart application using IoT and Cloud.	K3/S3

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	PSO3
CO1	3	3	3	1	3	3		2					2	3
CO2	3	3	3	1	3	3		2					2	3
CO3	3	3	3		3	2		2					2	3
CO4	3	3	3		2	2		2					2	3
CO5	3	3	3	1	2	3		2				1	2	3

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 IoT Introduction L-9 Hours

Introduction to IoT – IoT – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges.

Case studies: Architectural analysis for IoT applications

Unit 2 Hardware Platforms For IoT **L-9 Hours**

Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU.
Case studies: Data acquisition from sensors with hardware platforms

Unit 3 Protocols For IOT **L-9 Hours**

Protocols for IoT – Infrastructure protocol, Identification, Transport Layer Protocolos, Discovery, Data Protocols, Device Management Protocols.
Case Study: MQTT/CoAP usage in IoT applications

Unit 4 Cloud Computing **L-9Hours**

Introduction to Cloud Computing - Service Model – Deployment Model- Cloud Platforms – Amazon AWS – Microsoft Azure – Google APIs.
Case Studies: Risk Issues, and Legal Aspects of Cloud Computing

Unit 5 IoT And Cloud **L-9 Hours**

Role of Cloud Computing in IoT - Cloud Components - S3 – Lambda - IoT Core -Connecting a IoT applications to cloud Case Study: Cloud Data Security

Total: 45 Hours

G. Laboratory Experiments **Total: 30 Hours**

Part-1

Task 1 : Familiarization with Arduino/Raspberry Pi/Node MCU and perform necessary software installation.
Task 2 : Familiarization with Fritzing and Thnikercad for design and fabrication of circuits.
Task 3 : To interface LED/Buzzer with Arduino/ Raspberry Pi and write a program to implement traffic light system.

Task 4 : To interface Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program for object detection and find the distance between sensor and object.

Task 5 : To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to find the weather conditions and control the air conditioner.

Task 6 : To interface motor using relay with Arduino/Raspberry Pi and write a program to control the direction and speed of the motor.
Task 7 : To interface Bluetooth/WiFi with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.

Task 8 : Write a program on Arduino/Raspberry Pi to push the data to cloud for detecting the fire event using temperature, light and smoke sensors.

Task 9 : Write a program on Arduino/Raspberry Pi to upload/retrieve/visualize the sensor data to thingspeak/thingsio cloud for predicting the future data.
Task 10 :Write a program on Arduino/Raspberry Pi to stream the sensor data with IoT core and use Bigquery to store data being streamed from IoT devices. Create Pub/Sub model for event driven systems.
Task 11 :Use Cloud IoT Core for IoT based environmental monitoring application.

Task 12 :Use Cloud IoT Core for IoT based Smart Light Controlling& Monitoring System.

Part-2

Task 13: Implement a smart dust bin to detect level of Garbage, Temperature, Humidity, Gases like Ammonia, Carbon Monoxide and send a message with GPS coordinates to garbage collector using GSM module.

Task 14: Implement a person centric health care management system to detect the medical events using IoT components and cloud

Task 15:Implement a Smart home with IoT components and cloud for occupant monitoring.

Total: 45 Hour

H. Learning Resources

ii. Text Books:

1. Alam, Mansaf, Kashish Ara Shakil, and Samiya Khan, eds. Internet of Things (IoT): Concepts and Applications. Springer Nature, 2020. [Unit 1-3]
2. Mangla, Monika, Integration of Cloud Computing with Internet of Things: Foundations, Analytics and Applications. John Wiley & Sons, 2021. [Unit 4-5]

iii. Reference Books:

1. Lakhwani, Kamlesh, et al. Internet of Things (IoT): Principles, Paradigms and Applications of IoT. Bpb Publications, 2020.
2. Parikshit N. Mahalle, Nancy Ambritta P., Gitanjali Rahul Shinde, Arvind Vinayak Deshpande, The Convergence of Internet of Things and Cloud for Smart Computing, CRC Press, 2021.

iii.Online Resources:

1. "IoT (Internet of Things) Wireless & Cloud Computing Emerging Technologies"Accessed on: April. 16, 2021 [Online]. Available: https://www.coursera.org/lecture/iot-wireless-cloud-computing/2-1-iot-architecture-part-1-K6pdR
2. "Practical IoT Concepts-Devices, IoT Protocols & Servers",Accessed on: April. 16, 2021 [Online]. Available: https://www.udemy.com/course/practical-iot-devices-protocols-servers/
3. "Arduino Tutorials", Accessed on: April. 16, 2021 [Online]. Available: https://www.arduino.cc/en/Tutorial/HomePage
4. "Thingspaek IoT Cloud", Accessed on: April. 16, 2021 [Online]. Available: https://thingspeak.com/
5. "Tinkercad Tutorials", Accessed on: April. 16, 2021 [Online]. Available: https://www.tinkercad.com/
6. Industrial IoT on Cloud platform, Accessed on April. 16, 2021 [Online]. Available: https://www.coursera.org/learn/iiot-google-cloud-platform(online): NPTEL.

COURSECODE	COURSE TITLE	L	T	P	C
10212CS230	FORENSICS IN CYBER SECURITY	3	0	2	4

A. Preamble

This coursewill address methodsto properly conductacomputer forensics investigation.It includes digital evidence collection and evaluation of network and host system intrusionswithhands-onuseofpowerful forensicanalysistools.

B. PrerequisiteCourses

10211CS130 – FundamentalsofComputer Networks

10211CS103-Operatingsystems

C. CourseObjectives

Learnersareexposedto

- IntroductiontoDigitalForensicsandEvidences
- NetworkForensics
- ForensicApproachesandForensicDuplication
- DigitalForensicTools
- IncidentResponse

D. CourseOutcomes

Uponthesuccessfulcompletionof thecourse,studentswillbeableto:

CO No's	CourseOutcomes	K-Level
CO1	OutlineandExplorethefundamentalsofcyberforensicanalysis.	K2/S3
CO2	Inferandconductbasicnetworkforensicanalysis	K3/S3
CO3	Classifytheevidenceacquisitionandforensicsduplication	K2/S3
CO4	EvaluateandvalidatethetypesofForensictools	K2/S3
CO5	Detectcybersecurityincidentsanditsresponse	K2/S3

KnowledgeLevel(BasedonrevisedBloom'sTaxonomy)

K1-RememberK2-UnderstandK3-Apply K4-Analyze K5-Evaluate K6-Create

E. Correlationof COswithProgramoutcomesandProgrammeSpecificOutcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	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. CourseOutcomes

Unit1ForensicScience **L-9Hours**

Principles and Methods: Scientific approach to Forensics, Identification and Classification ofEvidence,**Location of Evidence:**StorageMedia,Harddrives,HardwareInterfaces,RecoveringData,MediaFileForensicSteps-**ForensicAnalysis:**Planning,CaseNotesandReports,QualityControl.

Unit2NetworkForensic **L-9Hours**

Network forensics overview-Securing a Network-Developing procedures for networkforensics-Investigatingvirtualnetworks-ExaminingHoneynetprojects-E-mailInvestigations: Role of client and server in E-mail, Investigating E-mailcrimes and violations,E-mailServers, E-mail Forensic tools.

Unit3DigitalForensicApproaches andForensicDuplication **L-9Hours**

Introduction-PolicyandProcedureDevelopment-EvidenceAssessmentEvidenceAcquisition - EvidenceExamination - Documenting and Reporting- **Introduction toForensic Duplication** - Rules of Forensic Duplication (Thumb Rule) - Necessity of ForensicDuplication - Forensic Duplicates as Admissible Evidence - Important Terms in ForensicDuplicate - Forensic Duplication Tool Requirements - Creating a Forensic Duplicate of aHardDrive-CreatingaQualifiedForensicDuplicateofaHardDrive.

Unit4ForensicsTools **L-9Hours**

EvaluatingForensicsToolNeeds-Tasksperformedbyforensicstools-**ForensicsSoftwareTools:**Command-lineforensictools,Linuxforensictools-**ForensicsHardwareTools:**Forensicworkstation,Write-Blocker-Validatingand TestingForensicsSoftware.

Unit5IncidentResponse **L-9Hours**

IncidenceResponseGoalsofIncidentResponse-PeopleInvolvedinIncidentResponseProcess - Incident Response Methodology - Activities in Initial Response - Phases after Detection of anIncident -ReportWritingandPresentation

Total: 45Hours

G. Laboratory Experiments **Total:30Hours**

Part-1

TASK1 StudyofComputerForensicsanddifferenttoolsusedforforensicinvestigation

TASK2	ToextractExchangeableimagefileformat(EXIF)DatafromImageFiles. **Tool**-ExifreaderSoftware
TASK3	ForensicsCaseInvestigationusinglivedata **Tool**-Autopsy
TASK4	ToRecoverDeletedFilesusingForensicsTools **Tool**-FTK/FileAnalyzer
TASK5	ToFindLastConnectedUSBonyoursystem **Tool**-Parse
TASK6	ToViewLastActivitiesonYourPC **Tool**-RegisterEditor/RegistryExplorer
TASK7	Toanalyzenetwork-relatedincident **Tool**-Wireshark
TASK8	Tomaketheforensicimageoftheharddrivetofindthesuspiciousactivity **Tool**-EnCase
TASK9	ToRestoretheEvidenceImagetofindcriminalactivity **Tool**-EnCase
TASK10	Tohideandextractanytextfilebehindanimagefile/AudiofileusingCommandPrompt. **Shellcomments/ShellBagsExplorer**
TASK11	Tocapturethephysicalmemoryofacomputerandanalyzeartifactsinmemory **Tool**-MagnetRAMCapture
TASK12	ToCollectEmailEvidenceinVictimPC **Tool**-EMailAnalyzer

Part-2

Usecases1:

You are on-site, conducting a preliminary examination of a Linux system. The hardware suiteincludes a 56KB modem. What areas of search should be included in your examination?Prepareanexaminationplanthatdetailswhatyouwilllookfor,andwhy.

Usecases2:

YoureceiveaWindowsOSXsystemandareaskedtosummarizetheapplicationsanddata on the hard drive. In addition, you are asked to report any recent system usage and anysignsofencryption,externalstoragemedia,orclocktampering.

Usecases3:

As a security investigator, you have been asked todetermine if company confidentialinformation(intellectualproperty)hasbeencopiedfromenterprisecomputers.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 capacityremovablemediahasbeenattachedtothesuspectcomputer.Apreviewexaminationrevealsthat software used for secure deletion had been downloaded to the desktop. Prepare aninvestigativeplanlistingthelinesofinvestigationthatyouplantopursue.

Usecases4:

A large accounting MNC company is going to audit certain activities by officers of a mediumsize, publicly tradedbank. During the investigation, the appointedauditorneeded toexamine several computer systems used by certain Bank employees. After collecting theevidence,the digital forensicexaminerswere immediatelydispatched and sent in to arrangefor the formal investigationof those systems to search for corroborating evidencein supportoftheauditteam'ssuspicionsandfindings.

Usecases5:

Discover you have known the existence of threatening e-mails being sent to the CEO of yourcompany at that time predict will you do the examination of the e-mails revealed that theyoriginated from outside of the country? Describe the steps you would take in your investigation.Inparticular,addresstheissueofjurisdictionandlocatingyourcounterpartsinthetarget country.

H.LearningResources

i. TextBooks:

1. ChuckEastom,"CertifiedCyber ForensicsProfessionalCertification,McGrawHill,July2017.(Unit1)
2. Bill Nelson, Amelia Philips and Chris Steuart, "Guide to Computer Forensics and Investigations",CengageLearning, 6th Edition, 2019(Unit2)
3. GregGogolin,"Digital ForensicsExplained",CRCPressTaylorandFrancisGroup,2013(Unit3,5)
4. Nilakshi Jain and Dhananjay R Kalbande, "Digital Forensic: The Fascinating World of DigitalEvidences",WileyPress,2017 (Unit4)

ii. ReferenceBooks:

1. Nhien-AnLe-Khac,"Security,Privacy,andDigitalForensicsintheCloud"WileyPress,2019,ISBN-13: 978-1119053286ISBN-10:1119053285.
2. NihadA.Hassan"DigitalForensicsBasicsAPracticalGuideUsingWindowsOS",ApressPublishers,2019.
3. MikeSheward"DigitalForensicDiaries"Secureowl,2017,ISBN:9781521514467.
4. GerardJohansen,"DigitalForensicsandIncidentResponseApracticalguidetodeployingdigitalforensictechniquesinresponsetocybersecurityincidents".

iii. OnlineReferences:

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/S3**
CO2	Identify the use of surface modeling concepts in 3D Character modeling	**K3/S3**
CO3	Use Materials to Improve the Visuals of 3D character	**K3/S3**
CO4	Build textures for 3D characters	**K3/S3**
CO5	Apply Rigging and Animation techniques on 3D Character model	**K3/S3**
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	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

Conceptualizing and creating the storyboard:

TASK 1

d) Prepare a storyboard for a given concept.
e) 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, d) Create an image texture to apply on the 3D Character e) Import the texture to the 3D animation tool f) 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 d) Changing their position, e) Orientation or size in time **Tool: Blender**
TASK 6	Animate the 3D character in following way: ByDeforming 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. c) Compositing - Assemble video clips together and enhance them d) 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 **d)** Add audio and Lip sync to the Developed 3D character **e)** 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 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/S3**
CO2	Identify the standards and management of identities in IAM environment	**K3/S3**
CO3	Utilize the Access management controls and principles for end user access management	**K3/S3**
CO4	Infer the necessity of Policies and governance in identity and access management	**K2/S3**
CO5	Identify the importance of Cloud based Identity and access management and its standards	**K3/S3**
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	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
10212CS251	VIRTUALIZATION TECHNIQUES	2	0	2	3

A. Preamble

This course aims at molding the learner to understand the fundamentals of Cloud Computing and Virtualization Technologies, their features and operations. The course helps the learners to assess the applicability of different Virtualization platforms to make effective resource utilization in IT infrastructure solutions.

B. Prerequisite Courses

10212CS103 - Operating Systems /10212CS130-Fundamentals of Computer Networks

C. Course Objectives

Learners are exposed to

- → The principles and applications of cloud computing and virtualization in enterprise information systems
- → Installation procedures of VMware products and to run virtual machines of different configurations
- → Microsoft Hype-V for creating and managing cloud environments.
- → Security issues found in Virtualized 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 need of cloud computing, models and benefits	**K2/S3**
CO2	Identify the various avenues of Virtualization and their Applications along with the different levels of implementation	**K3/S3**
CO3	Examine the Hardware support for virtualization – hypervisors and outcomes of virtualized Data centers	**K3/S3**
CO4	Construct and manage virtualized infrastructure using popular virtualization platforms.	**K3/S3**
CO5	Organize the techniques to address security concerns in virtualized environments:	**K3/S3**
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 1	PSO2 2	PSO3 3
CO1	2				3									
CO2	2				3									
CO3	2	1	2		3								1	
CO4	2	1	2		3								1	
CO5														

High- 3; Medium-2; Low-1

F. Course Contents

Unit – I Overview of Cloud Computing L- 6 Hours

NIST definition- History of Cloud Computing, Evolution of Cloud Computing, Traditional vs. Cloud Computing.Reason to move to Cloud Computing, Service models (IaaS, PaaS & SaaS).Cloud deployment models (Public, Private, Hybrid and Community Cloud), Benefits and Challenges of Cloud Computing.

Unit – II Virtualization and Hypervisors L- 6 Hours

Virtualization – Definitions – History: Virtual Memory Reasons for Moving to Virtualization- Characteristics – Benefits – Features, Implementation levels of Virtualization, **Hypervisor:** Types, Emulation: Basic Interpretation – Threaded Interpretation – Pre-Coded and Direct Interpretation – Binary Translation – Full and ParaVirtualization, Virtualization of CPU, Memory and I/O Devices – Storage Virtualization

Unit -III Virtual Machines in Data Centres L 6 Hours

System Architectures – Virtual Machine Basics – Taxonomy of Virtual Machines -Virtualization of CPU, Memory and I/O Devices – Storage Virtualization, Virtualization structures/tools and Mechanisms, Datacentre, Virtual Clusters, Cluster Management, Benefits of Virtualized Datacentres.

Unit - IV Virtualization Tools L- 6 Hours

Major Players and Products in Virtualization - Overview of VMware V Sphere, ESX/ ESXi, VMware workstation and Oracle virtual box, **VMware workstation:** Operations and Features, Benefits, **Hyper V:** Introduction to Hyper V Server Architecture - Hyper V hardware requirements - Guest operating systems specifications - Understanding of Virtual switches (Private, Internal, External) - Creating, Deleting Virtual Switches

Unit – V Virtual Machines Security L- 6 Hours

Top virtualization security issues: External attacks, Keeping snapshots on VMs, Sharing files between VM and host, or copy-pasting between host and remote console, VM sprawl, Security of offline & dormant VMs, Security of pre-configured (golden image) VM/active VMs, Lack of visibility and control over virtual networks

Total- 30 hours

G.Laboratory Experiments — Total- 30 hours

Part 1:

Task1:	Identify the prerequisites and enable virtualization in BIOS
Task2:	Download and InstallVMWare Workstation (WS) **Tools Required:** • VM Ware Workstation – Stable Version
Task3:	Creating Virtual machines using the VM Ware WS console **Tools Required:** • VM Ware Workstation – Stable Version
Task4:	Choose and Mounting ISO and Installing Windows 10 ProOS & Server 2019 OS on the created VM **Tools Required:** • VM Ware Workstation – Stable Version
Task5:	Model the migration features by managing virtual machines **Tools Required:** • VM Ware Workstation – Stable Version,
Task6:	i. Download and Install Microsoft Hyper-V ii. Configuring and managing Hyper-V Networking (create, delete, manage virtual switches) **Tools Required:** • Microsoft Server OS (Recent Stable Version) with Hyper –V,PowerShell, Network Connections Control Panel.
Task7:	Managing Hyper-V Storage (VHD types (vhd, vhdx, vhd set)(fixed, dynamic, differential) **Tools Required:** • Microsoft Server OS (Recent Stable Version) with Hyper –V,PowerShell,Hyper-V Manager PowerShell cmdlets.
Task8:	Configuring and managing Check pointsin Hyper-V **Tools Required:** Microsoft Server OS (Recent Stable Version) with Hyper –V,Checkpoint Management GUI.
Task9:	i. Creating and Modifying Virtual machines using the Microsoft Hyper-V console ii. Import and export Virtual machines **Tools Required:** • Microsoft Server OS (Recent Stable Version) with Hyper –V, System Center Virtual Machine Manager (SCVMM).

Part 2:

Usecases:

Usecase 1: Mr. Maarison is the incharge for establishing a lab environment using existing computers (PC), Workstations for training involving different scenarios. VM ware Workstation can be used to createa lab environment for this training purposes. With this hecan create multiple virtual machines and configure them to simulate different scenarios.
Technologies used:VMware Workstation.

Usecase 2: Mr.Abu is in need to develop and test applications over different platforms. With Hyper-V, he can create multiple virtual machines running different operating systems. He can set the hardware specifications, including CPU, RAM, and storage space to make variant capable platforms. This can be useful for testing and development purposes.
Technologies used: Hyper-V

Usecase 3:M/S. Info Systems planning to allow its employees to work from their home. Hyper-V can be used to create a virtual desktop infrastructure (VDI) environment, where multiple users can connect to virtual machines to access their desktops and applications. This can be useful for remote workers, also for organizations with limited hardware resources.
Technologies used: Hyper-V: Virtual Machine Management, Remote Connection Protocol

Usecase 4: Mr.Wilson is about to model a scenario which stands against disasters. To test disaster recovery scenarios Hyper-V can be used. He can create a backup of a virtual machine and then restore it to a different host machine to ensure that it works as expected.

Technologies used: Hyper-V: Virtual Machine Management, Backup and Storage, Replication.

Total- 60 hours

G. Learning Resources

i.Text Books:

1. RajkumarBuyya, ChristianVecchiola, S.ThamaraiSelvi, “Mastering Cloud Computing”, McGraw-Hill Education (India) Private Limited, 2017.
2. Chris Wolf, Erick M. Halter, Virtualization: From the Desktop to the Enterprise, A Press 2005
3. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach Publications, 2006.

ii.Reference Books:

1. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", ServiceTech Press, 2014. ISBN-13: 978-0-13-338752-0.
2. “Pro Microsoft Hyper-V 2019: Practical Guidance and Hands-On Labs”,Andy Syrewicze, Richard Siddaway, October 2018 , Apress, ISBN: 9781484241165

iii.Online References:

1. Prof. SowmyaKanti Ghosh, in Cloud Computing, NPTEL [Online], 2017. Available: https://archive.nptel.ac.in/courses/106/105/106105167/
2. https://docs.vmware.com/en/VMware-Workstation-Pro/index.html

3. https://learn.microsoft.com/en-us/iis/web-hosting/installing-infrastructure-components/hyper-v-guides

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS252	WINDOWS CLIENT 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

- Computer Networks
- 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.

C. 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/S3**
CO2	Manage disk storage in Windows, including creating and formatting partitions, extending or shrinking volumes, and managing disk quotas.	**K3/S3**
CO3	Configure network settings in client operating systems, including IP addressing, subnetting, and DNS configuration.	**K3/S3**
CO4	Configure and manage user accounts and permissions to enforce access control and minimize security risks.	**K3/S3**

CO5	Develop skills in troubleshooting network connectivity and communication issues.	**K3/S3**
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	PSO3
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							

High- 3; Medium-2; Low-1

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

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: 60 hours

H. Learning Resources (in IEEE Format)

i. Text Books:

[1] E. Bott and C. Siechert, "Windows 10 Inside Out," 3rd ed. Redmond, WA, USA: Microsoft Press, 2019.

ii. Reference 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] B. Hill, "Windows 10 Plain & Simple," Redmond, WA, USA: Microsoft Press, 2015.

iii. Online References:

[1] Microsoft Community, "Windows Community," Microsoft, Available: https://answers.microsoft.com/.
[2] Microsoft, "Windows Support Center," Microsoft Support, Available: https://support.microsoft.com/en-us/windows.
[3] Microsoft, "Windows Blog," Microsoft, Available: https://blogs.windows.com/.

[4] Microsoft, "Windows Dev Center," Microsoft Developer, Available: https://developer.microsoft.com/en-us/windows/.

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS253	WINDOWS SERVER ADMINISTRATION OPERATING SYSTEM	2	0	2	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 always monitoring the performance of servers. 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

10211CS103 - 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.
- Teach students how 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	Explore the configuration and management of the Windows server administration and power shell.	K3/S3
CO2	Apply Domain Control technique to store and manage the objects using AD DS and TCP/IP on window server.	K3/S3

CO3	Demonstrate with Filter, Restore, Backup and Common issues in windows server using DHCP DORA and DNS Server.	**K3/S3**
CO4	Implementation of group policy, files, print server, troubleshooting and also classify data using FSRM in windows server.	**K3/S3**
CO5	Use IIS and WDS to deploy and manage web application and network based installation through windows server and backup.	**K3/S3**
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	PSO3
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							

High- 3; Medium-2; Low-1

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 andDHCP — 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

H. 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/

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS254	CLOUD FUNDAMENTALS USING AZURE	2	0	2	3

A. Preamble

This course aims at moulding the learner to understand cloud concepts, Azure services, Azure workloads and support. The course helps the learners to assess the benefits and considerations of using Azure cloud services in enterprise IT infrastructure solutions.

B. Prerequisite Courses

10211CS105/10211CS130 -Computer Networks/Fundamentals of Computer Networks

C. Course Objectives

Learners are exposed to

- Cloud computing models and the underlying concepts
- Architectural components of Azure
- Storage and Deployment tools in Microsoft Azure
- Various Cloud computing programming models in developing services with Azure.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level
CO1	Illustrate the cloud computing models and underlying concepts.	K2/S3
CO2	Construct Architectural components of Azure	K2/S3
CO3	Experiment with Storage and Deployment tools in Microsoft Azure to design Cloud applications	K3/S3
CO4	Apply the concepts of Windows Azure to create and manage virtual machines	K3/S3
CO5	Develop services using various Cloud computing programming models with Azure.	K3/S3
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	PSO3
CO1	2				3									
CO2	2				3									
CO3	2	1	3		3								1	
CO4	2	1	3		3								1	
CO5	2	1	3		3								1	

High- 3; Medium-2; Low-1

F. Course Contents

Unit-I Introduction L-6 Hours

Cloud Computing – Characteristics of Cloud – Cloud Deployment Models – Cloud Service Models- Benefits - Shared responsibility model- consumption-based model- Reliability and predictability in cloud- security and governance in cloud- Cloud pricing models: Freemium, Pay Per Reservation, Pay per User, Subscription based Charging.

Unit-II Virtualization and Networking in Data Centers L- 6 Hours

Data Centers -Regions and availability zones – Cloud resources and Resource management groups - compute types: container instances - Azure storage services-Azure Migrate and Azure Data Box - Azure Virtual Networks, Azure DNS, Azure VPN Gateway-Azure ExpressRoute.

Unit-III Directory and Domain Services L- 6 Hours

Microsoft Azure Active Directory (Azure AD) and Azure AD Domain Services (Azure AD DS) Microsoft Defender for Cloud - External identities and guest access in Azure-Conditional Access in Microsoft Azure Active Directory-Authentication methods in Azure - Microsoft Entra -Role based access control (RBAC) – Microsoft Defender for Cloud.

Unit-IV Policy and Pricing L- 6 Hours

Azure Policy - Blueprints - Service Trust Portal - Factors affecting costs -Purpose of tags in Pricing- Compare: Pricing calculator and Total Cost of Ownership (TCO) calculator -Azure Site Recovery and Disaster Recovery- Azure Arc-Azure Cost Management and Billing tool.

Unit-V Azure Resources and Applications L- 6 Hours

Azure Cloud shell, CLI and Power Shell-Azure Resource Manager and templates (ARM templates) - Azure Kubernetes Services-Azure Service Health -Azure Monitor: Log Analytics, Azure Monitor alerts and Application Insights.

Total: 30 Hours

H.Laboratory Experiments **Total: 30 Hours**

Part – 1

Task 1 Deploy VM in Availability set and load balancing the traffic through External Load Balancer to achieve efficient traffic distribution.
Tools: Azure Subcription, Azure Portal, Vnet

Task 2 Deploy WebApps in two different regions and managing it through traffic manager to achieve high availability and global scalability.
Tools: Azure Subcription, Azure Portal, Vnet, Subnet, Availability set

Task 3 Create and migrate database from on premise to SQL Azure to leverage the benefits of a managed and highly available database platform.
Tools: Azure Subcription, Azure Portal,SQL SSMS,DMA

Task 4 Create an Azure Storage Account and Provisioning Azure Storage services.
Tools: Azure Subcription, Azure Portal,Azure storage Account

Task 5 Create a VET-to-VNET virtual networks to establish secure and scalable network connectivity between virtual networks.
Tools: Azure Subcription, Azure Portal, Vnet

Task 6 Deploy two VMs in Availability Set and load balancing it to increase the availability of application or service.
Tools: Azure Subcription, Azure Portal, Vnet, subnet, Availability set, Load Balancer

Task 7 Creation of VMs with portal, ARM Templates and PowerShell to provide flexibility and automation in the deployment and management of VMs.
Tools: Azure Subcription, Azure Portal, ARM Resource Manager, ARM Templates, Powershell

Task 8 Implement Azure AD Identity Protection for Authentication to enhance the security of your organization's resources by detecting and preventing identity-based attacks.
Tools: Azure Subcription, Azure Portal, Azure Active Directory(AD)

Task 9 Create and Manage roles and devices in Microsoft Azure to control access to Azure resources effectively.
Tools: Azure Subcription, Azure Portal, Azure Active Directory(AD),Azure RBAC

Task 10 Create a web based Campus Events Calendar application using Microsoft Azure.
Tools: Azure Subcription, Azure Portal,Azure App Services,Web Application Framework

Task 11 Implement a data storage and management in Azure using Azure SQL Database for Student Information System (SIS).
Tools: Azure Subcription, Azure Portal,Azure SQL Database: Azure SQL Database is a fully managed, cloud-based relational database service prov

Task 12 Create the own custom virtual machine with the required OS, Software and other components using Microsoft Azure.
Tools: Azure Subcription, Azure Portal, Virtual Machine ,OS Image

Part - 2

Use Cases:

Use Cases 1: Loan application processing

Azure Logic Apps can be used to automate loan application processing, allowing banks to quickly process and approve loan applications. The system can automatically verify customer information, perform credit checks, and generate loan agreements, reducing the time and effort required to process loan applications. Azure Logic Apps can be used to build workflows that automate loan application processing. The system can automatically verify customer information, perform credit checks, and generate loan agreements. Logic Apps can integrate with other Azure services, such as Azure Functions, to provide additional functionality.

Technologies Used: Azure Logic Apps, HTTPConnector, Azure SQL Database Connector, Azure Blob Storage Connector, Azure Service Bus Connector, Azure Cognitive Services Connectors, Azure Active Directory Connector.

Use Cases 2: Online banking portal

An online banking portal can be built using Azure App Service, which provides a platform for building web and mobile applications. The portal can provide customers with access to their account information, transaction history, and other features such as bill pay and fund transfers. Azure Active Directory can be used for authentication and authorization, ensuring that only authorized users can access the portal.

Technologies Used: Azure App Service, Technology stack such as ASP.NET, Node.js, Python, or PHP.

Use Cases 3: Disaster response and Recovery efforts

Azure can be used to quickly set up and deploy critical systems and infrastructure in response to natural disasters or other emergencies. Suppose there is a natural disaster, such as a hurricane, that has impacted a region, causing widespread damage to buildings, power lines, and communication networks. Emergency responders need to quickly set up temporary shelters and provide basic services such as food, water, and medical care to affected individuals. By using Azure for disaster response and recovery efforts, emergency responders can quickly set up critical systems and infrastructure, communicate more efficiently, and allocate resources more effectively, ultimately helping to save lives and mitigate the impact of the disaster on affected communities.

Technologies Used: Azure Virtual Machines, AzureStorage, Azure Site Recovery, Azure Backup

Use Cases 4: Fraud detection and prevention

Azure Machine Learning can be used to build predictive models for fraud detection and prevention. By analyzing customer data and transaction history, the system can identify potential fraudulent activity and alert staff to take action. Azure provides several options for storing and managing data, including Azure SQL Database, Azure Cosmos DB, and Azure Blob Storage. These services can be used to store transaction data, customer profiles, and other data needed for fraud detection and prevention.

Technologies Used: Azure Machine learning, Azure Cognitive Service.

Total: 60 Hours

G. Learning Resources

i. Text Books:

1. Jim Boyce, “Microsoft certified Azure Fundamentals Study Guide”, Sybex – A Wiley Brand, 2021.
2. Michael Collier and Robin Shahan,” Fundamentals of Azure – Microsoft Azure essentials” , Microsoft Press, 2015.

ii. Reference Books:

1. Namit Tanasseri, RahulRai, “Microservices with Azure”, 1st Edition, Packet Publishing, UK, 2017.
2. Sriram Krishnan, “Programming: Windows Azure”, O’Reilly, 2010.
3. Enamul Haque, “Cloud Service Management and Governance: Smart Service Management in Cloud Era”, Enel Publications.

iii. Online References:

1. “Introduction to Microsoft Azure Fundamentals” Available: “https://learn.microsoft.com/en-us/training/modules/describe-cloud compute /introduction-microsoft-azure-fundamentals”, [Online].
2. “Introduction to Azure Fundamentals”: Available:“https://learn.microsoft.com/en-us/training/modules/intro-to-azure-fundamentals/”, [Online].

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS255	ADMINISTERING MICROSOFT EXCHANGE SERVER	3	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/S3
CO2	Identify the recipient object and use cmdlets and scripts for Managing Exchange Servers	K3/S3
CO3	Make use of Exchange Server to configure, manage and restore client access, outlook and mobile messaging services.	K3/S3
CO4	Utilize Exchange Server to configuring and managing messaging transport services, Antivirus and AntiSpam solutions.	K3/S3
CO5	Apply security in Microsoft Exchange Server by using RBAC.	K3/S3

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	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-9

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-9

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-9

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-9

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-9

Monitoring - Troubleshooting, Securing: Audit Logging, Using RBAC: Overview- Requirements- Service Principals- Application Roles, Exchange Online and Office365: Overview - Migration - Hybrid Environment.

TOTAL: 45 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 encryptedmessages 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 performanceand security issues • Monitoring Exchange Server • Troubleshooting database availability • Troubleshooting Client Access servers
TASK 15	Securing and maintaining Exchange Server to protect Exchange fromviruses, 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

COURSECODE	COURSETITLE	L	T	P	C
10212CS256	OFFICE 365 ADMINISTRATION	3	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.PrerequisiteCourses

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/S3
CO2	Analyze and identify gaps in current Microsoft 365 security posture using Secure Score.	K3/S3
CO3	Compute Advanced Threat Analytics and learn to identify attacks using attack simulator in Microsoft 365.	K3/S3
CO4	Manage and configure devices with MDM and domains for MDM.	K3/S3
CO5	Create useful retention tags and retention policy.	K3/S3
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	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-9

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-9

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-9

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- 9

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-9

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: 45 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. LearningResources

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
10212CS257	Data Center Hosting _WINDOWS OPERATING SYSTEM	2	0	2	3

A. Preamble

This course is designed to provide students with a comprehensive understanding of the Windows operating system and its key features. Through a combination of lectures, hands-on exercises, and practical assignments, students will learn how to navigate the Windows user interface, manage files and folders, customize system settings, and troubleshoot common issues. 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. Perequisite Courses

10211CS103-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.
- Teach students how 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	Apply appropriate methods to manage users & groups and different methods for securing data and the Windows OS.	K3/S3
CO2	Implement IP network connectivity, name resolution using DNS , remote management and access for a Windows-based system.	K3/S3
CO3	Demonstrate the ability to implement security measures, different methods of encryption, monitoring and troubleshooting tools to diagnose and resolve performance issues in a Windows-based system.	K3/S3
CO4	Experiment with Backup , Restore and Troubleshooting Windows Server	K3/S3
CO5	Solve troubleshoot network connectivity issues and Manage and control Configuration Management Database (CMDB) to meet customer and ITIL	K3/S3
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	PO1	PSO1	PSO2	PSO3

											1			
CO1	1	1	1								2		2	
CO2	1	2	3	3	3			2			2		2	
CO3	1	2	3	3	3			2			2		2	
CO4	1	1	3	3	3			2			2		2	
CO5	1	2	3	2	3						2		2	

High- 3; Medium-2; Low-1

F.Course Contents

Unit 1 Introduction to Operating System, Authentication and Update Management 6 Hours

Server OS and Client OS-Different Versions/Editions of Windows OS (2003, 2008, 2012, 2016,2019)-Windows Server 2016 Overview-Windows Server 2016 Management-Deployment Methods-different editions and features of Windows Server-Authentication-different methods for securing data. Drivers-Windows Servicing Model-Updating Windows-updating Windows using WSUS-Windows Update for Business-Monitoring & Patching Tools-SolarWinds Patch Manager-Update through Intune Portal

Unit 2 Remote,Disk, File and Security Management 6 Hours

Remote Access-Remote Management-working principle of name resolution- remote access Technologies-Managing Storage, Disks, Volumes and Storage Spaces- options and benefits of local, cloud, and virtual Storage-File Systems-Managing User Files- common security threats-mitigate common security threats-encryption methods-secure the device by Windows firewall- benefits of using IPSec-features of Windows Defender.

Unit 3 Performance & Monitor, Backup & Restore and Trouble shooting 6 Hours

Windows Architecture-Support and Diagnostic Tools-Monitoring and Troubleshooting Computer Performance-SysInternal Tools-key stages in troubleshooting-purpose and benefits of the various tools-File Recovery-Application Troubleshooting-methods of file recovery-Troubleshooting Windows Startup,Operating System Service Issues-recovering from startup issues-advanced startup options-failed services- locked account scenarios- Troubleshooting Device Driver Failures, Hardware, Physical Failures.

Unit 4 Storage management and Windows command 6 Hours

Remediate driver issues,Peripherals.storage technologies and Usage-different storage topologies, FC & iSCSI- RAID redundancy RAID 0, RAID 1, RAID 5,RAID 10-disk types-iSCSI logical units-iSCSI target instances-ATA basic disk, dynamic disk, mount points, file systems, mounting a virtual hard disk, distributed file system- Command shell-Networking Information- Lists Installed Drivers- Hardware Information- Server is Reachable-Scan and Repare System Files .

Unit 5DNS Management , Basic Troubleshooting, ADDS Service,IT-IMS and ITIL 6 Hours

Windows Services-Windows Services Control Manager-Differences between Windows Services and Regular Applications Windows Services and Regular Applications-DNS Client Service-Windows troubleshooting-Knowledge of local and remote computer system diagnostic tools-Active Directory Service -Domain Controllers-Protocols in AD-Active Directory, Identity, and Access-AD console-Tree- IT Infrastructure-Infrastructure Management-Remote Infrastructure Management-Server Hardware, Component-Network Devicesknowledge database, work instructions- Service Life Cycle-Process and Function-Processes and Function in Service Operations-Processes in Service Transition-ITIL Incident Change and Problem Management

Total: 30 Hours

G.Laboratory Experiments

Total: 30 Hours

Task 17. Basics of VMware & Virtualization Technology.

Task 18. Authentication Management

a) Managing Users and Groups- Create a new user account, add it to a new group, and assign group permissions to a folder.
b) Configuring User Account Control- Configure User Account Control (UAC) settings to improve security on a Windows Server.
c) Implementing Device Registration- Implement device registration in Windows Server to improve security and control access to resources.
d) Managing Domain Authentication- Manage domain authentication in Windows Server to improve security and control access to resources.
e) Managing Local User and Microsoft Account Authentication- Manage local user and Microsoft account authentication in Windows Server to improve security and control access to resources.
f) Managing password and account options- Manage password and account options in Windows Server to improve security and control access to resources.
g) Managing Azure AD Authentication- Manage Azure AD Authentication to secure access to cloud-based resources.
h) Configure user account control. - Configure User Account Control (UAC) in Windows Server to enhance security and prevent unauthorized changes.

Task 19. Configuration Management

a) Register a device with a domain- Register a device with a domain in Windows Server to enable centralized management of devices and improve security.
b) Configure and Customize the Windows Start Menu- Configure and customize the Windows Start Menu in Windows Server to improve usability and enhance user productivity.
c) Common Configuration Options- Configure common configuration options in Windows Server to optimize performance and improve security.
d) Advanced Configuration Methods- Configure advanced configuration methods in Windows Server to optimize performance and improve security.
e) Managing Drivers and Devices- You are a system administrator responsible for managing a Windows Server environment with multiple client devices. You have received a request from a department manager to install a new printer on their department's client devices.
f) Synchronizing settings between devices- Synchronize settings between devices in Windows Server to enable seamless access to user preferences and settings.

Ex: system administrator is responsible for managing a Windows Server environment with multiple client devices. Administrator has received a request from a user who regularly works on multiple devices and wants their settings and preferences to be synchronized across all their devices.

Task 20. Update Management

a) Use the Windows control panel and setting app to configure settings. - Use the Windows Control Panel and Settings app to configure network settings on a client device in the Windows Server environment.

Ex:System administrator is responsible for managing a Windows Server environment with multiple client devices. Administrator has received a request from a user who needs to configure their network settings to access a new network resource.

b) Perform tasks using Windows PowerShell- Use Windows PowerShell to disable a specific feature on all client devices in the Windows Server environment.

Ex: system administrator is responsible for managing a Windows Server environment with multiple client devices. Administrator has received a request from the IT security team to disable a specific feature on all client devices to address a security vulnerability.

c) Configure client-side printing and managing print server properties- Configure client-side printing and manage print server properties in Windows Server to enable printing for a department's client devices.

Ex: system administrator is responsible for managing a Windows Server environment with multiple client devices Administrator has received a request from a department manager to configure a new printer on their department's client devices and manage the print server properties.

d) Configure Windows update settings- Configure Windows update settings in Windows Server to ensure that all client devices in the environment are up-to-date with the latest security patches.

Ex: system administrator is responsible for managing a Windows Server environment with multiple client devices. Administrator has received a request from the IT security team to configure Windows update settings on all client devices to ensure they are up-to-date with the latest security patches.

e) Configure Windows update using group policy- Configure Windows update settings using group policy in Windows Server to ensure that all client devices in the environment are up-to-date with the latest security patches.

Ex: system administrator is responsible for managing a Windows Server environment with multiple client devices. Administrator has received a request from the IT security team to configure Windows update settings on all client devices to ensure they are up-to-date with the latest security patches. However, Administrator need to configure the update settings using group policy to ensure consistency across all client devices.

Task 21. Remote Management

a) Configure IP Network Connectivity- Configure IP network connectivity settings in Windows Server to enable a new client device to connect to the network.

Ex: network administrator is responsible for managing a Windows Server environment with multiple client devices. You have received a request from a department manager to configure network connectivity settings on a new client device that has been added to their department.

b) Implement Name Resolution- Implement name resolution in Windows Server to ensure that all client devices can correctly resolve the FQDN of the new web-based application server.

Ex:You are a network administrator responsible for managing a Windows Server environment with multiple client devices. The IT department has recently deployed a new web-based application on a server in the environment. The application is accessed using a fully qualified domain name (FQDN), but some client devices are experiencing issues with resolving the name to the correct IP address.

c) Implement Wireless Network Connectivity- Implement wireless network connectivity in Windows Server to enable client devices to connect securely to the new wireless network.

Ex: A network administrator is responsible for managing a Windows Server environment with multiple client devices. Recently, the IT department has deployed a new wireless network for employees to use. The task at hand is to configure the wireless network settings and ensure that client devices can connect securely.

d) Configure IP network connectivity. - Configure IP network connectivity in Windows Server to ensure that the server can communicate with other servers and devices on the network.

Ex: A network administrator is responsible for managing a Windows Server environment with multiple client devices. The administrator discovers that one of the servers in the environment is unable to communicate with other servers or devices on the network. After investigation, it is determined that the server's IP address settings are incorrect, and it is not properly configured for the network.

e) Configure Windows for remote management and access- Configure a Windows Server to allow remote management and access using Remote Desktop Protocol (RDP). Ensure that all remote

connections are encrypted using SSL/TLS encryption. Test remote access to the server using a remote device, and verify that the connection is encrypted. Additionally, configure firewall rules to allow RDP traffic through the server's firewall, and create user accounts with appropriate permissions to allow remote access to the server.

Task 22. File management

a) Configuring and Managing File Access- In a Windows Server environment, create a shared folder and configure file access permissions to allow only certain users or groups to access the folder and its contents. Test the permissions by attempting to access the folder from a user account that does not have permission to do so.

Ex: As a Windows Server administrator, you have been tasked with configuring file access permissions for a shared folder that contains sensitive information. You need to ensure that only authorized users can access the folder and its contents. What steps would you take to configure and manage file access?

b) Configuring and Managing Shared Folders- Create a shared folder on a Windows Server and configure permissions to allow specific users to access it. Test the folder access by logging in as a user with the appropriate permissions and verifying that they can read and write to the folder, while other users cannot access it.

Ex: As a network administrator is responsible for managing a Windows Server environment that includes several file servers with shared folders. One of the departments in the organization needs access to a shared folder on one of the file servers, but only specific users should have read and write permissions to the folder. How network administrator configures and manage the shared folder to ensure that only the designated users have access to it?

c) Configuring and Managing Permissions and Shares- Configure a shared folder on a Windows Server and manage its permissions and shares. Create different user groups and assign them different levels of access to the shared folder. Test the access permissions by attempting to access the shared folder from different client devices using different user accounts.

Ex: IT administrator is responsible for managing the file server in your organization. The file server contains important documents and files that are

shared among different departments. IT administrator need to ensure that only authorized users have access to these files, and that the files are protected from unauthorized access or modifications. How IT administrator configure and manage permissions and shares for the files on the file server?

d) Using Conditions to Control Access and Effective Permissions- Configure a shared folder named "Finance" on a Windows Server and set the permissions to allow only members of the "Finance" group to access it. Configure a separate shared folder named "Public" that is accessible to all users. Use conditions to control access to the "Finance" folder based on the user's group membership. Test the configuration by logging in as a user who is a member of the "Finance" group and a user who is not a member, and attempting to access the folders.

e) Work Folders-

1. Install and configure Work Folders on a Windows Server 2016 or later server.
2. Create a new sync share for a department or group of users.
3. Configure the Work Folders sync settings for a user or group of users.
4. Test the Work Folders setup by syncing files between a work device and a personal device.
5. Monitor Work Folders synchronization and troubleshoot any issues that arise.

f) Synchronizing files with OneDrive- In the lab, you will be asked to configure OneDrive for Business synchronization settings, including selecting which folders to synchronize and setting

up security options such as encryption and conditional access. You will also learn how to monitor synchronization status and troubleshoot common synchronization issues. Finally, you will practice configuring policies to control access to OneDrive files and prevent data leakage.

Ex: IT administrator working at a company that has recently migrated to Microsoft 365. The management has asked administrator to configure OneDrive for Business to synchronize files between users' devices and the cloud. administrator need to ensure that the synchronization is secure and efficient, while also preventing unauthorized access to sensitive files.

Task 23. Performance and Monitor

a) Monitoring Reliability and Performance- how to use the Performance Monitor and Resource Monitor to monitor system reliability and performance.

Ex: You are the system administrator for a company that has a Windows Server environment. One of the servers in the environment is experiencing slow performance, and users have reported issues accessing the applications hosted on the server. You need to identify the cause of the performance issues and optimize the server for better reliability and performance.

b) Monitoring Events- how to use the Event Viewer tool to monitor events on a Windows Server.

Ex: As a system administrator, you are responsible for monitoring events on a Windows Server. One of the applications on the server is experiencing issues, and you suspect that it might be due to errors in the event log. You need to investigate the event log to find the root cause of the problem and resolve it.

c) Use monitoring tools to establish a performance baseline- As an IT administrator, you have been tasked with identifying the cause of a slow network performance issue in your Windows Server environment. You need to establish a performance baseline and monitor the network to identify potential bottlenecks and areas for optimization. What monitoring tools and techniques can you use to establish a performance baseline and identify potential network performance issues?

d) Optimize performance on Windows 10 clients. - In the lab, you have a Windows 10 client device that is running slow and needs to be optimized for better performance. Use the built-in performance optimization tools and techniques to identify and resolve performance issues, such as disabling unnecessary startup programs, defragmenting the hard drive, and adjusting power settings. Monitor the system performance using Task Manager and other performance monitoring tools to ensure that the changes have a positive impact on the system's overall performance.

Task 24. Backup Restore

a) Using File History to Recover Files- Using a Windows 10 device, set up and configure File History to automatically back up important files. Then, intentionally delete a file and use File History to restore it.

Ex: You work as an IT administrator for a company with multiple Windows 10 devices. One of the employees accidentally deleted an important file and needs to recover it. You need to use the File History feature to restore the deleted file.

b) Configure Windows Server to support individual file and system recovery.

You are the system administrator of a Windows Server environment. One of your users has reported that they have accidentally deleted an important file from their shared folder. You need to restore the file as quickly as possible. What steps would you take to recover the deleted file using the individual file recovery feature in Windows Server?

c) Recover a device using the Reset This PC function.

A support technician in a company that uses Windows 10 on all of its devices. One of the employees has reported that their laptop is not functioning properly and is experiencing various issues. Technician has diagnosed the problem and concluded that the best solution would be to reset

the device to its factory settings using the Reset This PC function. What steps the technician will take to ensure that the employee's personal files are not lost during the reset process? How the technician will help the employee restore their files once the reset is complete?

d) Solve application compatibility issues with the Application Compatibility Toolkit.

You are an IT administrator tasked with deploying a new application across your organization. After the deployment, you receive reports from some users that the application is not working properly and experiencing compatibility issues with their systems. You need to solve these compatibility issues to ensure the application is working as intended on all systems.

Task 25. Troubleshooting Windows Server

a) Using Advanced Startup and Windows RE to recover from Boot Failures

system administrator is responsible for managing a Windows environment in a large organization. One of the computers on the network is having boot issues, and it is not starting up properly. Administrator suspect that the boot files may be corrupted or missing. Administrator need to use the advanced startup options and Windows Recovery Environment (Windows RE) to recover the system and resolve the boot issues.

b) Recovering Windows using Reset This PC

You work as a technical support specialist for a company that has recently experienced some issues with one of its computers. The computer is running Windows 10, and the user has reported that it is running very slowly and has become unresponsive at times. You have tried various troubleshooting steps, but the issue persists. You decide to use the "Reset This PC" feature to try and fix the problem.

c) Troubleshooting Hardware by Using Windows Memory Diagnostics

Technician is responsible for maintaining a large number of computers in a corporate environment. One of the computers is experiencing frequent crashes and freezes, which could be caused by faulty memory modules. Technician need to troubleshoot the issue using Windows Memory Diagnostics to identify and resolve the problem.

d) Recovering Windows by using a Restore Point

You are a support technician for a small business. A user has reported that their computer has been acting up and they suspect that a recent software update may be the cause of the issue. You suspect that the update may have caused a conflict with the system's drivers, leading to stability issues. You want to try restoring the system to a previous state using a restore point to see if it resolves the issue. How would you go about doing this?

Task 26. Storage Management

a) Enable the iSCSI initiator

As a system administrator, you have been tasked with setting up an iSCSI storage solution for your organization. You need to enable the iSCSI initiator on a Windows Server to connect to the iSCSI target. How would you do this?

b) Configure iSCSI initiator

Your organization has recently decided to implement a new storage area network (SAN) using iSCSI technology. As part of your responsibilities, you need to configure the iSCSI initiator on the servers and ensure that they can connect to the new SAN.

c) Cofiguring iSCSI target

system administrator is responsible for managing a storage area network (SAN) in your organization. Technician has been asked to configure an iSCSI target to provide storage to a group of servers. The storage should be easily scalable and provide high availability.

Task 27. DNS Management

a) Installing and Configuring DNS Server

A network administrator is tasked with setting up a DNS server for your organization. Your organization has multiple internal networks and requires DNS resolution for internal resources. Additionally, your organization's website is hosted externally and needs to be accessible to users on the internet. Administrator need to install and configure the DNS server to meet these requirements.

b) creating DNS ZONE and Records

You have been tasked with setting up a new DNS server for your organization. One of your primary responsibilities is to create DNS zones and records for various services and resources on your network. You need to ensure that your DNS configuration is accurate and efficient, and that it provides reliable name resolution for all devices on your network. How would you approach this task, and what steps would you take to create and manage DNS zones and records?

Task 28. Installing a Domain Controller

You are an IT administrator responsible for setting up a new domain in your organization. Your organization has several departments with different access levels, and you need to set up a domain controller to manage user accounts and permissions. You decide to install a domain controller on a Windows Server 2019 machine. What steps will you take to install and configure the domain controller, and how will you ensure that it is properly configured to manage user accounts and permissions?

Task 29. Basic Troubleshooting Windows

a) Activating Windows

You have just installed Windows 10 on a new computer and need to activate it. You have a valid product key, but are unsure of the steps to take to activate Windows. What are the steps you should take to activate Windows?

b) Fix computer booting very slowly

You are a technical support specialist, and a user has reported that their computer is taking an unusually long time to boot up. The user has already tried restarting the computer several times but still experiences the same issue. What steps would you take to diagnose and fix the problem?

c) Kill background apps to speed your PC

You have noticed that your computer has been running very slowly lately, and you suspect that background apps may be the cause. You have tried closing some of the apps manually, but the issue persists. What steps can you take to kill background apps and speed up your PC?

d) Fixing the Blue Screen of Death

You have a Windows 10 computer that is displaying the Blue Screen of Death (BSOD) error message. The error message suggests that there is an issue with the system's memory. How would you troubleshoot and fix this issue?

e) Install the latest updates for your computer.

A system administrator is responsible for maintaining a network of computers. Recently, administrator has noticed that some of the computers are running slowly and experiencing frequent crashes. Upon investigation, administratorfind that many of the computers have outdated software and operating system versions. To resolve the issue, administrator decide to install the latest updates on all the computers.

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/
3. "Microsoft Windows Server 2016 Training for Beginners". Accessed on:
4. Apr. 04,2023 [Online]. Available:https://www.udemy.com/course/windows-server-2016/

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS259	ADVANCED SWITCHING AND NETWORKING TECHNIQUES	2	0	2	3

A. Preamble

This course covers network fundamentals install, operate, configure, and verify basic IPv4 and IPv6 networks. It also includes network access, IP connectivity, IP services, configuration of DNS, DHCP configuration and Wireless networks, Ethernet LANS in detail. This course also lays the foundation to advanced Computer networking concepts.

B. Prerequisite Courses

10211CS105/10211CS130- Computer Networks /Fundamentals of Computer Networks

C. Course Objectives

Learners are exposed to

- Understand Network Fundamentals.
- Identify the basic need of Network Access.
- Implement various IP Services
- Implement VLAN

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Design subnets and calculate the IP addresses to fulfill network requirements of an organization.	K3/S3
CO2	Evaluate the performance of Ethernet LAN and Wireless LAN through simulation.	K3/S3
CO3	Configure the VLAN Network and VLAN device settings.	K3/S3
CO4	Analyzing VTP Ethernet LAN Switching Configuration.	K3/S3
CO5	Assessing Network performance and using STP to track every connection in the specific network.	K3/S3
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	PSO 1	PSO 2	PSO 3
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 Network Addressing and Introduction to Wireless Networks L-6 Hours

Introduction to IP Addressing and configuration-DHCP Configuration and Troubleshooting-Understanding DNS and troubleshooting basic issues related to DNS-Introduction to Wireless Network and Architecture- Components of a WLAN (WLC, Access Point, EndPoints)

Unit 2 Introduction to Ethernet L- 6 Hours

Introduction to Ethernet -Terminology used in Ethernet switches - Frames, Transparent Bridging, Address Learning, Traffic Filtering, Frame Flooding, Multicast Traffic, Configure and troubleshoot-EtherChannel Concept-Discovery Protocols & L2 and L3 EtherChannel Configuration

Unit 3 VLAN L-6 Hours

VLAN - Configuring VLANs - Creation of an Ethernet VLAN - Traditional Inter-VLAN Routing - Create VLANs on the switch - Assign the VLANs to switch port - Configure the IP addresses on the router - Router-on-a-Stick Inter - VLAN Routing- Configuring Inter - VLAN Routing - Multilayer Switch Inter - VLAN Routing

Unit 4 VLAN Trunking Protocol L-6 Hours

VLAN Trunking Protocol (VTP) - Requirements of VTP – modes - Configuration - Layer 2 switching - LLDP concepts - LLDP Service - Analyzing Ethernet LAN Switching

Unit 5 Spanning Tree Protocol L- 6 Hours

Introduction to Spanning-Tree - concepts in STP- Varieties of Spanning Tree Protocols-Spanning Tree Configuration- Calculation process of the STP algorithm - STP Operation- Step-by-Step Instructions - STP protocol packets.

Total: 30 Hours

Laboratory Task: Total: 30 Hours

Task 1: Study of basic network command and Network configuration commands.

Task 2: Connect the computers in Local Area Network

Task 3: Perform an initial configuration of a Cisco Catalyst 2960 switch for the given topology diagram

Task 4: Configuring and Troubleshooting a Switched Network for the given topology diagram

- Establish console connection to the switch.
- Configure the host name and VLAN1.
- Use the help feature to configure the clock.
- Configure passwords and console/Telnet access.
- Configure login banners.
- Configure the router.
- Solve duplex and speed mismatch problems.
- Configure port security.
- Secure unused ports.
- Manage the switch configuration file.

Task 5: Connecting a Switch for the given topology diagram

- Connect a switch to the network.
- Verify the configuration on the switch

Task 6: Implementing an IP Addressing Scheme for the below topology diagram

- Subnet an address space based on the host requirements.
- Assign host addresses to devices.
- Configure devices with IP addressing.
- Verify the addressing configuration

Task 7: Configuring Ethernet and Serial Interfaces

- Configure a LAN Ethernet interface.
- Configure a WAN serial interface.
- Verify the interface configurations

Task 8: Configuring a Cisco Router as a DHCP Server for the given topology diagram

Task 9: Configure a layer 3 EtherChannel for the two links between switches Dist1 and Dist2 so that IPv4 packets can be routed between the two switches, as follows:

- → Configure the two links between the distribution switches as a static layer 3 EtherChannel with port-channel interface number 10.
- → Make the EtherChannel a routed port instead of a switch port.
- → Configure the IP addresses per the figure for the Port Channel interface

Task 10. Configure Port to VLAN Interface Settings on a Switch.

Task 11. Configure a routed port for connecting to the firewall on the L3 switch.

Task 12. In a typical network some switches are configured as VTP servers and other switches are configured as VTP clients. Create a VLAN on a VTP server switch which is automatically advertised to all switches inside the same VTP domain.

Task 13. Configure STP on Catalyst Switches.

Task 14. Create the network with values shown below containing 3 interconnected Ethernet switches and 3 computers. Verify that from PC1, you can ping the IP address of the other five devices. Subnet mask of all devices should be 255.255.255.0.

Total: 60 Hours

G. Learning Resources

i. Text 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.
3. Behrouz Forouzan, "Data Communications and Networking", Tata McGraw Hill, 5th Edition,2021.

ii. Reference Books:

1. Kurose and K.W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Addison-Wesley,2017.

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
10212CS260	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

10211CS105/10211CS130 - Computer Networks / Fundamentals of Computer Networks

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/S3
CO2	Configure IP Routing.	K3/S3
CO3	Interpret the IGRP and EIGRP.	K3/S3
CO4	Dynamic Routing Protocols.	K3/S3
CO5	Border Gateway Protocol.	K3/S3

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	PSO3
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 - 6 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-6 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- 6 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-6 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- 6 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: 30 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.
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

COURSECODE	COURSETITLE	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.PrerequisiteCourses

10212CS253 - Fundamentals of Computer Networks

C.Course Objectives

Learners are exposed to,

- Understand the basics of networking protocols and server storage techniques.
- Simulate Illustratethe 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/S3
CO2	Implement the methods for the Provisioning and deprovisioning of host and Pool of network storage Using EMC SAN Simulator.	K3/S3
CO3	Simulate the various cloud based storage techniques using NetApp Simulator.	K3/S3
CO4	Describe various storage backup and recovery strategies.	K3/S3
CO5	Infer the concepts of Data Center Virtualization.	K3/S3

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	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 L-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 L-7 Hours

EMC SAN - Unity - allocation of storage both SAN & NAS - deprovisioning of storage host creation - pool creation

Unit 3 NetApp L-4 Hours

Aggr - volume - qtree - quota - vserver - subnet - lif - cifs - nfs -iscsi -lun mgmt - snapshot & restore - snapmirror

Unit 4: Introduction to Backup and Restore L-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 L-5 Hours

VM-Memory expansion & Disk expansion-VM Planned move & datastore addition - Certification Checks - ESXiHost Restart--Resource allocation – increase & decrease - Data Center Virtualization: vSphere & ESXi - Data Center Virtualization: vCenter Server

Total: 30 hours

LAB TASKS: Total-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
    - o
- 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

COURSECODE	COURSETITLE	L	T	P	C
10212CS256	OFFICE 365 ADMINISTRATION	3	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/S3
CO2	Analyze and identify gaps in current Microsoft 365 security posture using Secure Score.	K3/S3
CO3	Compute Advanced Threat Analytics and learn to identify attacks using attack simulator in Microsoft 365.	K3/S3
CO4	Manage and configure devices with MDM and domains for MDM.	K3/S3
CO5	Create useful retention tags and retention policy.	K3/S3
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	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-9 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-9 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-9 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- 9 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 365 L-9 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: 45 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. LearningResources

i. Text Book(s):

3. Aaron Guilmette, Darryl Kegg, Ed Fisher ,"Microsoft 365 Administration Inside Out",3rd Edition,The Microsoft Press Store by Pearson,2023.
4. Carpe, Thomas,"Mastering Office 365 Administration",Packt,2018

ii. Reference Book(s):

3. Randy Nordell, Kathleen Stewart, Pat Graves, and Annette Easton,"Microsoft Office 365: In Practice, 2019 Edition",McGraw-Hill Education,2019.
4. "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
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/S3
CO2	Build an interactive Profiles creation with WAS Configuration tools using Console and Command Line Administration.	K3/S3
CO3	Utilize SSL Certificate in WebSphere Application Server to secure client server communication using SSL configurations	K3/S3
CO4	Make use of monitoring standard operations procedures, and deployment manager procedure for troubleshooting the WebSphere application server.	K3/S3
CO5	Apply Applying service packs to upgrade WAS and Troubleshoot WAS Admin Issues using Installation, Rollback of ifix/fix packs	K3/S3

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	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	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 **–** troubleshootingpool 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: Practicalstudy 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 andWebSphere 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
10212CS266	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/S3**
CO2	Design the Queue manager and handle various types of messages and properties	**K3/S3**
CO3	Apply regular backup and recovery procedures for MQ configurations for data.	**K3/S3**
CO4	Organize Interprocess Communication to manage message channels for inter-queue manager	**K3/S3**
CO5	Experiment the log management, diagnose, and resolve the common issues.	**K3/S3**

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	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 Bothld · 2013Barry Dearfie
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	1	0	2	2

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	PS O1	PS O2	PSO 3
CO1	2	2	3	3	3				2	2	2		3	2
CO2	2	2	3	3	3				2	2	2		3	2
CO3	2	2	3	3	3				2	2	2		3	2
CO4	2	2	2	3	3				2	2	2		3	2
CO5	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

- exerciseSGA 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/S3
CO2	Report aggregated data from single and multiple databases using SQL.	K3/S3
CO3	Employ database using Oracle.	K3/S3
CO4	Articulate Oracle database architecture with manageable schema objects.	K3/S3
CO5	Manage data movement, backup, security with database.	K3/S3
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	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.

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS263	IIS WEB SERVER TECHNOLOGIES	2	0	2	3

A. Preamble

The objective of this course is to provide basic concepts about IIS and its administration to create the interactive client-server integrated design of web applications. This course also teaches the enhanced security features using client certificate mapping, IP security, Request filtering and URL authorization. This course offers Microsoft's own cloud for logging and troubleshooting web applications using integrated services. Finally, the creation of an application server and SSL Certificate in Microsoft's IIS will be discussed.

B. Pre-requisite course

10211CS103 Operating Systems
10211CS105 Computer Networks

C. Course Objectives:

Learners are exposed to:

- Enable and configure IIS web server application
- Create web server and client, migration, authentication with advance controls
- Install and Manage SSL Certificate for Secure the Application server
- Monitor and optimize the performance of IIS server and client console
- Troubleshoot IIS console environment using Microsoft's Log

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 IIS Manager in Windows platform and also create client console using commands	K3/S3
CO2	Build an interactive client-server environment to fetch the active web page migration using Web Site Deployment console application.	K3/S3
CO3	Create, manage and configure SSL Certificate in IIS web server application to secure client server communication using ASP.NET Web page handler.	K3/S3
CO4	Make use of monitoring connection, components and respective action for optimizing the IIS web server application.	K3/S3
CO5	Apply Amazon Elastic Compute Cloud (Amazon EC2) to run application programs in AWS public cloud and Troubleshoot Amazon EC2 resources using Troubleshooting Console Environment	K3/S3
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	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO3
CO1		2	3	2	3	1							3	
CO2		2	3	2	3	1							3	2
CO3		2	3	2	3	3							3	2
CO4		2	3	2	3	3							2	2
CO5		2	1	2	3	1							2	2

High- 3; Medium-2; Low-1

Course Contents

UNIT 1 IIS Introduction and Administration 6 Hours

Introduction to IIS: IIS overview - IIS Architecture - System Management Overview. **IIS Administration:** System Management Overview - Installation and Configuration - Application Deployment - Security Management - Monitoring and Performance - SSL Configuration - Log rotation - Backup and Restoration - IIS vulnerability fixes

UNIT 2 Website Creation, Migration and Authentication with Advance Controls 6 Hours

Creating website & Migration: Process of creating first website - Binding Explanation - Website migration.**Application Pools:** Application pool identities - General - Advanced Settings – CPU Advanced Settings - process model - process orphaning - recycling - Default application pool settings. **Authentication:** Introduction about authentication in IIS - Anonymous authentication - Anonymous with Impersonation - Basic and digest authentication - Windows authentication - Forms authentication.

UNIT 3 IIS Extensions and Certificate Management 6 Hours

Microsoft IIS Extensions & Certificates: HTTPS Overview - HTTP/2 Overview - Features of HTTP/2 - Installing SSL Certificate - Backup - Restore SSL certificates - SSL certificate types - Trusting the self-signed certificate - SSL certificate authentication.

Certificate Management: CSR generation - Certificate installation - Certificate renewal process.

UNIT 4 IIS Monitoring, Optimization and Operations 6 Hours

IIS Monitoring: Worker Processes monitoring - Request failed tracing - Advanced logging module - Performance monitoring tool. **IIS Performance Optimization:** Configure Logging –

Disable Debugging - Threads per processor - Queue length - Application pool settings - Output cache - IIS Server Services - Restarting IIS Services.

Standard Operations Procedures: IIS services Start and Stop - Log Management.

UNIT 5 IIS Troubleshooting Console Environment 6 Hours

Troubleshooting:Known issues and solutions: Known errors and associated solutions while working as IIS admin - Troubleshooting different types of errors in IIS management console.

Total: 30 Hours

Use Case1 : Websites Hosting

Hosting websites on-premises or in the cloud, Microsoft IIS is the best choice for deploying websites using Microsoft technology such as ASP.NET pages. The websites interact with the customers requirements, such as access control, timesheet, and so on; this helps to automatically create and configure a website is a differential of the solution. This will be used to satisfy the untrained end user to install and configure a web application. However, Microsoft IIS has great features for advanced users, allowing for example, to host several sites on the same server and segregate them for internal publication such as on an intranet, as well as for external publication on the Internet.

Tools: IIS WEb server and AWS Console

Use Case 2 :Business web application hosting

To build a business web application to support operations which are hosted on Windows servers using IIS. The utilisation of IIS is probably considered fairly basic with it running HTTP based HTML websites using winforms and re-write rules. IIS is being used as a centralized web farm management tool for Business web application hosting. IIS will deploy and manage web sites and applications across large farms of web servers from a centralized location. Microsoft IIS makes it easy to centrally deploy and manage the configuration and content across a bunch of different web servers.also iis is used to manage several internal monitoring websites that keep a track a of different threads.

It allows us to host a variety of these websites across the business to manage different applications within the service. The business problem is addresses is that it allows us to easily host and change these monitoring websites to suit our business needs. Because Installation, usage, configuration is easy, without any lack of functionality

Tools :HTML and IIS internet web application server

Use Case 3 :Server- client deliverables hosting communication

In small projects, Microsoft IIS acts as the client deliverables. also Server- client deliverables projects require IIS to implement for overall project hosting and delivery. Because Microsoft IIS

is very easy to enable and uninstall, and its GUI is very informative. The Microsoft internet web server facilitates implementation of AWS cloud seamless. It is very useful due to its simplicity for small projects which primarily require Cloud requirements in AWS..

Tool : Microsoft IIS on Window Server 2012 R2 and AWS

LAB EXPERIMENTS **Total: 30 Hours**

TASK 1: Enable the IIS in Windows platform, create the Server 2012 (GUI and Core Edition) and Enable the Web Server.

TASK 2:

a) Create and verify the default IIS using command and Managing and Configuring the IIS Web Server.

b) Deploy the IIS Web Server Application using command and manage the security.

TASK 3: Implement how to backup and restore the SSL Certificate.

TASK 4:

a) Create a website using IIS and make forms authentication.
b) Migrate website from one IIS to another IIS

TASK 5: Configuring the advanced setting in CPU process model and process orphaning.

TASK 6: Configuring the application pool for a site or application using IIS.

TASK 7: SSL certificate creation with implementing authentication.

TASK 8: Implement CSR Certificate generation and renewal process.

TASK 9: IIS services start and stop along with log management.

TASK 10: Workers process monitoring based on advanced logging modules by using monitoring tools.

TASK 11: Tune the value of Thread Per Processor Limit and make sure you are disabling the IIS Web Server.

TASK 12: Troubleshooting different types of errors in IIS management console.

Total: Theory + Lab= 60 Hours

H. Learning Resources

i.Text Books:

1. Mike Volodarsky, ,Olga Londer“ ,Brett HillInternet Information Services (IIS) 7.0 Resource Kit”, 2008. [Unit 1 - 5]

ii.Reference Books:

1. Anwarul Haque , “Mastering Microsoft IIS Paperback”, 2018. [All Units]

iii.Online Resources:

1. “IIS Overview and Guide Material”, Accessed on: May. 6, 2021 [Online], Available: https://learn.microsoft.com/en-us/iis/

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS264	APPLICATION SERVER TECHNOLOGIES	2	0	2	3

A. Preamble

The objective of this course is to provide basic concepts about Apache Tomcat Server and its administration to create the interactive client-server integrated design of web applications. This course also teaches the enhanced security features using SSL certificate management mapping, security, JDBC Connectivity, Authentication and authorization. This course offers to implement the concepts of Jmeter application, certificate generation, log management of overall Apache Tomcat Administration will be discussed.

B. Pre-requisite course

10211CS212 - Web and Mobile Application Development

C. Course Objectives:

Learners are exposed to:

- Enable and configure the concept of HTML and JSP for Apache Web application.
- Configure the war file to deploy web applications.
- Use of JDBC connectivity to perform backend database connectivity for an Application Server.
- Monitor the security operations over Apache tomcat server and also control overall administration process flow.
- Troubleshoot and implement the various mechanism over jmeter application, logs and service packs.

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 structure of web application using HTML and JSP.	K3/S3
CO2	Build and configure war file to deploy web application.	K3/S3
CO3	Make use of JDBC connectivity to connect with Apache Tomcat Server.	K3/S3
CO4	Apply Java security concepts to perform authentication & authorization in a web application.	K3/S3
CO5	Implement the concepts like Jmeter application for testing, Certificate Generation, log management and service packs for developing the web application.	K3/S3
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	PS O1	PS O2	PS O3
CO1		2	3		3	1							3	
CO2		3	3		2	1							3	
CO3		3	2		3	2							2	2
CO4		3	3		3	2							3	3
CO5		3	3		3	2							3	3

High- 3; Medium-2; Low-1

F. Course Contents

UNIT 1 Apache Tomcat Installation and Directories L- 6 Hours

Apache Tomcat Overview: Apache Software Foundation Introduction-Apache Tomcat licensing. **Installing Apache Tomcat:** Download and install a JVM. **Apache Tomcat Directories:** Apache Tomcat Directory Structure, Common and shared Directories-The bin, The conf, logs. Server, work, temp, webapps Directory- **Structure of the Web Application**: Directory Structure-Deploying HTML and JSP Pages and Web Context-JSP Code-Deploying a Web App.

UNIT 2 Apache Tomcat Configuration, Management and Advanced Features 6 Hours

Configuring Apache Tomcat: Configuration of Apache Tomcat and Techniques-conf/web.xml file-Component Architecture-Server.xml File-Modifying server.xml. **Apache Tomcat Manager:** Deploying and Managing Web Application using the Apache Tomcat Manager-Starting and looking at Apache Tomcat Manager-Applications, Deploy, Server Information-Creating and Deploying a WAR File-Java Management Extensions (JMX) on Apache Tomcat-Apache Tomcat integration with Ant.

UNIT 3 JDBC Connectivity and Connecting Tomcat to Apache L-6 Hours

JDBC Connectivity: Overview of JDBC - JDBC Drivers - Connecting Database and Connection Pools-Defining a Data Source in Tomcat and Defining a Data Source Manually Modifying the Deployment Descriptor-Detecting and closing leaked database connections. **Connecting Tomcat to Apache:** HTTP Connectors- Web Server Advantages - Connector Protocols-Start Tomcat- Worker-Load balancing applications creation across multiple Tomcat Instances - Issues-Server affinity via sticky sessions-Shared session storage-Replicated sessions via Tomcat Clustering-Shared Hosting.

UNIT 4 Apache-Tomcat Security and Apache-Tomcat Administration L-6 Hours

Apache Tomcat Security: Configuration-Security Considerations-File System Security and Filesystem Recommendations-Java Security Manager-Granting Permissions to Java Apps-Java Permissions-Security Manager Tips and Security Realms- Different Types of Realms and Configuring a Realm-Users and Roles - authentication and authorization. **Apache-Tomcat Administration:** System Management Overview-Installation and Configuration - Application Deployment-Security Management-Monitoring and Performance-SSL Configuration- Log Rotation-Security Management-Perform failover procedures

UNIT 5 Load Testing and Certificate Management L-6 Hours

JMeter Application- Load Testing with JMeter- JMeter Installation- Add Report Listener-Run the Test Plan-Viewing the Results. **Certificate Management:** CSR generation-Certificate installation - Certificate renewal process.**Standard Operations Procedures:** Apache-Tomcat services Start and Stop-Log Management. **Applying service packs:** A brief overview of Patch process - installation of fix packs-Rollback of fix packs-Perform Apache-Tomcat upgrades/migrations.

Total: 30 Hours

G.LAB EXPERIMENTS Total: 30 Hours

TASK 1:

- Create a web application with web.xml configuration file
- Mapping a Servlet to a URL using web-app, resource-ref, env-entry, ejb-ref elements

TASK 2: Deploy a web application using the Apache Tomcat Manager:

- Use the Apache Tomcat Manager web application to deploy a web application.
- Access the Apache Tomcat Manager at http://localhost:8080/manager/html and enter your Apache Tomcat login credentials.
- Upload the WAR file or directory containing the web application files and deploy it using the Apache Tomcat Manager interface.
- Verify that the application is running by accessing it at the URL http://localhost:8080/<app-name>, where <app-name> is the name of your web application

TASK 3: Deploy a WAR file:

- Create a web application as a WAR (Web Application Archive) file and deploy it in Tomcat. Copy the WAR file to the webapps directory in the Apache Tomcat installation directory.
- Apache Tomcat will automatically extract the WAR file and deploy the web application.
- Verify that the application is running by accessing it at the URL

http://localhost:8080/<app-name>, where <app-name> is the name of your web application.

TASK 4: Develop a simple web server with Jakarta Project

TASK 5: Installation of MySQL and Configuration of Apache Tomcat to Connect to a Database and Deploy a JDBC Driver

TASK 6: Configuration of JNDI Resources and JavaMail Session and understand the working of environment and resource elements.

TASK 7: Configuration of an AJP Connector:

- Create the mod_jk.conf file
- Configure httpd.conf
- Enable virtual hosting as a standalone server using jk2 or webapp and create separate JVM for each host.

TASK 8: Create and Add Own Policies, enable the Java Security Manager and Create a Data Source Realm with the protection of passwords and FORM-based authentication

TASK 9: Configuration of Apache Tomcat for SSLin applications

TASK 10: Perform Backup, Restoration, disaster recovery and Apache-Tomcat vulnerability fixes

TASK 11: Create a Thread Group:

- Open JMeter
- Create a new Test Plan.
- Add a Thread Group to the Test Plan, and configure the Thread Group with the number of threads, ramp-up period, and loop count that you want to use for your load test.

TASK 12: Create and run the test plan by configuring the Thread group and HTTP Request and view the results

TASK 13: Identification of Known errors and associated solutions while working as Apache-Tomcat admin and troubleshoot different types of error codes for Apache-Tomcat issues.

TASK 14: Troubleshoot Apache Tomcat with unknown website authentication.

TASK 15: Database connection troubleshooting with Apache Tomcat.

Part 2:

Use Case1 : Websites Hosting

Hosting websites on-premises or in the cloud, Microsoft IIS is the best choice for deploying websites using Microsoft technology such as ASP.NET pages. The websites interact with the customers requirements, such as access control, timesheet, and so on; this helps to automatically create and configure a website is a differential of the solution. This will be used to satisfy the untrained end user to install and configure a web application. However, Microsoft IIS has great features for advanced users, allowing for example, to host several sites on the same server and segregate them for internal publication such as on an intranet, as well as for external publication on the Internet.

Tools: Apache Tomcat Webserver

Use Case 2 : Business web application hosting

To build a business web application to support operations which are hosted on Windows servers using IIS. The utilisation of IIS is probably considered fairly basic with it running HTTP based HTML websites using winforms and re-write rules. IIS is being used as a centralized web farm management tool for Business web application hosting. IIS will deploy and manage web sites and applications across large farms of web servers from a centralized location. Microsoft IIS makes it easy to centrally deploy and manage the configuration and content across a bunch of different web servers.alsoiis is used to manage several internal monitoring websites that keep a track a of different threads.

It allows us to host a variety of these websites across the business to manage different applications within the service. The business problem is addresses is that it allows us to easily host and change these monitoring websites to suit our business needs. Because Installation, usage, configuration is easy, without any lack of functionality

Tools : Apache Tomcat Web Server, HTML

Use Case 3 : Server- client deliverables hosting communication

In small projects, Microsoft IIS acts as the client deliverables. also Server- client deliverables projects require IIS to implement for overall project hosting and delivery. Because Microsoft IIS is very easy to enable and uninstall, and its GUI is very informative. The Microsoft internet web server facilitates implementation of AWS cloud seamless. It is very useful due to its simplicity for small projects which primarily require Cloud requirements in AWS..

Tool : Apache Tomcat Web Server,

Total: Theory+Lab= 60 Hours

H. Learning Resources

i.Text Books:

1.Aleksa Vukotic, James Goodwill,[5 -it 1 Un] .2011 ,"7Apache Tomcat "

ii.Reference Books:

1.Tanuj Khare, "Apache Tomcat 7 Essentials", 2012. [All Units]

iii.Online Resources:

1. "Apache Tomcat®", Accessed on: Nov. 18, 2023 [Online], Available: https://tomcat.apache.org/download-10.cgi /
2. "Apache Tomcat Server from Beginners to Advanced", Accessed on: Nov. 20, 2023 [Online], Available: https://www.udemy.com/course/apache-tomcat-for-beginners-and-advanced/

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS268	DATA BASE ADMINISTRATION USING MS SQL SERVER	2	0	2	3

A. Preamble

This course trains the student to control and regain the databases in System Architecture. It encompasses how to administrate, mitigate, monitor, control risk in database administration, configure in the cloud, migrate from one to another, etc. It adds to the existing capability of programming practice.

B. Prerequisite Courses

10211CS207- Database Management Systems

C. Course Objectives

Learners are exposed to

- overview of database systems and explains how to install SQL Server 2019 and its components.
- "Transact-SQL Language," which is intended for end users and application programmers of the Database Engine.
- all objectives of Database Engine system administration.

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Planning the installation of the SQL server and explaining using front-end tools for database engines.	K3/S3
CO2	Using the MSSQL objects, database objects, and Transact-SQL (T-SQL).	K3/S3
CO3	Managing Database Security and concurrency control.	K3/S3
CO4	Administrating SQL Server.	K3/S3
CO5	Performing Backup and Recovery techniques, automating system administration.	K3/S3
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	PSO3
CO1	3				3								3	
CO2	3	3	3		3								3	3
CO3	3	3	3		3								3	
CO4	3				3								3	3
CO5	3	2	3		3								3	

High- 3; Medium-2; Low-1

F. Course Contents

Unit 1 RDBMS Overview and Installation 4 Hours

Relational Database Systems- Introduction- data base design- normal forms- ER model- Syntax conversions- SQL server edition and management tools-Planning installation and installation of SQ server on Windows or Ubuntu- Front-End Tools for Data Base(DB) Engine- SQL Server Management Studio(SSMS)- using SSMS with the DB Engine-Authoring activities using SSMS. (chapters-1,2,3)

Unit 2 MSSQL Objects and T-SQL 8 Hours

SQL components- Basic Objects- Data Types- Transact-SQL(T-SQL) Functions- NULL values- Database Objects: Create, Modify, Remove- Queries- Select statement with its clauses and functions- sub-queries- join operator- correlated subqueries- table expressions- Modification of table contents (DML):-insert, Update, Delete, other T-SQL modification statements and clauses- Stored procedures- user-defined functions- system catalog- general interfaces- Proprietary Interfaces- Indices- types- T-SQL and Indices- Guidelines for creating and using Indices. (chapters-4,5,6,7,8,9,10)

Unit 3 Microsoft SQL Security and SQL Server database 6 Hours

Views- DDL Statements and views- DML Statements and Views- Security System of DB Engine- Encrypting data- Authentication- Schemas-Data Base Security- Managing DB Security using SSMS- Managing DB Security using T-SQL statements- Roles-Authorization- Change Tracking- Concurrency control-Transaction logs- editing- locking-isolation levels. Triggers- Create, modify, delete- application areas of DML: Triggers- After- instead of- Application areas of DDL Triggers- DB Level triggers- Server-Level Triggers. (Chapters: 10,11,12,13,14)

Unit 4 SQL Server: System Administration 6 Hours

System Databases- Master DB, Model DB, TempDB, MSDB- Disk storage- Data Pages- Properties, types- Editing information of storage- Parallel Processing- Utilities- BCP, SQLCMD, MSSQL-CLI, SQLSERVR- DBCC Commands- Policy-based Management. (Chapter-15)

Unit 5 Backup, Recovery, and System Availability 6 Hours

Reasons for Data Loss, Backup Methods- Full Database, Differential, Transaction Log, File or File Group- Performing Database Backup- Backing Up using T-SQL statements, Backing Upusing SSMS, Determining which databases to Backup- performing Database Recovery- Automatic, Manual- Recovery models- System Availability- using a stand by server, using RAID Technology, Database Mirroring, Failover Clustering, Log Shipping, AlwaysOn- Comparison of High-Availability Components- Automating System Administration Tasks- Starting SQL server Agent- Creating Jobs and operators- Alerts. (Chapters-16, and 17)

Total: 30 Hours

Laboratory Tasks: (Tool: MS SQL Server2019, SSMS 2019) **30 hours**

Task-01: Planning and installation of MS SQL server CO1, S3

Task-02: Planning and installation of SQL Server Management Studio CO1, S3

Task-03: DDL Operations on SQL databases. CO2, S3

Task-04: Writing DML queries for single-row functions on SQL databases. CO2, S3

Task-05: Writing advanced queries for multi-row functions, sub-querying. CO2, S3

Taks-06: Writing T-SQL queries using modification clauses. CO2, S3

Task-07: Program a stored procedure or function on business scenarios. CO2, S3

Task-08: Using catalog views, perform find-outs for the following. CO2, S3

a. Finding OS path and filename of the sample database
b. Finding integrity constraints that are defined on a table

Task-09: Implement DB Security on the Database using TDE and AE methods and perform managing security using SSMS. CO3, S3

Task-10: Implement DB Security on the Database using TDE and AE methods and perform managing security using T-SQL Statements. CO3, S3

Task-11: Outperform the large data in SQL server using indices, storage, DMF. CO4,S3

Task-12: Generate a policy that disables the use of CLR. CO4, S3

Task-13: Implement Backup methods on the databases and find outs for the below CO5,S3

a. Using TSQL statements
b. Using SSMS

Task-14: Implement Automation System Administering tasks. CO5, S3

G. Learning Resources (in IEEE Format)

i. Text Books:

1. Dusan Petkovic, " Microsoft SQL Server 2019- ABeginner's Guide", 7th edition, Mc Graw Hill, 2020.

ii. Reference Books:

1. Kellyn Gorman et al, " Introducing Microsoft SQL server 2019", First Edition, Packt Publishing Ltd, 2019.

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS270	INTRODUCTION TO SYSTEM PROGRAMMING, z/OS COMMANDS AND PANEL ON IBM Z	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

10212CS103-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/S3**
CO2	Demonstrate z/OS Commands and Panels on IBM Z.	**K2/S3**
CO3	Describe the responsibilities of JES and JCL.	**K2/S3**
CO4	ExplainSystem Programming Components.	**K2/S3**
CO5	Explain the z/OSMF and UNIX System Services.	**K2/S3**
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	PSO1	PSO2	PSO3
CO1					3								3	
CO2	2	3	3	3	3								3	3
CO3	2	3	3	3	3								3	
CO4				3	3								3	3
CO5		2	3	3	3								3	3

High- 3; Medium-2; Low-1

F. Course Contents

Unit 1 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 2 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 3 Introduction toJESand 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 4 System Programming Components **L-6Hours**

VSAM - zOS Components - zOS System Libraries - Application Infrastructure - Language Environment - Generation data groups – RAIM - IBM DB2 12 for z/OS – Networking Utilities

Unit 5 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. Lab Experiments: **Total: 30 Hours**

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

G. Learning Resources

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

COURSECODE	COURSETITLE	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	CourseOutcomes	K-Level
CO1	Comprehend the fundamentals and rise of deep learning	**K2/S3**
CO2	Apply knowledge of large language models in various NLP tasks	**K3/S3**
CO3	Develop and utilize prompt engineering techniques	**K3/S3**
CO4	Implement Langchain architecture for generative AI applications.	**K3/S3**
CO5	Apply diffusion models to progressively refine noise into high-quality images and videos	**K3/S3**
KnowledgeLevel(BasedonrevisedBloom'sTaxonomy) K1-Remember K2-UnderstandK3-ApplyK4-AnalyzeK5-EvaluateK6-Create		

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

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	3		2	1							3		1
CO2	3	3	3	2	2							3	2	2
CO3	1	2	3	2	3							1	2	2
CO4	1	2	2	2	3							1	1	2
CO5	3	3	2	2	3							3		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

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 cangenerate 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
10212CS278	Quantum Machine Learning	3	0	2	4

A. Preamble

Quantum computing represents a paradigm shift in computational science, offering unprecedented capabilities to solve problems intractable for classical computers. This course is designed to equip students with the foundational knowledge, technical skills, and critical thinking required to engage with this transformative field. As quantum technologies rapidly advance from theoretical breakthroughs to real-world applications in cryptography, optimization, and machine learning this course bridges theory and practice, preparing learners to contribute to academia, industry, and innovation.

B. Prerequisite Courses

- 10210MA101- Linear Algebra for Computing
- 10210MA103- Probability, Statistics and Queuing theory

C. Course Objectives

Learners are exposed to:

- Equip students with mathematical foundations for quantum computing.
- Introduce quantum gates, circuits, and logic operations.
- Explore fundamental and advanced quantum algorithms.
- Examine quantum machine learning techniques and applications.
- Provide hands-on experience with quantum programming frameworks (e.g., Qiskit, Cirq).

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level / S - Level
CO1	Apply core mathematical tools (Dirac notation, linear algebra) to solve quantum state evolution and measurement problems.	K3/S3
CO2	Implementing advanced mathematical frameworks (tensor products, group theory) to model and analyze multi-qubit quantum systems.	K3/S3
CO3	Design and implement quantum circuits using fundamental gates to achieve specific computational or error-correction tasks.	K3/S3
CO4	Execute basic and advanced quantum algorithms (e.g., Shor's, Grover's) to demonstrate computational advantages over classical approaches.	K3/S3
CO5	Deploy quantum machine learning algorithms (e.g., QSVM, QAOA) to optimize real-world classification or optimization problems.	K3/S3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create S1-Imitate, S2-Perform, S3-Precision, S4-Articulation, and S5-Naturalization		

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

Cos	PO1	PO 2	PO3	PO 4	PO5	PO 6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
CO1	3	2	2	2	2	2					2	3	2	2

CO2	3	3	2	2	2						2	3	3	2
CO3	2	2	3	2	3						2	3	2	3
CO4	2	3	3	3	3	2					2	3	3	3
CO5		2	3	2	3	3	2				2	3	2	3

1-Low,2-Medium,3- High

F. Course Content

UNIT I Mathematical Foundations of Quantum Computing L-9 Hours

Introduction - Linear Algebra: Vector spaces - Inner products - Matrices - Eigenvalues and eigenvectors - Complex Numbers and Probability - Complex Hilbert spaces - Born rule - quantum measurement - Dirac Notation: Bras, kets and operator representations - Qubit States: Superposition - entanglement - Bloch sphere representation - Postulates of Quantum Mechanics: State vectors - Time evolution - Composite systems.

UNIT II Advanced Mathematical Foundations L- 9 Hours

Hilbert Spaces: Infinite-dimensional spaces - Orthonormal bases - Tensor Products: Multi-qubit systems - Matrix product states - Partial trace and entanglement - Group Theory in QC: Pauli matrices - SU(2) group and symmetry in quantum systems - Quantum Entropy: Von Neumann entropy - Quantum information theory.

UNIT III Quantum Gates and Logics L-9 Hours

Single-Qubit Gates: Pauli-X/Y/Z, Hadamard - Phase and T gates - Multi-Qubit Gates: CNOT, SWAP, Toffoli, and controlled-phase gates - Quantum Circuits: Circuit diagrams, universality of gate sets - Quantum Error Correction: Shor code, surface codes, stabilizer formalism - Quantum Logic: Reversible computing, quantum parallelism.

UNITIV Quantum Algorithms L- 9 Hours

Basic Algorithms: Deutsch-Jozsa - Bernstein-Vazirani - Simon's algorithm - Quantum Fourier Transform (QFT): Phase estimation - Period finding - Advanced Algorithms: Shor's (factoring) - Grover's (search) - HHL (linear systems) - Quantum Simulation: Variational Quantum Eigensolver (VQE) - Quantum chemistry applications - Quantum Supremacy: NISQ devices -Random circuit sampling - Quantum Walk algorithm.

UNIT V Quantum Machine Learning Algorithms L- 9 Hours

Basic QML: Quantum Support Vector Machines (QSVM) - Quantum PCA - Advanced QML: Quantum Neural Networks (QNN) - Quantum Boltzmann Machines - Hybrid Algorithms: Quantum Approximate Optimization Algorithm (QAOA) - Quantum Generative Adversarial Networks (QGANs) – Quantum Reinforcement learning - Applications: Drug discovery - Financial modeling and Optimization - Challenges: Noise - Scalability and hybrid classical - Quantum workflows.

Total: 45 Hours

G. Laboratory Experiments Total: 30 Hours

Part - 1

TASK 1 Apply Born rule to calculate measurement probabilities for superposition states.
Tools: Python, NumPy, Matplotlib.

TASK 2	Construct Pauli-X/Y/Z matrices and apply them to qubit states. Compute eigenvalues/eigenvectors of quantum operators. **Tools**: NumPy, SymPy.
TASK 3	Build entangled states (Bell states) using tensor products. Measure entanglement entropy for bipartite systems. **Tools**: IBM Qiskit, NumPy.
TASK4	Verify commutation/anti-commutation relations of Pauli matrices. Decompose single-qubit gates into Euler angles. **Tools**: SymPy, Cirq.
TASK5	Implement a CNOT gate circuit. Simulate quantum teleportation using Qiskit. **Tools**: IBM Qiskit.
TASK6	Encode a logical qubit into 9 physical qubits. Simulate noise and recovery using Qiskit's noise models. **Tools**: Qiskit Aer (noise simulation).
TASK7	Code the algorithm for a 2-qubit oracle. **Tools**: PennyLane, IBM Qiskit.
TASK8	Implement Grover's algorithm for a 3-qubit database. **Tools**: Cirq, Matplotlib.
TASK9	Implement a QSVM on the Iris dataset using PennyLane. **Tools**: PennyLane, scikit-learn.
TASK10	Implement the QAOA algorithm to solve the Max-Cut problem using a hybrid quantum-classical approach. **Tools**: Qiskit Optimization, PyTorch.

Part - 2

Use Cases:

Use case 1: Accelerating Drug Discovery and Molecular Modeling
Use case 2: Climate Modeling
Use case 3: Quantum-Enhanced Machine learning models
Use case 4: Portfolio Optimization in Finance
Use case 5: Quantum Generative models for data synthesis

Total: 75 Hours

H. Learning Resources

i. Textbooks

1. Eleanor G. Rieffel & Wolfgang H. Polak, "Quantum Computing: A Gentle Introduction", Second Edition, MIT Press, 2020.
2. Michael A. Nielsen & Isaac L. Chuang, "Introduction to Quantum Mechanics", Cambridge University Press, 2010.
3. Chris Bernhardt, "Quantum Computing for Everyone", MIT Press, First Edition, 2019.
4. N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.

ii. Reference Books

1. Maria Schuld & Francesco Petruccione, "Quantum Machine Learning: Foundations and Applications", Springer, 2024.

2. Hassi Norlén, “Quantum Computing in Practice with Qiskit and IBM Quantum Experience”, Second Edition, Packt Publishing, 2020.

iii. Web Resources

1. IBM Quantum Experience - [Online] Available: https://quantum.ibm.com/
2. Google Quantum AI - [Online] Available: https://quantumai.google/
3. Microsoft Quantum Development Kit (QDK) - [Online] Available: https://learn.microsoft.com/en-us/azure/quantum/
4. Quantum Katas - [Online] Available: https://github.com/microsoft/QuantumKatas

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS279	Application Development And Maintenance	3	0	2	4

(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

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	2						3			
CO2	3	3	3	3	2						3			
CO3	3	3	3	3	2						3			
CO4	3	3	3	3	2						2			
CO5	3	3	3	3	2						2			

3 - High; 2 - Medium; 1 - Low

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.Laboratory Experiments — Total: 30 Hours

Part – 1

Task 1: Working with Unix OS Commands.
[**OS:** UNIX, LINUX, **IDE:** Terminal]

Task2. Develop a Simple Java application with class (Object), Methods and Packages.
[**Package:** java.io, java.util, **IDE:** Eclipse]

Task 3: Inheritance & Interfaces

- Demonstrate Method overloading, constructor and Method Overriding.
- Develop a code for user-defined interface and pre-defined interface concept
  [**Package:** java.io, java.util, **IDE:** Eclipse]

Task 4: Exception Handling Mechanism in Java

- Construct a program to handle user defined and predefined exceptions
- Design the code with performing Checked and Unchecked Exceptions
  [**Package:** java.io, java.lang, **IDE:** Eclipse]

Task 5: Conceptual Design after FTR
Using basic database design methodology and ER modeler, design Entity Relationship Diagram by satisfying the following sub tasks:

- Identifying the entities.
- Identifying the attributes.
- Identification of relationships, cardinality, type of relationship.
- Reframing the relations with keys and constraints.

[**Database:** MySQL]

Task6: Generating design of another traditional database model
Creating Hierarchical /Network model of the database by enhancing the sound abstract data by performing following tasks using forms of inheritance:

- Identify the specificity of each relationship, find, and form surplus relations.
- Check is-a hierarchy/ has-a hierarchy and performs generalization and/or specialization relationship.
- Find the domain of the attribute and perform a check constraint to the applicable.
- Rename the relations.
- Perform SQL Relations using DDL, DML, DCL commands
  [**Database:** MySQL]

Task7. Construct a dynamic webpage using JavaScript.
[IDE: Visual Studio**]**

Task8. Manipulating the DOM with javascript
[IDE: Visual Studio**]**

Task 9: UI/UX Design

- Design a UI for the home page using figma tool.
  [Tool: figma**]**

Task 10: AWS Cloud Practitioner
Deployment and Management
a) Choose a sample web application.
b) Deploy the application on an EC2 instance.
c) Outline the steps taken and any challenges faced during deployment.
[Services: AWS Cloud**]**

Part– 2 Use cases:

Use case-1: Develop Online learning platform
An educational technology company is planning to develop an online learning platform to offer programming courses to students. The platform aims to provide a seamless learning experience.
Technologies Used: JavaScript, UI/UX principle, Generative AI, AWS Cloud services.

Use case-2: Tracking the student marks statement:
In the college, every month the assessment test will be scheduled and results will be updated in the portal. Create the web page with username and password of each student and with admin controls. The student can track the test marks by applying their login credentials in the server page and get the exact marks, when the test is attended and when the marks are updated in the portal and result status. Demonstrate the web page with frontend and backend control to track the mark statements and design the interface to make it user friendly.
Technologies Used: JavaScript, UI/UX principle, Generative AI, AWS Cloud services.

Total: 75 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

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS280	Low-Code Development	1	0	2	2

A.Preamble

This course is designed to develop skills to design and analyze the latest low-code development using mendix platform and allow them to experiment and build a working solution. This enables them to build a project prototype to showcase their skills and add to their work portfolio.

B.Prerequisite Courses

10210CS101 - Problem Solving using C

C.Course Objectives

Students undergoing this course are expected to

- Develop skills in selecting the appropriate data mining algorithm for solving practical problems and identify an organizations information processing requirement
- Understand the standard development life cycle (SDLC) and use Agile methods to develop an information system that meets the business needs
- Develop database structures ,UML diagrams with workflow processes and business needs
- Build the user interfaces ,experiences and implement simple security with user role access

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 role of Mendix low code development and application life cycle management	K2
CO2	Build the domain model and creation of object entities and understating of elements in the microflow	K3
CO3	Develop the process automation model and association based data retrieval.	K3
CO4	Apply regular expression in the micro flow model and merging multiple flows for data validation and consistency	K3
CO5	Identify the security settings for user, data, microflows, entity access in all the levels	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	PO3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PS O1	PS O2	PSO 3
CO1		2	2		3								2	
CO2		2	2		3								2	
CO3		2	2		3								2	
CO4		2	2		3								2	
CO5		2	2		3								2	

3- High; 2-Medium; 1-Low

E. Course Content

UNIT 2 Data entity and Microflows **L-3 Hours**

Dynamic data, Entities and attributes-Attribute types, entities ,Objects and object creation. The Domain Model-Steps to add entities to domain model, Associations in the Domain model. Microflows- Need for a microflow, Elements of a microflow, Mendix Assist Logic Bot. Studio Mendix studio pro-Exploring mendix Studio Pro, The Team Server, Information Entity, Nested data.

UNIT 3 Process Automation and Retrieval **L-3 Hours**

Automation of Process flow, Triggering a Microflow from an Input Widget, Microflow Expressions, Microflows scope, Retrieving data, Association based data retrieval, analyze error, decisions in microflow , Stored vs Calculated Attributes, Object event handlers

UNIT 4 Data validation and consistency **L-3 Hours**

Checking Data validation and consistency of data ,validation Rules and types, Regular Expressions, Validation in Microflow, Merge Multiple Flows, Deleting Objects- Cascading Delete

UNIT 5 Data Security and Mobile app development **L-3 Hours**

Data Security and level, User and Module Roles, Access rules-page, Microflow access, Entity access, Mobile apps, PWA and its properties, Nanoflows -The nanoflow commons module, Sharing information via mobile social channels-update security and Publishing the project

Total : 15 Hours

E. Laboratory Experiments

Total : 30 Hours

Part - 1

TASK 1	Development of Project Life Cycle and Wireframe
TASK 2	Project Initiation, Project planning, Project Management, Teams Developed Development Methodologies(Waterfall & Agile)
TASK 3	Analyzing business needs & Requirements gathering
TASK 4	Creation of User Stories and importing into mendix studio
TASK 5	Design Thinking-Design, Develop Wireframes and project brainstorming to start the creation process
TASK 6	Data Modeling-Develop Entity Relationship Diagrams(ERDs) and build back end database using low- code
TASK 7	Development of User Interface Design for sprints
TASK 8	Advanced User interface and Design with Business Logic and Flows -Develop Business logic and flow of information with security and permission
TASK 9	Designing and Refining i) System Design & System Design Variations Implementation ii) Transition to the new system iii) Object Oriented Analysis & Design iv) Managing Systems Implementation
TASK 10	Project Presentation

Total : 45 Hours

Part-2

Use cases:

- Learning App Development
- Travel Management Application
- Health Care Management System
- Hospital Management System
- Upi Application
- Contacts Application
- Online Supermarket Application

Stories for Use Case: LEARNING APP DEVELOPMENT

Problem Statement

Jimmy is the director of the LearnNow company, which offers various trainings. He uses Excel to manage the training courses that the company offers. As the company is growing, it's becoming more and more difficult to keep a clear overview of all the courses.

The Solution

Jimmy has decided to use an app to keep track of everything. He wants to be able to easily register new participants, enter new courses into the system, and quickly schedule them in his agenda. The trainers will also benefit from a clear overview of when they have to teach each class.

Learning App Development - Sprints

1. As an administrator, I want to be able to easily access and manage my data, so I can run my company more efficiently. view and manage :- Courses,- Locations,- Teachers,- Trainees
2. Have a homepage that gives access to pages where information can be seen.
3. Connect the buttons to pages that show the information in the system.
4. Create detail pages to add and edit information.
5. Add the pages to the navigation menu.
6. As an administrator, I want to be able to schedule a training event at any time, so that the teachers can see their schedule, even from their phone.
7. Add the Training Event entity to the Domain Model
8. Extend the homepage with a button that goes to a training event overview page.
9. Create an overview page for the training events.
10. Create a detail page to manage the training events.
11. Add the page to the navigation menu.
12. As an administrator, I want to be able to schedule a training event directly from the homepage, so that I spend as little time as possible on this.
13. As an administrator, I want to be able to schedule a training event from the course overview page with the course name already selected, so that I spend as little time as possible on this.
14. As an administrator, I want to be able to add registrations to a training event, so that my teachers know who their students will be.
15. As an administrator, when scheduling a training event I want the end-date of the event to be automatically calculated, preventing me from making calculation errors.
16. Schedule a training event directly from the homepage.
17. Schedule a training event from the Course overview page, with the selected course prefilled.

18. Automatically calculate the end date of a training event, based on the start date and the duration.
19. As a teacher, I want to be able to see the number of trainees attending a training event at any time, so that I know what resources I need.
20. As an administrator, I want my data to be valid and consistent, so my database doesn't become messy.
21. As an administrator, I want to be able to delete training events that don't have registrations, so I can't accidentally delete a training event that people have already paid for to attend.
22. As an administrator, I want to be able to delete Trainees and all their Registrations, so that I can remove them from the system if they no longer wish to be a LearnNow student.
23. As an Administrator, I want the app to be secure, so I comply with the rules of data protection.
24. As a trainee, I want to view upcoming training events including their geolocation, so that I can choose the closest one
25. As an administrator, I would like trainees to be able to share information about training events, in order to promote offerings of the LearnNow app

Total: 45Hours

G. Learning Resources (in IEEE Format)

i. Online Recourses:

1. "Mendix Documents", Accessed on: Apr. 13, 2022 [Online] Available : https://docs.mendix.com/
2. "Studio 9 Guide", Accessed on: Apr. 13, 2022 [Online] Available: https://docs.mendix.com/studio/
3. "Mendix - Developer Portal GuideStudio Pro 9 Guide", Accessed on: Apr. 13, 2022 [Online] Available: https://docs.mendix.com/developerportal/
4. "Studio Pro 9 Guide", Accessed on: Apr. 13, 2022 [Online] Available: https://docs.mendix.com/refguide/

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS281	Industry Internet of Things	3	0	2	4

A. Preamble

This Course covers Intelligent IoT, which enables new business models and digital transformation. Intelligent IOT gives an informed tour to IoT solutions for smart healthcare, one of the most essential uses of IoT focusing on wearable healthcare sensors, body sensors, sophisticated pervasive healthcare systems, and big data analytics designed to help people lead better lifestyles.

B. Prerequisite Course

10211CS130- Fundamentals of Computer Networks

C. Course Objectives

Students are able to

- Introduce the basics of the Internet of Things (IoT).
- Understand sensors, communication, and networking in IoT.
- Explore IoT architecture, models, and tools like Arduino and Raspberry Pi.
- Study real-world IoT applications across various domains.
- Apply AI and IoT in industrial automation and smart systems.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/ S - Level
CO1	Understand general concepts of Internet of Things and Recognize various devices, sensors and applications	K2
CO2	Infer various M2M and IoT architectures	K3
CO3	Compare various design concepts to develop IoT solutions	K3
CO4	Identify Intelligent IoT solutions using sensors, actuators and Devices	K3
CO5	Build Intelligent IOT based applications for Industrial automation and other Sectors.	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	PSO1	PSO 2	PSO 3
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	2
CO4	-	2	2	-	-	-	-	-	-	-	-	-	-	2
CO5	2	3	2	-	-	-	-	-	-	-	-	-	-	2

3- High; 2-Medium; 1-Low

F.Course Contents

UNIT 1 INTRODUCTION TO IOT L -9 Hours

Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs.

UNIT 2 M2M TO IOT L-9 Hours

The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics. Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT. An Architectural Overview–Building architecture, Main design principles and needed capabilities.

UNIT 3 IOT REFERENCE ARCHITECTURE L-9 Hours

An IoT architecture outline, standards considerations. Reference Architecture and Reference Model of IoT, Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment. Constraints affecting design in IoT world- Introduction, Technical design Constraints.

UNIT 4 DOMAIN SPECIFIC APPLICATIONS OF IOT & TOOLS L- 9 Hours

IoT tools - IOT implementation using Python. Introduction to Arduino and Raspberry Pi - Implementation of IoT with Arduino and Raspberry. Home automation, Intelligent Algorithms for IOT, Industry applications, Surveillance applications, Other IoT application - Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Privacy and Security Issues in IoT.

UNIT 5 INDUSTRIAL AUTOMATION USING AI & IOT L- 9 Hours

Road to Industry 4.0: Internet of Things (IoT) and Industrial Internet of Things (IoT) and Internet of Services, smart manufacturing, smart devices and products, smart logistics, smart cities, predictive analytics. Case studies: Moisture and Humidity Control, Weather forecasting. [Edge Computing]

Total: 45 Hours

Laboratory Experiments Total : 30 Hours

Part - 1

TASK 1

Title: Sensor Data Acquisition and Actuation

Description: Implementation of sensor reading (e.g., temperature or light) and actuator control using Arduino or Raspberry Pi.

Language: Python

TASK 2

Title: IoT Networking and MQTT Communication

Description: Implement basic publish-subscribe communication using MQTT protocol between IoT devices.

Language: Python

TASK 3

Title: REST API for IoT Device Communication

Description: Develop a simple RESTful API using Flask to send and receive sensor data.

Language: Python

TASK 4

Title: M2M Communication Simulation

Description: Implement basic serial/I2C communication between two microcontrollers to

demonstrate M2M communication.
Language: Python / Arduino C
TASK 5
Title: Design and Analysis of IoT Architecture
Description: Create and analyze an IoT system architecture for a smart city or health application.
Tool: Lucidchart / Draw.io
TASK 6
Title: IoT Application Development with Raspberry Pi
Description: Implement a real-time IoT application such as home automation or smart surveillance.
Language: Python
TASK 7
Title: Cloud and Fog Computing in IoT
Description: Simulate sensor data upload to cloud and perform basic fog layer processing locally on edge devices.
Language: Python
TASK 8
Title: Data Aggregation and Visualization for Smart Cities
Description: Collect and visualize multi-sensor data using Python plotting libraries (matplotlib/plotly).
Language: Python
TASK 9
Title: IoT Security - Data Encryption
Description: Implement basic encryption (AES/Hashing) on sensor data before transmission.
Language: Python
TASK 10
Title: Industrial Automation with AI + IoT
Description: Implement a predictive maintenance or humidity control use case using sensor input and simple ML model.
Language: Python, Tool: scikit-learn

Part 2

Use cases
Use Case 1: Smart Home Automation

- **Description**: Control lights, fans, and appliances using sensors (temperature, motion) and actuators.
- **IoT Concepts**: Sensing, Actuation, REST APIs, MQTT, Home automation.

Use Case 2: Smart Agriculture (Soil Moisture Monitoring & Irrigation)

- **Description**: Measure soil moisture using a sensor and automatically trigger irrigation using actuators.
- **IoT Concepts**: Sensor network, Data acquisition, Edge computing, Automation.

Use Case 3: Connected Vehicles

- **Description**: Monitor vehicle diagnostics (fuel, location, tire pressure), and send alerts.
- **IoT Concepts**: M2M communication, Cloud storage, APIs, Real-time data visualization.

Use Case 4: Remote Health Monitoring

- **Description**: Track heart rate, temperature, and SpO2 using wearable sensors and alert doctors remotely.
- **IoT Concepts**: Sensor networks, Data encryption, REST APIs, Fog Computing.

Use Case 5: Industrial IoT for Predictive Maintenance

- **Description**: Monitor vibration, temperature of machinery and predict failures using ML.
- **IoT Concepts**: Edge computing, Predictive analytics, Industrial automation.

Use Case 6: Smart City Traffic Management

- **Description**: Use sensors and cameras to monitor and control traffic signals dynamically.
- **IoT Concepts**: Computer vision, Data aggregation, Smart city architecture.

Use Case 7: IoT Security in Smart Homes

- **Description**: Use encrypted transmission and device authentication to secure smart home data.
- **IoT Concepts**: Privacy & security, Encryption algorithms, Network protocols.

H.Learning Resources

i. Text Books:

1. Farshad Firouzi, Krishnendu Chakrabarty, Sani Nassif, , “"Intelligent Internet of Things", From Device to Fog and Cloud”, Springer, 2020
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internetof Things:Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.

ii. Reference Books:

1. Simon Monk, “Programming the Raspberry Pi: Getting Started with Python”, January 2012, McGraw Hill Professional
2. Massimo Banzi, “Getting Started with Arduino”, First Edition, February 2009, O'Reilly Media, Inc

iii. Online References:

1. “Edge AI for IOT Developers” Dec. 12, 2009. Accessed on: Jun. 28, 2021 [Online]. https://www.udacity.com/course/intel-edge-ai-for-iot-developers-nanodegree--nd131

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS282	Robotics & Automation	3	0	2	4

A.Preamble

Robotics and Automation course is designed to make students to impart basic knowledge of Robotics and automation concepts, robot vision, image processing sensors and implementation. Students are also exposed to gain knowledge over robot design and control through programming for industry applications.

B.Prerequisite Course

10211CS213-Python Programming

C.Course Objectives

Students are able to

- Understand the Fundamental concepts of robotics and automation
- Understand the concepts of robotic sensors, control and planning
- Understand the algorithmic approach towards designing intelligent systems.
- Learn about robotic automation in Industry 4.0.

D.Course Outcomes

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

CO No's	Course Outcomes	K – Level/ S - Level
CO1	Apply the fundamentals concepts of Robotics and automation	K3/S3
CO2	Implement various robotic vision processing application using robotic sensors	K3/S3
CO3	Use the concepts of robotics motion control and kinematics that form the structure of robotic systems.	K3/S3
CO4	Experiment with localization and path planning techniques	K3/S3
CO5	Build AI and robotic process automation applications related to industry automation.	K3/S3
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	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2	2	2										2	
CO2	2	2	2	2									2	2
CO3	3	2	2	2	2								2	2
CO4	3	2	2	2	2								2	2
CO5		2	2	2										2

3- High; 2-Medium; 1-Low

F. Course Contents

UNIT 1 INTRODUCTION TO ROBOTICS AND AUTOMATION L-6 Hours

Introduction to Robotics- History, Robot features, Artificial Intelligence and Robotics - Agent-Task environment model, Application of AI in robotics (unmanned systems, defense, medical, industries, etc.). Introduction to Automation- Definition, automation principles and strategies, scope of automation, socio-economic consideration, Information processing in manufacturing industry, Production concepts and automation strategies.

UNIT 2 SENSORS AND ROBOTIC VISION PROCESSING L-6 Hours

Introduction to sensors, Types of Sensors - Internal sensors and External sensors, Sensor data interpretation and sensor fusion. Robot vision processing - Image acquisition techniques, camera transfer characteristics, Raster scan, Image capture time, Image representation, picture coding techniques. Robot Control through Vision sensors, Robot vision locating position, Robot guidance with vision system. Vision applications in robotics.

UNIT 3 ROBOTIC CONTROL AND KINEMATICS L-6 Hours

Robot Control: Fundamental principles, Classification, Position, path and speed control systems, adaptive control, Types of control- open loop and closed loop. Kinematics systems - Definition of mechanisms and manipulators, Degrees of Freedom, Parameters of links and joints, Kinematic chains, Trajectory planning and control.

UNIT 4 LOCALIZATION AND INTELLIGENT PATH PLANNING L-6 Hours

Introduction to Localization and Mapping in robotics, Techniques - Extended Kalman Filter, Particle filter, Simultaneous localization and mapping (SLAM). Intelligent Path planning – Map representation, Adaptive Approaches - Reinforcement learning for control, Model Based learning approaches to control Learning maps and Evolutionary approaches.

UNIT 5 ROBOTICS AND AUTOMATION IN INDUSTRY 4.0 L-6 Hours

Introduction - Artificial Intelligence and Industry 4.0, Mobile robots and Industry 4.0 – Intelligent Features, Advanced user interface. Robotic Process Automation (RPA) , RPA Tools - UiPath , Kofax, Automation Anywhere, WinAutomation, AssistEdge, Automagica.

Total: 30 Hours

Laboratory Experiments **Total : 30 Hours**

Part - 1

Part-2

Use Cases:

Use Case 1: Consider an environment where your robot can be used to find the distance from an obstacle using robotic vision. Apply distance or proximity sensors to detect the obstacles and

TASK 1	Implementation of a basic Robotic Automation program. **Language: Python**
TASK 2	Implementation of vision control sensor. Language: Python
TASK 3	Implement robotic pick and place process. **Language: Python**
TASK4	Implement robotic computer vision programming. **Language: Python , Tool: OpenCV**

TASK5	Implement robotic Trajectory planning and analysis. **Language: Python**
TASK6	Create a mobile robot to perform Forward kinematics and validation.
TASK7	Localization and Mapping in robotics using SLAM. **Language: Python**
TASK8	Implement path planning algorithm for robotics. **Language: Python**
TASK9	Implementation of degrees of freedom. **Language: Python**
TASK10	Implementation of RPA for industry application. **Tool: Open-source RPA**

to avoid collisions. Use vision sensors to acquire 3D data of the environment for object detection and collision avoidance.

Use Case 2: Consider an environment where robotic navigation can be performed using 2D vision sensors and image processing libraries like OpenCV to detect the presence of objects.

Use Case 3: Use mobile robots and apply SLAM technique to build up a map of an unknown environment or update a map within a known environment by tracking the current location of a robot to perform robotic trajectory and also estimate localization your mobile robot using the map.

Use Case 4: Consider robot arm DoF (Degree of Freedom) to make the robot arm reach the target component from any state. The arm should not go below the ground. The target component is always placed above the ground and within the reach of the robotic arm.

Use Case 5: For an industry perform create a bot to automate sending of E-mail, where the user just needs to provide their login credentials and the user email they want to send and rest of the work will be done by the bot.

Total: 60 Hours

H.Learning Resources

i. Text Books:

1. M. P. Groover, Ashish Dutta, “Industrial Robotics”, Tata McGraw-Hill Education Pvt. Ltd, 2012. [Unit 1-5]

ii. Reference Book(s):

1. John J. Craig, “Introduction to Robotics”, Pearson Education Asia, 2009. [Unit -1]
2. Lentin Joseph, Learning Robotics Using Python, Packt, 2015. [Unit 2-4]
3. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications”, McGraw Hill, 2012. [Unit 5]

iii. Online Resource(s):

1. “Mobile Robots”. Accessed on: May, 27, 2021[Online]. Available: https://onlinecourses.nptel.ac.in/noc21_me44/preview
2. Mechanisms and Robotics Lab (ernet.in). Available: http://vlabs.iitkgp.ernet.in/mr/#
3. Webots: robot simulator. Available: https://cyberbotics.com/ [Open-source simulator]

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS283	Industrial Automation	3	0	0	3

A. Preamble

Industrial Automation became a must part of every industry. Automation helps industries to have increased quality with high productivity, accuracy, and precision to industrial processes. The course will provide students, an opportunity to learn the industrial automation techniques and address engineering problems related to process industries. After completion of this course, the students will be industry ready for deployment in the field of Automation.

B. Prerequisite Course

10212CS211-Artificial Intelligence Techniques

C. Course Objectives

Students are able to

- Introduce the basics of the Internet of Things (IoT).
- Understand sensors, communication, and networking in IoT.
- Explore IoT architecture, models, and tools like Arduino and Raspberry Pi.
- Study real-world IoT applications across various domains.
- Apply AI and IoT in industrial automation and smart systems.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/ S - Level
CO1	Understand Industrial Automated production lines, work part transfer mechanism and buffer storage analysis.	K2
CO2	Select the right material handling system for a given application.	K2
CO3	Apply testing strategies on different industry based applications	K3
CO4	Demonstrate a given engineering problems in the framework of different AI methods	K3
CO5	Apply the concept of AI in Robotic 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	PO 1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO9	PO1 0	PO 11	PSO 1	PSO 2	PSO 3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2		-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	2	2	2	-	-	-	-	-	-	-	2	-	-
CO4	-	2	2	2	-	-	-	-	-	-	-	-	-	2
CO5	-	2	2	-	-	2	-	-	-	-	-	-	-	2

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Introduction L-9 Hours

Definition, automation principles and strategies - scope of automation - Architecture of Industrial Automation system, socio-economic consideration, low cost automation - Production concepts and automation strategies - Fixed Automation: Automated Flow lines, Methods of Work part Transport. Transfer Mechanism - Continuous transfer, intermittent transfer - Indexing mechanism Automation for Machining Operations, Design and Fabrication Considerations. Analysis of Automated Flow Lines: General Terminology and Analysis.

Unit 2 Material Handling **L-9 Hours**

Concepts of material handling, principles and considerations in material handling systems design, conventional material handling systems - industrial trucks, monorails, rail guided vehicles, conveyor systems, cranes and hoists, advanced material handling systems, automated guided vehicle systems, automated storage and retrieval systems(ASRS), Product identification system: Barcode, RFID etc. Introduction to Automation Plant design software

Unit 3 Automated Inspection and Testing **L-9 Hours**

Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods. Image representation, object recognition and categorization, depth measurement, visual inspection. Key performance Indicators.

Unit 4 Industrial AI Applications **L-9 Hours**

AI in Robotics : Applications in unmanned systems, defense, medical, Industrial AI in Monitoring, optimization and control. AI applications in Industry Automation using -natural language processing, AI in retail and ecommerce, Healthcare industries, logistics and transportation, manufacturing industries, Robotic perception, localization, mapping-configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

Unit 5 Robotics in Automation **L-9 Hours**

Application of Robots in welding, Spray painting, assembly operation, cleaning, robot for underwater applications. Gripper force analysis and gripper design for typical applications, design of multiple degrees of freedom, active and passive grippers - Factors influencing the choice of a robot, robot performance testing- Impact of robot on industry and society.

Total: 45 Hours

H.Learning Resources

i. Text Books:

1. M.P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, 5 th Edn., Pearson Education, 2016
2. Deb S R.and DebS., —”Robotics Technology and Flexible Automation”, Tata McGraw Hill Education Pvt. Ltd, 2010

Reference Book(s) [IEEE Format]:

1. Nicholas Odrey , Mitchell Weiss , Mikell Groover, Roger Nagel & Ashish Dutta, "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2017

Web Resource(s) [IEEE Format]:

1.https://onlinecourses.nptel.ac.in/noc20_me39/preview
2.https://www.mindsmapped.com/course-category/industrial-automation/

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS283	Industrial Automation	3	0	0	3

A. Preamble

Industrial Automation became a must part of every industry. Automation helps industries to have increased quality with high productivity, accuracy, and precision to industrial processes. The course will provide students, an opportunity to learn the industrial automation techniques and address engineering problems related to process industries. After completion of this course, the students will be industry ready for deployment in the field of Automation.

B. Prerequisite Course

10212CS211-Artificial Intelligence Techniques

C. Course Objectives

Students are able to

- Introduce the basics of the Internet of Things (IoT).
- Understand sensors, communication, and networking in IoT.
- Explore IoT architecture, models, and tools like Arduino and Raspberry Pi.
- Study real-world IoT applications across various domains.
- Apply AI and IoT in industrial automation and smart systems.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/ S - Level
CO1	Understand Industrial Automated production lines, work part transfer mechanism and buffer storage analysis.	K2
CO2	Select the right material handling system for a given application.	K2
CO3	Apply testing strategies on different industry based applications	K3
CO4	Demonstrate a given engineering problems in the framework of different AI methods	K3
CO5	Apply the concept of AI in Robotic 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO 2	PSO 3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2		-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	2	2	2	-	-	-	-	-	-	-	2	-	-
CO4	-	2	2	2	-	-	-	-	-	-	-	-	-	2
CO5	-	2	2	-	-	2	-	-	-	-	-	-	-	2

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Introduction L-9 Hours

Definition, automation principles and strategies - scope of automation - Architecture of Industrial Automation system, socio-economic consideration, low cost automation - Production concepts and automation strategies - Fixed Automation: Automated Flow lines, Methods of Work part Transport. Transfer Mechanism - Continuous transfer, intermittent transfer - Indexing mechanism Automation for Machining Operations, Design and Fabrication Considerations. Analysis of Automated Flow Lines: General Terminology and Analysis.

Unit 2 Material Handling **L-9 Hours**

Concepts of material handling, principles and considerations in material handling systems design, conventional material handling systems - industrial trucks, monorails, rail guided vehicles, conveyor systems, cranes and hoists, advanced material handling systems, automated guided vehicle systems, automated storage and retrieval systems(ASRS), Product identification system: Barcode, RFID etc. Introduction to Automation Plant design software

Unit 3 Automated Inspection and Testing **L-9 Hours**

Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods. Image representation, object recognition and categorization, depth measurement, visual inspection. Key performance Indicators.

Unit 4 Industrial AI Applications **L-9 Hours**

AI in Robotics : Applications in unmanned systems, defense, medical, Industrial AI in Monitoring, optimization and control. AI applications in Industry Automation using -natural language processing, AI in retail and ecommerce, Healthcare industries, logistics and transportation, manufacturing industries, Robotic perception, localization, mapping-configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

Unit 5 Robotics in Automation **L-9 Hours**

Application of Robots in welding, Spray painting, assembly operation, cleaning, robot for underwater applications. Gripper force analysis and gripper design for typical applications, design of multiple degrees of freedom, active and passive grippers - Factors influencing the choice of a robot, robot performance testing- Impact of robot on industry and society.

Total: 45 Hours

H.Learning Resources

i. Text Books:

3. M.P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, 5 th Edn., Pearson Education, 2016
4. Deb S R.and DebS., —”Robotics Technology and Flexible Automation”, Tata McGraw Hill Education Pvt. Ltd, 2010

Reference Book(s) [IEEE Format]:

2. Nicholas Odrey , Mitchell Weiss , Mikell Groover, Roger Nagel & Ashish Dutta, "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2017

Web Resource(s) [IEEE Format]:

1.https://onlinecourses.nptel.ac.in/noc20_me39/preview
2.https://www.mindsmapped.com/course-category/industrial-automation/

COURSE CODE	COURSE TITLE	L	T	P	C
10212CS112	Cybersecurity Policy, Law And Ethics	3	0	0	3

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 Course

10211CS130-Fundamentals of Computer Networks

C. Course Objectives

Students are able to

- Understand the basic concepts and need for cybersecurity and security policies.
- Learn about Indian and international cyber laws and their role in handling cybercrimes.
- Identify key cybersecurity regulations, standards, and privacy laws used in the industry.
- Analyze different types of cybercrimes and explore how legal systems respond to them.
- Apply ethical principles to digital activities, focusing on responsible behavior in cyberspace.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/ S - Level
CO1	Interpret the need of Cybersecurity policy and its operation	K2
CO2	Classify the cyber laws and the restrictions in cybersecurity	K2
CO3	Understand the Cybersecurity regulations and risk management	K2
CO4	Infer the vulnerabilities and threats in cybersecurity and exploitation	K2
CO5	Summarize the concept of cyber ethics, and the accountability standards	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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2		2									-	-	-
CO2			2									-	-	-
CO3		2	3			2						2	-	-
CO4	2	2										-	-	2
CO5						2		3				-	-	2

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Introduction to Cybersecurity **L-9 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 **L-9 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 **L-9 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 **L- 9 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 **L- 9 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: 45 Hours

H.Learning Resources

i. 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)

ii. Reference Book(s):

1. Joakim Kavrestad, "Fundamentals of digital forensics, theory, methods, and real life applications", Second Edition, ISBN 978-3-030-38954-3, Springer, 2020

iii. Web Resource(s) :

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

10212CS277	Deep Learning Techniques	3	0	2	4

A.Preamble

In this course students will be gain knowledge on how to build and train neural network architectures such as Convolutional Neural Networks, Recurrent Neural Networks, LSTMs, and Autoencoders. Understand the capabilities, challenges, and consequences of deep learning compared to Machine learning and prepare students in the development of leading-edge AI technology.

B.Prerequisite Course

10212CS223 - Machine Learning Techniques

C.Course Objectives

Students are able to

- •Understand basic concepts of deep learning Framework
- •Understand CNN, RNN and GAN architecture models
- •Perform model optimization and deployment

D.Course Outcomes

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

CO No's	Course Outcomes	K – Level/ S - Level
CO1	Explore data processing techniques using various deep learning frameworks for classification.	K3/S3
CO2	Build and train Convolutional Neural Network (CNN) model for real time applications.	K3/S3
CO3	Use various Convolutional Neural Network architectures for model building.	K3/S3
CO4	Demonstrate Recurrent Neural Networks and LSTM Networks	K3/S3
CO5	Apply attention mechanisms and transformer models for sequence and vision-based tasks.	K3/S3
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	PSO1	PSO 2	PSO 3
CO1	3	3	3	3		2						3		
CO2	3	2	2	2	2	2						3	2	
CO3	3	3	3	3	2	2						3	2	
CO4	3	3	3	3	2	2						2	2	
CO5	3	3	3	3	3	2						2	2	

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1- Data Processing and Deep Learning Framework **L-9 Hours**

Introduction to Data Handling – Data processing and Normalization using Deep Learning libraries and Data Augmentation Techniques.vDeep Learning Frameworks – PyTorch, TensorFlow and Keras. Deep Learning Parameters – Epoch, Learning rate, Batch size, Open-source deep learning tools.

Unit 2 – DeepConvolutional Neural Networks (CNN) **L-9 Hours**

Deep learning Layers – Convolutional Layer- Convolutional Properties and operations, Pooling Layer – Role and its types. Activation Layer – Significance and its types. Optimizers – Stochastic

gradient, RMSProp, Ada Delta and Adam optimizers. Loss Function – Mean Square Error (MSE), Binary Cross Entropy, Categorical cross Entropy and Sparse Categorical cross Entropy.

Unit 3- Convnet Architecture and Transfer Learning **L-9 Hours**

Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization, Addressing Overfitting and Underfitting issues. Transfer Learning, Advance architectures – Generative Adversarial Networks (GANs), Autoencoders, One shot learning, Siamese Networks and Capsule networks.

Unit 4 – Recurrent Neural Networks (RNN) **L-9 Hours**

Introduction toRecurrent Neural Networks (RNN)–RNN architecture, Building RNN step by step, Gated Recurrent Unit (GRU), Long-Short Term Memory (LSTM), LSTM architecture, Bi-LSTM.Language Models- Word embedding, Word-Level RNNs.

Unit 5- Transformers **L-9Hours**

Introduction to Attention Mechanisms – Limitations of RNNs and LSTMs in sequential modeling– Types of attention: additive and multiplicative. Self-Attention and Multi-Head Attention – Scaled dot-product attention – Multi-head attention – Positional encoding Transformer Architecture – Components of encoder and decoder. Pretrained Transformer models: BERT, GPT – Fine-tuning vs. pretraining – Vision Transformers (ViT).

Total: 45 Hours

G.Laboratory Experiments: **Total:30 Hours**

Part – 1

Task 1 Load a dataset (e.g., MNIST or CIFAR-10), perform data normalization, and visualize the effect of normalization on sample images.
(Framework: TensorFlow/Pytorch).

Task 2 Apply data augmentation techniques (such as rotation, flipping, scaling) on images using TensorFlow or PyTorch libraries
(Framework: TensorFlow/Pytorch).

Task 3 Implement a simple CNN for image classification with convolutional, pooling, and activation layers.
(Framework: TensorFlow/Pytorch).

Task4 Compare training results using different optimizers and loss functions on the CNN model.
(Framework: TensorFlow/Pytorch).

Task5 Load a pretrained CNN model and perform transfer learning on a new dataset.
(Framework: TensorFlow/Pytorch).

Task6 Build a simple **Generative Adversarial Network (GAN)** to generate image. Visualize and compare real vs. generated/reconstructed images.
(Framework: TensorFlow/Pytorch).

Task7 Build and train an RNN model for sequence prediction (e.g., character-level text generation).
(Framework: TensorFlow/Pytorch).

Task8 Implement an LSTM or Bi-LSTM model for sentiment analysis using a text dataset.
(Framework: TensorFlow/Pytorch).

Task9 Implement scaled dot-product attention and multi-head attention mechanisms on sample input sequences.
(Framework: TensorFlow/Pytorch).

Task10 Fine-tune a pretrained Transformer models on a text classification task and evaluate its performance.
(Framework: TensorFlow/Pytorch).

Part-2
Use Cases:

1. Medical Image Diagnosis and Report Generation

2. Autonomous Vehicle Perception and Decision Making

3. Smart Customer Support Chatbot with Visual Input

4. Financial Fraud Detection and Reporting

5. E-commerce Product Recommendation and Review Analysis

Total:75 Hours

H.Learning Resources

i. Text Books:

1. I Goodfellow, Y Bengio and A Courville, "Deep Learning",1st Edition MIT Press, 2017. [Unit 1-5]

ii. Reference Books:

1. Venkatesan, Ragav, and Baoxin Li. “Convolutional neural networks in visual computing: a concise guide”. CRC Press, 2017.[Unit-2,3]
2. Nikhil Buduma.,“Fundamentals of Deep Learning”, O'Reilly Media, 2017. [Unit-4,5]

iii. Online References:

1. “Deep Learning Specialization”. Accessed on: April 20, 2021 [Online]. https://www.coursera.org/specializations/deep-learning.
2. “Deep Learning Nanodegree”, Accessed on: April. 16, 2021 [Online]. Available: https://www.udacity.com/course/deep-learning-nanodegree--nd101

PROGRAM ELECTIVE

(Self Learning Courses)

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10212CS401	SOCIAL NETWORKS	12	-	3

CourseCategory:

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)

CourseProvider : 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

CourseCategory:

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

CourseProvider : NPTEL
Professor : Prof. Samit Bhattacharya, 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

CourseCategory:

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

CourseProvider : 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

CourseCategory:

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

CourseProvider	:	NPTEL
Professor	:	Prof. Balaraman Ravindran
University	:	IIT Madras

COURSE CODE	COURSE TITLE	W	H	C
10212CS405	RESPONSIBLE & SAFE AI SYSTEMS	12	-	3

CourseCategory:

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

CourseProvider : 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

CourseCategory:

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

CourseProvider : 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

CourseCategory:
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
CourseProvider : 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

CourseCategory:
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
CourseProvider : NPTEL
Professor : Prof. Meenakshi D'souza

University : IIIT Bangalore

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS411	Deep Learning for Natural Language Processing	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Explore Natural Language Processing and shallow and Deep Neural Networks.	K3
CO2	Build and train Convolutional Neural Network (CNN) model for real time applications.	K3
CO3	Use various Recurrent Neural Network architectures using GRU, LSTM.	K3
CO4	Apply Various Large Language Models and Unique Architecture Differences.	K3
CO5	Perform Parameter Efficient Fine-Tuning (PEFT) using LoRA and QLoRA.	K3

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	3	3	3		2	2					3	
CO2	3	2	2	2	2	2	2					3	2
CO3	3	3	3	3	2	2	2					3	2
CO4	3	3	3	3	2	2	2					2	2
CO5	3	3	3	3	3	2	2					2	2

Course Contents

Week 1:

- Introduction to NLP: What is Natural Language Processing? A brief primer on word and sentence level tasks and n-gram language Model.

Week 2: Introduction to Deep Learning

- Shallow and Deep Neural Networks
- Representation Learning

Week 3: Word Representations

- Word2Vec
- Glove
- fastText,
- Multilingual representations with emphasis on Indian Languages

Week 4: Recurrent Neural Networks
- RNN LMs
- GRUs, LSTMs, Bi-LSTMs
- LSTMs for Sequence Labeling
- LSTMs for Sequence to Sequence

Week 5: Attention Mechanism
- Sequence to Sequence with Attention
- Transformers: Attention is all you need

Week 6: Self-supervised learning (SSL), Pretraining
- Designing SSL objectives
- Pretrained Bi-LSTMs: ELMO
- Pre-trained Transformers: BERT, GPT, T5, BERT

Week 7:
- Applications: Question Answering, Dialog Modeling, Text Summarization
- Multilingual extension with application to Indian languages

Week 8: Instruction Fine-tuning, FLAN-T5, Reinforcement Learning through Human Feedback (RLHF)

Week 9: In-context learning, chain-of-thought prompting. ScalingLaws. Various Large Language Models and unique architectural differences

Week 10: Parameter Efficient Fine-tuning (PEFT) - LoRA, QLoRA

Week 11: Handling Long Context, Retrieval Augmented Generation (RAG)

Week 12: Analysis and Interpretability, ethical considerations

Course Provider : NPTEL
Professor : **Prof. Pawan Goyal**
University : IIT Kharagpur

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS412	Machine Learning for Engineering and science applications	**12**	**-**	**3**

Course Category:

Independent Learning (Self - Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Explain the mathematical and computational foundations of machine learning, including linear algebra, probability, and optimization.	K2
CO2	Apply machine learning models such as linear regression, logistic regression, and neural networks to solve real-world problems.	K3
CO3	Describe the architecture and operations of advanced neural networks, including CNNs, RNNs, LSTMs, and GRUs.	K2

CO4	Implement classical machine learning techniques like Bayesian Regression, SVM, Random Forests, k-Means, and Expectation Maximization for specific applications.	K3
CO5	Develop generative and probabilistic models using advanced techniques such as Monte Carlo methods, autoencoders, and GANs to address complex tasks.	K3

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO 8	PO9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2	3			3				2					2
CO2	3	2	2		3				2			2		
CO3	2	2	2		3				3	3				
CO4	3	2	3	3	2				3				3	
CO5	2	3	3	2	3				2			2		3

Course Contents

Week 1: Mathematical Basics 1 – Introduction to Machine Learning, Linear Algebra
Week 2: Mathematical Basics 2 - Probability
Week 3: Computational Basics – Numerical computation and optimization, Introduction to Machine learning packages
Week 4: Linear and Logistic Regression – Bias/Variance Tradeoff, Regularization, Variants of Gradient Descent, MLE, MAP, Applications
Week 5: Neural Networks – Multilayer Perceptron, Backpropagation, Applications
Week 6: Convolutional Neural Networks 1 – CNN Operations, CNN architectures
Week 7: Convolutional Neural Networks 2 – Training, Transfer Learning, Applications
Week 8: Recurrent Neural Networks RNN, LSTM, GRU, Applications
Week 9: Classical Techniques 1 – Bayesian Regression, Binary Trees, Random Forests, SVM, Naïve Bayes, Applications
Week 10: Classical Techniques 2 – k-Means, kNN, GMM, Expectation Maximization, Applications
Week 11: Advanced Techniques 1 – Structured Probabilistic Models, Monte Carlo Methods
Week 12: Advanced Techniques 2 – Autoencoders, Generative Adversarial Network

Course Provider : NPTEL
Professor : Dr Balaji Srinivasan
Dr Ganapthy Krishnamurthi
University : IIT Madras

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS413	Quantum Algorithms And Cryptography	**12**	**-**	**3**

Course Category:

Independent Learning (Self - Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the basics of Quantum Information, Entanglement, No Cloning, Quantum Parallelism	**K1**
CO2	Analyzing the Quantum Algorithms and Cryptography Algorithms	**K2**
CO3	Understand the concept of Public key encryption and fully homomorphic encryption	**K1**
CO4	Applying concept of the Quantum key distribution, Quantum one time pad, Quantum public key encryption and Quantum fully homomorphic encryption	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3		3	3							3		
CO2	3	3	3	3	3	2						3		
CO3	3	2		3	3							3		
CO4	3	3	3	3	3	2						3		

Course Contents

Week 1: Basics of Quantum Information
Week 2: Entanglement, No Cloning, Quantum Parallelism.
Week 3: Quantum Algorithms: Deutsch-Jozsa, Simons, Bernstein-Vazirani
Week 4: Introduction to Cryptography, principles of cryptographic design, building cryptography from RSA, Discrete Log
Week 5: Key exchange, Symmetric and public key encryption, Random Oracle Model, RSA and Elgamal encryption
Week 6: Boolean Fourier Analysis, Grover's Algorithm, Quantum Foruier Transform
Week 7: Shor's Algorithm, Hidden subgroup problem
Week 8: Post Quantum Crypto: Introduction to lattices, Useful Lattice Problems. Learning with Errors and Short Integer Solution problem. Connection to dihedral hidden subgroup problem.
Week 9: Public key encryption and fully homomorphic encryption
Week 10: Quantum key distribution, Quantum one time pad
Week 11: Quantum public key encryption
Week 12: Quantum fully homomorphic encryption

Course Provider : NPTEL

Professor : PROF. SHWETA AGRAWAL
University : IIT Madras

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS414	Foundation of Cloud IoT Edge ML	**8**	**-**	**2**

Course Category:
Program Elective (Self - Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamentals of Cloud Computing, its limitations for low-latency use cases, and how Edge Computing addresses these challenges in supporting real-time IoT applications.	**K2**
CO2	Understand IoT edge platforms such as Azure IoT Hub and AWS IoT Platform, focusing on their role in secure and efficient data processing and communication.	**K2**
CO3	Apply containerization and orchestration techniques, such as Docker and Kubernetes, in Edge Computing to improve the security and scalability of IoT applications.	**K3**
CO4	Understand the principles of distributed IoT systems, including time ordering, clock synchronization, and secure storage system design.	**K2**
CO5	Apply MQTT and Kafka in building IoT pipelines, ensuring efficient and secure data transfer in edge-based IoT systems.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2						2	3	2	
CO2	3	3	2	2	3				2	2	2	2	3	
CO3	2	3	3	2	3	2	2	2		3	3	3	1	
CO4	3	2	2	3	2					2	2	2	2	
CO5	2	3	3	2	3	2		2	2	3	3	3	2	

(H-3, M-2, L-1)

Course Contents

Week 1: Introduction to Cloud and its limitations to support low latency use cases
Week 2: Edge computing to support IoT applications such as self-driving cars, etc
Week 3: Introduction to IoT Edge platforms such as Azure IoT hub, AWS IoT platform
Week 4: Introduction to docker container and kubernetes in edge computing
Week 5: Concepts of distributed systems in IoT applications such as time ordering and clock synchronisation, distributed snapshot, etc

Week 6: Edge Design of IoT storage system like key value store
Week 7: Introduction to MQTT and Kafka for end-to-end IoT pipeline

Week 8: Use Cases of Machine Learning for IOT in predictive maintenance, image classifier, and self-driving cars.

Course Provider : NPTEL

Professor : Prof. Rajiv Misra

University : IIT, Patna

COURSE CODE	COURSE TITLE	W	H	C
10212CS416	Artificial Intelligence: Knowledge Representation and Reasoning	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Apply symbolic reasoning using propositional logic and direct proofs.	K3
CO2	Demonstrate proficiency in first-order logic, including unification and resolution methods.	K3
CO3	Implement forward and backward chaining and resolution refutation to derive conclusions.	K3
CO4	Use Prolog and logic programming for building rule-based systems with Horn clauses and Rete algorithm.	K3
CO5	Design knowledge representation models using semantic networks, frames, and description logics.	K3

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	3	3	2	1	-	-	-	-	-	-	2	2
CO2	3	3	3	2	1	-	-	-	-	-	-	2	2
CO3	3	3	3	2	1	-	-	-	-	-	-	2	2
CO4	3	3	3	3	1	-	-	-	-	-	-	2	2
CO5	3	3	3	3	1	-	-	-	-	-	-	2	2

Course Contents

Week1: Introduction.Historyand Philosophy.
Week2: SymbolicReasoning.Truth,Logic,andProvability.
Week3: PropositionalLogic.Direct Proofs.TheTableauMethod.

Week4: FirstOrderLogic.UniversalInstantiation.TheUnificationAlgorithm.
Week5: ForwardandBackwardChaining. TheResolutionRefutationMethod.
Week 6: Horn Clauses and Logic Programming. Prolog.
Week7: RuleBasedSystems.TheOPS5Language.TheRete Algorithm.
Week8: RepresentationinFirstOrderLogic.ConceptualDependency.
Week9: Frames. DescriptionLogics and the WebOntologyLanguage
Week 10: Taxonomies and Inheritance. Default Reasoning.
Week11: Circumscription.Auto-epistemicReasoning.EventCalculus
Week12: EpistemicLogic.Knowledgeand Belief.

Course Provider : NPTEL
Professor : Prof. Deepak Khemani
University : IIT Madras

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	Course Provider	W	H	C
10212CS421	Machine Learning for Soil and Crop Management	**NPTEL**	**12**	**-**	**3**

Course Category:
Open Elective (Self - Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Comprehend the applications of ML and DL in agriculture	**K2**
CO2	Apply Principal Component Analysis (PCA) and regression models in agricultural contexts.	**K3**
CO3	Understand and apply diffuse reflectance spectroscopy in crop and soil analysis.	**K2**
CO4	Understand digital soil mapping techniques and their agricultural applications	**K2**
CO5	Apply UAVs combined with ML for enhanced agricultural monitoring	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO1 0	PO11	PSO1	PSO 2	PSO 3
CO1	3	2		2	3	2					3	3	3	3
CO2	3	3	2	3	3	2		2	2		3	3	3	3
CO3	3	3	3	3	3	3		2	2	2	2	2	2	
CO4	3	3	2	3	3	2					2	2	2	

CO5	3	3	2	3	3	3		2	2	2	3	1		

Course Contents:

Week 1: General Oerview Of Ml And Dl Applications In Agriculture
Week 2: Basics Of Multivariate Data Analytics
Week 3: Principal Component Analysis And Regression Applications In Agriculture
Week 4: Applications Of Classification And Clustering Methods In Agriculture
Week 5: Diffuse Reflectance Spectroscopy: Basics And Applications For Crop And Soil
Week 6: Use Of Ml For Portable Proximal Soil And Crop Sensors
Week 7: Ml And Dl For Soil And Crop Image Processing
Week 8: Uav And Ml Applications In Agriculture
Week 9: Hyperspectral Remote Sensing And Ml Applications In Agriculture
Week 10: Digital Soil Mapping – General Overview
Week 11: Digital Soil Mapping With Continuous Variables
Week 12: Digital Soil Mapping With Categorical Variables

Course Provider : NPTEL
Professor : Prof. Somsubhra Chakraborty

University : IIIT Kharagpur

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS422	Algorithms in Computational Biology and Sequence Analysis	**12**	**-**	**3**

Course Category:

Independent Learning (Self - Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Apply the knowledge of molecular biology and genetics to use bioinformatics tools, databases, and algorithms for analyzing biological sequences.	**K3**
CO2	Demonstrate the application of string-matching algorithms such as suffix trees, suffix arrays, and Burrows-Wheeler Transform (BWT) for solving exact matching problems in genomic data.	**K3**
CO3	Implement dynamic programming and heuristic alignment techniques to perform pairwise sequence alignment and evaluate the alignment significance using statistical measures.	**K3**
CO4	Apply graph algorithms, including de Bruijn graphs and overlap graphs, to solve genome assembly problems and construct evolutionary trees using multiple sequence alignment.	**K3**

CO5	Use Hidden Markov Models (HMMs) and large language models to classify biological sequences, predict genes, and interpret genomic variations through pangenome graphs.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2
CO1	3	2	1	2	1								1
CO2	3	3	2	3	2								2
CO3	2	3	3	2	3								2
CO4	3	2	3	3	2								1
CO5	2	3	2	3	3								2

Course Contents

Week 1: Introduction

- Brief review of the fundamentals of molecular biology and genetics.
- Examples of widely used software, algorithms, databases.

Week 2: **Strings and exact matching**

- Suffix trees, suffix arrays, BWT, and their applications

Week 3: Pairwise Sequence Alignment

- Classic dynamic programming ideas for pairwise sequence alignment.
- Statistical measures of alignment significance.

Week 4: Heuristic Sequence Alignment

- Mathematical ideas underlying heuristic sequence aligners.
- Applications of sequence alignment for mutation finding and disease diagnosis.

Week 5: Genome reconstruction using graph algorithms

- de Bruijn Graphs, Overlap graphs, Shortest common superstring

Week 6: Evolutionary tree construction

- Multiple sequence alignment – formulations, optimal and approximation algorithms
- Classical and contemporary algorithms for inferring evolutionary trees.

Week 7: Sequence models and classification

- Gene finding. Hidden Markov models
- Large language models for biological sequences

Week 8: Pangenome graphs

- Gene finding. Hidden Markov models
- Large language models for biological sequences

Week 9: Discussion of research papers

Week 10: Discussion of research papers(Cont.,)

Week 11: Discussion of research papers(Cont.,)

Week 12: Discussion of research papers(Cont.,)

Course Provider : NPTEL
Professor : Prof. Chirag Jain

University : IISc Bangalore

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	Course Provider	W	H	C
10212CS423	Introduction to Large Language Models (LLMs)	**NPTEL**	**12**	**-**	**3**

Course Category:

Open Elective (Self - Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamental principles of NLP, including its pipeline and key applications.	**K2**
CO2	Apply statistical language models and smoothing techniques for text processing tasks	**K3**
CO3	Develop and implement neural architectures, including deep learning models and PyTorch, for NLP tasks.	**K3**
CO4	Analyze and utilize advanced word representations (Word2Vec, GloVe) and tokenization strategies for better text understanding.	**K3**
CO5	Design and implement advanced neural language models, including RNNs, LSTMs, GRUs, Transformers, and attention mechanisms.	**K2**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1			3	3		3	2	2	2	2	2			
CO2	2					2	2	2	2	2	2	2	2	
CO3	2	2				3	3	2	3	2	2	2	2	
CO4	2	2				3	2	2	2	2	2	2	2	2
CO5	2	2				3	3	3	3	3	3			2

Course Contents:

Week 1

- Course Introduction
- Introduction to NLP (NLP Pipeline, Applications of NLP)

Week 2

- Introduction to Statistical Language Models

- Statistical Language Models: Advanced Smoothing and Evaluation

Week 3

- Introduction to Deep Learning (Perceptron, ANN, Backpropagation, CNN)
- Introduction to PyTorch

Week 4

- Word Representation
  - Word2Vec, fastText b. GloVe
- Tokenization Strategies

Week 5

- Neural Language Models
  - a. CNN, RNN b. LSTM, GRU
  - Sequence-to-Sequence Models, Greedy Decoding, Beam search
- Other Decoding Strategies: Nucleus Sampling, Temperature Sampling, Top-k Sampling
- Attention in Sequence-to-Sequence Models

Week 6

- Introduction to Transformers
  - a. Self and Multi-Head Attention b. Positional Encoding and Layer Normalization
- Implementation of Transformers using PyTorch

Week 7

- Transfer Learning: ELMo, BERT (Encoder-only Model)
- Transfer Learning: GPT (Decoder-only Model), T5 (Encoder-decoder model)
- Introduction to HuggingFace

Week 8

- Instruction Fine-tuning
- In-context Learning and Prompting Techniques
- Alignment with Human Feedback (RLHF)

Week 9

- Parameter-efficient Adaptation (Prompt Tuning, Prefix Tuning, LoRA)
- An Alternate Formulation of Transformers: Residual Stream Perspective
- Interpretability Techniques
-

Week 10

- Knowledge graphs (KGs)
  a. Representation, completion
  b. Tasks: Alignment and isomorphism
  c. Distinction between graph neural networks and neural KG inference

Week 11

- Open-book question answering: The case for retrieving from structured and unstructured sources;retrieval-augmented inference and generation
- Retrieval augmentation techniques
  a. Key-value memory networks in QA for simple paths in KGs
  b. Early HotPotQA solvers, pointer networks, reading comprehension
  c. REALM, RAG, FiD, Unlimiformer
  d. KGQA (e.g., EmbedKGQA, GrailQA)
    - **Week 12**

- Overview of recently popular models such as GPT-4, Llama-3, Claude-3,Mistral, and Gemini
- Ethical NLP – Bias and Toxicity
- Conclusion

Course Provider : NPTEL
Professor : Prof. Tanmoy Chakraborty
Prof. Soumen Chakraborti
University : IIT Bombay

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS425	Essentials of Data Science With R Software-1: Probability and Statistical	12	-	3

CourseCategory:

Independent Learning (Self - Learning Course)

CourseOutcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Understand data science, probability theory, and random variables.	K2
CO2	Apply probability distributions for real-world data problems.	K3
CO3	Explain sampling distributions, convergence, and CLT.	K2
CO4	Perform point and interval estimation using R software.	K3
CO5	Conduct hypothesis testing for attributes and other problems.	K3

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1			3	3		3								
CO2	2					2						2	2	
CO3	2	2				3						2	2	

CO4	2	2				3						2	2	2
CO5	2	2				3								2

Course Contents

Week 1:Introduction to data science, basic calculations with R Software and probability theory
Week 2:Probability theory and random variables
Week 3: Random variables and Discrete probability distributions
Week 4:Continuous probability distributions
Week 5:Sampling distributions and Functions of random variables
Week 6:Convergence of random variables, Central limit theorems and Law of large numbers
Week 7: Statistical inference and point estimation
Week 8:Methods of point estimation of parameters
Week 9:Point and confidence interval estimation
Week 10:Confidence interval estimation and test of hypothesis
Week 11: Test of hypothesis
Week 12:Test of hypothesis for attributes and other tests

CourseProvider : NPTEL
Professor : Prof. Shalabh
University : IIT Kanpur

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS426	Essentials of Data Science With R Software-2: Sampling Theory and Linear Regression Analysis	**12**	**-**	**3**

CourseCategory:

Independent Learning (Self - Learning Course)

CourseOutcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Understand data science, probability theory, and random variables.	**K2**
CO2	Apply advanced sampling techniques like stratified sampling and bootstrap in R.	**K3**
CO3	Understand concepts of regression models and their importance in data science.	**K2**
CO4	Perform simple and multiple regression analysis using R software.	**K3**
CO5	Apply LASSO regression for variable selection and model optimization in R.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1			3	3		3								
CO2	2					2						2	2	
CO3	2	2	2		2	3						2	2	
CO4	2	2			2	3						2	2	2
CO5	2	2	2		2	3								2

Course Contents

Week 1:Introduction to data science and Calculations with R Software
Week 2:Basic Fundamentals of Sampling
Week 3: Simple Random Sampling
Week 4:Simple Random Sampling with R
Week 5:Stratified Random Sampling
Week 6:Stratified Random Sampling with R
Week 7: Bootstrap Methodology with R
Week 8:Introduction to Linear Models and Regression and Simple linear regression Analysis
Week 9:Simple Linear Regression Analysis with R
Week 10:Multiple Linear Regression Analysis
Week 11: Multiple Linear Regression Analysis with R
Week 12:Variable Selection using LASSO Regression

CourseProvider : NPTEL
Professor : Prof. Shalabh
University : IIT Kanpur

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS435	Secure Computation : Part I	12	-	3

Course Category:

Independent Learning (Self - Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamental principles of cryptography as well as distributed computing	K1
CO2	Analyzing secure Computation: motivation and real-world examples, various dimensions, recalling relevant	K2
CO3	Understand the concept of Secret sharing, Linear secret-sharing, general secret-sharing, secure message transmission, Perfectly-secure MPC tolerating general adversaries	K1
CO4	Applying concept of the Various optimizations of Yao's 2PC protocol, Mixed-world MPC protocols: The case of 2 PC in ABY Framework	K3

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3		3		3							3		
CO2		3	3		3	2						3		
CO3		2	3	3	3							3		
CO4		3	3	3	3	2						3		

Course Contents

Week 1: Secure Computation: motivation and real-world examples, various dimensions, recalling relevant topics from abstract algebra (groups, rings, fields) and cryptography
Week 2: Secret sharing (motivation, definition and applications), Shamir secret-sharing, additive secret-sharing, replicated secret-sharing
Week 3: Linear secret-sharing, general secret-sharing, secure message transmission (SMT)
Week 4: BenOr-Goldwasser-Wigderson (BGW) protocol: security proof and detailed analysis
Week 5: Degree-Reduction problem and various solutions, efficient protocols for evaluating multiplication gates, MPC in the pre-processing model
Week 6: Perfectly-secure MPC tolerating general adversaries, perfectly-secure MPC for small number of parties (the case of secure 3PC)
Week 7: Goldreich-Micali-Wigderson (GMW) protocol: security proof and detailed analysis, Oblivious transfer (OT)

Week 8: Construction of OT protocols from various cryptographic assumptions, GMW protocol in the pre-processing model

Week 9: OT extension, Yao's protocol for secure 2-party computation
Week 10: Various optimizations of Yao's 2PC protocol
Week 11: Mixed-world MPC protocols: The case of 2 PC
Week 12: Mixed-world 2PC protocols in the ABY framework

Course Provider : NPTEL
Professor : By Prof. Ashish Choudhury
University : IIIT Bangalore

cademic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS436	Privacy and Security in Online Social Media	**12**	**-**	**3**

Course Category:

Independent Learning (Self - Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamental principles of Privacy and Security in Online Social Media	**K1**
CO2	Analyzing data collection from social networks, challenges, opportunities, and pitfalls in online social networks, APIs	**K2**
CO3	Understand the concept of Trust, credibility, and reputations in social systems	**K1**
CO4	Applying concept of the Information privacy disclosure, revelation and its effects in OSM and online social networks	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3		3		3							3		
CO2		3	3		3	2						3		
CO3		2	3	3	3							3		
CO4		3	3	3	3	2						3		

Course Contents

Week 1: What is Online Social Networks, data collection from social networks, challenges, opportunities, and pitfalls in online social networks, APIs

Week 2: Collecting data from Online Social Media.
Week 3: Trust, credibility, and reputations in social systems
Week 4: Trust, credibility, and reputations in social systems
Week 5: Online social Media and Policing
Week 6: Information privacy disclosure, revelation and its effects in OSM and online social networks
Week 7: Phishing in OSM & Identifying fraudulent entities in online social networks
Week 8: Refresher for all topics
Week 9 to 12: Research paper discussion

Course Provider : NPTEL
Professor : Prof. Ponnurangam Kumaraguru
University : IIIT Hyderabad

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS437	Games and Information	**12**	**-**	**3**

CourseCategory:

Independent Learning (Self - Learning Course)

CourseOutcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Understand the fundamental principles of static games, dynamic games and mechanism designs in gaming.	**K1**
CO2	Analyze the concept of information structures, role of information structure on equilibria, Bayesian games and information asymmetry.	**K2**
CO3	Apply the pre-play communication – achievable payoffs and correlated equilibria.	**K3**
CO4	Implement applications on game theory in finance.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	3			3	2						2	2	
CO2	3	3	2		3	2						2	2	
CO3	3	3	2		3					3			2	
CO4	3	3	2		3								2	

Course Contents

Week 1: Outline of the course, Definition of a game, Nash equilibrium, Examples of Nash equilibrium, Weakly dominated strategies.

Week 2: Strictly dominated strategies, Aumann model of incomplete information, Knowledge operator, Common knowledge, Structure theorem of common knowledge.

Week 3: Dynamic games, Information structures, Commitment, Mixed and Behavioral strategies, Kuhn's theorem, Bayesian games, Bayesian Nash equilibrium. Mechanism design(ContdProof of the structure theorem of common knowledge, Aumann model of incomplete information with belief, Aumann's agreement theorem, Zero-sum game definition, Security strategies, Saddle point strategies.

Week 4: Further properties of saddle point strategies, Mixed strategies, Existence of mixed saddle point strategies, Von-Nuenmann minmax theorem.

Week 5: Computation of mixed saddle point strategies for various matrix games, Existence of nash equilibrium for non-zero-sum game via Kakutani fixed point theorem.

Week 6: Existence of Nash equilibrium for infinite strategy space via Brower's fixed point theorem, Quantal response: definition and examples, Dynamic game definition, solution concept, Standard normal form of a dynamic game, Threat equilibrium.

Week 7: Extensive Form Game, Single Acts Games, Informationally Inferior Games

Week 8: Information Structure in Single Act Games, Nested and Ladder Nested Extensive, Equilibrium Algorithm Lecture, Stagewise Multi-Act Game, Feedback Nash Equilibrium, Stagewise Multi-Act Game, Feedback Nash Equilibrium

Week 9: Mixed & Behavioral Strategies, Conditions for Equivalence of Mixed & Behavioral Strategies, Kuhn's Theorem, Equivalence of Mixed and Behavioral Strategies

Week 10: Games of Incomplete Information, Bayesian Nash Equilibrium, Self-enforcement of Nash Equilibrium, Stackelberg game

Week 11: Principal-Agent Models, Moral Hazard and Adverse Selection, Games with Contracts

Week 12: Correlated Equilibrium, Bayesian Game with Mediated Communication, Revelation Principle, Bayesian Nash Equilibrium

CourseProvider : NPTEL
Professor : Prof. Ankur A. Kulkarni
University : IIT Bombay

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS438	Human Computer Interaction	**12**	**-**	**3**

CourseCategory:

Independent Learning (Self - Learning Course)

CourseOutcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Understand the user-centered design thinking, usability principles, interface development, rapid prototyping methodologies, and evaluation techniques.	**K1**
CO2	Differentiate between human-computer interaction, user experience design, and design thinking concepts.	**K2**
CO3	Apply user-centered design strategies, data gathering techniques, rapid prototyping tools, and methods for effectively communicating design concepts.	**K3**
CO4	Implement a prototype and assess innovative design ideas using user-centric approaches, leveraging both manual techniques and automated tools such as advancements in Artificial Intelligence, including Large Language Models (LLMs).	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	2	2				1					2		
CO2	3		2				1					2		
CO3	3	2	2		1		1			3		2		
CO4	3	2	2		1		1					2		

Course Contents

Week 1: Introduction to HCI + Case study
Week 2: What is Design + Case study
Week 3: What is Interaction + Case study
Week 4: What is the User Perspective + Case study
Week 5: What is an Interface + Case study
Week 6: What is Data Requirement, Gathering and Analysis

Week 7: Prototyping and Smart UI + Case study
Week 8: Iterative Design and Evaluation + Case study
Week 9:HCI with IoT and Applications + Case study
Week 10: HCI and AI (including LLMs) + Case study
Week 11: Privacy, Security, and HCI + Case study
Week 12: HCI and AI based Conversational Systems and Applications(e.g., Finance, Healthcare, Education, Software Engineering,Assessment, Information Retrieval) + Projects

CourseProvider : NPTEL
Professor : Prof. Rajiv Ratn Shah
University : IIIT Delhi

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS439	Introduction to Graphic Design	**8**	**-**	**2**

Course Category:

Independent Learning (Self - Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the foundational elements of Graphic Design, including Basic Design Principles, Typography, Publication Design and Branding & Identity.	**K1**
CO2	Analyze the concepts of abstracting visual information through pictograms, icons, symbols, and the integration of typography to craft compelling visual narratives.	**K2**
CO3	Design innovative solutions that make information engaging, informative, entertaining, and thought-provoking, fostering critical thinking.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	3	3									2		
CO2	3	3	3		1		2					2	1	
CO3	3	3	3		1		2			3		2	1	

Course Contents

Week 1: Introduction to Design (Course plan and content)
Week 2: Introduction to Design Elements

Week 3: Introduction to Design Principles
Week 4: Exploring gestalt Principles

Week 5: Introduction to typography
Week 6: Introduction to Identity Design
Week 7: Introduction to Print and publication
Week 8: Review & Discussion

Course Provider :	NPTEL
Professor :	Prof. Mohammad Shahid, Prof. Saurav Khuttiya Deori
University :	IIT Hyderabad
Academic Year:	2024-2025
Semester :	Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS440	Augmenting Design Thinking with Human-Computer Interaction	**8**	**-**	**2**

CourseCategory:

Independent Learning (Self - Learning Course)

CourseOutcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Understand and define the problem to arrive at an empathetic solutionby prioritizing the user needs.	**K1**
CO2	Design an intuitiveinterface that provide efficiency to the user.	**K2**
CO3	Understand various approaches to idea generation and selection with the help of design principles and methods to create meaningful interfaces.	**K1**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	3										2	1	
CO2	3	2	3		2		1					2	1	
CO3	3	2	1		2		1					2	1	

Course Contents

Week 1: Introduction to concepts of Design Thinking and Human-Computer Interaction.

- What is design thinking?
- Need for design thinking.
- Working Model of Design Thinking
- Process and phases of design thinking
- Design thinking applications
- How to get started with Design Thinking

Week 2: Divergent and Convergent Thinking and its impact on innovation.

- Definition, Necessities, Differences
- Strategies of design thinking
- Convergent Thinking Process
- Application, Planning and Implementation

Week 3: Principles and Methods of Idea Generation and Selection.

- Necessities and importance
- Various methods of Idea generation
- Techniques and tools for idea selection
- Methods of effective idea communication

Week 4: Understanding human interactions with interfaces, user behaviours, and their preferences.

- Need Analysis
- Design for experience
- Design for storytelling
- Empathy mapping
- Context mapping
- Stakeholder mapping
- Customer journey mapping
- Trend analysis
- Universal design and design for accessibility

Week 5: Design Research Methods.

- Primary and secondary methods
- Areas of research (ethnography, anthropometry, ergonomics)
- Types of interview and different methods
- Questionnaire design and application challenges
- Data analysis
- Case study

Week 6: Design process and Prototyping.

- Card sorting & Thematic analysis
- Information Architecture
- Low fidelity Wireframe
- Paper-prototyping
- Design elements (colour, shape, text, etc.)
- High fidelity Wireframe
- User testing
- Case study

Week 7: Tools and Techniques.

- Figma design walkthrough
- Figma prototype walkthrough
- Evaluation techniques
- Task analysis

Week 8: Case studies, best practices, and guidelines.

- Product case study
- Tips and techniques on best practices
- Dialogues notation

CourseProvider : NPTEL
Professor : Prof. Sonal Atreya
University : IIT Roorkee

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS411	Deep Learning for Natural Language Processing	**12**	**-**	**3**

CourseCategory:

Independent Learning (Self - Learning Course)

CourseOutcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Understand the fundamental principles of Natural Language Processing and Deep Learning	**K1**
CO2	Analyzing Word Representations , Recurrent Neural Networks, Attention Mechanism	**K2**
CO3	Understand the concept of Self-supervised learning(SSL),Pre training, Applications	**K1**
CO4	Applying concept of the Parameter Efficient Fine-tuning(PEFT)-LoRA, QLoRA	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3		3		3							3		
CO2		3	3		3	2						3		
CO3		2	3	3	3							3		
CO4		3	3	3	3	2						3		

Course Contents

Week1:

Introduction to NLP: What is Natural Language Processing? A brief primer on word and sentence level tasks and n-gram language Model.

Week2: Introduction to Deep Learning

- Shallow and Deep Neural Networks
- Representation Learning

Week3:Word Representations

- Word2Vec
- Glove
- Fast Text,
- Multi lingual representations with emphasis on Indian Languages

Week4:Recurrent Neural Networks

- RNNLMs

- GRUs, LSTMs, Bi-LSTMs
- LSTMs for Sequence Labeling
- LSTMs for Sequence to Sequence

Week5: Attention Mechanism

- Sequence to Sequence with Attention
- Transformers: Attention is all you need

Week6:Self-supervised learning(SSL),Pre training

- Designing SSL objectives
- Pre trained Bi-LSTMs: ELMO
- Pre trainedTransformers:BERT,GPT,T5,BART

Week7:

- Applications: Question Answering, Dialog Modeling, Text Summarization
- Multi lingual extension with application to Indian languages

Week8: Instruction Fine-tuning, FLAN-T5, Reinforcement Learning through Human Feedback (RLHF)

Week9: In-contextlearning,chain-of-thought prompting. Scaling Laws. Various Large Language Models and unique architectural differences

Week10: Parameter Efficient Fine-tuning(PEFT)-LoRA, QLoRA

Week11: Handling Long Context, Retrieval Augmented Generation(RAG)

Week12: Analysis and Interpretability, ethical considerations

CourseProvider : NPTEL
Professor : Prof. Pawan Goyal
University : IIT Kharagpur

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS412	Machine Learning for Engineering and science applications	**12**	**-**	**3**

CourseCategory:

Independent Learning (Self - Learning Course)

CourseOutcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Understand the fundamental principles of Machine Learning, Linear Algebra	**K1**
CO2	Analyzing Computational Basics – Numerical computation and optimization, Introduction to Machine learning packages	**K2**
CO3	Understand the concept of Neural Networks – Multilayer Perceptron, Backpropagation, Applications	**K1**

CO4	Applying concept of the Advanced Techniques 1 – Structured Probabilistic Models, Monte Carlo Methods	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3		3		3							3		
CO2		3	3		3	2						3		
CO3		2	3	3	3							3		
CO4		3	3	3	3	2						3		

Course Contents

Week 1: Mathematical Basics 1 – Introduction to Machine Learning, Linear Algebra
Week 2: Mathematical Basics 2 - Probability
Week 3: Computational Basics – Numerical computation and optimization, Introduction to Machine learning packages
Week 4: Linear and Logistic Regression – Bias/Variance Tradeoff, Regularization, Variants of Gradient Descent, MLE, MAP, Applications
Week 5: Neural Networks – Multilayer Perceptron, Backpropagation, Applications
Week 6: Convolutional Neural Networks 1 – CNN Operations, CNN architectures
Week 7: Convolutional Neural Networks 2 – Training, Transfer Learning, Applications
Week 8: Recurrent Neural Networks RNN, LSTM, GRU, Applications
Week 9: Classical Techniques 1 – Bayesian Regression, Binary Trees, Random Forests, SVM, Naïve Bayes, Applications
Week 10: Classical Techniques 2 – k-Means, kNN, GMM, Expectation Maximization, Applications
Week 11: Advanced Techniques 1 – Structured Probabilistic Models, Monte Carlo Methods
Week 12: Advanced Techniques 2 – Autoencoders, Generative Adversarial Network

CourseProvider : NPTEL
Professor : Prof. Balaji Srinivasan, Prof. GanapathyKrishnamurthi

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS413	Quantum Algorithms And Cryptography	12	-	3

CourseCategory:

Independent Learning (Self - Learning Course)

CourseOutcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Understand the basics of Quantum Information, Entanglement, No Cloning, Quantum Parallelism	K1
CO2	Analyzing the Quantum Algorithms and Cryptography Algorithms	K2
CO3	Understand the concept of Public key encryption and fully homomorphic encryption	K1
CO4	Applying concept of the Quantum key distribution, Quantum one time pad, Quantum public key encryption and Quantum fully homomorphic encryption	K3

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3		3	3							3		
CO2	3	3	3	3	3	2						3		
CO3	3	2		3	3							3		
CO4	3	3	3	3	3	2						3		

Course Contents

Week 1: Basics of Quantum Information
Week 2: Entanglement, No Cloning, Quantum Parallelism.
Week 3: Quantum Algorithms: Deutsch-Jozsa, Simons, Bernstein-Vazirani
Week 4: Introduction to Cryptography, principles of cryptographic design, building cryptography from RSA, Discrete Log
Week 5: Key exchange, Symmetric and public key encryption, Random Oracle Model, RSA and Elgamal encryption
Week 6: Boolean Fourier Analysis, Grover's Algorithm, Quantum Foruier Transform
Week 7: Shor's Algorithm, Hidden subgroup problem
Week 8: Post Quantum Crypto: Introduction to lattices, Useful Lattice Problems. Learning with Errors and Short Integer Solution problem. Connection to dihedral hidden subgroup problem.
Week 9: Public key encryption and fully homomorphic encryption
Week 10: Quantum key distribution, Quantum one time pad
Week 11: Quantum public key encryption
Week 12: Quantum fully homomorphic encryption

Course Provider	**:**	NPTEL
Professor	**:**	PROF. SHWETA AGRAWAL, IIT Madras

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	W	H	C
10212CS414	Foundation of Cloud IoT Edge ML	**8**	**-**	**2**

Course Category:

Independent Learning (Self - Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Understand the fundamental principles of Cloud Computing and Edge Computing to support IoT applications	**K1**
CO2	Analyzing the IoT Edge platforms such as Azure IoT hub, AWS IoT platform	**K2**
CO3	Understand the concept of docker container and kubernetes, MQTT and Kafka for end-to-end IoT pipeline	**K1**
CO4	Applying concept of Machine Learning for IOT in predictive maintenance, image classifier, and self-driving cars	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO2	PSO 3
CO1	3	3			3								3	
CO2	3	3	3	2	3	2							3	
CO3	3	2	3		3								3	
CO4	3	3		2	3	2							3	

Course Contents

Week 1: Introduction to Cloud and its limitations to support low latency use cases
Week 2: Edge Computing to support IoT applications such as self driving cars, etc
Week 3: Introduction to IoT Edge platforms such as Azure IoT hub, AWS IoT platform
Week 4: Introduction to docker container and kubernetes in edge computing
Week 5: Concepts of distributed systems in IoT applications such as time ordering and clock synchronisation, distributed snapshot, etc
Week 6: Edge Design of IoT storage system like key value store
Week 7: Introduction to MQTT and Kafka for end-to-end IoT pipeline
Week 8: Use Cases of Machine Learning for IOT in predictive maintenance, image classifier, and self-driving cars

Course Provider **:** NPTEL
Professor **:** PROF. RAJIV MISRA

University : IIT Patna

OPEN ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
10213CS101	OBJECT ORIENTED PROGRAMMING USING JAVA	3	0	0	3

A.Preamble

This course provides basic concepts about Object Oriented Programming, Java Packages, Exceptions, Database connectivity, Java Streams, JavaFX and Java Servlets, JSP, Spring and Hibernate. After successful completion of this course learners can able to develop software modules for real world problem.

B.Pre-requisite courses:

10210CS101 - Problem Solving using C

C.Course Objectives:

Learners are exposed to,

- Implement Basic OOP principles to solve problems
- Practice Java basic constructs
- Build efficient Programming practice in Java
- Web application development with DB servers
- Work on Frameworks such as Spring and Hibernate

D.Course Outcomes:

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

CO Nos	Course Outcomes	K - Level
CO1	Explain the fundamentals of Java and Object Oriented Programming (OOP) concepts to solve problems.	K2
CO2	Apply the concepts of java inheritance and exception handling mechanisms for real world problem.	K3
CO3	Solve the problems using Java Streams, Collections, UI Design and Threads	K3
CO4	Develop simple web applications using JSP, Servlet with JDBC and Hibernate Framework	K3
CO5	Build quality standalone and web applications using Spring Framework.	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
CO1		2									
CO2		2	2								
CO3		2	2								
CO4		2	3		2						
CO5	2	2	3		2						

3- High; 2-Medium; 1-Low

F.Course contents

UNIT 1 Basics Of OOPS And Java **L-9 Hours**

Introduction to object-oriented programming - Features of Java - JVM- Keywords- Variables - Data types – Operators - Control statements -Command line arguments - Classes and Methods - Objects –Java Packages – Build-in packages - user-defined package -Access specifiers: private, protected, default, public - Constructors - Method Overloading - Type Casting - this keyword- Static – Arrays, Multi-dimensional Arrays.

UNIT 2 INHERITANCE, EXCEPTION HANDLING ANDSTRING **L-9 Hours**

Basics of Inheritance - Forms of Inheritance - Super keyword – Final - Method Overriding – Abstraction: Abstract Classes - Interfaces. Exception Handling: Java Exception Hierarchy - Exception Types - Throwing and Catching exceptions -Declaring New Exception Types – custom exceptions. String class – Immutable String - String handling methods.

UNIT 3 JAVA STREAMS, COLLECTIONS, UI DESIGN, THREAD **L-9 Hours**

Java Streams: Features, methods – Generic Classes and Methods - Collections Frameworks: List, Queue, Set and Map.JavaFX: Architecture, Effects, Transformation, Animation, Layouts, UI Controls, Event Handling.Threads: Life cycle - Thread states - Thread priority– Thread Synchronization.

UNIT 4 SERVER PROGRAMMING, HIBERNATE FRAMEWORK **L-9 Hours**

Introduction to Servlet and JSP, JDBC, Example Web applications with DB - Basics of Java Networking.Introduction to Java Frameworks - Basics of Hibernate – Hibernate Web application - Hibernate Mapping and types – HQL – Annotations – Caching. Integrating Hibernate and Spring.

UNIT 5 JAVA SPRING FRAMEWORK **L-9 Hours**

Basics of Spring – Spring in IDE– Dependency Injection – Constructor Injection – Spring ORM: Spring with Hibernate – SPEL -Spring MVC – Spring Web – Spring JDBC – Spring with Angular – Spring Boot.

TOTAL: 45Hours

G.Learning Resources (in IEEE Format)

i. Text Books:

1. Herbert Schildt, “Java: the Complete Reference”, Eleventh edition, Tata Mc-Graw Hill, 2019. [unit 1, 2, 3]

2. Jim Keogh, “J2EE: The complete Reference”, First Edition, Tata Mc-Graw Hill, 2017. [unit 4]
3. K. Santosh Kumar, “Spring and Hibernate”, McGraw Hill Education, 2017. [unit 4,5]

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. Jason Hunter, William Crawford, “Java Servlet Programming”, Second Edition, O'Reilly-2018.

iii. 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	COURSE TITLE	L	T	P	C
10213CS102	DATA STRUCTURES	3	0	0	3

A.Preamble

This course aims at molding the learner to understand the various data structures, their organization and operations. The course helps the learners to assess the applicability of different data structures and associated algorithms for solving real world problem.

B.Prerequisite Courses

10210CS101 - Problem Solving using C

C.Course Objectives

Learners are exposed to

- Understand basic elementary data structures.
- Illustrate the basic properties of Trees and Graphs.
- Implement various techniques of sorting and searching algorithms.
- Choose efficient data structure and apply them to solve problems.

D.Course Outcomes

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

CO No’s	Course Outcomes	K - Level
CO1	Design modular algorithms to find solution for computational problem with time and space complexities using suitable linear data structure.	K3
CO2	Demonstrate the familiarity with tree data structure, rule to manipulate those, and their canonical applications	K3
CO3	Solve unstructured problem using balanced search tree algorithm, hashing function.	K3
CO4	Implement an appropriate algorithm using graph ADT for an application.	K3
CO5	Apply sorting and searching techniques for real world 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	2	2							
CO2	2	3	3	2							
CO3	2	3	2	2							
CO4	2	2	2	2							
CO5	2	2	3	2							

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Introduction to Data Structure **L- 9 Hours**

Introduction: Dynamic aspects of operations on data, Characteristics of data, Creation, Manipulation and Operations on data, Data Structure and its types, Abstract Data Types (ADTs), Analysis of algorithms and its Types, Asymptotic Notation. Arrays: Allocation, Operations and Storage with one-dimensional arrays and multidimensional arrays. Stacks: Operations on Stacks, Applications of Stacks, Queues: Operations and its types. Linked lists: Operations and Types of linked list (singly, doubly and circularly linked list), Implementation of Stack and Queue using linked list, Applications of Linked List.
Case Study: Tower of Hanoi, Sparse matrix.

Unit 2 Trees **L-9 Hours**

Introduction to Trees – Definitions and concepts, Representation of Binary Tree, Types of Binary tree, properties, structure and applications of binary tree, Binary Tree Traversal with Recursive and Non-Recursive - Expression Tree, Binary Search Trees – Definition, Properties and Operations of binary search tree. Priority Queue: Operations, Implementations- Heaps: properties and types of Heaps, Binary Heap: Representation, Declaration and Creation of Heap, Heapifying, Inserting and Deleting an element, Destroying Heap, Heap Sort. Case Study: Priority Queue in bandwidth management

Unit 3 Special Trees & Hashing **L-9 Hours**

AVL Tree: Properties, Declarations, Rotations, Insertion, Deletion. B-Tree: Properties, Insertion, Deletion –Trie: Insertion, Deletion, Searching.Hashing - Separate Chaining – Open Addressing – Linear Probing – Quadratic Probing – Double Hashing –Rehashing. Case Study: DNA sequence matching

Unit 4 Graphs **L-9 Hours**

Introduction to Graphs – Operations on graphs – Representation of Graph – Topological Sort - Graph Traversal - Depth first search – Breadth First Search – Minimum Spanning Tree – Prim's Algorithm- Kruskal's Algorithm – Disjoint subsets and Union-Find algorithms – Shortest Path Algorithms – Unweighted Shortest Paths –Dijkstra's Algorithm. Applications of Graphs. Case Study: Representing Google maps, Recommendations on e-commerce websites.

Unit 5 Sorting, Searching **L-9 Hours**

Searching Techniques: Linear Search, Binary Search.Sorting techniques: Insertion Sort, Selection sort, Merge sort, Quick Sort, Shell sort, Bubble sort, Counting sort, Bucket sort, Radix sort. Case Study: Tim Sort

Total: 45 Hours

G.Learning Resources

i. Text Books:

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, Reprinted edition 2013. [Unit 1,2,3]
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, "Fundamentals of Data Structure in C", Universities Press,2017. [Unit 4,5]

ii. Reference Books:

1. V. Aho, J. E. Hopcroft, and J. D. Ullman, “Data Structures and Algorithms”, Pearson Education, First Edition, Reprint 2017. [Unit 1,2]
2. R. F. Gilberg, B. A. Forouzan, “Data Structures”, Second Edition, Thomson India Edition, 2007. [Unit 3,4]
3. Seymour Lipschutz, “Data Structures with C”, Scham’s outlines, Tata McGraw Hill, 2017. [Unit 4,5]

iii. Online References:

1. “Introduction to Data Structures and Algorithms” 31.12.2009. Accessed on Apr. 20, [Online]. Available: https://nptel.ac.in/courses/106/102/106102064/.
2. “Data Structures and algorithms”. Accessed on: Apr. 15, 2021 [Online]. Available: https://www.coursera.org/specializations/data-structures-algorithms.
3. “Data structures Visualization” 2011. Accessed on: Apr. 15, 2021 [Online]. Available: https://www.cs.usfca.edu/~galles/visualization/Algorithms.html
4. “Data Structures Fundamentals” 2021, Accessed on: Apr. 20,2021 [Online]. Available: https://www.edx.org/course/data-structures-fundamentals

COURSE CODE	COURSE TITLE	L	T	P	C
10213CS103	OPERATING SYSTEMS	3	0	0	3

A.Preamble

This course provides discussion about Operating systems kernel architecture, address spaces, system call interface, processes & threads, inter process communication, CPU scheduling deadlock, scheduling, main memory, virtual memory and file systems. This course aims to understand how Operating system makes computer system convenient to use in an efficient manner.

B.Prerequisite Courses

10211CS102 - Data Structures

C.Course Objective

Learners are exposed to

- Recognize operating Systems basic concepts, structures and System Calls
- Apply process management concepts and Synchronization techniques
- Learn different CPU scheduling algorithms and Deadlock Handling methods
- Understand Various Memory and File management techniques

D.Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Describe the operating system structures ,operations and system calls	K2
CO2	Demonstrate process management concepts and process synchronization methods for real time problems.	K3
CO3	Illustrate CPU scheduling algorithms and deadlock handling methods for the given situation.	K2
CO4	Explain the concepts of various memory management techniques.	K2
CO5	Discussthe concepts of disk Management and File System Interface.	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
CO1	2										
CO2	2	3	2	2							
CO3	2	3	2	2							
CO4	2	2	2	2							
CO5	2	2	2	2							

3- High; 2-Medium; 1-Low

F.Course Contents

UNIT 1 STRUCTURE AND OVERVIEW OF OPERATING SYSTEMS L- 8 Hours

Operating system overview: Objectives – functions - Computer System Organization - operating System Operations- System Calls, System Programs-Operating- System Structure: Traditional UNIX system structure-The Mac OS X structure - Architecture of Google's Android.

UNIT 2 PROCESS MANAGEMENT L-10 Hours

Processes: Process Concept – Threads - Process Scheduling - Operations on Processes – Inter process Communication - Communication in Client–Server Systems-Pipes (RPC, Pipes) - Process Synchronization: The Critical-Section Problem - Semaphores – Mutex Locks- Classic Problems of Synchronization – Monitors. Case Study: Windows Threads and Linux Threads

UNIT 3 CPU SCHEDULING AND DEADLOCK MANAGEMENT L-9 Hours

CPU Scheduling: Scheduling Criteria - Scheduling Algorithms. Deadlocks: Deadlock Characterization - Methods for Handling Deadlocks - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock. Case Study: Real Time CPU scheduling

UNIT 4 MEMORY MANAGEMENT L-9 Hours

Main Memory: Swapping - Contiguous Memory Allocation, Segmentation, Paging - Structure of the Page Table - Virtual Memory: Demand Paging - Page Replacement - Allocation of Frames – Thrashing. Case study: Virtual machine

UNIT 5 STORAGE STRUCTURE & FILE SYSTEMS L-9 Hours

Mass Storage Structure: Disk Structure - Disk Scheduling - Disk Management-Structure - File-System Interface: File Concepts -Directory Structure - File Sharing – Protection- File Allocation Methods-NFS. Case study: Recovery in Windows.

TOTAL: 45 Hours

G.Learning Resources (in IEEE Format)

i. Text Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2016.

ii .Reference Books:

1. Andrew S. Tanenbaum, "Modern Operating Systems", 4th Edition, Prentice Hall, Wesley, 2014.
2. Operating Systems: Principles and Practice (2nd Edition), by Thomas Anderson and Michael Dahlin.

iii. Online Resources:

1. "Learn Operating System" Accessed on: April 21, 2021 [Online]. Available:https://www.tutorialspoint.com/operating_system/index.htm
2. Prof.Santanu Chattopadhyay, "Operating System Fundamentals" July 25,2019. Accessed on: April 21, 2021 [Online]. Available:https://nptel.ac.in/courses/106/105/106105214/

COURSE CODE	COURSE TITLE	L	T	P	C
10213CS104	DATABASE MANAGEMENT SYSTEMS	3	0	0	3

A.Preamble

Databases form the backbone of all major applications today – tightly or loosely coupled, intranet or internet based, financial, social, administrative, and so on. Structured Database Management Systems (DBMS) based on relational and other models have long formed the basis for such databases. While DBMS's differ in the details, they share a common set of models, design paradigms via a Structured Query Language (SQL) or NoSQL. More specifically, this course introduces relational data models; entity-relationship modeling, SQL, data normalization, database design and modern databases asd well lightweight databases.

B.Prerequisite Courses

10211CS102 – Data Structures

C.Course Objectives

Learners are exposed to

- Design a database at basic level like Entity-Relationship modeling, Relational Modeling.
- Devise a database using Armstrong axioms, functional dependencies and views.
- Acquire knowledge of Query processing and concurrency transaction control.
- Learn an implementation issues with nontraditional databases.

D.Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Infer database system with basic database designing methodologies.	**K2**
CO2	Design a database schema for a given problem-domain.	**K3**
CO3	Apply normalization for the given database application.	**K3**
CO4	Relate the properties of transaction, and recovery management.	**K2**
CO5	Use of storage and CRUD operations in modern databases.	**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
CO1	2										
CO2		3	2	2							
CO3		3	2								

CO4		**2**	**2**								
CO5		**2**		**2**							

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Introduction To DBMS L-9 Hours

Purpose of Database System – Database Schema and Instances- Views of data – Database Languages - Database System Architecture – Database users and Administrator –Distributed Databases-DDB System Architecture-Database models-Entity–Relationship model – E-R Diagrams - Introduction to relational databases –Structure of relational databases- Relational model-Basics- From E/R diagrams to Database Design- Hierarchical model-Tree-structure diagrams- data retrieval-update facility-virtual records-mapping of hierarchies to files-Network Model- Data-structure diagrams-DBTG model- data retrieval-Find-Get-Set processing-update facility-Mapping network to files. Case study: Conference Management system.

Unit 2 Database Design And Query Optimization L-9 Hours

Keys and Integrity Constraints - Relational Algebra – Relational Calculus-Tuple –Structured Query language(SQL) Basic and additional Operations –Database Languages Revisited – create-alter- update-insert-rename-truncate-drop-select query commands-grant-revoke-rollback-commit control commands-Operators-aggregate functions-string-indent-date functions-set-union-union all-aliasing-Nested Queries & Join Queries–Join-Natural-inner-equi-cross/cartesian-outer-left-right-full outer join-Common Table Expressions-limit function in statistics-summarizing-Embedded SQL- Indexes and Triggers –compound-Views Definitions -Materialized view-Assertions-Query Processing and Optimization-Heuristics and cost estimates in Query Optimization-Tuning. Case study: Restaurant chain for network model.

Unit 3 Functional Dependencies And Normalization L-9 Hours

Introduction and problem of data Redundancy-Features of good Relational database design-Functional Dependencies - Normalization – First Normal Form-minimal cover-canonical Cover-Decomposition- Second Normal Form- Third Normal Form –controversies with SQL in Normalization-Advanced Normalization -Boyce/Codd Normal Form, Fourth Normal Form and Fifth Normal Form- Dependencies preservation-Denormalization-Case Studies of database system like Air-cargo services**.**

Unit 4 Transaction And Concurrency L-9 Hours

Transaction Concepts –Schedules- Transaction States - Concurrent Execution-Serializability- -Two Phase locking Protocol –Timestamp ordering Protocol-Validation Based Protocol-Multiple Granularity-Intention lock modes-Multiple granularity locking

scheme-Replication in Distributed databases-Deadlock-Handling-Prevention-Wait-die scheme- wound-wait scheme- Detection-Wait-for graph-Phantom phenomenon-Distributeddeadlock detection-Index locking-weak levels of concurrency- Concurrency in index structures- B+ Tree crabbing- -Types of Failure-Recoverability -Recovery and Prevention- Log based recovery-undo-redo-checkpoint-Recovery Algorithm-Transaction rollback with Logical undo- Recovery Algorithm with Logical Undo-ARIES Recovery Algorithm.

Case study: Instances and Log recovery process in Oracle and Microsoft Access.

Unit 5 Storage And Modern Databases L-9 Hours

RAID storage -Modern databases-XML Databases- CAP Theorem-Datalog-Basic structure-Syntax-semantics-Relational operation in Datalog-Recursion in Datalog-Power of Recursion-Monotonicity-Non-monotonicity-NoSQL-Data models-Key value store, column families-Document Databases-MongoDB-Introduction to MongoDB- CRUD operations-

Create-Insert-Update-Query-Removing documents-Sharding- Introduction to Mongoose-core concepts-extending models-CRUD operations with mongoose. Case study: Designing local library in Amazon using mongoose-SQLite-Building and Installing SQLite-DDL-

DML-TCL-Select-compound select- alternate Join- JOIN..ON, JOIN..USING-Database design-SQL functions and SQLite extensions-Virtual Tables and Modules.

Total: 45 Hours

G.Learning Resources

i.Text Books:

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, “Database System Concepts”, Seventh Edition, Tata McGraw Hill, 2019.[Units-1,2,3,4,5]
2. Shannon Bradshaw, E Brazil, Kristina Chodorow, "MongoDB: The Definitive Guide - Powerful and Scalable Data Storage", Third Edition, Shroff/O'Reilly Inc., January 2020.[Unit-5]
3. AgusKurniawin, “Python and SQLite Development”, First Edition, PE Press, January 2021. [unit-5]

ii.Reference Books:

1. Raghu Ramakrishnan et al, “Database Management Systems”, Third Edition, McGraw Hill, 2014.
2. Elmasri Ramez, Navathe S, “Fundamentals of Database System”, Seventh Edition, Pearson, 2017.
3. J.D.Ullmann et al, "Database Systems: The Complete Book", Second Edition, Pearson Ed, Inc, 2009.

iii.Online References:

1. “Database Management System Part-1&11” Mar.25, 2019. Accessed on Feb.20, 2021[Online].Available:https://infytq.onwingspan.com/en/viewer/web_module/lex_auth_01305427365738086410 06_shared?collectionId=lex_auth_0127580666728202 2456_shared&collectionType=Course.
2. “Database Design”, Dec 31, 2009. Accessed on May05,2021[Online]. Available: https://nptel.ac.in/courses/106/106/106106093/.
3. “Designing local library models”, Accessed on: May 05, 2021[online]. Available: https://developer.mozilla.org/en-US/docs/Learn/Server-side/Express_Nodejs/mongoose.

COURSE CODE	COURSE TITLE	L	T	P	C
10213CS105	COMPUTER NETWORKS	3	0	0	3

A.Preamble

This course is to provide students with an overview of the concepts and fundamentals of computer networks. Topics to be covered include: data communication concepts and techniques in a layered network architecture, communications switching and routing, types of communication, network congestion, network topologies, network configuration and management, network model components, layered network models (OSI reference model, TCP/IP networking architecture) and their protocols, various types of networks and their protocols.

B.Prerequisite Courses

10211CS102 - Data Structures

C.Course Objectives

Learners are exposed to

- Build an understanding of the fundamental concepts of computer networking, protocols, architectures, and applications.
- Understand the division of network functionalities into layers.
- Learn the flow control and error control mechanisms.
- Obtain the skills of subnetting and routing mechanisms.
- Explain the transport layer and application layer protocols.

D.Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Discuss the basic fundamentals of networks for data communication and protocol Layering.	**K2**
CO2	Know the various techniques and standards of analog and digital data communication and its standards	**K2**
CO3	Apply various error detection, correction and flow control techniques for efficient transmission of data.	**K3**
CO4	Interpret the functions and protocols of network and transport layer.	**K2**
CO5	Outline the various protocols of application layer.	**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
CO1	3										
CO2	3	2									
CO3	3	3		2							
CO4	2	3		2							

CO5	3										

3- High; 2-Medium; 1-Low

F.Course Contents

Unit 1 Introduction **L-8 Hours**

Data Communication: system components (Passive and Active)-Topology-Network Models: OSI-TCP/IP-Physical and Logical Addressing-WLAN-Data and Signals - Transmission Impairment - Data rate and Channel capacity.

Unit 2 Physical Layer **L- 9 Hours**

Transmission Media: Guided Media - Unguided Media -Digital Transmission - Digital-To - Digital Conversion - Analog Transmission - Digital-To-Analog Conversion - Wireless - Wired LANs: Ethernet - Token ring - Connecting Devices – Switching techniques – Bandwidth Metrics.

Unit 3 Data Link Layer **L-10 Hours**

Link Layer: Types of errors –Error detection- VRC, LRC, CRC andChecksum techniques - Data Forward and backward error correction - Hamming code. Flow control: stop and wait- sliding window protocol, Error control: Stop and wait ARQ- Go-Back-N ARQ- Selective Repeat ARQ Protocols- Asynchronous and Synchronous Protocol- Logical Link Control protocols: HDLC, ALOHA and FDDI.

Unit 4 Network layer, Transport Layer **L-10 Hours**

Logical Addressing: Addressing Methods - IPV4 - IPV6 - Frame Format - IPV6 implementation scenarios and challenges – ARP– RARP - DHCP – ICMP - Unicast Routing Protocols – Intra and Interdomain Routing - Distance Vector Routing - Link State Routing-Transport Layer: Process-to-Process Delivery: UDP – TCP - Congestion Control Techniques - Quality of Service - Techniques to Improve QoS.

Unit 5 Application Layer and Network Security **L-8 Hours**

Session Layer: Functions-Protocols: Winsock, Socket-Remote Procedure Call-Presentation Layer: Functions- Compression Techniques: Lossy and Lossless - Application layer protocols: REMOTE LOGGING - TELNET -EMAIL– DNS – FTP -HTTP – SDN-Introduction-Security Fundamentals.

Total: 45 Hours

F.Learning Resources

i. Text Books:

1. Behrouz Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 5th Edition,2021. (Reprinted) (Unit 1 to 5)

ii. Reference Books:

1.Kurose and K.W. Ross, “Computer Networking: A Top-Down Approach Featuring the Internet”, Addison-Wesley,2017

2. Andrew S. Tanenbaum, David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2013.

3. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud,5th Edition,2017

iii. Online References:

1.“Computer Communication Specialization” Course Era [online] 2019. Available:https://www.coursera.org/specializations/computer-communications

2.”Introduction to Networking” edx [online] 2020,Available: https://www.edx.org/course/introduction-to-networking

3.“Computer Networking” Udacity [online] 2020, ../../WELCOME/AppData/Roaming/Microsoft/Word/Available: https://www.udacity.com/course/computer-networking--ud436
4.“Computer Networks and Internet Protocol” NPTEL [online] 2018, Available: https://nptel.ac.in/courses/106/105/106105183/

COURSE CODE	COURSE TITLE	L	T	P	C
10213CS106	DATA WAREHOUSING AND DATA MINING	3	0	0	3

A.Preamble

The course introduces the concepts of data warehouses, modeling and design of data warehouse, techniques for preprocessing, data mining algorithms such as Association rule analysis, classification, clustering and applications of data mining.

B.Prerequisite Courses

10213CS104- Database Management Systems

C.Course Objectives

Students undergoing this course are expected to

- Be familiar with the concepts of Data warehouse, Multidimensional data model and OLAP.
- Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
- Apply data mining techniques in various applications like social, scientific and environmental context.
- Develop skills in selecting the appropriate data mining algorithm for solving practical problems.

D.Course Outcomes

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

CO No’s	Course Outcomes	K - Level
CO1	Discuss the subject areas for which a data warehouse is to be built.	K2
CO2	Design Multidimensional data model for data warehouse and analyze the market needs by applying the suitable OLAP operations.	K3
CO3	Choose appropriate input data and preprocess it to provide suitable input for range of data mining algorithms	K3
CO4	Apply Association rule mining, classification techniques to discover various mining patterns.	K3
CO5	Identify the similar objects using clustering techniques and explore recent trends in data mining such as web mining, text mining and spatial	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
CO1	2										
CO2		3	2	3							
CO3	2										
CO4	2	2		2							

CO5	2	2		2	2						

3- High; 2-Medium; 1-Low

F.Course Content

UNIT 1 Data Warehousing **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, Mapping the Data Warehouse to a Multiprocessor Architecture, DBMS Schemas for Decision Support, Metadata Management in Data Warehouse: Introduction to Metadata, Categorizing Metadata, Metadata management in practice, Tools for Metadata management.

UNIT 2 Business Analysis **L-9 Hours**

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 – OLAP Guidelines – Hypercube &Multicubes- Multidimensional versus Multirelational OLAP – Categorization of OLAP Tools- Tuning for data warehouse - Computation of Data Cubes, modeling - OLAP data, OLAP queries - Data Warehouse back end tools - Tuning and testing of Data Warehouse.

UNIT 3 Data Mining **L-9 Hours**

Introduction to Data mining and Knowledge Discovery – Data – Databases – Data Mining Functionalities – Steps in Data Mining Process, Architecture of Typical Data Mining systems – Interesting Pattern - Classification of Data Mining Systems – Data Mining Task Primitives – Data Mining Query Languages, Designing Graphical User Interfaces Based on a Data Mining Query Language Architectures of Data Mining Systems. – Issues –Data Preprocessing: Needs Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

UNIT 4 Association Rule Mining And Classification **L-9 Hours**

Association Rule Mining, Mining SingleDimensional Boolean Association Rules from Transactional Databases, Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules from Relational Databases and DataWarehouses, From Association Mining to Correlation Analysis, – Constraint Based Association Mining – Classification and Prediction - Basic Concepts - Decision Tree Induction - Bayesian Classification –Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction: Linear Regression - Logistic Regression.

UNIT 5 Clustering, Applications And Trends In Data Mining **L-9 Hours**

Cluster Analysis - Types of Data – Categorization of Major Clustering Methods– Partitioning Methods: K-Means – Hierarchical Methods: Agglomerative and Divisive Clustering –BRICH - ROCK- Chameleon- Density Based Method- DBSCAN-OPTICS-DENCLUE- Outlier Analysis

– Mining Complex Types of Data: Multi dimensional Analysis and Descriptive Mining of Complex, Data Objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time-Series and Sequence Data, Mining Text Databases, Mining the World Wide Web.
Case Studies (Simulation Tool).

Total : 45 Hours

G.Learning Resources (in IEEE Format)

i.Text Books:

1. W.H. Inmon, “Building the Data Warehouse”, John Wiley & Sons, Inc, 4th Edition, 2005-(Online Publication : 2014). (Unit 1)
2. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012. (Unit 2-5)

ii.Reference Books:

1. Hadley Wickham and Garrett Grolemund ”R for Data Science”- O’Reilly Media Inc.,2017.
2. Alex Berson and Stephen J. Smith, “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Tenth Reprint 2007.
3. Julia and David Robinson-“Text Mining with R” -O’Reilly Media Inc.,2017.

iii.Online References:

1. Data Mining, Standford University, [Online] http://infolab.stanford.edu/~ullman/mmds/ch1.pdf
2. Data Warehouse Design: Modern Principles and Methodologies, Golfarelli & Rizzi, [online] https://cdn.ttgtmedia.com/searchDataManagement/downloads/Data_Warehouse_Design.pdf

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

10211CS102- 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	PSO1	PSO2	PSO3
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-9Hours**

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-9Hours**

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-9Hours**

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-9Hours**

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

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	PSO3
CO1	3	3	3	3	2									
CO2	3	3	3	3	2									
CO3	3	3	3	3	2									

CO4	3	3	3	3	2									
CO5	3	3	3	3	2									

High- 3; Medium-2; Low-1

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

COURSE CODE	COURSE TITLE	L	T	P	C
10213GE302	PROGRAMMING CHALLENGES	0	0	4	2

A. Preamble

This course will empower students with a strong foundation in problem-solving, algorithmic thinking, coding proficiency, and code optimization. This course helps, students to participate in live coding challenges on platforms like Code chef, hacker earth, code forces, enhancing their problem-solving skills and increasing their competitiveness in technical interviews and coding competitions.

B. Prerequisite Course:

10210CS101-Problem solving using C

C. Course Objectives

Learners are exposed to:

- Master algorithmic thinking and the design of efficient algorithms.
- Learn strategies for competitive coding and performing well under time constraints.
- Understand the importance of code optimization for real-world applications..

D.Course Outcomes

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

CONo's	Course Outcomes	K - Level
CO1	Apply algorithms to solve real-world coding challenges.	K3
CO2	Develop effective coding and debugging skills in time-sensitive scenarios.	K3
CO3	Identify optimized algorithms to efficiently solve complex problems in coding challenges.	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 POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3							3			
CO2	3	3	3	3							3			
CO3	3	3	3	3							3			

3 - High; 2 - Medium; 1 - Low

F. Course Contents

This programming challenges course facilitates practical, hands-on experiences for students, empowering them to apply their knowledge and enhance their problem-solving skills. One of the key components of this course involves participating in live coding challenges on platforms like CodeChef, hacker earth, leet code. These challenges are designed to test the ability of the student to solve real-world problems and to reinforce the concepts and skills learned by the student throughout the course.

Total: 60 Hours

G.Learning Resources

Online Resources:

1. https://www.hackerrank.com
2. https://leetcode.com
3. https://www.geeksforgeeks.org
4. https://www.codechef.com

COURSE CODE	COURSE TITLE	L	T	P	C
10213GE204	APPLICATION DEVELOPMENT AND MAINTENANCE	3	0	2	4

(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		

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	2						3			
CO2	3	3	3	3	2						3			
CO3	3	3	3	3	2						3			
CO4	3	3	3	3	2						2			
CO5	3	3	3	3	2						2			

3 - High; 2 - Medium; 1 - Low

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 CloudPractitioner 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.Laboratory Experiments Total: 30 Hours

Part – 1

Task 1: Working with Unix OS Commands.

[**OS:** UNIX, LINUX, **IDE:** Terminal]

Task2. Develop a Simple Java application with class (Object), Methods and Packages.
[**Package:** java.io, java.util, **IDE:** Eclipse]

Task 3: Inheritance & Interfaces

- Demonstrate Method overloading, constructor and Method Overriding.
- Develop a code for user-defined interface and pre-defined interface concept
  [**Package:** java.io, java.util, **IDE:** Eclipse]

Task 4: Exception Handling Mechanism in Java

- Construct a program to handle user defined and predefined exceptions
- Design the code with performing Checked and Unchecked Exceptions
  [**Package:** java.io, java.lang, **IDE:** Eclipse]

Task 5: Conceptual Design after FTR

Using basic database design methodology and ER modeler, design Entity Relationship Diagram by satisfying the following sub tasks:

- Identifying the entities.
- Identifying the attributes.
- Identification of relationships, cardinality, type of relationship.
- Reframing the relations with keys and constraints.

[**Database:** MySQL]

Task6: Generating design of another traditional database model

Creating Hierarchical /Network model of the database by enhancing the sound abstract data by performing following tasks using forms of inheritance:

- Identify the specificity of each relationship, find, and form surplus relations.
- Check is-a hierarchy/ has-a hierarchy and performs generalization and/or specialization relationship.
- Find the domain of the attribute and perform a check constraint to the applicable.
- Rename the relations.
- Perform SQL Relations using DDL, DML, DCL commands
  [**Database:** MySQL]

Task7. Construct a dynamic webpage using JavaScript.
[IDE: Visual Studio**]**

Task8. Manipulating the DOM with javascript
[IDE: Visual Studio**]**

Task 9: UI/UX Design

- Design a UI for the home page using figma tool.
  [Tool: figma**]**

Task 10: AWS Cloud Practitioner
Deployment and Management
a) Choose a sample web application.
b) Deploy the application on an EC2 instance.
c) Outline the steps taken and any challenges faced during deployment.
[Services: AWS Cloud**]**

Part– 2 Use cases:

Use case-1: Develop Online learning platform

An educational technology company is planning to develop an online learning platform to offer programming courses to students. The platform aims to provide a seamless learning experience.
Technologies Used: JavaScript, UI/UX principle, Generative AI, AWS Cloud services.

Use case-2: Tracking the student marks statement:
In the college, every month the assessment test will be scheduled and results will be updated in the portal. Create the web page with username and password of each student and with admin controls. The student can track the test marks by applying their login credentials in the server page and get the exact marks, when the test is attended and when the marks are updated in the portal and result status. Demonstrate the web page with frontend and backend control to track the mark statements and design the interface to make it user friendly.
Technologies Used: JavaScript, UI/UX principle, Generative AI, AWS Cloud services.

Total: 75 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

OPEN

ELECTIVE

(Self Learning Courses)

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10213CS442	SOCIAL NETWORKS	12	-	3

CourseCategory: 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)

CourseProvider : 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

CourseCategory: 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

CourseCategory: 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

CourseProvider : 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

CourseCategory: 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

CourseProvider : 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

CourseCategory: 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

CourseProvider : NPTEL
Professor : Prof Ponnurangam Kumaraguru

Prof Balaraman Ravindran
Prof Arun Rajkumar

University : IIIT Hyderabad
IIT Madras

Academic Year:	2024-2025
Semester :	Winter

COURSE CODE	COURSE TITLE	W	H	C
10213CS448	Data Analytics with Python	12	-	3

Course Category:

Open Elective (Self- Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Understand and apply data analytics fundamentals	K3
CO2	Analyze sampling and distributions	K3
CO3	Perform hypothesis testing for decision-making	K3
CO4	Model relationships through regression	K3
CO5	Explore advanced regression techniques	K2

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO1 0	PO11	PSO1	PSO 2
CO1	2	3	2	2	1	2	1					2	3
CO2	2	3	3	2	1	2	1					2	3
CO3	2	3	3	2	1	2	1					2	2
CO4	3	3	2	3	2	2	1					3	3
CO5	2	3	2	3	3	1	1					2	3

Course Contents:

Week 1 : Introduction to data analytics and Python fundamentals
Week 2 : Introduction to probability
Week 3 : Sampling and sampling distributions

Week 4 : Hypothesis testing
Week 5 : Two sample testing and introduction to ANOVA
Week 6 : Two way ANOVA and linear regression
Week 7 : Linear regression and multiple regression
Week 8 : Concepts of MLE and Logistic regression
Week 9 : ROC and Regression Analysis Model Building
Week 10 : C^2 Test and introduction to cluster analysis
Week 11 : Clustering analysis
Week 12 : Classification and Regression Trees (CART)

Professor : By Prof. A Ramesh
University : IIT Roorkee

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	Course Provider	W	H	C
10213CS449	The Joy of Computing using Python	NPTEL	12	-	3

Course Category:
Open Elective (Self - Learning Course)

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Motivation for Computing	K2
CO2	Variables and Expressions: Design your own calculator	K3
CO3	Loops and Conditionals: Hopscotch once again	K3
CO4	Lists, Tuples and Conditionals: Lets go on a trip	K3
CO5	Sorting: Arrange the books and Searching : Find in seconds	K3

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	1	1	-	-	-	-	2	2	
CO2	2	3	3	3	2	2	1	-	-	-	-	3	3	
CO3	2	3	3	3	2	2	1	-	-	-	-	2	3	
CO4	2	3	3	3	2	3	1	-	-	-	-	3	3	
CO5	3	3	2	3	2	1	1	-	-	-	-	3	2	

Course Contents:

- Motivation for Computing
- Welcome to Programming!!
- Variables and Expressions : Design your own calculator
- Loops and Conditionals : Hopscotch once again
- Lists, Tuples and Conditionals : Lets go on a trip
- Abstraction Everywhere : Apps in your phone
- Counting Candies : Crowd to the rescue
- Birthday Paradox : Find your twin
- Google Translate : Speak in any Language
- Currency Converter : Count your foreign trip expenses
- Monte Hall : 3 doors and a twist
- Sorting : Arrange the books
- Searching : Find in seconds
- Substitution Cipher : What's the secret !!
- Sentiment Analysis : Analyse your Facebook data
- 20 questions game : I can read your mind
- Permutations : Jumbled Words
- Spot the similarities : Dobble game
- Count the words : Hundreds, Thousands or Millions.
- Rock, Paper and Scissor : Cheating not allowed !!
- Lie detector : No lies, only TRUTH
- Calculation of the Area : Don't measure.
- Six degrees of separation : Meet your favourites
- Image Processing : Fun with images
- Tic tac toe : Let's play
- Snakes and Ladders : Down the memory lane.
- Recursion : Tower of Hanoi
- Page Rank : How Google Works !!

Professor : By Prof.Sudarshan
University : IIT Ropar

Academic Year: 2024-2025
Semester : Winter

COURSE CODE	COURSE TITLE	Course Provider	W	H	C
10213CS450	Introduction to Large Language Models (LLMs)	NPTEL	12	-	3

CourseCategory:

Open Elective (Self- LearningCourse)

CourseOutcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)

CO1	Understand the Foundations of Natural Language Processing (NLP)	**K2**
CO2	Apply Deep Learning Techniques to NLP Tasks	**K3**
CO3	Build and Analyze Language Models	**K3**
CO4	Develop Models with PyTorch for NLP Applications	**K3**
CO5	Design and Train Advanced Sequence-to-Sequence Models	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	3	2	3	1	1						2	3	
CO2	2	3	3	3	2	1						3	3	
CO3	3	3	3	3	2	1						3	3	
CO4	3	3	3	3	2	1						3	3	
CO5	3	3	3	3	3	2						3	3	

CourseContents:

Week 1

1. Introduction to NLP – Part 1 (NLP pipeline, applications of NLP)
2. Introduction to NLP – Part 2 (distributional semantics)

Week 2

1. Introduction to Deep Learning (Perceptron, ANN, backpropagation, CNN)
2. Word vectors (Word2Vec, GloVe, fastText)

Week 3

1. Introduction to Statistical Language Models (N-gram LM, Perplexity, Smoothing)
2. Language Models with CNN and RNN

Week 4

1. Introduction to PyTorch
2. Implementation of RNNs and LSTMs using PyTorch

Week 5

1. Sequence-to-sequence models, Beam search
2. Attention and self-attention

Week 6

1. Introduction to Transformers
2. Positional Embedding, various tokenization strategies
3. Implementation of Transformers using PyTorch

Week 7

1. Transfer Learning: ELMo, BERT (Encoder-only Model)
2. Transfer Learning: GPT (Decoder-only Model), T5 (Encoder-decoder model)

Week 8

1. Prompting (hard and soft) and Instruction fine-tuning (FLAN)
2. Advanced prompting (Chain of Thoughts, Graph of Thoughts, Prompt Chaining, etc.)
3. Introduction to HuggingFace Library

Week 9

1. Alignment with Human Feedback: RLHF, RLAIF
2. Parameter-efficient adaptation (Prompt tuning, Prefix tuning, LoRA)

Week 10

1. Knowledge graphs (KGs)
   a. Representation, completion
   b. Tasks: Alignment and isomorphism
   c. Distinction between graph neural networks and neural KG inference

Week 11

1. Open-book question answering: The case for retrieving from structured and unstructured sources;retrieval-augmented inference and generation
2. Retrieval augmentation techniques
   a. Key-value memory networks in QA for simple paths in KGs
   b. Early HotPotQA solvers, pointer networks, reading comprehension
   c. REALM, RAG, FiD, Unlimiformer
   d. KGQA (e.g., EmbedKGQA, GrailQA)

Week 12

1. Overview of recently popular models such as GPT4, Llama 3, Claude 3,Mistral, and Gemini
2. Ethical NLP – Bias and Toxicity
3. Conclusion

Professor : **Tanmoy Chakraborty,** , **Prof. SoumenChakraborti**
University : IIT Delhi, IIT Bombay

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10212CS410	Introduction to Internet of Things	12	-	3

CourseCategory:

Program Elective (Independent Learning - Self - Learning Course)

CourseOutcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Understand the fundamental principles of Introduction to IoT, Basics of Networking	K1
CO2	Analyzing the Sensor Networks, Integration of Sensors and Actuators with Arduino	K2
CO3	Understand the concept of Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi	K1
CO4	Applying concept of the IoT with Cloud Computing, Fog Computing, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring	K3

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3		3		3							3		
CO2	3	3	3		3	2						3		
CO3		2		3	3							3		
CO4		3		3	3	2						3		

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

CourseProvider : NPTEL
Professor : Prof. SudipMisra
University : IIT Kharagpur

Academic Year: 2024-2025
Semester : Summer

COURSE CODE	COURSE TITLE	W	H	C
10213CS447	Advanced Computer Architecture	**12**	**-**	**3**

CourseCategory:

Open Elective (Self - Learning Course)

CourseOutcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Apply the concepts of in-order and out-of-order pipelines to analyze processor performance.	**K3**
CO2	Implement branch prediction and advanced speculation techniques to optimize execution.	**K3**
CO3	Demonstrate compiler optimization techniques to enhance instruction-level parallelism (ILP).	**K3**
CO4	Design cache memory systems with optimization strategies for reduced latency and improved performance.	**K3**
CO5	Apply low-power design techniques and hardware reliability principles to modern processors.	**K3**

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	3	3	2	2								2
CO2	3	3	3	3	3								2
CO3	3	2	3	3	3								2
CO4	3	3	3	3	3								2
CO5	3	3	3	3	2	2							2

Course Layout

Week-1:In-order pipelines overview
Week-2:Out-of-order pipelines, Branch prediction
Week-3:Advanced branch prediction techniques
Week-4:Issue, select, and commit
Week-5:Aggressive speculation
Week-6:Compiler techniques for enhancing ILP
Week-7:Caches: optimizations Design, modeling, and
Week-8:On-chip networks
Week-9:Theory of memory models
Week-10:Coherence Protocols
Week-11:Low power design
Week-12:Reliability and Hardware Security

CourseProvider : NPTEL

Professor : Prof. SmrutiRanjan Sarangi

University : IIT DELHI

VALUE ADDED COURSE

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
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	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 calculation6 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

2. 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:

4. Nina Godbole, SumitBelapure, “Cyber Security”, Willey India, Edition 1, 2012.
5. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, “Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives”, CRC Press, ISBN 9780815371335, 2018.
6. Raef Meeuwisse, “Cyber Security for Beginners”, Cyber Simplicity Ltd., 2017.

ii. References Books:

4. Gary M. Jackson, “Predicting Malicious Behavior: Tools and Techniques for Ensuring Global Security”, John Wiley & Sons Publisher, June 2012.
5. Roger Grimes, “Hacking the Hacker”, Wiley India, 2017.
6. 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_01384318264289689632577_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_013842854944423 93625073_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_0129563012988354561318_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 Concepts6 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:
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	Total Hours
10218CS936	LINUX ADMINISTRATION	30

A. Preamble

InfosyslaunchedInfyTQ-ALinux administrator mustknowhowto manipulateandmanage processes. Introduce yourself to processes, services, and daemons, and how tomanage themin Linux.

B. Prerequisite course

Nil

C. Course Objectives:

Learnersareexposedto:

- 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:

Uponthesuccessfulcompletionofthecourse,studentswillbeableto:

CO	CourseOutcomes	K-Level
CO1	Illustratemanipulationandmanagingtheprocessin Linux	K3
CO2	ApplySystemtostartandstop theprocessin Linux	K3

K1-RememberK2-UnderstandK3-Apply K4-Analyze K5-Evaluate K6-Create

E. CorrelationofCOswithProgramoutcomesandProgrammeSpecificOutcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2										2		
CO2	2	2		2	2									

High-3;Medium-2;Low-1

E. Coursecontents

PROCESSANDMONITOR

List and identify running processes, recognize common running process monitorprocessesand their resource utilization, start and stop processes, set or chan thepriorityfora process.

TROUBLESHOOTANDSYSTEMD

Troubleshootoridentifyproblemprocesses,startandstopanetworkservice,configureaservi tostartornotstartatboot,useSystemDtostartservices,workwithSystemDto managerunningservices, useSystemDtomanagethe system.

TOTAL30 Hours

H.LearningResources:

i. OnlineResources:

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

A. Course Category: Value Added Course

COURSE CODE	COURSE TITLE	Total Hours
10218CS937	BASH SHELL SCRIPTING ADMINISTRATION	30

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_0138431286894264323149 8_shared?collectionType=Course&collectionId=lex_auth_013843129228853248322 03_shared&pathId=lex_auth_0138431276830720003219 2_shared

COURSE CODE	COURSE TITLE	Total Hours
10218CS941	JAVA PROGRAMMING FUNDAMENTALS	30

A. CourseCategory: ValueAddedCourse
B. OfferedSemester:WinterSemester2023-2024
C. Branch:B.Tech.,CSE
D. CourseHandlingFaculty:Mrs.K. PREMA
E. Duration oftheCourse: 27.12.23to27.04.24
F. CourseOutcome:

Thestudents will be ableto proficiently:

- Create Java programsusing thefundamentalprogramming constructs
- Implementanddesigna classbasedonattributesandbehaviorsofobjects
- DevelopJavacodethatdemonstratestheworkingofdifferentkeywordsin Java
- ExplainandimplementdifferentObject-Oriented conceptsinJava
- DevelopJavacodethatusestheappropriateaccessmodifiers,packagedeclarations
- Identify,applyandunderstandtheworkingofthe most commonAPIsused in Java
- ExplainsaboutExceptionHandling,CollectionsFrameworkand,Generics.
- Determinethebestpractices thatareto befollowedin Java

G. Preamble:

JavaProgrammingFundamentalsisdesignedtointroducethefundamentalsofJavaprogramming and its object-oriented features. It will help out the learners to understand various

keywords available in Java and Java's architecture. Also, this coursewill help learners to know the working of Java APIs through hands on approach.

H. Course Contents

Module–1: **6Hour**

AboutJavaProgrammingFundamentals,IntroductionandFeaturesofJava,JavaArchitecture, Java Development Kit

Module–2: **6Hour**

Data Types, Keywords and Identifiers, Operators, Type Casting, Widening and Narrowing, Conditional Statements,Control FlowandLooping,Arrays:IntroductiontoArrays,Enhancedforloop

Module–3: **Hour**

ObjectOrientedConceptsusingJava,ClassandObject, Constructors,thisKeyword,Inheritance, Polymorphism, super Keyword

Module–4: **6Hour**

FinalKeyword,staticModifier,VariableArguments,EnumeratedDataTypes,AbstractclassInterfacePackage Access Modifiers Java Libraries.

Module–5: **6Hour**

Exceptions,Generics,TheCollectionsFramework,Date/TimeAPIs.

I. LearningResources

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 toProject 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 successfulcompletionofthiscourse,thestudentswere 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. CourseContent:

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. LearningResources:

i. TextBooks:

1. GuidovanRossum,LearningPython:CrashCourseTutorial,ThePythondevelopmentteampublishers, 2020. [Unit-1,2,3]
2. BhartiMotwani,“DataAnalyticsusingPython”,paperbackedition,WileyPublishingLtd,2020. [Unit-4]
3. JamesR.Parker,“GameDevelopmentUsingPython”,2ndedition,MercuryLearningandInformation publishers, 2021. [Unit-5]

ii. ReferenceBooks:

1. David M.Baezly , “Python Essential Reference”,Addison-Wesley Professional; 5thedition, 2021.
2. John Shovic, Alan Simpson, “Python for dummies”,JohnWiley&Sons, 2020.

iii. OnlineReferences:

i. ProgrammingforEverybody(GettingStartedwithPython),Accessedon02,April2021[Online] Available:https://www.coursera.org/learn/python

ii.https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0138436723625 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**

COURSE CODE	COURSE TITLE	HOURS
10218CS907	Advanced Data Structures & Algorithms in Java: Sorting & Searching Algorithms	45

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 Contents:

Module I **L-15 Hours**

Discover the key concepts covered in this course - recognize the trade-offs involved in Choosing sorting algorithms - describe the selection sort algorithm-write code to implement selection sort- explain the bubble sort algorithm

Module II **L-15 Hours**

Write code to implement bubble sort-implement adaptive bubble sort with early stopping-define the insertion sort algorithm-write code to implement insertion sort-summarize the shell sort -Algorithm-write code to implement shell sort-describe the merge sort algorithm-

develop methods for splitting and merging operations-write code to implement merge sort-define the quick sort algorithm

Module III **L-15 Hours**

Write code to implement quick sort-describe the binary search algorithm-design and write code for linear search-design and write code for binary search-design and write code for jump search-design and write code for interpolation search-summarize the key concepts covered in this course

Total : 45 Hours

Online Reference:

TOC - Advanced Data Structures & Algorithms in Java: Sorting & Searching Algorithms | Infosys Springboard

Course Contents:

Module I **L-15 Hours**

COURSE CODE	COURSE TITLE	HOURS
10218CS909	STEM Components	45

Introduction to Electronics, Robotics, IoT & Sensors- Electronics, Robotics, IoT & Sensors- Rapid prototyping tools

Module II **L-15 Hours**

Mechanical, Electrical & measurement tools- Power supply, accessories & safety equipment

Module III **L-15 Hours**

Projects based on Modules:

Water Level Monitoring System- Decibel Meter- Keypad Basics-Earthquake Detector-Water Flow Control- Blink using Node MCU- Colour Detector- Alcohol Meter- Bluetooth with Arduino- Temperature Based Speed Control- Heart Rate Monitoring System

Total: 45 Hours

Online Reference:

https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01373853188853760046

Course Contents

COURSE CODE	COURSE TITLE	HOURS
10218CS917	Database Design	45

Module I **L-15 Hours**

Define a database, describe how data is stored in tables containing records and fields, and describe flat, hierarchal, and relational databases-Define database management systems (DBMS) and relational database management systems (RDBMS)-Describe the purpose of and navigate SQL Server Management Studio (SSMS), a SQL Server instance, and its objects describe the data types supported by SQL Server

Module II **L-15 Hours**

Describe the importance of data integrity to related database tables and list the methods for enforcement define the standards used in tables for data storage such as removing duplicates, breaking down fields, and the use of primary keys in the context of SQL Server examples

Module III **L-15 Hours**

Define the standards used in column design and its properties such as auto increment columns, default and null values, and modifying size and format in the context of SQL Server examples- Define the table and column properties such as collation, data type, size, and field properties in the context of SQL Server examples define relationships in a database such as one-to-many, one-to-one, and many-to-many, outlining the role of primary, composite, and foreign keys in the context of SQL Server examples

Total: 45 Hours

Online Reference:

https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013501594002235392125 82

COURSE CODE	COURSE TITLE	HOURS
10218CS932	Python Concurrent Programming: Introduction to Concurrent Programming	45

Course Contents

Module I **L-15 Hours**

Recognize what sequential execution is and what its limitations are-describe multithreading and compare its performance with a sequential execution of tasks identify the specific use cases for multithreading-summarize multiprocessing and contrast it with multithreading.

Module II **L-15 Hours**

Describe the implementation of threads and processes in the Python language recognize what a race condition is and when it can occur with concurrent programming-outline how locks can help concurrent tasks synchronize their actions on shared resources-summarize how semaphores can restrict the number of concurrent tasks accessing a shared resource

Module III **L-15 Hours**

Identify the use cases for event and condition objects in Python and distinguish between the two -recognize when a deadlock can occur in an application and the actions you can take to avoid it-enumerate the built-in data structures available in Python for concurrent programming-outline how pools of threads and processes can optimize concurrency in your application-recall the different synchronization mechanisms in Python and the conditions necessary for deadlocks

Total: 45 Hours

Online Reference:

TOC - Python Concurrent Programming: Introduction to Concurrent Programming | Infosys Springboard

COURSE CODE	COURSE TITLE	HOURS
10218CS934	Computer Assembling & Troubleshooting	45

Course Contents:

Module I **L-15 Hours**

Overview of Computer Assembling: Overview of Computer Assembling-Introduction- Hardware Pictures-Hardware Learning about Basic Networking & Topologies: Lan Wan Topologies -Basic Networking-Fibre Optic Cable

Module II **L-15 Hours**

Understanding about Motherboard Concept: Motherboard diagram and parts- Installation of Ram & sbquo; Rom & sbquo; HDD & sbquo; optical drive cd rom- Assembling of basic computer parts- Installation of win xp and assigning ip Address

Module III **L-15 Hours**

Learning about Troubleshooting PC: Basic troubleshooting PC-Sound and video cards troubleshooting-Pinging IP address-Network troubleshooting in win7 and 8-Keyboard problems-troubleshooting-Crimping tool and network tester-video- Library-Northbridge and southbridge and virus and enabling macros in ms office

Total: 45 Hours

Online Reference:
TOC - Computer Assembling & Troubleshooting | Infosys Springboard

COURSE CODE	COURSE TITLE	HOURS
10218CS938	Fine Tuning Large Language Models	45

Course Contents:

Module I **L-15 Hours**

Prelude-Pre-Requisites-Concepts Related to Fine-Tuning-Fine Tuning Related Concepts-Understanding Model Fine Tuning-Quiz – Concepts-Types of LLMs used for Fine Tuning-Quiz

Module II **L-15 Hours**

Types of LLMs-Fine-tuning Remotely Hosted Models-Environment Setup and Access-Fine Tuning Process-Data Preparation for Fine Tuning-Model Fine Tuning Using Azure OpenAI Studio-Model Fine Tuning Using Python API Access-Model Evaluation-Quiz - Fine Tuning Remote Models

Module III **L-15 Hours**

Fine-tuning Locally Hosted Models-Why use locally hosted models? -Environment and Access-Select Appropriate Model-T5-Base Fine Tuning-BART Model-Distilled BART Fine Tuning-Examples of Fine-Tuning Use Cases-Examples of Fine-tuning Use-cases-Limitations and Risks-Limitations and Risks associated with Fine Tuned Models

Total: 45 Hours

Online Reference:

TOC - Fine Tuning Large Language Models | Infosys Springboard

COURSE CODE	COURSE TITLE	HOURS
10218CS946	**Practical OpenCV 3 Image Processing with Python**	**45**

Course Contents:

Module I **L-15 Hours**

Building an Image Search Engine from Scratch - The Course Overview- Learning about Hough Transformations-Stretch, Shrink, Warp, and Rotate Using OpenCV 3-Image Derivatives-Histogram Equalization-Reverse Image Search

Module II **L-15 Hours**

Finding Targets and Number Plate Recognition in Video Stream-Delaunay Triangulation and Voronoi Tessellation-Mean-Shift Segmentation-Medical Imaging and Segmentation-Extracting Contours from Images- Template Matching for Object Detection- Background Subtraction from Images

Module III **L-15 Hours**

Scene Understanding and Automatic Labeling from Images - Harris Corner Detection - SIFT, SURF, FAST, BRIEF, and ORB Algorithms - Feature Matching and Homography to Recognize Objects- Mean-Shift, Cam-Shift, and Optical Flow-Feature Extraction Using Convolutional Neural Nets (CNNs)-Visual Object Recognition and Classification Using CNNs

Total: 45 Hours

Online Reference:

TOC - Practical OpenCV 3 Image Processing with Python | Infosys Springboard

COURSE CODE	COURSE TITLE	HOURS
10218CS967	Learning PHP 7	45

Course Contents:

Module I **L-15 Hours**

Introduction to PHP 7 - PHP 7 Versus PHP 5.x- Setting Up the Environment – Basic PHP Syntax Variables, Constants, and Operators- Arrays – Conditionals – Loops-Object-oriented Programming – Functions - Classes and Objects - Namespace and Composer- Web Application Basic Concepts- Project Structure Overview-Controllers and Log System

Module II **L-15 Hours**

Database Interaction - MySQL and Basic SQL Syntax - CRUD Operation with PDO Doctrine ORM-Basic Security Concepts - Registration Page, Controller, and Validations Registration Page, Database, and Password, Authentication and Authorization Login Authentication and Authorization Firewall - Posting a Message - The Personal Dashboard-Improving the Application with Asynchronous Calls - Ajax Calls with jQuery - Error Handling - Uploading a Photo-Commenting on a Post - Be More Social with Likes

Module III **L-15 Hours**

Scene Understanding and Automatic Labeling from Images - Harris Corner Detection - SIFT, SURF, FAST, BRIEF, and ORB Algorithms - Feature Matching and Homography to Recognize Objects-Mean-Shift, Cam-Shift, and Optical Flow-Feature Extraction Using Convolutional Neural Nets (CNNs)-Visual Object Recognition and Classification Using CNNs

Total: 45 Hours

Online Reference:
TOC - Learning PHP 7 | Infosys Springboard

Course Contents:

COURSE CODE	COURSE TITLE	HOURS
10218CS979	Network Security	45

Module I **L-15 Hours**

Introducing Network Security - Installation of Virtual Machines the Course Overview Overview of Network Security- Discussion of the Different Types of Vulnerabilities in Networks - Network Vulnerability Test Scope and Process - Network Scanning and Information Gathering - Various Network Footprinting Techniques - Securing Networks by Detecting Footprinting - Scanning Techniques of Networks - Securing Networks Techniques Against Scanning

Module II **L-15 Hours**

Attacks on Networks-Overview of Attack Methods on Networks-Major Attacks on Networks-Minor Attacks on Networks-Detect and Troubleshoot Major Attacks-Detect and Troubleshoot Minor Attacks

Module III **L-15 Hours**

Networks Security Tools and Techniques – Firewalls-VPNs-Honeypots-Intrusion Detection System and Filters - Other Countermeasure Techniques

Total: 45 Hours

Online Reference:
TOC - Network Security | Infosys Springboard

COURSE CODE	COURSE TITLE	HOURS
10218CS995	AI Artificial Intelligence with Python	45

Course Contents:

Module I **L-15 Hours**

Introduction Introduction to Predictive AnalysisRandom Forest and Extremely Random Forest Class Imbalance and Grid Search Dealing with Class Imbalance Grid Search Adaboost Regressor Adaboost Regressor Predicting Traffic Using Extremely Random Forest Regressor Traffic Prediction

Module II **L-15 Hours**

Detecting patterns with Unsupervised Learning Detecting patterns with Unsupervised Learning Clustering Clustering Meanshift Clustering Meanshift Continues Affinity Propagation Model Affinity Propagation Model Affinity Propagation Model Continues Clustering Quality Clustering Quality Program of Clustering Quality Gaussian Mixture Model Gaussian Mixture Model Program of Gaussian Mixture Model Classifiers

Module III **L-15 Hours**

Classification in Artificial Intelligence- Logistic Regression Classifier- Naive Bayes Classifier- Support Vector Machines Classifier-Logic Programming- Concept of Logic Programming-Matching the Mathematical Expression Parsing Family Tree and its Example Analyzing Geography Logic Programming-Heuristic Search-Constraint Satisfaction Problem

Total: 45 Hours

Online Reference:
TOC - AI Artificial Intelligence with Python | Infosys Springboard

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS921	Functional Data Structures And Algorithms	45

H. Preamble

This course introduces students to improve the code base of an application and improve efficiency. With the advent of functional programming, and with powerful functional languages such as Scala, Clojure and Elixir becoming part of important enterprise applications, functional data structures have gained an important place in the developer toolkit.

I. Prerequisite Course

10210CS101 - Problem Solving using C

J. Course Objectives

Learners are exposed to:

- To improve the code base of an application and improve efficiency.
- Immutable and persistent data structures are thread-safe by definition and hence very appealing for writing robust concurrent programs

K. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	To improve the code base of an application and improve efficiency.	K2
CO2	Able to write robust concurrent programs.	K2
CO3	To express traditional algorithms in a functional setting	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

L. Correlation of Cos with Program Outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2										2			
CO2	2	2		2							2			
CO3	3	2												

3- High; 2-Medium; 1-Low

M. Course Contents

Module 1 Functional ProgrammingL-9 Hours

The Course Overview-The Imperative Way and a Higher Level of Abstraction-Functional Programming and Boilerplate-Higher Order Functions-Recursion Aids Immutability-Copy-On-Write, Laziness, and Deferred Execution-Composing Functions

Module 2 Building Blocks L-9 Hours

Referential Transparency-Vectors Versus Lists-Complexities and Collections-The Big O Notation-Space/Time Trade-Off

Module 3 Lists L-9 Hours

Getting the Value at Index-Modifying a List Value-List Head and Tail Drop Elements-Concatenating Lists-Persistent Data Structures and Tail Call Optimization-List Append and Prepend

Module 4 Binary Trees L-9 Hours

Node Definitions-Building the Tree-Comparing Trees-The Accumulator Idiom-Binary Search Trees

Module 5 More List Algorithms L-9 Hours

Binary Numbers-Greedy Algorithms and Backtracking

Total:45 Hours

N. Learning Resources

Online References:

1.https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094419512565760 1921_shared/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS924	Comptia IT Fundamentals: Operating Systems	45

A. Preamble

This course enables the students to learn about computer operating systems, including the types and basic features of OSs and the application hardware interface. Next, explore Windows management, including managing applications, devices, users, and access control. Finally, investigate file systems, key OS features, task scheduling, and common methods for tweaking a Windows OS, including using command line interfaces (CLIs) to perform operations. This course helps prepare learners for the CompTIA IT Fundamentals (ITF+) certification exam, FC0-U61.

B. Prerequisite Course

10211CS102-Data Structures

C. Course Objectives

Learners are exposed to:

- Learn computer operating systems, including the types and basic features of OSs and the application hardware interface
- Explore Windows management, including managing applications, devices, users, and access control
- Illustrate file systems, key OS features, task scheduling, and common methods for tweaking a Windows OS, including using command line interfaces (CLIs) to perform operations.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Learn computer operating systems, including the types and basic features of OSs and the application hardware interface	K2
CO2	Explore Windows management, including managing applications, devices, users, and access control	K2
CO3	Illustrate file systems, key OS features, task scheduling, and common methods for tweaking a Windows OS, including using command line interfaces (CLIs) to perform operations.	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	PSO3
CO1	2											2		
CO2	2	2										2	2	
CO3	2	2										2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-9 Hours
The Course Overview-The Imperative Way and a Higher Level of Abstraction-Functional Programming and Boilerplate-Higher Order Functions-Recursion Aids Immutability-Copy-On-Write, Laziness, and Deferred Execution-Composing Functions

Module 2L-9 Hours
Manage Windows applications and devices-name basic user management and access control activities-identify various file system types and features

Module 3L-9 Hours
Outline key operating system features, including compression, encryption, journaling, limitations, and naming rules-enable NTFS file and folder encryption and compression-list basic file management activities

Module 4 L-9 Hours
Examine the purpose and features of Windows services-explore the role of Windows processes-outline the purpose and features of device drivers-schedule tasks in Microsoft Windows

Module 5 L-9 Hours
Compare and contrast command line interfaces (CLI) and graphical user interfaces (GUI)-utilize the basics of the Windows Command Prompt-use Windows PowerShell for basic purposes-summarize the key concepts covered in this course

Total:45 Hours

G. Learning Resources

i. Online References:

1. TOC - CompTIA IT Fundamentals: Operating Systems | Infosys Springboard

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS925	Computer Assembling & Troubleshooting	45

A. Preamble

This course enables the students to be well versed in Computer Hardware Basics, Assembling, Troubleshooting, fiber optics, concepts of networking

B. Prerequisite Course

10211CS201-Digital Electronics

C. Course Objectives

Learners are exposed to:

- Learn Computer Hardware Basics and Assembling
- Experiment various Troubleshooting and Fiber Optics concepts in networking
- Demonstrate the aspects of Networking in the real-world Application.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Learn Computer Hardware Basics and Assembling	K2
CO2	Experiment various Troubleshooting and Fiber Optics concepts in networking	K2
CO3	Demonstrate the aspects of Networking in the real-world Application.	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	PSO3
CO1	2	2										2		
CO2	2	2		2								2		
CO3	2	2										2	2	

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-9 Hours

Overview of Computer Assembling-Introduction-Hardware Pictures-Hardware

Module 2L-9 Hours

Learning about Basic Networking &Topologys-Lan Wan Topologys-Basic Networking-Fibre Optic Cable

Module 3L-9 Hours

Understanding about Motherboard Concept-Motherboard diagram and parts- Installation of Ram‚Rom‚HDD‚optical drive cd rom-Assembling of basic computer parts-Installation of win xp and assigning ip address

Module 4 L-9 Hours

Learning about Troubleshooting PC-Basic troubleshooting PC-Sound and video cards troubleshooting-Pinging IP address-Network troubleshooting in win7 and 8-Keyboard problems-troubleshooting

Module 5 L-9 Hours

Crimping tool and network tester-Northbridge and southbridge and virus and enabling macros in ms office

Total:45 Hours

G. Learning Resources

I. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013842791817256960241 80_shared/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS926	Network Function Virtualization Fundamentals	45

A. Preamble

This course introducesthe goals and benefits of network function virtualizationrecognize the major use cases for network function virtualization without SDN, and the benefits that it brings recognize the major use cases for network function virtualization and Software Defined Networking combined, and the benefits they bringrecognize the main overlay protocols used in network function virtualization systemsdescribe the operation of virtual switches, routers, and firewalls in a network function virtualization systemdescribe the operation of network load balancers, intrusion detection and intrusion prevention, and antivirus devices in a network function virtualization system

B. Prerequisite Course

10210CS101-Problem Solving Using C

C. Course Objectives

Learners are exposed to:

- Describe the goals and benefits of network function virtualization
- Illustrate the main overlay protocols used in network function virtualization systems
- Explain the operation of virtual switches, routers, and firewalls in a network function virtualization system

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Describe the goals and benefits of network function virtualization	K2
CO2	Illustrate the main overlay protocols used in network function virtualization systems	K2
CO3	Explain the operation of virtual switches, routers, and firewalls in a network function virtualization 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	PSO1	PSO2	PSO3
CO1	2											2		
CO2	2	2										2	2	2
CO3	2	2										2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1 **L-9 Hours**

Goals and benefits of network function virtualization

Module 2 **L-9 Hours**

Recognize the major use cases for network function virtualization without SDN, and the benefits that it brings

Module 3 **L-9 Hours**

Recognize the major use cases for network function virtualization and Software Defined Networking combined, and the benefits they bring-recognize the main overlay protocols used in network function virtualization systems

Module 4 **L-9 Hours**

Operation of virtual switches, routers, and firewalls in a network function virtualization system

Module 5 **L-9 Hours**

Operation of network load balancers, intrusion detection and intrusion prevention, and antivirus devices in a network function virtualization system

Total:45 Hours

G. Learning Resources

I. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013501582702026752118 11/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS927	NLP With LLMS: Fine-Tuning Models For Language Translation, & Summarization	45

A. Preamble

This course introduces Causal language modeling (CLM), text translation, and summarization demonstrate the versatility and depth of language understanding and generation by artificial intelligence (AI). Fine-tuning models help improve the performance of models for these specific tasks. In this course, Studentswill explore CLM with DistilGPT-2 and masked language modeling (MLM) with DistilRoBERTa, learning how to prepare, process, and fine-tune models for generating and predicting text.

B. Prerequisite Course

10211CS101-Discrete Mathematics

C. Course Objectives

Learners are exposed to:

- Demonstrate the versatility and depth of language understanding and generation by artificial intelligence (AI). Experiment classification and association models to overcome the problem of over fitting
- Explore CLM with DistilGPT-2 and masked language modeling (MLM) with DistilRoBERTa, learning
- Able to prepare and evaluate training data and learn to use BLEU scores for assessing translation quality.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Examine the basic concepts of data mining and machine learning concepts	K2
CO2	Design and evaluate the dimensionality reduction algorithms using real world datasets.	K2
CO3	Apply various algorithms of Classification and Association.	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	PSO3
CO1	2	2										2		
CO2	2	2		2								2		
CO3	2	2		2								2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-9 Hours
load and process data for causal language modeling (CLM)-fine-tune a DistilGPT model for CLM

Module 2L-9 Hours
Fine-tune a DistilRoBERTa model for masked language modeling (MLM)

Module 3L-9 Hours
preprocess text for translation-generate BLEU scores for text translationfine-tune the T5-small model for translation

Module 4 L-9 Hours
Load and visualize data for summarization-summarize text with a regular T5-small model-fine-tune a T5-small model for summarization

Module 5 L-9 Hours
Compare the performance of fine-tuned T5 and baseline T5 models-summarize the key concepts covered in this course

Total:45 Hours

G. Learning Resources

I. Online References:

1. TOC - NLP with LLMs: Fine-tuning Models for Language Translation, & Summarization | Infosys Springboard

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS928	Design 3.0: Design Lifecycle	45

A. Preamble

This course introduces students to follow Cisco's recommended design methodology by exploring the use of a design lifecycle approach. Examine the benefits of this approach, design projectization, and documentation generated during the lifecycle.

B. Prerequisite Course

10211CS106-Formal Languages and Automata Theory

C. Course Objectives

Learners are exposed to:

- Identify characteristics of the PBM design lifecycle deal with characterization, roadmaps, and ROI Experiment classification and association models to overcome the problem of over fitting
- Identify the role of access points in the PBM lifecycle
- Analyze and recognize the step used in PPDIOO network design to identify network requirements

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Understand the tasks during the Plan, Build, and Manage phases of the PBM lifecycle.	**K2**
CO2	Explain the act of compiling network device specifications	**K2**
CO3	Analyze the step used in PPDIOO network design to identify network requirements	**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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO1	PSO 2	PSO 3
CO1	3											2		
CO2	3		2			2						2		
CO3	3		2			3						2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-9 Hours

Recognize tasks during the Plan, Build, and Manage phases of the PBM lifecycle-identify characteristics of the PBM design lifecycle deal with characterization, roadmaps, and ROI

Module 2L-9 Hours

Recognize which characteristics of the PBM lifecycle deal with systemization, upgrades, and efficiency-specify characteristics of the Plan, Build, and Manage network lifecycle phases-identify the role of access points in the PBM lifecycle

Module 3L-9 Hours

Identify the step used in PPDIOO network design process to establish business requirements-specify benefits of implementing the PPDIOO process

Module 4 L-9 Hours

Identify the act of compiling network device specifications-specify where to find information for performing tests in a given scenario

Module 5 L-9 Hours

Recognize the step used in PPDIOO network design to identify network requirements

Total:45 Hours

G. Learning Resources

i. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0135015754059694081098 7/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS957	Getting Started With Arduino Uno	45

A. Preamble

This course introduces students to rewarding journey into the world of electronics and programming using Arduino UNO, which is a popular microcontroller board that allows learners to create and control a wide range of projects

B. Prerequisite Course

10211CS201- Digital Electronics

C. Course Objectives

Learners are exposed to:

- Utilizing UNO board, its components, and how it can be used to build a wide range of projects.
- Analyze various sensors, such as temperature sensors, light sensors, and motion sensors, and learn how to interface them with the Arduino UNO board.
- Adapt code, integrate additional components, and unleash your creativity to build unique Arduino-based projects

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Understand the process of setting up the Arduino IDE, installing the necessary drivers, and connecting the Arduino UNO board to computer.	**K2**
CO2	Analyze the various sensors and communication between devices through different communication protocols, such as Serial, I2C, and SPI.	**K2**
CO3	Develop code, integrate additional components, and unleash creativity to build unique Arduino-based projects.	**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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO1	PSO 2	PSO 3
CO1	2	3										1	3	
CO2	2	3			1									
CO3	1	2			3									3

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-12 Hours

Introduction to Arduino Pin-Introduction to Arduino and Installation of Arduino IDE

Module 2L-12 Hours

Basic Project Based on Arduino-Blink an LED-Ultrasonic Using Arduino-IR sensor using Arduino-Servo using ArduinoTemperature sensor using Arduino

Module 3L-12 Hours

Intermediate Projects Based on Arduino-Alcohol Meter-RGB Color Detector using TCS3200 Color Sensor & Arduino-Decibel Meter

Module 4 **L-9 Hours**

Advance Projects Traffic Management System

Total:45 Hours

G. Learning Resources

i. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01380987573801779217/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS967	OPENCV: Advanced Image Operations	45

A. Preamble

A high-level understanding of advanced image processing operations in OpenCV is provided in this course. Various blur techniques, including simple, Gaussian, and median blurs, will be explored, with their advantages, limitations, and ideal use cases analyzed. Object highlighting through edge detection will be covered, and the enhancement of images by adding shapes and objects will be demonstrated. Finally, the use of pre-trained classifiers for detecting people in images and the application of morphological transformations to emphasize or suppress specific image features will be discussed.

B. Prerequisite Course

C. Course Objectives

Learners are exposed to:

- Efficient ways of handling noise in an image and to perform Gaussian and median blur operations to smoothen an image
- Plot a circle, line, rectangle, and ellipse in an image
- Apply morphological transformations such as erosion and dilation to emphasize specific features of an image

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Apply the Laplacian, Sobel, and Canny operators to detect edges in an image.	**K2**
CO2	Analyze and perform Gaussian and median blur operations to smoothen an image and reduce noise	**K2**
CO3	Developtrained classifiers to detect eyes, faces, and people in images and apply morphological transformations	**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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2	1				2						2		
CO2	2	1				3						2	2	
CO3	2	2				3						2	1	1

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-12 Hours

discover the key concepts covered in this course-apply and blur noise in an image

Module 2L-12 Hours

Perform Gaussian and median blur operations to smoothen an image-apply the Laplacian, Sobel, and Canny operators to detect edges in an image plot a circle, line, rec-tangle, and ellipse in an image

Module 3L-12 Hours

Introduce a text element, polygon, and arrow to an OpenCV image-use trained classifiers to detect eyes, faces, and people in images

Module 4 L-9 Hours

Apply morphological transformations such as erosion and dilation to emphasize specific features of an image-summarize the key concepts covered in this course

Total:45 Hours

G. Learning Resources

i. Online References:

1. infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0135015578043678727513/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS973	Data Structures And Algorithms In Python: Sorting Algorithms	45

A. Preamble

This course explores widely used sorting algorithms in Python and examines their performance metrics. The selection sort algorithm and its operations will be detailed, while the bubble sort process will be analyzed for time, space, and swap complexity. Steps for performing insertion sort will be outlined and compared to bubble sort. The shell sort algorithm will be discussed, focusing on its divide-and-conquer approach and performance. Sorting with merge sort will be explained, along with its complexity measures. Finally, the quicksort algorithm's partitioning and sorting process will be covered.

B. Prerequisite Course

10211CS102 – Data Structures

C. Course Objectives

Learners are exposed to:

- Sorting algorithms such as bubble sort, selection sort, shell sort, merge sort and quick sort using python
- Analyze the time and space complexity of various sorting algorithms
- Explore various strategies/ techniques such as divide and conquer, partitioning techniques in sorting algorithms

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Discuss various sorting algorithm techniques and their pros and cons	K2
CO2	Analyze space and time complexity for different sorting techniques	K2
CO3	Recall various performance metrics for all the sorting algorithm and their properties	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	PSO1	PSO2	PSO3
CO1	2	2										3		
CO2	2	1				2						2		
CO3	2	2				2						2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-12 Hours

Discover the key concepts covered in this course-identify the various properties of sorting algorithms that must be considered when selecting the right one for your data.

Module 2L-12 Hours

Describe the operations involved when sorting a list of values using the Selection Sort algorithm-summarize the process of a Bubble Sort when applied to a list of values- recall the performance of the Bubble Sort on various measures such as time, space, and number of swaps.

Module 3L-12 Hours

Describe the steps involved in performing an Insertion Sort and compare it to the Bubble Sort-outline the workings of the Shell Sort and recall the performance metrics of this divide and conquer algorithm.

Module 4 L-9 Hours

Describe the process of sorting a list of elements using Merge Sort and list the complexity of this algorithm on various measures-describe how the Quicksort algorithm partitions and sorts a list of elements-recall the performance metrics of the Quicksort algorithm describe considerations for picking a sorting algorithm, list the properties of the Insertion Sort algorithm, and summarize the Shell Sort algorithm.

Total:45 Hours

G. Learning Resources

i. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0135015631086632969071/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS975	Programming Essentials	45

A. Preamble

This course explores how to install CouchDB, as well as MapReduce, RESTFul, and some basic programming using Java and JavaScript.

B. Prerequisite Course

10210CS101 - Problem Solving using C

C. Course Objectives

Learners are exposed to:

- Create new database with CouchDB and basics of MapReduce programming
- Describe the three basic tasks of an API as it relates to NoSQL and the concept of RESTful API
- Examine the three most important libraries that will allow for .NET to use POST functionality and using Java and Javascript to perform basic functions with a NoSQL data store

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Examine the basic concepts of data mining and machine learning concepts	**K2/S3**
CO2	Design and evaluate the dimensionality reduction algorithms using real world datasets.	**K3/S3**
CO3	Apply various algorithms of Classification and Association.	**K3/S3**
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	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2	2							1	1		3		
CO2	3	3	3	2	2				1	1		3		
CO3	3	3	3	2	2				1	1		3	2	

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-12 Hours

Install CouchDB-create a new database with CouchDB-different options of the Futon console-programming language that is the foundation for the MapReduce concept-the basics of MapReduce programming.

Module 2L-12 Hours

Hadoop uses a FIFO process-API is and how it is used in NoSQL-the three basic tasks of an API as it relates to NoSQL-RESTful API-how RESTful API works.

Module 3L-12 Hours

Four basic commands of cURL-how to post and retrieve items from a NoSQL data store using cURL-how to use .NET to perform basic functions with a NoSQL data store-the libraries for use with .NET that are available with CouchDB.

Module 4 L-9 Hours

The three most important libraries that will allow for .NET to use POST functionality-use Java to perform basic functions with a NoSQL data store-use JavaScript to perform basic functions with a NoSQL data store-use the C programming language to perform basic functions with a NoSQL data store.

Total:45 Hours

G. Learning Resources

i. Text Books:

1. EthemAlpaydin,, “Introduction to Machine Learning”, 4th edition, MIT Press, 2020 (Unit 1 to 4)

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS984	Big Data Solutions, Architecture, CQL, & DDL	45

A. Preamble

This course introduces students to Apache Cassandra which is an open-source NoSQL database management system for handling large amounts of data and also Explore the mechanics and architecture of Cassandra, data modeling, and the Cassandra Query Language (CQL).

B. Prerequisite Course

10211CS102-Data Structures

C. Course Objectives

Learners are exposed to:

- Compare Cassandra with traditional SQL RDBMS, and describe the advantages of Cassandra NoSQL in the modern environment
- Describe the component architecture and operational characteristics of the Cassandra framework
- Understand and work with Cassandra platform, cqlsh, keyspaces, Tables and Partitions.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Describe Cassandra, its operation characteristics and advantages in modern environment for developing new applications or redesigning existing applications	**K2/S3**
CO2	Discuss the difference between the Casandra data model and the traditional relational model. Describe best practices for Cassandra data modelling	**K3/S3**
CO3	Examine how to work with Cassandra platform and perform CRUD operations on a Cassandra Database	**K3/S3**
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	PSO3
CO1	2	3			2								2	
CO2	2	3			2								2	
CO3	2	2			2								2	

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-12 Hours

Cassandra and its operation characteristics-compare Cassandra with traditional SQL RDBMS and describe the advantages of Cassandra NoSQL in the modern environment.

Module 2L-12 Hours

Driver for migrating to Cassandra and considering Cassandra for new application development-describe when and why Cassandra might be selected when developing new applications, or when considering the redesign of existing applications.

Module 3L-12 Hours

The component architecture and operational characteristics of the Cassandra framework-Casandra data model, discuss the difference between the Casandra data model and the traditional relational model. Describe best practices for Cassandra data modelling.

Module 4 L-9 Hours

The fundamentals of the CQL syntax- Casandra DDL commands and command syntax-Cassandra platform-Cassandra cqlsh-Cassandra Keyspaces-Cassandra Tables (Column Families)-work with Partitions- live Cassandra and perform CRUD operations on a Cassandra Database

Total:45 Hours

G. Learning Resources

i. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013501562 6969825288598/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS985	Software Testing - Testing Techniques	45

A. Preamble

This course introduces students of software engineering or software professional a complete understanding of software testing. It covers the psychology or mindset that a tester should possess in order to be able to test a program successfully.

B. Prerequisite Course

10211CS109– Object Oriented Programming using Java

C. Course Objectives

Learners are exposed to:

- Understand the psychology or mindset that a tester should possess in order to be able to test a program successfully
- Recall the Inspection checklist and walkthroughs
- Analyze Agile testing methods and Testing metrics and various challenges in testing

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Understand the psychology or mindset that a tester should possess in order to be able to test a program successfully	K2
CO2	Discuss the various testing methods and data gathering methods	K2
CO3	Examine various testing techniques and metric that are considered across various testing 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	PSO1	PSO2	PSO3
CO1	2	3										1	3	
CO2	2	3			1									
CO3	1	2			3									3

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-12 Hours

Introduction-Psychology of Testing-Principles of Testing-Introduction to Static TestingInspection Checklists and Walkthroughs test case design techniques-Equivalence Partitioning-Boundary value analysis-Error Guessing Cause Effect Graphing-Cause Effect Graphing – Introduction-Cause Effect Graphing – Steps-Cause Effect Graphing

Module 2L-12 Hours

Path Testing-White box - Exhaustive Path Testing and Statement Decision Condition-White box - Multiple Condition coverage-Testing Techniques-Unit Testing-Non incremental Testing-Incremental Testing-Systems, Regression, Acceptance Testing

Module 3L-12 Hours

Security Testing-Performance Testing-Performance Testing goals-Non functional testing types-Usability Considerations-Usability testing methods-Test User Selection-Data Gathering methods

Module 4 L-9 Hours

Agile Testing-Intro to Agile Testing-Extreme Programming-Extreme Testing-Benefits and drawbacks of TDD-Mobile Testing-Intro to Mobile Testing-Mobile Testing Challenges-Mobile Test Conditions-Real devices vs emulators-Basic ecommerce architecture-Testing Challenges & Metrics

Total:45 Hours

G. Learning Resources

i. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013842168396521472143 75_shared/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS987	Building ArcGIS Cross-Platform Applications With Javascript	45

A. Preamble

This course enables the students to developing both web and mobile GIS applications, The ArcGIS API for JavaScript is the preferred way of developing your custom applicationsThis practical course provides you with hands-on experience in developing custom web and mobile ArcGIS Server applications with step-by-step style exercises. Along with introducing you to the HTML/CSS/JavaScript technology stack, you will learn to add intuitive geographic layers of information to your map, interactive query and display of spatial data, add user interface widgets, access geoprocessing tasks, and much more in your own web and mobile GIS applications

B. Prerequisite Course

10210MA103- Probability, Statistics and Queuing theory

C. Course Objectives

Learners are exposed to:

- Apply the concepts of supervised and unsupervised learning algorithms for real time applications
- Experiment 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/Skill Level
CO1	Enable the students to excel in the software for developing both web and mobile GIS applications	**K2**
CO2	Illustrate the efficient way to develop custom web and mobile ArcGIS Server applications	**K2**
CO3	learn to display the spatial data, add user interface widgets, access geoprocessing tasks, web and mobile GIS applications.	**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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO1	PSO 2	PSO 3
CO1	2	2										2		
CO2	2	2										2	2	
CO3	2	2										2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-12 Hours

First Custom Application-The Basics of a Custom App-Using WebMap-Introduction to Widgets and UI-Introducing SceneView

Module 2L-12 Hours

ArcGIS API for JavaScript Core-Accessor-Collections-Promises-Loadables

Module 3L-12 Hours

Maps and Views-Map and View Architecture-WebMaps-WebScenes-Layers and LayerViews-Portal API

Module 4 L-9 Hours

Widgets and Accessor-Widgets-Popups-Extending Accessor-TypeScript Integration

Module 4 L-9 Hours

Custom Widget Development-Decorators-Custom Widget-Custom ViewModel

Total:45 Hours

G. Learning Resources

i. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094408679858176167 8_shared/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS988	Python Parallel Programming Solutions	45

A. Preamble

This course will teach you parallel programming techniques using examples in Python and help you explore the many ways in which you can write code that allows more than one process to

happen at once Starting with introducing you to the world of parallel computing, we move on to cover the fundamentals in Python

B. Prerequisite Course

10210MA103- Probability, Statistics and Queuing theory

C. Course Objectives

Learners are exposed to:

- Exploring the thread-based parallelism model using the Python threading module by synchronizing threads and using locks, mutex, semaphores queues, GIL, and the thread pool
- To Learn the process-based parallelism to synchronize processes using message passing and will learn about the performance of MPI Python Modules
- Distributed computing with the usage of various inbuilt modules

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Exploring the thread-based parallelism model using the Python threading module by synchronizing threads and using locks, mutex, semaphores queues, GIL, and the thread pool	**K2/S3**
CO2	To Learn the process-based parallelism to synchronize processes using message passing and will learn about the performance of MPI Python Modules	**K3/S3**
CO3	Illustrate Distributed computing with the usage of various inbuilt modules	**K3/S3**
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	PSO3
CO1	2	2										2		
CO2	2											2		
CO3	2	2										2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1 **L-9 Hours**

Getting Started with Parallel Computing and Python-The Parallel Computing Memory Architecture-Memory Organization-Memory Organization (Continued)-Parallel Programming Models-Designing a Parallel Program-Evaluating the Performance of a Parallel Program-Introducing Python-Working with Processes in Python-Working with Threads in Python

Module 2 **L-9 Hours**

Thread-Based Parallelism-Thread Synchronization with RLock-Thread Communication Using a Queue-Evaluating the Performance of Multithread Applications-Thread Synchronization with Lock-Using a Thread in a Subclass-Determining the Current Thread-Defining a Thread-Thread-Synchronization with Semaphores-Thread Synchronization with a Condition-Thread Synchronization with an Event-Using the "with" Statement

Module 3 **L-9 Hours**

Process-Based Parallelism-Avoiding Deadlock Problems-Using Broadcast for Collective Communication-Using Scatter for Collective Communication-Point-to-Point Communication-Spawning a Process-Naming a Process-Running a Process in the Background-Killing a Process Using a Process in a Subclass-Exchanging Objects between Processes-Synchronizing Processes Managing a State between Processes-Using a Process Pool-Using the mpi4py Python Module-Using Gather for Collective Communication-Using Alltoall for Collective Communication-The Reduction Operation-Optimizing the Communication

Module 4 **L-9 Hours**

Asynchronous Programming-Using the concurrent.futures Python Modules-Event Loop Management with Asyncio-Handling Coroutines with Asyncio-Manipulating a Task with Asyncio-Dealing with Asyncio and Futures

Module 5 **L-9 Hours**

PU Programming with Python-Building a PyCUDA Application-Understanding the PyCUDA Memory Model with Matrix Manipulation-Kernel Invocations with GPU Array-Evaluating Element-Wise Expressions with PyCUDA-The MapReduce Operation with PyCUDA-GPU Programming with NumbaPro-Using GPU-Accelerated Libraries with NumbaPro-Testing Your GPU Application with PyOpenCL-Evaluating Element-Wise Expressions with PyOpenCl-Building a PyOpenCL Application-Using the PyOpenCL Module-Using the PyCUDA

Total:45 Hours

G. Learning Resources

i. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094439078862848260 0_shared/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS990	Ensemble Machine Learning Techniques	45

A. Preamble

This course introduces students learn about the Docker Swarm Remote and to retrieve information from the cluster, and deploy and scale services using the API. Able to learn how to search for logs using Kibana, and collect metrics to monitor containers running in the cluster.you will be able to use Docker Swarm Remove API, parse and send logs to a centralized place, and collect metrics and monitor your Docker Swarm cluster.

B. Prerequisite Course

10210MA103- Probability, Statistics and Queuing theory

C. Course Objectives

Learners are exposed to:

- Learn about the Docker Swarm Remote and to retrieve information from the cluster, and deploy and scale services using the API.
- Analyzeand search for logs using Kibana, and collect metrics to monitor containers running in the cluster.
- Demonstrate the principles used to Remove API, parse and send logs to a centralized place, and collect metrics and monitor the cluster using Docker Swarm.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	To learn about the Docker Swarm Remote API, retrieve information from the cluster, and deploy and scale services using the API.	**K2**
CO2	Analyze and search for logs using Kibana, and collect metrics to monitor containers running in the cluster.	**K2**
CO3	Demonstrate the principles used to Remove API, parse and send logs to a centralized place, and collect metrics and monitor the cluster using Docker Swarm.	**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	PSO1	PSO 2	PSO 3
CO1	2	2										2		
CO2	3	3										2		
CO3	3	3										2	2	

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-12 Hours

Introduction to Ensemble Learning-Setting Up Python-Setting Up Dependencies implementing Simple Ensemble Techniques in Python-Problems that Ensemble Learning Solves-Ensemble Learning for Classification-Implementing Ensemble Learning for Classification-Ensemble Learning for Regression-Implementing Ensemble Learning for Regression

Module 2L-12 Hours

Creating Robust Models with Bagging Technique-Using Random Forest to Analyze Sonar Chirp Data-Using the Decision Tree to Determine Weight at Birth-Basics of Bagging-How Bagging Works-Making Predictions on Movie Ratings Using SVM-Random Forest

Module 3L-12 Hours

Converting Weak Models to Strong Models Using Boosting-Introduction to Boosting-AdaBoost Algorithm-Other Boosting Algorithms--Predicting Churn Using Boosting

Module 4 L-9 Hours

Stacking Models Together-Overview of Stacking Technique-Implementing - to Use Stacking

Total:45 Hours

G. Learning Resources

i. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094410506496001885_shared/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS993	R For Data Science: Data Visualization	45

A. Preamble

This courseexplores the advantageous aspects of the programming language R in this 8-video Skillsoft Aspire course. An essential skill for statistical computing and graphics, R has become the tool of choice for data science professionals in every industry and field. Learn how to create reproducible high-quality analyses, while taking advantage of R's great graphic and charting capabilities.

B. Prerequisite Course

10210MA103- Probability, Statistics and Queuing theory

C. Course Objectives

Learners are exposed to:

- Explores the advantageous aspects of the programming language R
- Create reproducible high-quality analyses of Data in various data mining process.
- Demonstrate various Plots such as whisker, mtcaretc

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Examine the basic concepts of data mining and machine learning concepts	**K2**
CO2	Design and evaluate the dimensionality reduction algorithms using real world datasets.	**K3**
CO3	Demonstrate various Plots in order to visualize the data in the	**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	PSO1	PSO 2	PSO 3
CO1	2											2		
CO2	2	2										2		
CO3	2													

3- High; 2-Medium; 1-Low

F. Course Contents

- Create a scatter plot
- Create a line graph
- Create a bar chart
- Create a box and whisker plot
- Create a histogram
- Create a bubble plot

- Use an appropriate plot to visualize data

Total:45 Hours

G. Learning Resources

i. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013501589077950464125 77/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS994	Hacking Techniques And It Security - Hacking And Data Mining	45

A. Preamble

This course deals with the learning about introduction to computer security and cyber-crime, why cyber security, types of hackers attacks and spoofing, web spoofing and session hijacking, dos and buffer overflow attacks, passwords attacks, introduction to data mining, data mining subtypes, usage of data mining and controversies, goal, introduction to spamming, types of spamming and counteractions, general counteractions against spamming-introduction of data mining-major issues with data mining, association rule mining, algorithm for frequent pattern mining, summary of data mining

B. Prerequisite Course

10210MA103- Probability, Statistics and Queuing theory

C. Course Objectives

Learners are exposed to:

- Apply the concepts of Computer Security and its types
- Experiment Spamming Spoofing and Spamming Techniques. to overcome the various security issues.
- Analyse and suggest appropriate Data mining techniques.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Apply the concepts of Computer Security and its types	**K2**
CO2	Experiment Spamming Spoofing and Spamming Techniques. to overcome the various security issues	**K2**
CO3	Analyse and suggest appropriate Data mining techniques	**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	PSO1	PSO 2	PSO 3
CO1	3	2										2		
CO2	2	2		2								2	2	2
CO3	2	2										2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-12 Hours

Hacking-Introduction to Computer Security and Cyber Crime-Why Cyber Security-1-Types of Hackers Attacks and Spoofing-Types of Hackers Attacks and Spoofing Continued-Web Spoofing and Session Hijacking-Dos and Buffer overflow Attacks-Passwords Attacks

Module 2L-12 Hours

Data Mining-Usage of Data Mining and Controversies Continued-Introduction to Datamining-Data Mining Subtypes-Usage of Data Mining and Controversies

Module 3L-12 Hours

Spam-Damage Caused by Spamming-Introduction to Spamming-Types of Spamming and Counteractions-Types of Spamming and Counteractions Continued-General Counteractions Against Spamming

Module 4 L-9 Hours

Cyber Terrorism-Introduction to Cyber Terrorism-Dos and Potential of Cyber Terrorism-Dos and Potential of Cyber Terrorism Continued-Strength of Internet

Total:45 Hours

G. Learning Resources

i. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384278719820595224073_shared/overview.

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS988	Block Chain Developer	45

A. Preamble

This course introduces students Current Issues in Financial Markets is a cutting-edge course that addresses the dynamic nature of global financial markets. Through case studies, real-time data analysis, and expert-led discussions, participants will delve into contemporary issues shaping the financial landscape. The course covers a wide range of topics, including market disruptions, sustainability challenges, cryptocurrencies, fintech innovations, and the impact of global events on financial stability.

B. Prerequisite Course

10210MA103- Probability, Statistics and Queuing theory

C. Course Objectives

Learners are exposed to:

- Apply the concepts of Block Chain to make the students delve into contemporary issues shaping the financial landscape.
- Demonstrate the wide range of topics including market disruptions, sustainability challenges, cryptocurrencies, fintech innovations.
- Experiment the impact of global events on financial stability.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	To make the students delve into contemporary issues shaping the financial landscape	**K2**
CO2	Demonstrate the wide range of topics including market disruptions, sustainability challenges, cryptocurrencies, fintech innovations.	**K3**
CO3	Experiment the impact of global events on financial stability	**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	PSO1	PSO 2	PSO 3
CO1	3	2										3		
CO2	2	2	2	2								2	2	
CO3	2	2										2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-15 Hours
Blockchain technology basics
Module 2L-15 Hours
Opportunities and challenges
Module 3L-15 Hours
Current Direction of Applications

Total:45 Hours

G. Learning Resource

i. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012422726109208576645/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS999	Natural Language Processing With Projects	45

A. Preamble

This course will teach you how machines can be trained to understand and process human language using various NLP algorithms. You'll explore lexical processing, basic syntactic processing, and mechanisms like those used by Google Translator to grasp language context and translation.

B. Prerequisite Course

10210MA103- Probability, Statistics and Queuing theory

C. Course Objectives

Learners are exposed to:

- Explore lexical processing, basic syntactic processing, and mechanisms like those used by Google Translator to grasp language context and translation.
- To train your models on natural language understanding (NLU) for text summarization, sentiment analysis, and entity recognition, all through real-world projects
- To create chatbots or working on Alexa and Google Home projects. 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/Skill Level
CO1	Explore lexical processing, basic syntactic processing, and mechanisms like those used by Google Translator to grasp language context and translation	**K2**
CO2	Design your models on natural language understanding (NLU) for text summarization, sentiment analysis, and entity recognition, all through real-world projects	**K2**
CO3	Create chatbots or working on Alexa and Google Home projects. Demonstrate the aspects of simple perceptron and multi-layer perceptron	**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	PSO1	PSO 2	PSO 3
CO1	3	2									2			
CO2	3	2									2			
CO3	3	2	2					2			2			

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1L-12 Hours

1Natural Language Processing-Examine Text Using NLTK-Raw Text Accessing (Tokenization)-NLP Pipeline and Its Example-Regular Expression with NLTK

Module 2L-12 Hours

Stemming-Lemmatization-Segmentation-Segmentation Example-Segmentation Example Continues-Information Extraction-Tag Patterns

Module 3L-12 Hours

Chunking-Representation of Chunks-Chinking-Chunking wirh Regular Expression-Named Entity Recognition

Module 4 L-9 Hours

Trees-Context Free Grammar-Recursive Descent Parsing-Recursive Descent Parsing Continues-Shift Reduce Parsing

Total:45 Hours

G. Learning Resources

i. Online References:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_014222726109208576645/overview

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS935	Explore Computer Networking Basics And Unravel The Secrets Behind Network Operations	30

O. Preamble

This course provides a foundational understanding of computer networking, covering essential topics like IP addressing, routing, switching, and network security. Students will gain practical skills for configuring and troubleshooting networks, along with insights into emerging technologies such as SDN, IoT, and 5G. By the end, participants will be equipped to understand, secure, and manage modern networks effectively

P. Prerequisite Course

10211CS105-Computer Networks

Q. Course Objectives

Learners are exposed to:

- This course introduces the fundamentals of computer networking, covering essential topics like IP addressing, routing, switching, and network security basics.
- Students will learn how networks operate, how devices communicate, and how data flows across networks.
- By the end, participants will have a foundational understanding of network structure, protocols, and basic troubleshooting, with insights into emerging technologies like SDN and IoT.

R. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Understand the Basics of Networking Concepts	K2
CO2	Apply IP Addressing and Subnetting Techniques	K3
CO3	Explain Routing and Switching Fundamentals	K3
CO4	Implement Basic Network Security Measures	K3
CO5	Explore Emerging Trends and Technologies in Networking	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

S. 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	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	2		2					2			3		
CO2	3	3		2					2			2		
CO3	3	2		2					2			2		
CO4	3	2		2								2		
CO5	3	2										3		

3- High; 2-Medium; 1-Low

T. Course Contents

Unit 1 Introduction to Computer NetworksL-6 Hours

Network Types and Topologies: LAN, WAN, MAN, PAN, and hybrid networks - Basic Networking Concepts: Hosts, nodes, clients, servers, and transmission media – Network Models: OSI and TCP/IP models with their functions and protocol layers - Data Transmission Basics**:** Bandwidth, latency, and data transfer rates.

Unit 2 IP Addressing and Subnetting L-6 Hours

IPv4 and IPv6: Addressing schemes, structure, and differences – **Subnetting**: Classes, subnet masks, and CIDR notation – IP Address Configuration: Static vs. dynamic IP addressing (DHCP) – Address Translation: NAT and its role in local vs. global addressing

Unit 3 Routing and Switching Fundamentals L-6 Hours

Routing Basics: Types of routing (static, dynamic) and routing protocols (RIP, OSPF, BGP) – Switching Techniques: Circuit switching, packet switching, and virtual circuit switching – Network Devices: Introduction to routers, switches, and hubs – VLANs: Concepts, configuration basics, and benefits of network segmentation

Unit 4 Unit 4 Network Security Essentials L-6 Hours

Introduction to Network Security: Importance, objectives, and principles – Firewalls and Security Protocols: Types of firewalls, VPN basics, and SSL/TLS – Common Network Threats: Malware, phishing, DoS attacks, and intrusion detection – Basic Network Defense Mechanisms: IDS, IPS, and basic encryption methods

Unit 5 Emerging Trends and Technologies in Networking L-6 Hours

Software-Defined Networking (SDN): Basics, architecture, and use cases – Wireless Networks: Wi-Fi standards, basics of wireless security, and mobile networking – Internet of Things (IoT): Network requirements for IoT devices and security considerations – Future Network Technologies: Introduction to 5G, cloud networking, and edge computing

Total:30 Hours

U. Learning Resources

iv. Online References:

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.
3. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud,5th Edition,2017
4. Andrew S. Tanenbaum, David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2013.

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS940	Natural Language Processing for CSE	30

A. Preamble

The primary goal of the course is to familiarize students with the fundamentals of naturallanguageprocessing.Thefundamentalsincludelinguisticfeatures,keyalgorithmsforhandling basic problems, and statistical and shallow machine learning models for a variety of naturallanguageprocessing applications

B. Prerequisite Course

110211CS120 -Machine Learning

C. Course Objectives

Learners are exposed to:

- Thiscourseaimstoprovideacomprehensiveview of building real-world natural languageprocessing (NLP) applications.
- The diverseapplications of NLP are based on a commonset of ideas, drawing on algorithms, linguistics,logic, statistics, and more.
- The goal of thiscourse is also to provide an overview ofthese foundations. The course covers themost important topics in the field, keeping abalancebetweentheoryandpractice.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Understandbasicsoflinguistics, probability andstatistics associatedwithNLP	K2
CO2	TostudystatisticalapproachestoNLPandunderstandsequence Labelling	K3
CO3	To explore semantics ofwords and semantic rolelabelingofsentences	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	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	2							1	1		3		
CO2	3	3	3	2	2				2	2		2		
CO3	3	3	3	2	2				1	1		3	2	

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction L-6 Hours

Origins and challenges of NLP – Language Modeling: Grammar-based LM, StatisticalLM – Regular Expressions, Finite-State Automata – English Morphology, Transducers forlexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum EditDistance

Unit 2 WordLevelAnalysis L-6 Hours

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff –Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-basedtagging,Issues in PoS tagging– Hidden Markovand MaximumEntropymodels.

Unit 3 SyntacticAnalysis L-6 Hours

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms forgrammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programmingparsing– Shallowparsing–ProbabilisticCFG,ProbabilisticCYK,ProbabilisticLexicalizedCFGs– Featurestructures,Unificationoffeaturestructures.

Unit 4 SemanticsandPragmatics L-6 Hours

Requirementsforrepresentation,First-OrderLogic,DescriptionLogics–Syntax-DrivenSemanticanalysis,Semanticattachments–WordSenses,RelationsbetweenSenses,ThematicRoles,selectionrestrictions–WordSenseDisambiguation,WSDusingSupervised,Dictionary&Thesaurus,Bootstrappingmethods–WordSimilarityusingThesaurusandDistributionalmethods

Unit 5 :DiscourseAnalysisandLexicalResources L-6 Hours

Explore the evolving job market opportunities in the increasingly digitized world.-Learn thelifelonglearningeducationalopportunities-importanceofindustrycertificationsandcommunitiesofInterestrelatedtotheIoT.-ExploreIoTRelatedJobandLearningOpportunities

Total:30 Hours

G. Learning Resources

i. Online References:

1. https://www.deeplearning.ai/resources/natural-language-processing/
2. https://www.coursera.org/specializations/natural-language-processing

COURSE CODE	Course Title	TOTAL HOURS
10218CS944	Geo-Spatial Technologies Using AI	30

A. Preamble

To provide the knowledge of basic data structures and their implementations. To understand importance of data structures in context of writing efficient programs. To develop skills to apply appropriate data structures in problem solving.

B. Prerequisite Course

10212CS211 - Artificial Intelligence Techniques

C. Course Objectives

Learners are exposed to:

- To equip students with the knowledge to integrate AI with geospatial technologies for solving spatial problems.
- To Focus on applying AI-driven methods for geospatial data analysis, automation, and decision-making in areas like urban planning, environmental monitoring, and disaster management.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Understand geospatial technologies, including GIS, remote sensing, GPS, and data visualization	K2
CO2	Apply AI techniques like machine learning and deep learning for geospatial data analysis.	K3
CO3	Develop AI-driven solutions for real-world problems using geospatial tools and techniques	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	PSO3
CO1	3	1							1			3		
CO2	3	2	2	2	2				1			3		
CO3	3	3	3	2	2				1			3		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Geospatial TechnologieL-6 Hours

Overview of Geospatial Technologies: Introduction to GIS, remote sensing, and GPS, Key applications of geospatial technologies in various fields - Types of Geospatial Data: Raster, vector, and LiDAR data types, Structure and characteristics of geospatial datasets, Geospatial Data Acquisition, Storage, and Visualization: Methods of collecting geospatial data: Satellite, drone, and ground-based methods, Data storage techniques: Databases, cloud storage, Visualization of geospatial data through maps and 3D models - Basic Geospatial Analysis: Introduction to spatial analysis techniques, Geospatial data processing and interpretation

Unit 2 Artificial Intelligence Fundamentals L-6 Hours

Introduction to AI: Basics of Artificial Intelligence, machine learning, deep learning, and NLP, Overview of algorithms used in AI applications - Supervised and Unsupervised Learning: Key concepts in supervised learning: Classification, regression, Unsupervised learning techniques: Clustering, anomaly detection - AI Algorithms for Geospatial Data: Application of machine learning in analysing geospatial data, Introduction to deep learning models used for image classification and object detection - Time-Series Analysis for Geospatial Data: Techniques for monitoring changes in the environment over time using geospatial data

Unit 3 Geospatial Data Analysis with AI L-6 Hours

Image Processing for Geospatial Data: Techniques in processingremote sensing imagery, Image classification, enhancement, and segmentation - AI Models for Geospatial Applications: Land use/land cover classification, Object detection and feature extraction from satellite and drone images - Spatial Data Mining: Identifying patterns and clusters in geospatial data, Anomaly detection and change detection using AI techniques - Geospatial Pattern Recognition - Detecting spatial relationships and trends in large datasets

Unit 4 Applications of AI in Geospatial Technologies L-6 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-6 Hours

Urban Planning and Smart Cities - Using AI to optimize traffic flow and design smart infrastructure, Geospatial analysis for urban sprawl and population density modelling, Environmental Monitoring and Conservation :AI for deforestation monitoring, climate change tracking, and ecosystem health, Using geospatial AI for wildlife conservation and habitat protection - Disaster Management : AI-driven early warning systems for floods, hurricanes, and wildfires, Real-time damage assessment and post-disaster recovery using geospatial AI - Agriculture and Precision Farming: AI for monitoring crop health, pest control, and soil analysis, Geospatial AI in precision farming for yield prediction and resource management

Total:30 Hours

G. Learning Resources

i. Online References:

1. Longley, Paul A., Michael F. Goodchild, David J. Maguire, and David W. Rhind, Geographic Information Systems and Science, 4th Edition, Wiley, 2015.
2. Russell, Stuart, and Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson, 2010.
3. Ortiz, Pedro G., and Rafael J. A. G. Vázquez, Machine Learning for Geospatial Data Analysis, Springer, 2020.
4.
artell, William C., Geospatial Intelligence and the American Military, Praeger Security

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS956	Programming Skill In C For Computer Science &Engineering	30

A. Preamble

The course places a strong emphasis on problem-solving using C as a tool. It introducesessential programming techniques such as conditional statements, loops, and recursion. Additionally, it offers a brief overview of foundational software engineering practices, including modularization,commenting,andadheringtonamingconventions.Thesepractices areessentialforeffectivecollaborationandteamworkinprogrammingprojects.

B. Prerequisite Course

10210CS101-ProblemSolvingUsingC

C. Course Objectives

Learners are exposed to:

- Thecourseplacesastrongemphasisonproblem-solvingusing C as a tool.
- It introduces essential programmingtechniquessuchasconditionalstatements,loops,andrecursion.
- Additionally, it offers a brief overview

offoundationalsoftwareengineeringpractices,includingmdularization, commenting, and adhering to namingconventions.Thesepracticesareessentialforeffective collaboration and teamwork in programming projects

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Illustrate the right data representation formats based on the requirements of the problem	**K2**
CO2	ApplyLooping, FunctionsandArraysforsolvingrealtimeproblems.	**K3**
CO3	SolveProblemsusingPointersand Recusiveroutines.	**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	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2	2							1	1		3		
CO2	3	3	3	2	2				1	1		3		
CO3	3	3	3	2	2				1	1		3	2	

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1

DataconceptsinC:Constants,Variables,Expressions,Operators,andoperator precedence in C. Statements : Declarations, Input-Output Statements, Compoundstatements, Selection Statements. Conditions, Logical operators, Precedences. Repetitivestatements,while construct,Do-while Construct,for construct.Data types,size andvalues.Char, UnsignedandSigned data types.Number systemsandrepresentations.Constants,Overflow.

Module 1I

Arrays.Strings.Multidimensionalarraysandmatrices.Functions: Theprototypedeclaration,Functiondefinition.Functioncall:Passingargumentstoafunction, by value, by reference. Scope of variable names. Recursive function calls, Tailrecursion. Analyzing recursion, Tree of recursion, linear recursion. Sorting problem:SelectionSort,InsertionSort,Comparisonbetweensortingalgorithms.Sortinginmultidimensional arrays. Sorting in strings. Search problem: Linear search and binarysearch.Comparisonbetweensearchprocedures.RecursiveandIterativeformulations

Module 1II

Pointers: Pointer variables. Declaring and dereferencing pointer variables.Pointer Arithmetic. Examples. Accessing arrays through pointers. Pointer types, Pointersand strings. String operations in C. Structures in C : Motivation, examples, declaration,and use. Operations on structures. Passing structures as function arguments. type definingstructures

Module 1V

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

Module V

Self-referentialstructures.DynamicDataStructures.LinkedLists.Examples

Total:30 Hours

G. Learning Resources

i. Online References:

1. Introduction To Programming In C", Accessed on June.30,2023, [Online].Available https://onlinecourses.nptel.ac.in/noc22_cs40/preview 2.

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS958	A BEGINNER'S GUIDE TO REINFORCEMENT LEARNING	30

A. Preamble

This course introduces students to Reinforcement Learning (RL), focusing on its applications in industrial settings. Students will learn fundamental RL concepts and explore advanced methods such as deep reinforcement learning, policy optimization, and multi-agent systems. The course emphasizes practical applications in industrial automation, robotics, predictive maintenance, and decision-making in manufacturing. Each unit combines theoretical knowledge with hands-on practice to equip students with skills to implement RL in real-world industrial scenarios

B. Prerequisite Course

10212CS215 -Deep Learning

C. Course Objectives

Learners are exposed to:

- To embark on a journey to understand the core principles and techniques of Reinforcement Learning
- It offers a platform to explore how agents can make a sequence of decisions by taking actions in an environment to maximize some notion of cumulative reward
- Learns able to design, implement, and evaluate RL solutions for real-world problems using frameworks like OpenAI Gym, TensorFlow, and PyTorch

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Understand of the core concepts and terminology in RL.	K2/S3
CO2	Formulate decision-making problems as Markov Decision Processes.	K3/S3
CO3	Implement and tune RL algorithms using Python and PyTorch.	K3/S3
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	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2	2		2					1			2		
CO2	3	3		2					2			2		
CO3	3	3		2					1			2		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Reinforcement LearningL-6 Hours

Reinforcement Learning overview- Comparison with supervised and unsupervised learning- Agents, environments, states, actions, and rewards.- Markov Decision Process (MDP)- Exploration vs. exploitation trade-off

Unit 2 Value-Based and Policy-Based MethodsL-6 Hours

Value-Based Methods- Q-Learning- Deep Q-Networks (DQN) and enhancements (Double DQN, Dueling DQN)- Policy-Based Methods- policy gradients and the REINFORCE algorithm

Unit 3 Advanced RL Techniques L-6 Hours

Proximal Policy Optimization (PPO)- Trust Region Policy Optimization (TRPO)- Deterministic Policy Gradients (DDPG) and Soft Actor-Critic (SAC)- Overview of multi-agent RL.

Unit 4 Deep Reinforcement Learning for Robotics and Automation L-6 Hours

Deep RL in Robotics: Using RL for robotic path planning, object manipulation, and control- Automation in Industrial Systems- Autonomous robotics for assembly lines and material handling

Unit 5 Deployment, Real-Time Decision-Making, and Case Studies L-6 Hours

RL Model Deployment in Real-Time Environments- Challenges of deploying RL models in real-world industrial settings- Real-time inference and decision-making requirements- Case studies: Predictive maintenance, autonomous vehicles, and smart manufacturing

Total:30 Hours

G. Learning Resources

i. Text Books:

1. **Reinforcement Learning: An Introduction (2nd Edition) by Richard Suttonand Andrew Barto.**

ii. Online References:

1. arXiv.org - Reinforcement Learning Papers

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS959	IMAGE MINING AND RETRIEVAL USING MATLAB	30

A. Preamble

This course provides a resource platform to lean basics of image mining and processing techniquesusing python programming language in MATLAB. This course also helps to develop image processing applications in Minor and Major Projects

B. Prerequisite Course

10211CS111 Image Processing

C. Course Objectives

Learners are exposed to:

- To reduce its information to relevant data
- To indexing it relatively to a model and/or to a previous knowledge, in order to facilitate its retrieval and interpretation by a machine. .

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Understand the image processing methods and image operations.	K2
CO2	Experiment with file handling operations in MATLAB	K3
CO3	Apply image processing Drawing tools in MATLAB	K3
CO4	Utilize the image enhancement methods and morphological tools in MATLAB	K3
CO5	Make use of Image segmentation techniques to detection of objects	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	PSO1	PSO 2	PSO 3
CO1	2								1					
CO2	2								2					
CO3	2								1					
CO2	2	3							2			2		
CO3	2	3							1			3		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction L-6 Hours

Digital Image- Image Acquisition – Sampling and Quantization– Image processing steps – Image Types- Color Fundamentals and Models, Image operations – Arithmetic, Geometric and Filtering– English Morphology, Transducers forlexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum EditDistance

Unit 2 WordLevelAnalysis L-6 Hours

Basic I/O scripts, Reading/writing an image file, converting between an image and raw bytes- Accessing image data, Reading/writing a video file, Capturing camera frames, Displaying an image in a window, Displaying camera frames in a window

Unit 3 SyntacticAnalysis L-6 Hours

Converting images between different color models, drawing on Images - Text and Polygons, Direct Drawing on Images with a mouse, Detecting lines, circles, and other shapes.

Unit 4 SemanticsandPragmatics L-6 Hours

Color Mappings, Blending and Pasting Images, Blending and Pasting Images Image Thresholding, Blurring and Smoothing, Morphological Operators, Histograms

Unit 5 :DiscourseAnalysisandLexicalResources L-6 Hours

Introduction to Object Detection, TemplateMatching, Corner Detection Harris Corner Detection, - Shi-Tomasi Detection, EdgeDetection, ContourDetection, Feature Matching Watershed Algorithm Custom Seeds with Watershed Algorithm. Case Study - Detecting and recognizing Faces

Total:30 Hours

G. Learning Resources

i. Online References:

1. https://www.deeplearning.ai/resources/natural-language-processing/
2. https://www.coursera.org/specializations/natural-language-processing

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS960	PYTHON PROGRAMMING	30

A. Preamble

The objective of this course is to provide learners an insight into Python programming, and develop programming skills to manage the development of software systems. It covers programming structures, important instructions, data representations, file handling, Exception handling, String handling, regular expressions and file data processing. This course also lays the foundation to data processing, UI design and gaming.

B. Prerequisite Course

110211CS307–COMPETITIVE CODING II

C. Course Objectives

Learners are exposed to:

- To understand the high-level, general-purpose dynamic programming language of the decade.
- To be widely utilized for creating websites and software, automating tasks, analyzing data, and visualizing dataThe goal of thiscourse is also to provide an overview ofthese foundations. The course covers themost important topics in the field, keeping abalancebetweentheoryandpractice.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Understand the basic program structure and elements of Python Language	K2
CO2	Know the concept of file manipulation, string manipulation and regular expression	K3
CO3	Learn the exception handling and multithreading concepts using python	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	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2	1		2					2			2		
CO2	2	2		2					2			2		
CO3	2	2		2					2			2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module – I: Python Environment Setup and EssentialsL-5 Hours

Python Basics: variables - data types- operators and expressions - control statements -comments in the program - python collections (List, Tuple, Set, Dictionary) – modules -packages and composition. Python functions - built-in functions - Lambda functions- python iterator and generator

Module – II: File Manipulation, String Handling and Regular Express L-5 Hours

Programming language concepts. -Introduction to flowcharts, visual programming in Blockly and Python. - Create a simple game with Python. - Rapid Prototyping with a Raspberry Pi and Arduino

Module – III: Exception Handling and Multi-Threading in pythonL-10 Hours

Exception handling: try, except and finally block, handling multiple exceptions, raise an exception, User defined exception- python multithreading- thread and threading Module- Synchronizing Threads in Python

Module – IV: Data Analysis using Python libraries L-10 Hours

NumPy: Introduction, NdArrayobject, DataTypes, ArrayAttributes, Indexing and Slicing, Array manipulation, mathematical functions, Matplotlib; Pandas: Introduction to pandas datastructures- series- DataFrame- Panel- basic functions- descriptive statistics function- iterating data frames- statistical functions- aggregations- visualization-plotting graphs using plotly Library.

Total:30 Hours

G. Learning Resources

i. Online References:

1. Programming for Everybody (Getting Started with Python), Accessed on 02, April 2021
2. Introduction to Python Programming, Accessed on 02, Apri l2021 [Online] Available:https://www.edx.org/professional-certificate/introduction-to-python-programming
3. The Python Standard Library, Accessed on 02, April2021 [Online]

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS961	ANDROID APPLICATION DEVELOPMENT	30

A. Preamble

This course equips fresh graduates with essential Android development skills, providinghands-on training to build high-quality applications. Gain expertise through a comprehensive program that fosters growth and prepares you for industry success

B. Prerequisite Course

110211CS212 -Web and Mobile Application Development

C. Course Objectives

Learners are exposed to:

- To Transform fresh campus recruits into skilled mobile application developers through its acclaimed training program
- Students can benefit from flexible, on-demand learning that delivers essential skills anytime, anywhere.
- To offer continuous development in mobile technologies, leveraging the expertise of the Infosys innovation ecosystem.
- To help the students qualify for employment opportunities for a career

in mobile app development

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Illustrate basic programming on android studio	**K3**
CO2	Apply user interface design for designing Android Application	**K3**
CO3	Develop functions for android app	**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	PSO1	PSO 2	PSO 3
CO1	2	2		1					2			2		
CO2	3	2		2					2			2		
CO3	3	3		2					2			2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1 : Introduction to Android Development and Android StudioL-6 Hours

Overview of Android OS and its architecture- Setting up Android Studio and creating a simple project- Understanding Android project structure- Basic programming concepts for Android(variables, data types, loops, etc.) Running and debugging applications on emulators andphysical devices

Module 2 : User Interface Design in AndroidL-6 Hours

Introduction to Android UI components and Layouts-Creating responsive designs using ConstraintLayout, LinearLayout, and RelativeLayout - Working with XML for UI designApplying styles, themes, and color resources for UI consistency-Basics of Material Design for
Android

Module 3 : Implementing Interactive Components and Event HandlingL-6 Hours

Building interactive elements: buttons, text fields, checkboxes, and more- Setting up click listeners and event handling for user interactions- Creating custom views and implementing Animations- Designing adaptive layouts for different screen sizes and orientations -Using RecyclerView for dynamic lists and data display

Module 4 : Functions and Data Handling in Android Applications L-6 Hours

Understanding functions and modular programming in Android-Passing data between activities and fragments-Saving and retrieving data using Shared Preferences and local databases - Introduction to SQLite and basic database operations- Working with JSON dataand parsing for network responses

Module 5 : Testing, Debugging, and Finalizing an Android Application L-6 Hours

Debugging tools and logcat in Android Studio-Writing and running unit tests for appComponents- Enhancing app performance and optimizing resources0-Preparing apps fordeployment on Google Play Store- Final project: Developing a basic Android app incorporating
learned skills

Total:30 Hours

G. Learning Resources

i. Online References:

1. https://developer.android.com/

A.Preamble

This course introduces students to new and actively evolving interdisciplinary field of modern data analysis. This course will consider methods of Machine Learning and Data Mining Learning. It also includes dimensionality reduction techniques which help to deal with huge datasets.

COURSECODE	COURSETITLE	HOURS
10218CS962	MACHINE LEARNING: ALGORITHMS AND PRACTICES	30

B.PrerequisiteCourses

10211CS211- Python Programming

C.CourseObjectives

Learnersareexposedto

- Develop proficiency in implementing and optimizing machine learning algorithms from scratch.
- Apply machine learning algorithms to solve real-world problems in areas such as image recognition, natural language processing, and recommendation systems.
- Explore techniques for hyper parameter tuning, such as grid search and random search, to enhance model performance.

D.CourseOutcomes

Uponthesuccessful completionof thecourse,students will beableto:

CO No's	CourseOutcomes	K-Level
CO1	Examine the basic concepts of data mining and machine learning concepts	K2
CO2	Apply pre-processing techniques and explore the using visualization techniques	K2
CO3	Implement various algorithms of Regression and Classification.	K2
CO4	Use the concept of neural networks for learning linear and non-linear activation functions	K3
CO5	Experiment various clustering algorithms to solve real time problems	K3

KnowledgeLevel(BasedonrevisedBloom'sTaxonomy)

K1-Remember K2-UnderstandK3-ApplyK4-AnalyzeK5-EvaluateK6-Create

E.CorrelationofCOswithPrograoutcomes andProgrammeSpecificOutcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PS O 1	PS O 2	PS O 3
CO1	3	2		2					2			3		
CO2	3	2		2					2			2		
CO3	3	3		2					2			2		
CO4	3	2		2								2		
CO5	3	3										3		

3-High;2-Medium;1-Low

F. CourseContents

Module 1 **6 Hours**

Introduction to data pre-processing, dataset, Pandas library, Numpy library, Matplotlib library in python.

Module 2 **6 Hours**

Intoduction to Mathematics: Linear Algebra, Probability Theory, Optimization Techniques. Introduction to Statistics: Statistical Decision Theory - Regression, Classification, Bias Variance.

Module 3 **6 Hours**

Introduction to Supervised Learning – Regression Analysis: Linear Regression, Logistic Regression, Ridge Regression, LASSO Regression.

Module 4 **6 Hours**

Classification Analysis: Classification, K-NN, Decision Tree, Naive Bayes, Support Vector Machines.

Module 5 **6 Hours**

Introduction to Unsupervised Learning:Clustering-Types: Centroid-based Clustering, Density-based Clustering, Connectivity based Clustering, Distribution-based Clustering-means Clustering, PCA

H.. Learning Resources:

i. Online Resources:

1. https://developers.google.com/machine-learning/crash-course
2. Machine Learning: The Art and Science of Algorithms that Make Sense of Data (1st Edition) by Peter Flach

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS963	SOFTWARE DESIGN THINKING	30

A. Preamble

This course to understand the principles of Design Thinking, a creative solution-based approach to problem solving. It embraces empathy for users, fosters collaboration across disciplines, and iterates tirelessly to uncover elegant solutions.

B. Prerequisite Course

10211CS208 - Software Engineering

C. Course Objectives

Learners are exposed to:

- To understand the principles of Design Thinking, a creative solution-based approach to problem solving.
- To embrace empathy for users, fosters collaboration across disciplines, and iterates tirelessly to uncover elegant solutions.

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D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Describe how to improve collaboration between development and operation	K2
CO2	Implement Agile software methodology for faster development of quality software	K2
CO3	Describe how to improve collaboration between development and operation	K2
CO4	Design Thinking For Strategic Innovation	K3
CO5	Implement Automated Installations and Deployments	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	PSO3
CO1	2	2										2		
CO2	2	2										2		
CO3	1	2	2											
CO4	1	2	2											
CO5	3	2	2									2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module – I: Introduction to Design ThinkingL-6 Hours

Introduction to Design Thinking – Importance of Design Thinking – History of Design Thinking- Design Thinking Framework - Design Thinking Methods - Empathies –Define – Ideate – Prototype – Test- Customer Example

Module – II: Introduction to Agile L-6 Hours

History of Agile – Agile principles –Agile Methodology Overview- Agile frameworks – Extreme programming - Rational Unified Process (RUP) - Test Driven Development (TDD) – Feature Drive Development (FDD)-Scrum - Kanban Methodology

Module – III: Software Development L-6 Hours

Software Development- using Extreme Programming – Roles & Rules - Software Development using Scrum Framework – Scrum team – Sprints – Sprints planning – Metrics – Scrum tools - Case Studies

Module – IV:Design Thinking For Strategic Innovation L-6 Hours

Innovation Management-Changing Management Paradigms-Design Thinking related to Science and art-Design Thinking in Business-Linking Design Thinking Solution to Business Challenges

Module – V: DevOps L-6 Hours

Introduction to DevOps – DevOpsvs Agile – DevOps Principles and Life Cycle – Introduction to CI / CD &DevOps Tools– Version Control – Build Automation

Total:30 Hours

G. Learning Resources

i. Online References:

1. https://www.infosys.com/about/knowledge-institute/insights/documents/system-design.pdf
2. https://library.fes.de/pdf-files/bueros/indien/15404-20190508.pdf

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS964	NETWORK SIMULATOR 2	30

A. Preamble

This course is to provide students with an overview of the concepts and Network simulator-2. Topics to be covered include: Introduction to NS-2 and Software Tools used NS-2, Software Architecture andTCL Interpreter, Basic Linux Commands, Flow of Simulation, Node Commands, Simulator Commands, Trace and NAM Commands, Wireless Network Programs, Mobile/Wireless Node Structure, Protocol Works, Various Programs for different routing protocols using TCL Script

B. Prerequisite Course

10211CS130-Fundamentals of Computer Network

C. Course Objectives

Learners are exposed to:

- Buildanunderstandingofthefundamentalconceptsof Network Simulator,protocols,architectures,andapplications.
- Understandthe Software Tools used in NS-2.
- Learnthe Software Architecture and TCL Interpreter.
- Obtaintheskills of Flow of Simulation and different node commands.

Explainthe Mobile/Wireless Node Structure and Protocol works

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Explainthebasicfundamentalsofnetwork simulatoranddiscussthevarious routing techniquesandstandardsofwireless networks.	K2
CO2	Applyvarious commands andTCL scripts for wireless transmissionofdata.	K3
CO3	Interpretthe functionsandprotocolsof Mobile Adhoc Networks.	K3
CO4	Explainthefunctionsandprotocolsof Mobile Adhoc Networks.	K3
CO5	Understandthevariousprotocols ofMobile Adhoc Networks.	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	PSO1	PSO2	PSO3
CO1	3	2		2					2			2		
CO2	3	2		2					2			2		
CO3	3	2		2					2			2		
CO4	2	2		2					2			2		
CO5	3	2							2			3		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Network Simulator-2 L-6 Hours

Introduction -Network Components -Node and Routing- Link – Tracing -Queue Monitor -Packet flow Example- Characteristics of NS2-Sofware Tools used with NS2- Software Architecture – NS Programming- TCL Interpreter-NAM- X Graph- Simulation Tool

Unit 2 Basic Linux and Commands L-6 Hours

Linux Commands- Simulation System Architecture – Installation of NS2 – Installation of Linux- Bash File Settings – Bash File Settings – NS2 Directory Structures

Unit 3 Scenarios and Commands L-6 Hours

First Simulation scenario – Flow of Simulation (Ns-node, Network Topology Link, Routing Transport, Application, Packet Flow), Second Simulation scenario - Simulation Script 2- Node Orientation- Node Commands- Link Commands- Simulator Command- Trace Commands - NAM Commands – Third Simulation scenario - Wired File Format

Unit 4 Wireless Networks Programs L-6 Hours

Simulation Program for LAN Network- Unicast Program- Multicast Program 1 and 2, Mobile/Wireless Node Structure, WSN Program 802.11, WSN Program 802.15.4

Unit 5 Protocol Works L-6 Hours

Procedure to construct Malicious Node in TCL Script – Generate Random Mobility in NS2 – Generate Random Agents and Applications in NS2- Wireless Network Construction in TCL Script – Variuous programs for Communication between the nodes using AODV, DSR, DSDV routing Protocol TCL Script

Total:30 Hours

G. Learning Resources

i. Text Books:

1. Neeraj Bhargava ,Pramod Singh Rathore, Dr.Ritu Bhargava, Dr.Abhishek Kumar, Computer Network simulation in NS2", BPB Publication, 5th Edition,2018.

ii. **Reference Book:**

1. TeerawatIssariyakul ,Ekram Hossain, "Introduction to Network Simulator NS2, Springer,2012

ii. Online References:

1. Basics of Network Simulation "http://vlabs.iitkgp.ac.in/ant/1/theory/
2. Network Simulator -2 Turotial " https://www.ns2project.com/network-simulator-2-tutorial/"

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS965	PYTHON PROGRAMMING FOR MACHINE LEARNING MODELS	30

A. Preamble

The primary goal of the course is to familiarize students with the fundamentals of machine learning models.Thefundamentalsincludelinguisticfeatures,keyalgorithmsforhandlingbasic problems, and statistical and shallow machine learning models using python

B. Prerequisite Course

10211CS211- Python Programming

C. Course Objectives

Learners are exposed to:

- Identify the concepts or functionality of various fundamental elements of Machine Learning.
- Identify the concepts, benefits, or functionality of Regression techniques
- Identify the concepts, operation, or functionality of classification and clustering

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Identify the concepts or functionality of various fundamental elements of Machine Learning	K3
CO2	Identify the concepts, benefits, or functionality of Regression techniques	K3
CO3	Identify the concepts, operation, or functionality of classification and clustering	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	PSO1	PSO 2	PSO 3
CO1	3	2	3						2			3		
CO2	3	2	2						2			2		
CO3	3	3	2						2			3		

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1 - Introduction to Machine LearningL-6 Hours

Applications of Machine Learning, Supervised vs Unsupervised Learning, Python libraries suitable for Machine Learning

Module 2 – Regression L-6 Hours

Linear Regression, Non-linear Regression, Model evaluation methods.

Module 3 - ClassificationL-6 Hours
K-Nearest Neighbour, Decision Trees, Logistic Regression, Support Vector Machines, Model Evaluation.
Module 4 - Unsupervised Learning L-6 Hours
K-Means Clustering, Hierarchical Clustering, Density-Based Clusterin
Module 5 - Recommender Systems L-6 Hours
Content-based recommender systems, Collaborative Filtering

Total:30 Hours

G. Learning Resources

i. Online References:

1. **I**ntroduction to machine learning with python", Accessed on Jan.24, 2022 [Online]. Available: https://www.oreilly.com/library/view/introduction-to-machine/9781449369880

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS966	NETWORK SECURITY FUNDAMENTALS FOR ENGINEERS	30

A. Preamble

This course on Network Security Fundamentals is an in-depth introduction to the security of a network, with an emphasis on equipping learners with basic skills and knowledge in protecting network infrastructures. Students will learn about major concepts of security, threats, vulnerabilities, and the defense mechanisms at work through both theory and practice. Students leave this course better prepared to pursue careers in cybersecurity and significantly enhance job prospects by gaining a deeper understanding of the principles of network security and how they are applied.

B. Prerequisite Course

10211CS105- Computer Networks

C. Course Objectives

Learners are exposed to:

- This course offers a comprehensive introduction to network security, equipping students with essential skills and knowledge to safeguard network infrastructures. by combining theoretical insights with practical applications.
- This course prepares participants for careers in cybersecurity, enhancing their professional capabilities and employment prospects

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Understand the fundamental concepts of network security, including the CIA Triad and various types of attacks.	K2
CO2	Identify, and implement cryptographic techniques to protect network data	K3
CO3	Develop and manage secure network architectures.	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	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	2								1		3		
CO2	3	3								2		2		
CO3	3	3								1		3		

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1 Introduction to Network SecurityL-5 Hours

Overview of Network Security, Security Goals: Confidentiality, Integrity, Availability (CIA Triad), Types of Attacks: Passive vs. Active Attacks, Classical encryption techniques -Cipher techniques -Ceaser cipher, affine cipher, Playfair Cipher, Vigenère Cipher, Vigenère cipher, Rail Fence Technique

Module II. Cryptography L-5 Hours

Introduction to Cryptography, Symmetric Encryption: AES, DES, Asymmetric Encryption: RSA, Elgamal, Hash Functions and Digital Signatures

Module III. Network Security Protocols L-5 Hours

Secure Sockets Layer (SSL) / Transport Layer Security (TLS), Internet Protocol Security (IPsec), Secure Shell (SSH)

Module IV. Network Threats and Vulnerabilities L-5 Hours

Malware: Viruses, Worms, Trojans, Denial of Service (DoS) and Distributed DoS (DDoS) Attacks, Phishing and Social Engineering, Man-in-the-Middle (MitM) Attacks, Vulnerability Assessment and Penetration Testing

Module V. Network Defense Mechanisms L-5 Hours

Firewalls, Intrusion Detection Systems (IDS), Basic Network Security Tools, Understanding Network Access Control (NAC)

Module VI . Services Secure Network Design L-5 Hours

Fundamentals of Network Design, Network Segmentation, Basic Cloud Security, Simple Security Practices for Network Design

Total:30 Hours

G. Learning Resources

i. Online References:

1. Coursera: "Introduction to Cyber Security Specialization" by NYU (New York University) edX: "Introduction to Network Security" by University of Washington/
2. Computer and Information Security Handbook" edited by John R. Vacca

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS968	DATA MANIPULATION AND ANALYSIS USING PYTHON PROGRAMMING FOR COMPUTER SCIENCE ENGG	30

A. Preamble

The objective of this course is to provide learners an insight into data manipulations in Python programming and develop programming skills to manage the development of software systems. It covers programming structures, important instructions, and data representations, visualization. This course also lays the foundation to data processing and visualization.

B. Prerequisite Course

10211CS105- Computer Networks

C. Course Objectives

Learners are exposed to:

- This course provides a platform to understand the basic Statistical and Probability measures for data science, descriptive analytics on the benchmark data sets and to apply correlation and regression analytics on standard data sets.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Perform descriptive analytics on the benchmark data sets.	K3
CO2	Make use of the basic Statistical and Probability measures for data science	K3
CO3	Present and interpret data using visualization packages in Python.	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	PSO3
CO1	3	2		2					2			3		
CO2	3	2		2					2			2		
CO3	3	3		2					2			2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module I: NUMPY L-6 Hours

Origins and challenges of NLP – Language Modeling: Grammar-based LM, StatisticalLM – Regular Expressions, Finite-State Automata – English Morphology, Transducers forlexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum EditDistance

Module II: PANDASL-6 Hours

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff –Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-basedtagging,Issues in PoS tagging– Hidden Markovand MaximumEntropymodels.

Module III: MATPLOTLIBL-6 Hours

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms forgrammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programmingparsing– Shallowparsing–ProbabilisticCFG,ProbabilisticCYK,ProbabilisticLexicalizedCFGs– Featurestructures,Unificationoffeaturestructures.

Total:30 Hours

G. Learning Resources

i. Online References:

1. Programming for Everybody (Getting Started with Python), Accessed on 02, April 2021 [Online] Available: https://www.coursera.org/learn/python/
2. The Python Standard Library, Accessed on 02, April 2021 [Online] Available: https://docs.python.org/3/library/

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS969	RED-HAT LINUX ADMINISTRATOR	30

A. Preamble

The RED HAT Associate course will teach students the necessary skills Linux administration "survival skills" by focusing on foundational Linux concepts and core tasks. Students will learn how to apply command-line concepts, enterprise-level tools,Configuring, installing, upgrading, maintaining Linux systems using established standards and procedures. Students starting on their journey towards becoming a full-time Linux system administrator.

B. Prerequisite Course

10211CS105- Computer Networks

C. Course Objectives

Learners are exposed to:

- The REDHAT Associate course will teach students the necessary skills Linux administration "survival skills" by focusing on foundational Linux concepts and core tasks.
- Students will learn how to apply command-line concepts, enterprise-level tools, Configuring, installing, upgrading, maintaining Linux systems using established standards and procedures.
- Students starting on their journey towards becoming a full-time Linux system administrator.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Practice on Basic commands to manage the text files.	K3
CO2	Modify users access control of the file system and manage Linux processes.	K3
CO3	Practice on configuration of remote systems and network management.	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	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	2		2					2			3		
CO2	3	2		2					2			2		
CO3	3	3		2					2			3		

3- High; 2-Medium; 1-Low

F. Course Contents

Module – 1: Access the command line,Manage files from the command line 3 Hour

Log into a Linux system and run simple commands using the shell. Copy, move, create, delete, and organize files while working from the bash shell.

Module – 2: Get help in Red Hat Enterprise Linux,Create, view, and Edit text files 3 Hour

Resolve problems by using local help systems.Manage text files from command output or in a text editor.

Module – 3: Manage local users and groups , Control access to files 4 Hour

Create, manage, and delete local users and groups, as well as administer local password policies.Set Linux file system permissions on files and interpret the security effects of different permission settings.

Module – 4: Monitor and manage Linux processes, Control services and daemons 4 Hour

Evaluate and control processes running on a Red Hat Enterprise Linux system. Control and monitor network services and system daemons using systemd.

Module – 5: Configure and secure SSH, Analyze and store logs 4 Hour

Configure secure command line service on remote systems, using OpenSSH. Locate and accurately interpret logs of system events for troubleshooting purposes.

Module – 6: Manage networking,Archive and transfer files 4 Hour

Configure network interfaces and settings on Red Hat Enterprise Linux servers. Archive and copy files from one system to another.

Module – 7: Install and update software, Access Linux files systems 4 Hour

Download, install, update, and manage software packages from Red Hat and yum package repositories.Access, inspect, and use existing file systems on storage attached to a Linux server.

Module – 8: Analyze servers and get support,Comprehensive review4 Hour

Investigate and resolve issues in the web-based management interface, getting support
from Red Hat to help solve problems.

Total:30 Hours

G. Learning Resources

i. Online References:

1. Red Hat Academy", Accessed on July, 2024 [Online]. Available: https://www.redhat.com/en/services/training/rh124-red-hat-system-administration-i

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS970	**DATA ANALYTICS USING PYTHON**	**30**

A. Preamble

The Data Analytics Using Python course equips learners with the essential skills to analyze, interpret, and visualize data using Python programming and its powerful libraries. Through hands-on projects, students will develop the ability to solve real-world problems and derive actionable insights from data

B. Prerequisite Course

10211CS202-Design And Analysis of Algorithms

C. Course Objectives

Learners are exposed to:

- To analyze, interpret, and visualize data using Python programming and its powerful libraries.
- To solve real-world problems and derive actionable insights from data.
- To apply data cleaning techniques to preprocess real-world datasets for analytics tasks.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	**Demonstrate** the use of Python libraries such as Pandas and Matplotlib to perform data exploration and visualization.	**K2**
CO2	**Apply** data cleaning techniques to preprocess real-world datasets for analytics tasks.	**K3**
CO3	**Solve** practical problems by developing Python scripts for data manipulation and analysis.	**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	PSO1	PSO 2	PSO 3
CO1	2	1		1					1			1		
CO2	2	2		1					2			2		
CO3	3	2		2					2			2		

3- High; 2-Medium; 1-Low

F. Course Contents

Module 1: Introduction to Data Analytics and Python **2 hours**

Overview of the course and its objectives-Importance of data analytics in today's world Introduction to Python and its role in data analysis.

Module 2: Python Basics for Data Analytics **2 hours**

Python syntax, variables, and data types.Understanding lists, tuples, sets, andctionaries.Basic operations and control structures in Python.

Module 3: Data Preprocessing and Cleaning **2 hours**

Understanding raw data challenges.Handling missing values, duplicates, and outliers.Using Python libraries (Pandas, NumPy) for data cleaning.

Module 4: Exploratory Data Analysis (EDA) **2 hours**

Concepts and techniques of EDA.Summarizing data using statistical measures.Creating data visualizations using Matplotlib and Seaborn.

Module 5: Working with DataFrames and Pandas **2 hours**

Introduction to Pandas DataFrames.Importing, filtering, and transforming data.Aggregating and merging datasets.

Module 6: Data Visualization Techniques **2 hours**

Creating effective visualizations with Matplotlib and Seaborn.Designing line charts, bar graphs, scatter plots, and heatmaps.Customizing plots for better insights.

Module 7: Introduction to NumPy for Data Analysis **2 hours**

Understanding arrays and their applications.Performing operations on NumPy arrays.Mathematical and statistical operations using NumPy.

Module 8: Data Extraction from Various Sources **2 hours**

Extracting tabular data from CSV, Excel, and databases.Working with non-tabular data such as JSON and XML Using APIs to fetch data for analysis.

Module 9: Statistical Analysis with Python **2 hours**

Basics of descriptive and inferential statistics.Hypothesis testing and p-value interpretation.Correlation and regression analysis.

Module 10: Introduction to Machine Learning with Python **2 hours**

Understanding the basics of supervised and unsupervised learning.Implementing linear Regression and k-means clustering using Scikit-learn.Evaluating machine learning models.

Module 11: Time Series Analysis **2 hours**

Basics of time series data and its components.Visualizing time series trends using Python.Forecasting techniques and implementation.

Module 12: Advanced Data Manipulation with Python **2 hours**

Using advanced Pandas functions for transformation.Pivot tables and reshaping data.Optimizing performance with large datasets.

Module 13: Building Dashboards with Python **2 hours**

Introduction to Dash and Plotly for interactive visualizations.Designing and customizingdashboards.Sharing dashboards for collaboration.

Module 14: Case Studies and Real-World Applications **2 hours**

Solving a business problem using data analytics.Step-by-step analysis of a real-world dataset.Presenting findings and actionable insights.

Module 15: Ethical Considerations and Best Practices **2 hours**

Understanding data privacy and security challenges.Ethical considerations in data analysis.Best practices for clean and maintainable Python code

Total:30 Hours

G. Learning Resources

i. Online References:

1. **Applied Data Science with Python Specialization",** University of Michigan, "Course Overview,"Coursera, www.coursera.org/specializations/data-science-python.
2. **"Think Stats: Exploratory Data Analysis in Python",** Allen B. Downey, "Book Overview," O'Reilly Media, www.greenteapress.com/thinkstats2/.
3. **"Python for Data Science and Machine Learning Bootcamp",** Jose Portilla, "Course Overview," Udemy, www.udemy.com/course/python-for-data-science-and-machine-learning-bootcamp/.
4. **"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow",** AurélienGéron, "Book Overview," O'Reilly Media, www.oreilly.com/library/view/hands-on-machine-learning/9781492032632/.

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS971	CLOUD LET COMPUTING	30

A. Preamble

Cloud computing represents a revolutionary shift in how computing resources are delivered, managed, and utilized. It provides on-demand access to shared pools of configurable computing resources, such as servers, storage, applications, and services, over the internet. By leveraging cloud computing, organizations can reduce capital expenditure, enhance scalability, increase flexibility, and improve efficiency in their IT infrastructure. This model supports innovations, optimizes resource allocation, and enables businesses and individuals to access technology services from virtually anywhere, allowing for greater collaboration and operational agility in a digital-first world

B. Prerequisite Course

10210CS101-Fundamentals of Computer Science

C. Course Objectives

Learners are exposed to:

- To give the idea of cloud let computing and its services available todaywhich may lead to the design and development of simple cloud service
- Focused on some key challenges and issues around cloud computing

.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Learn how the current digital transformation is creating unprecedented economic opportunity.	K3
CO2	Understand how the IoT is bridging the gap between operational and information technology systems.	K3
CO3	Develop critical thinking and problem-solving skills using both real equipment and Cisco Packet Tracer.	K3
CO4	Soft skills such as teamwork and articulating problems and solutions in a business context	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	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2	1		2			1		2			2	2	3
CO2	2	2	2	1			1		2				2	1
CO3	3	2	2	1			1		2			1		
CO4	1			2			2							

3- High; 2-Medium; 1-Low

F. Course Contents

Module I: Introduction and Cloud Services and Security	5 hours
Module II: Data-Intensive Technologies for Cloud Computing	5 hours
Module III: Standards and Applications Using Cloud Service	5 hours
Module IV: Virtualization for Cloud to Collaborative Online	5 hours
Module V: Digitization of the Business	5 hours
Module VI: Create an IoT Solution	5 hours

Total:30 Hours

G. Learning Resources

i. Online References:

1. Tutorial - https://www.javatpoint.com/cloud-computing-tutorialTest Practice https://education.emc.com/guest/certification/exams.aspx/
2. https://www.coursera.org/specializations/natural-language-processing

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS972	DIGITAL IMAGE PROCESSING FOR COMPUTER SCIENCE ENGG	30

A. Preamble

Image processing is a core course in the stream of Computer Science & Engineering. This course provides an introduction to basic concepts, methodologies and algorithms of digital image processing focusing on the following two major problems concerned with digital images: (1) image enhancement and restoration for easier interpretation of images, and (2) image analysis and object recognition. Some advanced image processing techniques (e.g., wavelet and multiresolution processing) will also be studied in this course

B. Prerequisite Course

10210MA101-LinearAlgebraforComputing

C. Course Objectives

Learners are exposed to:

- Thiscourseaimstoprovideacomprehensiveview of building real-world Imageprocessing (NLP) applications.
- The diverseapplications of Image Processing are based on a commonset of ideas, drawing on algorithms, linguistics,logic, statistics, and more.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Explainthetheoretical foundationsforimageprocessingtechniques.	K2
CO2	Applyimagetransformationsand enhancementtechniques to improve thequalityofrealtimeimages.	K3
CO3	Comparevariousfiltersforimagerestorationandconstruction techniques.	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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3				1									
CO2	3	3		3	2							3		
CO3	3	3			1									

3- High; 2-Medium; 1-Low

F. Course Contents

Unit – I: Digital Image Fundaments **6 Hours**

Introduction to Digital Image Processing, Image Formation and Acquisition, Basic Image File Formats, Image Sampling and Quantization, Pixel Relationships, Case Study – Basic Image Processing Operations

Unit – II: Image Transforms and Enhancement 6 Hours

Introduction to 2D Transforms: Fourier Transform, Discrete Wavelet Transform, Basic Image Enhancement Techniques, Histogram Processing, Smoothing and Sharpening Techniques, Case study: Medical image diagnosis

Unit – III: Image Restoration 6 Hours

Image Degradation Models - Basic Noise Models, Introduction to Filtering Techniques: Inverse Filtering, Wiener Filtering, Blind Deconvolution, Image Reconstruction from Projections, Case study: Biometric analysis

Unit – IV:Image Compression 6 Hours

Basics of Data Compression, Overview of Lossless and Lossy Compression Techniques, LZW coding, Huffman, Lossy: Predictive Coding, Transform coding, Wavelet coding, Introduction to JPEG Compression Standard, Case study: Climatic data analysis

Unit– V:Image Segmentation 6 Hours

Fundamentals of Image Segmentation, Edge Detection Techniques, Introduction to Thresholding and Region-Based Segmentation, Boundary descriptors, Shape numbers, Simple and Topological Descriptors, Texture, Case Study: Plant crop detection using image segmentation

Total:30 Hours

G. Learning Resources

i. Text Book:

1. Rafael C Gonzalez, Richard E Woods, Digital Image Processing, Pearson Education, 4th edition, 2018. [Unit 1-5]

ii. Reference Book:

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,' Digital Image Processing using MATLAB', Pearson Education, Inc., 2004/
2. Rick Szelisk, “Computer Vision: Algorithms and Applications”, Springer 2011
3. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, First Edition, PHI Learning Pvt. Ltd., 2011

iii. Online References:

1. “Fundamentals of Digital Image and Video Processing”, 2016, Accessed on June 20, 2021. [Online]. Available: https://www.coursera.org/learn/digital/
2. Digital Image Processing”, 2017, Accessed on June 20, 2021, https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee75/

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS974	ROLES OF COMPUTER SCIENCE ENGINEERING IN HEALTHCARE	30

A. Preamble

This Course aims to explore the intersection of technology and healthcare, focusing on how computer science engineering can revolutionize the healthcare industry. Through this course, students will delve into topics such as medical imaging, electronic health records, telemedicine, and artificial intelligence in healthcare

B. Prerequisite Course

10210CS101-Fundamentals of Computer Science

C. Course Objectives

Learners are exposed to:

- Understand the Intersection of Computer Science and Healthcare.
- Explore Key Technologies in Healthcare.
- Examine Health Informatics and Decision Support Systems.
- Evaluate Ethical, Legal, and Social Implications of Technology in Healthcare.
- Prepare for Future Trends in Health Technology.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Identify and describe the major computer science technologies (such as AI, ML, IoT, EHR, and HIS) that are transforming healthcare systems.	**K2**
CO2	Develop innovative solutions utilizing computer science engineering to address challenges in healthcare delivery and patient care.	**K3**
CO3	Analyze the impact of technology on healthcare delivery, patient outcomes, and overall healthcare system efficiency.	**K3**
CO4	Evaluate the ethical and legal considerations associated with the integration of computer science engineering in healthcare practices.	**K3**
CO5	Gain the ability to evaluate and implement telemedicine and remote healthcare solutions that improve patient access and care delivery in remote areas.	**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	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	1		2			2		1	1		2		
CO2	2	2	2	1	2		2		2	2		2		
CO3	3	2	1	1	2		3		1	1		2		
CO2	1	2		2	2				2	2				
CO3	3				2		1		1	1		1		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Cloud Computing Impact on Healthcare ServiceL-6 Hours

Introduction to Cloud Computing in Healthcare - Healthcare Data Management in the Cloud - Telemedicine and Remote Patient Monitoring - Electronic Health Records and Cloud Storage - Security and Privacy Considerations in Cloud Computing

Unit 2 IoT Contributions to the Healthcare Industry L-6 Hours

Overview of Internet of Things (IoT) technology - Applications of IoT in the healthcare sector - Benefits and challenges of implementing IoT in healthcare - Types of IoT devices and sensors used in healthcare - Remote patient monitoring and telehealth solutions - Ethical and regulatory considerations in the use of IoT in healthcare

.

Unit 3 The Influence of Machine Learning Methods on Healthcare L-6 Hours

Overview of machine learning techniques - Applications of machine learning in healthcare - Supervised Learning in Healthcare - Unsupervised Learning in Healthcare - Challenges and opportunities for the future of healthcare machine learning

.

Unit 4 Unit 4 The Significance of Big Data in HealthcareL-6 Hours

Introduction to Big Data in Healthcare - Applications of Big Data Analytics in Healthcare - Data Analytics concepts

Unit 5 :Cybersecurity in Healthcare IT L-6 Hours

Importance of cybersecurity in protecting patient data and healthcare systems - Best practices for securing electronic health records (EHR) and medical devices - Overview of encryption, firewalls, and intrusion detection systems - Role of biometrics and multi-factor authentication in healthcare security

Total:30 Hours

G. Learning Resources

iv. Online References:

1. https://www.deeplearning.ai/resources/natural-language-processing/
2. https://www.coursera.org/specializations/natural-language-processing

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS976	DATA SCIENCE FOR ENGINEERS-COMPUTER SCIENCE & ENGG	30

A. Preamble

In today's rapidly advancing technological landscape, data has become a critical asset in engineering fields, driving innovation, improving efficiency, and enabling data-driven decision-making. This course, Data Science for Engineers, is designed to bridge the gap between engineering and data science. Through a practical, hands-on approach, students will learn to harness the power of data to address engineering challenges, build predictive models, and deploy real-world applications

B. Prerequisite Course

10211CS207 Database Management system

C. Course Objectives

Learners are exposed to:

- Conduct data pre-processing, feature engineering, and exploratory data analysis on engineering datasets.
- Build and evaluate regression, classification, and anomaly detection models for engineering problems using R.
- Deploy predictive and classification models for real-time and interactive engineering applications.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	To conduct data pre-processing, feature engineering, and exploratory data analysis on engineering datasets.	K3
CO2	To build and evaluate regression, classification, and anomaly detection models for engineering problems using R.	K3
CO3	Deploy predictive and classification models for real-time and interactive engineering 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO 2	PSO 3
CO1	2	1							2	1		2	2	
CO2	2	2	2						2	2			2	
CO3	3	2	1						3	1		1	2	

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Data Science and Engineering L-6 Hours

Overview of data science principles and the data science lifecycle Importance of data science in engineering fields Real-world applications in engineering (e.g., predictive maintenance, quality control) Introduction to R for Data Science: RStudio, R syntax basics, and project setup

Unit 2 IoT Contributions to the Healthcare IndustryL-6 Hours

Data acquisition methods: APIs, databases, web scraping Working with various data formats in R (CSV, JSON, SQL, etc.) Data preprocessing techniques in R: cleaning, handling missing values, normalization, and transformation Feature engineering and selection for engineering datasets R packages for data wrangling: dplyr, tidyr, and data.table.

Unit 3 The Influence of Machine Learning Methods on Healthcare L-6 Hours

Descriptive statistics with R Data visualization in R using ggplot2, plotly, and shiny for interactive plots Identifying patterns, trends, and outliers in dataCorrelation analysis and dimensionality reduction techniques (PCA, t-SNE) with R packages such as FactoMineR and factoextra.

Unit 4 The Significance of Big Data in Healthcare L-6 Hours

Supervised vs. unsupervised learning, Regression and classification algorithms in R (linear regression, logistic regression, decision trees), Clustering methods (k-means, hierarchical clustering, DBSCAN),Evaluation metrics for engineering applications (accuracy, precision, recall, F1 score, ROC-AUC),R packages for machine learning: caret, and random Forest. Model tuning and hyperparameter optimization in R

Unit Cybersecurity in Healthcare IT L-6 Hours

Real-world case studies (predictive maintenance, process optimization, quality assurance) using R. Capstone project involving a real engineering problem, with full project lifecycle implementation in R

Total:30 Hours

G. Learning Resources

i. Online References:

1. Introduction To Linear Algebra - By Gilbert Strange
2. Applied Statistics And Probability For Engineers – By Douglas Montgomery

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS977	DATA STRUCTURES USING C	30

A. Preamble

To provide the knowledge of basic data structures and their implementations. To understand importance of data structures in context of writing efficient programs. To develop skills to apply appropriate data structures in problem solving

B. Prerequisite Course

10211CS105- Computer Networks

C. Course Objectives

Learners are exposed to:

- This course provides a pioneer in transforming fresh campus recruits into quality software professionals through its world-renowned training program.
- Students can benefit from the always-on, anytime-anywhere learning catered, through a continuous transfer of digital skills and expertise in data structure.
- This course helps to qualify for more employment.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Implement the data structures and their applications essential for programming/problem solving.	K3
CO2	Apply linear and non Linear Data Structures for the given application	K3
CO3	Apply concepts of Hashing, Files and their organization and sorting algorithms.	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	PSO3
CO1	3	2							1	1		3		
CO2	3	3	3	2	2				2	2		2		
CO3	3	3	3	2	2				1	1		3	2	

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Data StructuresL-6 Hours

Algorithms and Flowcharts, Basics Analysis on Algorithm, Complexity of Algorithm, Introduction and Definition of Data Structure, Classification of Data, Arrays, Various types of Data Structure, Static and Dynamic Memory Allocation, Function, Recursion.

Arrays, Pointers and Strings: Introduction to Arrays, Definition, One Dimensional Array and Multidimensional Arrays, Pointer, Pointer to Structure, various Programs for Array and Pointer. Strings. Introduction to Strings, Definition, Library Functions of Strings

Unit 2 Stacks and Queue L-6 Hours

Introduction to Stack, Definition, Stack Implementation, Operations of Stack, Applications of Stack and Multiple Stacks. Implementation of Multiple Stack Queues, Introduction to Queue, Definition, Queue Implementation, Operations of Queue, Circular Queue, De-queue and Priority Queue.

Unit 3 Linked Lists and Trees L-6 Hours

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms forgrammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programmingparsing– Shallowparsing–ProbabilisticCFG,ProbabilisticCYK,ProbabilisticLexicalizedCFGs– Featurestructures,Unificationoffeaturestructures.

Unit 4 Graphs, Searching, Sorting and Hashing Graphs L-6 Hours

Requirementsforrepresentation,First-OrderLogic,DescriptionLogics–Syntax-DrivenSemanticanalysis,Semanticattachments– WordSenses,RelationsbetweenSenses,ThematicRoles,selectionrestrictions– WordSenseDisambiguation,WSDusingSupervised,Dictionary&Thesaurus,Bootstrappingmethods–WordSimilarityusingThesaurusandDistributionalmethods

Unit 5 :Searching and Sorting L-6 Hours

Explore the evolving job market opportunities in the increasingly digitized world.-Learn thelifelonglearningeducationalopportunities-importanceofindustrycertificationsandcommunitiesofInterestrelatedtotheIoT.-ExploreIoTRelatedJobandLearningOpportunities

Total:30 Hours

G. Learning Resources

i. Text Books:

1. E. Horowitz &Sahni,Fundamental Data Structure, Galgotia Book Source, 1983. Tannenbaum, Data Structure Using C, Pearson Education, 2003/
2. Kruz, Data Structure and Programming Design, 1987
3. N. Wirth, Algorithms +Data Structure = Program, Prentice Hall of India, 1979
4. Goodrich &Tamassia, Data Structures and Algorithms in C++, 2nd Edition, John Wiley & Sons, 2011

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS978	NATURAL LANGUAGE PROCESSING SPECIALIZATION	30

A. Preamble

NLP Specialization is designed to provide learners with a comprehensive understanding of how machines process and understand human language. This course covers the fundamental techniques and advanced methods in NLP, including text preprocessing, word embeddings, deep learning models, and cutting-edge transformer architectures

B. Prerequisite Course

10210CS101-Fundamentals of Computer Science

C. Course Objectives

Learners are exposed to:

- To equip learners with a comprehensive understanding of language processing fundamentals, techniques, and tools.
- To develop skills to tackle challenges in NLP, understand ethical considerations.
- To create practical applications such as chatbots and recommendation systems.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Describe NLP concepts, tokenization, stemming, lemmatization, and stopword removal.	K2
CO2	Implement word embedding models to represent and analyze text data for various NLP applications.	K3
CO3	Implement seq2seq models and basic atten-tion for translation and text generation tasks.	K3
CO4	Fine-tune BERT, GPT, or T5 for specific tasks like sentiment analysis, question answering, or text summarization.	K3
CO5	Design and functionality of common NLP applications, including chatbots, recommendation systems, and translation tools.	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	PSO3
CO1	2	1		2					2			2		
CO2	2	2	2	1					2					
CO3	3	2	1	1					2			1		
CO4	1			2								1		
CO5	2								1			1		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Foundations of Natural Language ProcessingL-6 Hours

Overview of NLP and language structure-Text preprocessing: tokenization, stemming, lemmatization, stopword removal-Basic NLP applications (e.g., text classification, named entity recognition)-Tools and libraries: NLTK, spaCy, and introductory Python for NLP

Unit 2 Word Embeddings and Text Representation L-6 Hours

Traditional representations: Bag of Words, TF-IDF-Distributed word representations-Word2Vec, GloVe, FastText Semantic similarity and vector spaces Applications of word embeddings in NLP tasks

Unit 3 Deep Learning for NLP L-6 Hours

Fundamentals of neural networks and deep learning for text Recurrent neural networks (RNNs), LSTMs, GRUs for sequence data Sequence-to-sequence models and attention mechanisms Introduction to Transformers and their applications

Unit 4 Advanced Language Models and Transformers L-6 Hours

Transformer architecture and the evolution of language models-Pre-trained models: BERT, GPT, T5, and fine-tuning for NLP tasks-Applications in NLP: question answering, summarization, sentiment analysis Practical training and fine-tuning of large-scale models

Unit 5 Data Visualization with Matplotlib and Seaborn L-6 Hours

Real-world NLP applications: chatbots, recommendation systems, Translation-Model evaluation metrics (e.g., BLEU, ROUGE, F1-score)-Ethical considerations: bias, fairness, and privacy in NLP

Total:30 Hours

G. Learning Resources

i. Text book:

1. "Speech and Language Processing" by Daniel Jurafsky& James H. Martin
2. "Deep Learning for Natural Language Processing" by Palash Goyal, Sumit Pandey, and Karan Jain

ii. Online References:

1. Coursera - Natural Language Processing Specialization (by deeplearning.ai) https://www.coursera.org/specializations/natural-language-processing#outcomes edX - Natural Language Processing with Deep Learning (by Stanford University)
2. https://online.stanford.edu/courses/xcs224n-natural-language-processing-deep-learning

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS980	INTRODUCTION TO ARTIFICIAL INTELLIGENCE FOR COMPUTER SCIENCE AND ENGINEERING	30

A. Preamble

This course provides an introduction to the fundamental concepts, techniques, and applications of Artificial Intelligence (AI). It covers a broad range of topics including search algorithms, knowledge representation, machine learning, natural language processing, and intelligent agents. Students will gain the foundational skills needed to design and implement AI-based systems

B. Prerequisite Course

10211CS102-Data Structures

C. Course Objectives

Learners are exposed to:

- Thiscourseaimstoprovideacomprehensiveview of building real-world natural languageprocessing (NLP) applications.
- The diverseapplications of NLP are based on a commonset of ideas, drawing on algorithms, linguistics,logic, statistics, and more.
- The goal of thiscourse is also to provide an overview ofthese foundations. The course covers themost important topics in the field, keeping abalancebetweentheoryandpractice.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Understand the fundamentals of AI, intelligent agents, and problem-solving methods.	K2
CO2	Apply search algorithms for solving AI problems.	K3
CO3	Understand and implement knowledge representation techniques, including logical systems and reasoning.	K3
CO4	Apply machine learning algorithms to solve real-world problems.	K3
CO5	Apply NLP techniques for text processing, classification, and language models.	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	PSO1	PSO2	PSO3
CO1	3	2	3									3		
CO2	2	3		3								3		
CO3	3	1			3							3		
CO4	2	1												
CO5	2	1	3											

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to AI and Intelligent AgentsL-6 Hours
Definition of AI, Types of AI: Narrow AI vs General AI, Intelligent agents and environments, Problem-solving methods, Performance measures and agent architectures
Unit 2 Problem-Solving and Search AlgorithmsL-6 Hours
Search strategies: Uninformed search (BFS, DFS), informed search (A*, reedy), Heuristic Functions, Local search algorithms, Constraint satisfaction problems.
Unit 3 Knowledge Representation L-6 Hours
Representation of knowledge: Propositional and first-order logic, Semantic networks, frames, and rule-based systems, Reasoning under uncertainty, Bayesian networks and inference.
Unit 4 :Machine Learning Basics L-6 Hours
Supervised vs unsupervised learning, Regression and classification algorithms, Decision trees, k-NN, SVM, and neural networks, Evaluation metrics and cross-validation
Unit 5 :DiscourseAnalysisandLexicalResources L-6 Hours
Basics of NLP and text processing, Techniques for syntactic and semantic analysis, Text classification, sentiment analysis, and language models, Chatbots and language generation models

Total:30 Hours

G. Learning Resources

i. Text Books:

1. Artificial Intelligence: A Guide for Thinking Humans" by Melanie Mitchell/
2. Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
3. Python Machine Learning" by Sebastian Raschka
4. Pattern Recognition and Machine Learning" by Christopher M. Bishop
5. Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS981	BUILDING BLOCKS OF JAVA	30

A. Preamble

Java, a versatile and widely-used programming language, is built on core components including its syntax, data types, variables, operators, control statements, and object-oriented principles, which collectively enable the creation of robust and platform-independent applications

B. Prerequisite Course

10210CS101-ProblemSolvingUsingC

C. Course Objectives

Learners are exposed to:

- Learn the fundamental aspects of Java programming, focusing on object-oriented principles and design.
- Understand the role of stack and heap memory and the use of wrapper classes in Java.
- Develop expertise in exception handling, string manipulation, and Java I/O operations, for efficient error management and data processing.
- Learn to effectively use Java's collection framework
- Acquire skills in thread management, synchronization, and multi-threading in Java, alongside developing graphical user interface (GUI) applications.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Discuss Java standards and declaration rules to structure and write efficient programs.	K2
CO2	Apply operators and boxing techniques to implement business logic in Java applications.	K3
CO3	Illustrate exceptions, manipulate strings, and handle date-related operations in Java programs	K2
CO4	Implement Generics, collections, and concurrency to enhance program functionality and performance.	K3
CO5	Develop GUI-based applications using Java's event-driven programming 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2	2			2							2		
CO2	3	3			2							3		
CO3	2	2			2							2		
CO4	3	3			2							3		
CO5	3	3			2							3		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Declaration ,Access Control and Object Orientation L-6 Hours

Identifiers and JavaBeans standards - Declaring Classes - Declaring Interfaces - Declaring Class Members - Constructor - Declaring Enums- Encapsulation and Inheritance - Plymorphism and Reference variable casting - Overridding and Overloading - Constructor and Instantiation – Static Variable and methods - Coupling and cohesion - Garbage Collection

Unit 2 Assignment and Operators **L-6 Hours**

Stack and Heap memory Overview - Literals, Assignments and variables - Method calling Mechanism Array and Overloading - Wrapper class and Boxing Assignment Operator, relational Operator - Instance of and Conditional Operator

Unit 3 Exceptions Strings and I/O Formatting **L-6 Hours**

Exception - String, String methods -StringBuffer, StringBuilder - File Navigation, I/O - Dates, Numbers and Currency

Unit 4 Generics, Collections, Inner Classes **L-6 Hours**

Object class Methods Collections- List, Set, Map, Queue, ArrayListTreeSet, TreeMaps and Backed Collections Regular and Local Inner Classes - Anonymous Inner class and Nested Classes

Unit 5 Threads, Development and Swing **L-6 Hours**

Threads Thread Synchronization - Javac and java commands , JAR ,Import statement Swing Environment –Controls- Layout Management- Event Handling – Action- Event Handling – Mouse, Keyboard- Menu and Menubars - Developing sample application using SWINGs

Total:30 Hours

G. Learning Resources

i. Text Books:

1. SCJP Sun Certified Programmer for Java 6 Study Guide: Exam 310-065 by Kathy Sierra McGraw Hillhttps://www.coursera.org/specializations/natural-language-processing

ii. Online Books:

1. Cay S. Horstmann and Gary Cornell, “Core Java: Volume I - Fundamentals”, Sun Microsystems Press, Ninth Edition, 2013
2. RajkumarBuyya ,S. ThamaraiSelvi ,Xingchen Chu “Object Oriented Programming with Java: Essentials and Applications” Tata McGraw Hill Education 2009
3. P.J. Deitel& H.M. Deitel, “Java: How to Program Java 2”, Prentice Hall, Seventh Edition, 2011.
4. Herbert Schildt, “Java: The Complete Reference”, McGraw Hill Education, Ninth Edition, 2014

iii. Online Resources:

1. http://docs.oracle.com/javase/tutorial/java/
2. http://www.java2s.com/Tutorial/Java/CatalogJava.htm
3. http://www.javatpoint.com/java-swing
4. https://docs.oracle.com/javase/tutorial/collections/intro/

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS982	REACT JS AND NODE JSL	30

A. Preamble

React JS has rapidly revolutionized the landscape of web development. This technology has emerged as a dominant force in building interactive and scalable user interfaces. Developed and maintained by Meta, React's component-based architecture, declarative approach, and efficient virtual DOM have made it a favourite amongst developers worldwide. Moreover, by delving into React's rich ecosystem, developers can unlock vast opportunities to build dynamic web applications, mobile apps, and even desktop applications. Furthermore, React professionals can establish a solid foundation for success in the ever-evolving field of modern web development

B. Prerequisite Course

10211CS212- Web and Mobile Application Development

C. Course Objectives

Learners are exposed to:

- Understand the core concepts of React, including components, JSX, props, and state.
- Learn the benefits of using React for building user interfaces compared to traditional approaches.
- Build reusable and modular UI components.
- Manage component lifecycle methods and hooks effectively
- Learn routing concepts and implement React Router for single-page applications (SPA).
- Create dynamic and nested routes with navigation.
- Learn optimization techniques like memoization, lazy loading, and code splitting

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Describe the core concepts of React and its benefits over traditional development approaches.	K2
CO2	Explain the concept of components and their importance in React's modular architecture.	K2
CO3	Handle user events and interactions within React applications.	K3
CO2	Implement client-side routing in a React application using React Router.	K3
CO3	Explain the principles of Redux and its role in managing application state.	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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	2	2						2			2		
CO2	3	2	2						2			2		
CO3	3	3	2						2			3		
CO4	2	3	2						2			2		
CO5	3	2							2					

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to React L-6 Hours

Overview of React and its benefits, setting up a development environment, Understanding JSX syntax, Creating and rendering React components, Introduction to React hooks (use State, use Effect)

Unit 2 Component-based Architecture L-6 Hours

Understanding the concept of components, Props and state management in React. Functional components vs. class components, Creating reusable components Component lifecycle methods

Unit 3 Handling Events and Forms L-6 Hours

Event handling in React, Forms and controlled components, Handling user input with forms Form validation techniques, React Router: Introduction to React Router, Setting up routes in a React application, Creating nested routes, Implementing route parameters and query strings, Using NavLink and Redirect components.

Unit 4 State Management with Redux L-6 Hours

Introduction to Redux and its principles, setting up Redux in a React application, Actions, reducers, and the store, Connecting React components to Redux, Asynchronous actions with ReduxThunk

Unit 5 React Hooks L-6 Hours

Understanding React hooks in depth, use State, use Effect, use Context, and more Custom hooks and their usage, best practices for using hooks.

Total:30 Hours

G. Learning Resources

i. Text Book:

1. Learning React: Modern Patterns for Developing React Apps" Alex Banks and Eve Porcello Publisher: O'Reilly Media
2. https://www.coursera.org/specializations/natural-language-processing

ii. Reference Books:

1. React – Up & Running: Building Web Applications" Author: StoyanStefanov Publisher: O'Reilly Media /
2. React in Action" Mark Tielens Thomas Publisher: Manning Publications

iii. Online References:

1. https://reactjs.org/docs/Description: The definitive guide to React, including in-depth explanations, examples, and best practices. Free Code Camp React Tutorials
2. https://www.freecodecamp.org/Description: A collection of beginner-friendly tutorials and projects to practice React concepts. React – A Complete Guide (Udemy)
3. https://www.udemy.com/course/react-the-complete-guide-incl-redux/Dscription: A comprehensive online course covering React, hooks, Redux, and

advanced patterns

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS983	COMPUTER SCIENCE ENGG APPROACHES TO ENVIRONMENTAL MANAGEMENT	30

A. Preamble

This course on Computer Science Engineering with Environmental Management provides a comprehensive understanding of the fundamentals of computer science and their applications in environmental management. It includes the use of computational tools and techniques for environmental data analysis and explores the role of technology in promoting environmental sustainability

B. Prerequisite Course

10211CS213 -Python Programming

C. Course Objectives

Learners are exposed to:

- Understand computer science fundamentals and their applications in environmental management.
- Learn computational tools for environmental data analysis.
- Explore the use of technology for environmental sustainability.
- Conduct environmental impact assessments.
- Discover emerging technologies and career opportunities in this field

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Understand environmental management fundamentals.	K2
CO2	Apply computational tools for environmental data analysis.	K3
CO3	Understand technologies for sustainability.	K2
CO4	Conduct basic environmental impact assessments.	K3
CO5	Conduct basic environmental impact assessments.	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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	2		2		2			2			2		
CO2	3	2	2	2					2			2		
CO3	3	3		2		2			2			3		
CO4	2	3		2		2			2			2		
CO5	3	2		2		2			2			2		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Environmental ManagementL-6 Hours

Overview of Environmental Management -Definition and importance Key environmental issues and challenges -Sustainable Development and Environmental Policies - Principles of sustainable development -Global and local environmental policies and regulations.

Unit 2 Fundamentals of Computer Science EngineeringL-6 Hours

Introduction to Computer Science Engineering - Overview of computer science principles - Key areas in computer science: Algorithms, Data Structures - Software Development C - Programming Basics -Introduction to programming languages (Python/Java) - Writing and understanding basic code

Unit 3 Environmental Data Analysis L-6 Hours

Environmental Data Collection Techniques - Types of environmental data (air quality, water quality, biodiversity) - Methods for data collection and sensors - Data Analysis and Visualization - Statistical methods for data analysis - Tools for data visualization (e.g., Tableau, Matplotlib)

Unit 4 Computational Tools for Environmental Management L-6 Hours

Geographic Information Systems (GIS) - Introduction to GIS and spatial analysis - GIS applications in environmental management - Machine Learning for Environmental Applications - Introduction to machine learning concepts - Case studies on machine learning applications in environmental management

Unit 5 Projects and Practical Applications L-6 Hours

Environmental Impact Assessment Projects- How to conduct an environmental impact assessment- Project planning and execution- Final Project Presentation and Discussion - Student presentations of their projects - Group discussion and feedback

Total:30 Hours

G. Learning Resources

i. Text Books:

1. Gilbert M. Masters, “Introduction to Environmental Engineering and Science,” Pearson Education, 3rd Edition, 2013
2. Richard T. Wright and Dorothy F. Boorse, “Environmental Science: Toward a Sustainable Future,” Pearson Education, 13th Edition, 2020

ii. Reference Books:

1. Daniel P. Loucks and Eelco van Beek, “Water Resource Systems Planning and Management,” Springer, 2017/
2. Chang H. Oh, “Environmental Toxicology and Risk Assessment,” CRC Press, 2020
3. R. K. Trivedy, “Handbook of Environmental Laws, Acts, Guidelines, Compliances & Standards,” 2021

iii. Online References:

1. Environmental Management and Sustainability” by edX [Online], 2020. Available: https://www.edx.org/course/environmental-management-and-sustainability
2. Environmental Data Analysis” by Coursera [Online], 2021. Available: https://www.coursera.org/specializations/environmental-data-analysis
3. Geographic Information Systems (GIS) Specialization” by Coursera [Online], 2019. Available: https://www.coursera.org/specializations/gis

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS986	APTITUDE IN ADVANCED CONCEPTS IN C PROGRAMMING	30

A. Preamble

The course places a strong emphasis on problem-solving using C as a tool. It introduces essential programming techniques such as conditional statements, loops, and recursion. Additionally, it offers a brief overview of foundational software engineering practices, including modularization, commenting, and adhering to naming conventions. These practices are essential for effective collaboration and teamwork in programming projects

B. Prerequisite Course

10210CS101-ProblemSolvingUsingC

C. Course Objectives

Learners are exposed to:

- It introduces essential programming techniques such as conditional statements, loops, and recursion.
- Additionally, it offers a brief overview of foundational software engineering practices, including modularization, commenting, and adhering to naming conventions

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Illustrate the right data representation formats based on the requirements of the problem.	K3
CO2	Apply Looping, Functions and Arrays for solving real time problems.	K3
CO3	Solve Problems using Pointers and Recursive routines.	K3
CO4	Understanding Linked List Basics, Dynamic Memory Management&Algorithm 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3				2				2		
CO2	3	3	3	3				2				3		
CO3	3	3	2	2				3				3		
CO4	3	3	2	2				3				3		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Variables, Operators, Expressions and ConditionalsL-8 Hours

Data concepts in C: Constants, Variables, Expressions, Operators, and operator precedence in C. Statements: Declarations, Input-Output Statements, Compound statements, Selection Statements. Conditions, Logical operators, Precedence. Repetitive statements, while construct, Do-while Construct, For construct. Data types, size and values. Char, Unsigned and Signed data types. Number systems and representations. Constants, Overflow

Unit 2 Loops, Functions, ArraysL-8 Hours

Arrays. Strings. Multidimensional arrays and matrices. Functions: The prototype declaration, Function definition. Function call: Passing arguments to a function, by value, by reference. Scope of variable names. Recursive function calls, Tail recursion. Analysing recursion, Tree of recursion, linear recursion. Sorting problem: Selection Sort, Insertion Sort, Comparison between sorting algorithms. Sorting in multidimensional arrays. Sorting in strings. Search problem: Linear search and binary search. Comparison between search procedures. Recursive and Iterative formulations.

Unit 3 Pointers, Recursion L-8 Hours

Pointers: Pointer variables. Declaring and dereferencing pointer variables. Pointer Arithmetic. Examples. Accessing arrays through pointers. Pointer types, Pointers and strings. String operations in C. Structures in C: Motivation, examples, declaration, and use. Operations on structures. Passing structures as function arguments. type defining structures.

Unit 4 Linked Lists L-6 Hours

Self-referential structures. Dynamic Data Structures. Linked Lists. Examples

Total:30 Hours

G. Learning Resources

i. Online References:

1. Introduction To Programming In C", Accessed on June.30,2023, [Online]. Available:https://onlinecourses.nptel.ac.in/noc22_cs40/previewhttps://www.coursera.org/specializations/natural-language-processing

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS989	FUNDAMENTALS OF FUTURE RESEARCH TECHNOLOGY	30

A. Preamble

This course introduces the fundamentals of future research technology, algorithmic framework for machine learning and big data analytics, machine learning and big data analytics, nanoscience research and social network analysis with respective applications. The main notion of this course is to build future research technology knowledge using a rich set of future research technology. Three milestone assessments have been added in the course to evaluate students' performance periodically.

B. Prerequisite Course

10210CS101-ProblemSolvingUsingC

C. Course Objectives

Learners are exposed to:

- To provide aspiring engineers with future research and technological advancements, shaping a better future for humanity.
- To direct job opportunities from multinational company, which will be awarded to students based on their performance.
- To acquire sufficient knowledge and skills to secure job opportunities in various multinational companies.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Illustrate basic of IoT and AI Research Technology	K2
CO2	Apply Abstraction, Packages in ML and Big Data Analytics	K3
CO3	Demonstrate Nanoscience with Social Network Analysis	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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO 2	PSO 3
CO1	3	2		3								3		
CO2	3	2		2								2		
CO3	3	2		2								3	2	

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 IoT and Artificial Intelligence Research TechnologyL-10 Hours

IoT Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control. Cisco IoT system – Converged Plant wide Ethernet

Model (CPwE) – GridBlocks Reference Model – IBM Watson IoT platform – Manufacturing – Power Utility Industry- Introduction to AI - Problem formulation, Problem definition - Production systems, Control strategies, Search strategies, Problem characteristics, Production system characteristics - Advanced plan generation systems – Bayesian network – Certainty factors, Bayesian theory – Dempster Shafer theory- K strips – Strategic explanations - Knowledge acquisition – Meta knowledge, Heuristics, Typical expert systems – MYCIN, DART, XOON, Expert systems shells

Unit 2 Machine Learning and Big Data Analytics Research L-10 Hours

Bayes Optimal Classifier — Bayes Theorem — Decision Tree learning —EM Algorithm — Explanation Base Learning —FOCL Algorithm —Genetic Algorithms —Gibbs Algorithm — Hypothesis Space Search—K- Nearest Neighbour Learning —Mistake Bound Model —Naïve Bayes Classifier —Neural Network Representation —Reinforcement Learning —Sequential-Covering Algorithm —Temporal Difference Learning—- HDFS - MapReduce and YARN - Apriori Algorithm - Decision Trees Algorithms - Decision Trees in R - Naïve Bayes - Bayes` Theorem - Graph Databases Hive - Sharding - Hbase - Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Real time Analytics Platform (RTAP) applications - Case Studies - Real Time Sentiment Analysis Using Graph Analytics for Big Data.

Unit 3 Future Nanoscience Research and Social Network AnalysisL-10 Hours

Bio imaging – Information storage-Nano computer –Micro Electro Mechanical Systems (MEMS) –molecular switch –Nano Electro Mechanical Systems (NEMS) -Nano medicines – Nanocrystal –Nanoparticles for sun barrier products –nanoprobes –super chip –Targeted drug delivery –Co-Citation networks - Collaboration networks – Community welfare – Cover networks – Emergence of the Social Web – Introduction to Semantic Web - Social Network analysis.

Total:30 Hours

G. Learning Resources

i. Text Books:

1. Mohamed Elhoseny, Mohamed Abdel-Basset, K. Shankar, “ Artificial Intelligence Techniques in IoT Sensor Networks”, CRC Press/Chapman & Hall, 2022.[Module 1]
2. . Brett Lantz, “Machine Learning with R: Learn techniques for building and improving machine learning models, from data preparation to model tuning, evaluation, and working with big data”, Fourth Edition, Packt Publishing, 2023. [Module 2]
3. Gang Zhang et al, “Nanofabrication and its Application in Renewable Energy”, First Edition, Royal Society of Chemistry, 2014. [Module 3]
4. Galety, et al, “ Social Network Analysis : Theory and Applications”, First Edition, 2022. [Module 3]

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS991	PYTHON DATA SCIENCE	30

A. Preamble

The Python for Data Science course is designed to equip learners with the essential skills needed to extract, process, analyze, and visualize data using Python. Through hands-on projects and real-world datasets, participants will learn how to harness the power of Python to transform raw data into meaningful insights that can drive business strategies, research, and innovations

B. Prerequisite Course

10210CS101-ProblemSolvingUsingC

C. Course Objectives

Learners are exposed to:

- To equip learners with the essential skills needed to extract, process, analyze, and visualize data using Python.
- Through hands-on projects and real-world datasets, participants will learn how to harness the power of Python.
- Python to transform raw data into meaningful insights that can drive business strategies, research, and innovations..

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Set up a Python environment using Anaconda and Jupyter Notebooks to begin working with data science projects.	K3
CO2	Write Python code using basic data types, control flow, and functions to automate tasks and perform simple data manipulations.	K3
CO3	Use NumPy to create and manipulate arrays for performing efficient numerical computations.	K3
CO4	Use pandas to clean, manipulate, and analyze large datasets in tabular format and Create clear and informative visualizations using Matplotlib and Seaborn to communicate insights from data.	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	PSO3
CO1	3	2	3	3					2			2		
CO2	3	3	3	3	2				2			3		
CO3	3	3	2	2	2				3			3		
CO4	3	3	2	2					3			3		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Python for Data ScienceL-6 Hours

Overview of Python and its Applications in Data Science-Setting up Python-Environment (Anaconda, Jupyter Notebooks)- Introduction to Data Science – Workflow- Writing your First Python Script

Unit 2 Python Basics for Data ScienceL-6 Hours

Review of Basic Python Syntax and Data Typee- Lists, Tuples, and Dictionaries for Data Manipulation- Control Flow (if, else, loops) and Functions- Introduction to List Comprehensions

Unit 3 Working with NumPy L-6 Hours

Introduction to NumPy Arrays and Array Operations- Creating and Manipulating Arrays (1D, 2D, and beyond)- Vectorized Operations and Broadcasting- Performing Mathematical and Statistical Operations with NumPy- Array Indexing and Slicing.

Unit 4 Data Manipulation with Pandas L-6 Hours

Introduction to Pandas DataFrames and Series-Loading Data from CSV, Excel, and Other File Formats-DataFrame Operations (Selection, Filtering, Sorting)-Data -Cleaning: Handling Missing Values, Duplicates, and Data Transformation-Grouping, Aggregation, and Pivot Tables in Pandas-Combining and Merging DataFrames

Unit 5 Data Visualization with Matplotlib and Seaborn L-6 Hours

Introduction to Data Visualization Concepts-Plotting with Matplotlib: Line, Bar, and Scatter Plots-Customizing Plots: Titles, Labels, and Legends-Creating Advanced -Visualizations with Seaborn: Histograms, Box Plots, and Heatmaps-Visualizing -Relationships and Trends in Data

Total:30 Hours

G. Learning Resources

i. Online References:

1. https://docs.python.org/3 /
2. https://jupyter.org

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS992	REACT FRAMEWORK	30

A. Preamble

React is a popular JavaScript library for building user interfaces, particularly single-page applications. It enables developers to create reusable UI components, manage application state efficiently, and ensure fast rendering with a virtual DOM

B. Prerequisite Course

10210CS101-ProblemSolvingUsingC

C. Course Objectives

Learners are exposed to:

- Learn how to define JSX.
- Install React.
- Create a React project.
- Create a React component.
- Work with dynamic data

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Understand React Fundamentals	K1
CO2	Develop Interactive Web Applications	K2
CO3	Integrate React with backend Services	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	PSO3
CO1	3	3	1	3					2			2		
CO2	2	3	2	3					2			3		
CO3	2	3	2	2					3			3		

3- High; 2-Medium; 1-Low

F. Course Contents

1. Experiment to Create Simple React App for Searching Emoji
2. Experiment to Create Pokedex-The List of PokemonWith Live Search
3. Experiment to Create Bitcoin Price Index Master
4. Experiment to Create Hacker News Page With React Graphqlmaster
5. Experiment to Create Simple Product Compare Page Built In React
6. Experiment to Perform A React Hooks App For Calculating BMI
7. Experiment to Perform Application Which Allows Kids To Practice Basic Mathematics
8. Experiment to Create Simple E-Commerce Cart Application Built Using React

9. Experiment to Perform Implementation of TheIos Calculator Built In React
10. Experiment to Perform Minimal Yet Responsive Unit Converter Built With React Material-Ui& Convert-Units
11. Experiment to Create Displays A List Of Movies As A List Of Cards Using React Cards

Total:30 Hours

G. Learning Resources

i. Online References:

1. https://developer.cisco.com
2. https://developer.cisco.com/codeexchange/github/repo/webex/react-ciscospark/

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS996	IMAGE PROCESSING AND ITS APPLICATION USING MATLAB	30

A. Preamble

This course provides a resource platform to learn basics of Biometric Image processing applications using MATLAB. This course also helps to develop image processing applications in Minor and Major Projects

B. Prerequisite Course

10211CS118- Image Processing Techniques

C. Course Objectives

Learners are exposed to:

- This course provides a pioneer in transforming fresh campus recruits into quality software professionals through its world-renowned training program.
- Students can benefit from the always-on, anytime-anywhere learning catered, through a continuous transfer of digital skills and expertise in data structure.
- This course helps to qualify for more employment.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Explain the fundamentals of steps in image processing.	K2
CO2	Apply various image enhancement techniques to improve the quality of the image	K3
CO3	Construct various threshold and region based segmentation techniques.	K3
CO4	Interpret various image compression techniques.	K3
CO5	Demonstrate different image representation and it's application	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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	2							2	1		3		
CO2	3	2							2	2		2		
CO3	3	3							2	1		2		
CO4	3	2										2		
CO5	3	3										3		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Digital Imaging L-6 Hours

DigitalImaging:Introduction–StepsinImageProcessingSystems–ImageAcquisition– Image Sampling and Quantization – Pixel Relationships – Linear and Nonlinear Operations. MATLAB: The MATLAB Desktop – Using the MATLAB Editor/Debugger – GettingHelp– SavingandRetrievingworkSessionData–DigitalImageRepresentation– ImageI/OandDisplay– ClassesandImageTypes–M-FunctionProgramming

Unit 2 Image Enhancement L-6 Hours

Image Enhancement-Spatial Domain-Gray level transformation- Histogram Processing-Spatial filter-smoothing and sharpening- Frequency domain: Filtering Frequency-DFT, FFT, DCT.

Unit 3 Image Segmentation L-6 Hours

Image Segmentation-Detection of Discontinuities, Edge operation. Edge Linking and Boundary detection, Thresholding and Region based segmentation; Morphological-Watershed, Motion Segmentation.

Unit 4 Image compression L-6 Hours

Multi Resolution Analysis and Compression: Image Pyramids –Multi resolutionexpansion – Wavelet TransformsImageCompression: Fundamentals –Models –Elements ofInformationTheory– Error Free Compression–LossyCompression–CompressionStandards

Unit 5 Image representation and It's application L-6 Hours

ImageRepresentation - Boundary descriptors, Simple Descriptors, Shape numbers, Regional descriptors, Simple and Topological Descriptors, Texture. Applications of Image Processing-Finger Print Recognition, Face Recognition, Iris Recognition

Total:30 Hours

G. Learning Resources

i. Text Book:

1. Rafael C Gonzalez, Richard E Woods, Digital Image Processing, Pearson Education, 4th edition, 2018. [Unit 1-5]

ii. Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,' Digital Image Processing using MATLAB', Pearson Education, Inc., 2004
2. Rick Szelisk, "Computer Vision: Algorithms and Applications", Springer 2011
3. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt

COURSE CODE	COURSE TITLE	TOTAL HOURS
10218CS997	CYBER SECURITY AND APPLIED ETHICAL HACKING	30

A. 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

B. Prerequisite Course

10210CS101-Fundamentals of Computer Science

C. Course Objectives

Learners are exposed to:

- Understand the basic principles and importance of network security in safeguarding digital infrastructures.
- Utilize tools like Nmap and Recon-ng to perform footprinting of target networks.
- Explore and interpret data from Common Vulnerabilities and Exposures
- Perform wireless network scanning and identify security flaws in wireless protocols.
- Analyze ethical and legal challenges in cybersecurity and ensure compliance with laws and regulations.

D. Course Outcomes

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

CO No's	Course Outcomes	K – Level/Skill Level
CO1	Overview of network security concepts and importance of ethical hacking in cybersecurity	**K2**
CO2	Techniques for passive and active reconnaissance,tools for foot printing and information gathering	**K3**
CO3	Vulnerability scanning tools ,Common Vulnerabilities and Exposures databases Exploitation frameworks	**K3**
CO4	Maintaining access (backdoors, rootkits) and Covering tracks and anti-forensics	**K3**
CO5	Gaining knowledge on Web application architecture	**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	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2	1		2			2		2			2	2	3
CO2	2	2	2	1			1		2				2	1
CO3	3	2	1	1			1		3			1	2	2
CO4	1	2		2			2					2		
CO5	3								1			1		

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction to Network securityL-5 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.

Unit 2 Information Gathering and Footprinting L-5 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.

Unit 3 Enumeration and Vulnerability Assessment L-5 Hours

Vulnerability scanning tools – Nessus, OpenVAS – Common vulnerabilities and exposure (CVE) databases – Exploitation frameworks(Metasploit) – Exploiting vulnerabilities – buffer overflows –SQL injection

Unit 4 Post Exploitation and Wireless Network hacking L-5 Hours

Maintaining access – backdoors – rootkits – Covering tracks – Anti-forensics – Wireless Network Hacking:

Wireless standards – WEP – WPA – WPA2 – Wireless network scanning – cracking

Unit 5 Web Application Hacking L-5 Hours

Web application architecture – exploiting common web vulnerabilities: XSS – CSRF – Social Engineering: Psychological principles – Phishing attacks – Mitigation strategies

Unit 6Penetration testing and Ethical Issues L-5 Hours

Penetration testing – Methodologies: Reconnaissance – Scanning – Exploitation – Post-exploitation – Legal and Ethical Issues – Laws and regulations related to hacking – responsible disclosure

Total:30 Hours

G. Learning Resources

i. Text Book:

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. RaefMeeuwisse, “Cyber Security for Beginners”, Cyber Simplicity Ltd., 2017

ii. Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,' Digital Image Processing using MATLAB', Pearson Education, Inc., 2004
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

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- 2
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0138431824628968963257 7_shared/overview
3. https://www.coursera.org/learn/cybersecurity-for-everyone

Industry/Higher Institute Interaction Learning Courses

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS945	Next Generation of Wired and Wireless Networks	1	-	-	1

COURSE CATEGORY

Industry / Institute Higher Learning

CourseOutcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the foundational principles of next-generation networks, including advanced wired and wireless networking technologies, and their role in modern communication systems.	**K2**
CO2	Analyze and apply network virtualization and cloud computing concepts to optimize network performance and scalability in diverse environments.	**K3**
CO3	Evaluate security challenges in next-generation networks and develop strategies to ensure secure communication and data integrity.	**K3**
CO4	Explore emerging networking technologies and their applications in industries, focusing on innovation and future trends.	**K3**
CO5	Assess the regulatory and ethical considerations associated with next-generation networks, ensuring compliance and responsible implementation.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2									2
CO2	3	3	3	3	3									2
CO3	3	2	3	3	3									2
CO4	3	3	3	3	3									2
CO5	3	3	3	3	2	2								2

COURSE CONTENT

Module 1: Foundations of Next Generation Networks
Module 2: Advanced Wired Networking Technologies
Module 3: Wireless Networking Technologies
Module 4: Network Virtualization and Cloud Computing
Module 5: Security and Next Generation Networks
Module 6: Emerging Technologies and its Applications
Module 7: Regulatory and Ethical Considerations

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS948	**Innovation Management**	1	-	-	1

COURSE CATEGORY

Industry / Institute Higher Learning

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Develop an understanding of innovation concepts, models, and methodologies to address real-world challenges through creative problem-solving approaches.	**K3**
CO2	Apply tools and techniques for fostering innovation and building an innovative mindset in both individual and organizational contexts.	**K3**
CO3	Analyze case studies and examples to explore the relationship between innovation and entrepreneurship, and anticipate future trends in innovation.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		3	3	2				2	2	2	2			2
CO2		3	3	3				2	2	2	2			2
CO3		2	3	3				2	2	2	2			2

COURSE CONTENT

1. Introduction to Innovation
2. Creative Thinking and Problem-Solving
3. Innovation Models and Methodologies
4. Innovation in Action: Case Studies and Examples
5. Tools and Techniques for Sparking Innovation
6. Building an Innovative Mindset
7. Innovation and Entrepreneurship
8. The Future of Innovation

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS946	Entrepreneurs Essentials	1	-	-	1

COURSE CATEGORY

Industry / Institute Higher Learning

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamental principles of entrepreneurship, including the traits and characteristics of successful entrepreneurs, and their role in economic and social development.	K2
CO2	Analyze the opportunities and risks associated with entrepreneurship to develop informed strategies for starting and managing sustainable ventures.	K3
CO3	Explore sustainable practices in entrepreneurship by designing activities and products that address societal needs while being economically and politically viable.	K3

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1							2	2	2	2	2			2
CO2							2	2	2	2	2			2
CO3							2	2	2	2	2			2

COURSE CONTENT

1. Becoming An Entrepreneur
2. Goals
3. Identify characteristics of successful entrepreneurs
4. Describe the opportunities and risks of entrepreneurship.
5. Entrepreneurs Essentials
6. To introduce activities and products that serve people's needs and are sustainable
7. Economically and politically

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS921	Natural Language Processing	1	-	-	1

COURSE CATEGORY

Industry / Institute Higher Learning

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the foundational concepts of Natural Language Processing (NLP) and apply them to real-world problems, such as text classification and sentiment analysis, using Python.	**K2**
CO2	Implement language models, syntax parsing, and text processing techniques to analyze and extract meaningful insights from textual data.	**K3**
CO3	Develop hands-on expertise in applying NLP methods and tools to build solutions for tasks like sentiment analysis and text classification.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2									2
CO2	2	2	2	2	2									2
CO3	2	2	2	2	2									2
CO4	2	2	2	2	2									2
CO5	2	2	2	2	2									2

COURSE CONTENT

- Introduction to Natural Language Processing
- Text Classification + Hands-on Python
- Language Models + Hands-on Python
- Syntax & Parsing + Hands-on Python
- Sentiment Analysis + Hands-on Python

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS935	Introduction to Symbolic and Connectionist AI	1	-	-	1

COURSE CATEGORY

Industry / Institute Higher Learning

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamentals of Artificial Intelligence (AI), including symbolic AI, classical expert systems, and fuzzy expert systems, and their applications in solving real-world problems.	K2
CO2	Develop hands-on skills in building and implementing AI systems, such as rule-based systems, classical expert systems, and fuzzy expert systems, to address complex decision-making tasks.	K3
CO3	Explore advanced AI concepts, including connectionist AI, neural networks, and hybrid systems, to design and apply innovative	K3

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	2	2									2
CO2	2	2	3	2	2									2
CO3	2	2	3	2	2									2

COURSE CONTENT

- Introduction to AI and Symbolic AI
- Hands-on Session on Building a Simple Rule-Based System
- Classical Expert Systems
- Hands-on Session on Developing a Classical Expert System

- Fuzzy Expert Systems
- Hands-on Session on Implementing a Fuzzy Expert System
- Introduction to Connectionist AI and Neural Networks
- Advanced Neural Networks and Deep Learning
- Hybrid Systems and Applications

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS949	Organizational Innovation	0	0	2	1

COURSE CATEGORY

Industry / Institute Higher Learning

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the principles of innovation and its role in organizations	K2
CO2	Analyze the relationship between organizational learning	K3
CO3	Evaluate new organizational forms and strategies for information management to enhance communication	K3

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1							2	2	2	2	2			2
CO2							2	2	2	2	2			2
CO3							2	2	2	2	2			2

COURSE CONTENT

- Defining innovation
- Innovation in organizations
- Innovation culture
- Innovation ecosystems
- Organizational learning
- Innovation and design
- Communication and decision-making
- New organizational forms
- Information management
- Open business models
- Problem solving and innovation
- Risk taking
- Organizational change

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS936	Intelligent Optimization and Machine Learning Applications	1	-	-	1

COURSE CATEGORY

Industry / Institute Higher Learning

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamental principles of optimization and intelligent optimization techniques	**K2**
CO2	Develop hands-on skills in designing and implementing optimization algorithms	**K3**
CO3	Apply optimization methods and machine learning techniques to real-world scenarios	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2		2									2
CO2	2	2	2		2									2
CO3	2	2	2		2									2

COURSE CONTENT

- Introduction to Optimization and Intelligent Optimization
- Simulated Annealing
- Tabu Search
- Introduction to Tabu Search
- Hands-on Session on Developing a Tabu Search Algorithm
- Evolutionary Algorithms
- Swarm Intelligence
- Machine Learning Applications

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS944	**Fieldbus Architecture**	1	-	-	1

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamental principles of optimization and intelligent optimization techniques	**K2**
CO2	Develop hands-on skills in designing and implementing optimization algorithms	**K3**
CO3	Apply optimization methods and machine learning techniques to real-world scenarios	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2											2
CO2	2	2	2											2
CO3	2	2	2											2

COURSE CONTENT

Module 1: Introduction to Industrial Automation and Fieldbus
Module 2: Fieldbus Standards and Protocols
Module 3: Profibus
Module 4: Foundation Fieldbus
Module 5: Modbus
Module 6: Device Net and Other Fieldbus Protocols
Module 7: Fieldbus Network Design and Troubleshooting
Module 8: Fieldbus Security and Integration
Module 9: Case Studies and Practical Applications

Module 10: Future Trends in Fieldbus Technology

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS933	Industrial IoT	1	-	-	1

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamental concepts of IoT, including its ecosystem, market, enabling technologies, and communication protocols, to build a strong foundation in IoT systems.	**K2**
CO2	Analyze the role of data management, analytics, and wireless communication technologies in IoT, while addressing critical aspects of security and privacy.	**K3**
CO3	Explore Industrial IoT (IIoT) technologies, protocols, and real-world case studies to design and implement innovative IoT solutions for diverse applications.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1		2	2	2	2									2
CO2		2	2	2	2									2
CO3		2	2	2	2									2

COURSE CONTENT

- Overview of IoT
- IoT Ecosystem and Market
- Enabling Technologies
- IoT Communication and Networking
- Wireless Communication Technologies
- Networking Protocols
- Data Management and Analytics in IoT
- Security and Privacy in IoT
- IIoT Technologies and Protocols
- Case Studies and Real-World Applications
- Future Trends and Conclusion

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS932	Vehicular and Mobile Networks	1	-	-	1

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamentals of vehicular networks and their integration with cellular and 5G technologies to enable intelligent transportation systems.	K2
CO2	Analyze security, trust, and privacy challenges in vehicular networks and develop strategies to address them effectively.	K3
CO3	Explore advanced topics in vehicular and mobile networks, including emerging 5G and beyond technologies, to design innovative solutions for future mobility.	K3

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		2	2	2	2									2
CO2		2	2	2	2									2
CO3		2	2	2	2									2

COURSE CONTENT

- Fundamentals of Vehicular Networks
- Vehicular Network Security, Trust and Privacy
- Cellular Network Technologies
- 5G and Beyond Technologies
- Advanced Topics in Vehicular and Mobile Networks

COURSE CODE	COURSE TITLE	L	T	P	C

10215CS950	**Entrepreneurial strategies**	1	-	-	1

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamentals of entrepreneurial strategy, including opportunity identification, validation, and strategic planning for market entry.	**K2**
CO2	Develop financial and operational strategies to effectively manage resources and drive business growth.	**K3**
CO3	Explore approaches to scaling, ensuring sustainability, and crafting a long-term vision for entrepreneurial ventures.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1							2	2	2	2	2			2
CO2							2	2	2	2	2			2
CO3						2	2	2	2	2	2			2

COURSE CONTENT

- Module 1: Introduction to Entrepreneurial Strategy
- Module 2: Identifying and Valida/ng Opportunities
- Module 3: Strategic Planning and Go-to-Market (GTM) Strategy
- Module 4: Financial and Operational Strategies
- Module 5: Scaling, Sustainability, and Long-Term Vision

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS940	**Large Language Model**	1	-	-	1

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	**O1:** Understand the fundamental concepts of Natural Language Processing (NLP)	**K2**
CO2	**CO2:** Develop hands-on skills in implementing deep learning techniques such as Perceptrons, ANN, CNN, and Transformers using tools like PyTorch for NLP tasks.	**K3**
CO3	**CO3:** Explore advanced topics in NLP including knowledge graphs and LLM Models, to analyze their impact on language understanding and generation.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2								2		2
CO2	2	2	2	2								2		2
CO3	2	2	2	2								2	2	2

Course Content

- Introduction to NLP
- Introduction to Statistical Language Models
- Statistical Language Models: Advanced Smoothing and Evaluation
- Introduction to Deep Learning (Perceptron, ANN, Backpropagation, CNN)
- Introduction to PyTorch
- Neural Language Models
- Introduction to Transformers
- Knowledge graphs
- Overview of recently popular models such as GPT-4, Llama-3, Claude-3,Mistral, and Gemini

COURSE CODE	COURSE TITLE	L	T	P	C
10215CS947	**Venture Development**	1	-	-	1

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Develop an entrepreneurial mindset by understanding the process flow and essential skills required to identify and capitalize on business opportunities.	**K2**
CO2	Analyze various business models and design effective operational, logistical, and financial strategies for a successful venture.	**K3**
CO3	Critically evaluate and present new venture plans by assessing their feasibility, sustainability, and market potential.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1						2	2	2	2	2	2			2
CO2						2	2	2	2	2	2			2
CO3						2	2	2	2	2	2			2

Course Content

- Overview of The Entrepreneurial Mindset and Skills-Process Flow
- Understanding Various Business Models
- Outlining Operations and Logistics
- Comprehensive Financial Planning and Management Team
- Presenting and Evaluating-Critiquing New Venture Plans

Course code	Course Name	L	T	P	C
10215CS951	Green AI	1	0	2	2

Course Category Industry / Institute Higher Learning

Resource persons

1. Sagar Yadav, Data Scientist, Edunet foundation
2. Mr. SarthakNarnor Curriculum Developer for AI, ML and Green Technology, Edunet foundation

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Understand the principles of green skilling, sustainability, and the contributions of Artificial Intelligence (AI) to sustainable development.	**K2**
CO2	Gain foundational knowledge of Artificial Intelligence, Machine Learning, and Python programming to address environmental challenges.	**K2**
CO3	Apply data analytics and Machine Learning techniques using Python for environmental and sustainability-focused applications.	**K3**
CO4	Design and implement AI-driven solutions, including Generative AI and Large Language Models (LLMs), for sustainable innovations.	**K3**
CO5	Evaluate the ethical, fairness, and sustainability considerations in AI applications to ensure responsible and impactful deployment.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3	3	2	3	1	2						2	3	
CO2	2	3	3	3	2	2						3	3	
CO3	3	3	3	3	2	2						3	3	
CO4	3	3	3	3	2	2						3	3	
CO5	3	3	3	3	3	2						3	3	

Course content

Module 1: Foundation of Green Skilling, Sustainability and AI Contributions
Module II: Fundamentals of Artificial Intelligence, Machine Learning and Python Programming
Module III: Applied Data Analytics with Python for Environmental Applications
Module IV: Implementation and Deployment of Machine Learning and Deep Learning Algorithms
Module V: AI for Green Applications
Module VI: Generative AI and Large Language Models (LLMs) for Sustainable Solutions

Module VII: AI Ethics, Fairness, and Sustainability

Course code	Course Name	L	T	P	C

10215CS954	Introduction to IoT& Applications	1	0	1	1

Course Category

Industry / Institute Higher Learning

Resource persons

Prof. Michael OpokuAgyeman, Professor of Computer Engineering, University of Northampton, UK

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revisedBloom's Taxonomy)
CO1	Understand the fundamental concepts of the Internet of Things (IoT) and its applications in creating smart, connected systems.	**K2**
CO2	Develop knowledge of embedded systems, including design principles, basic computer architecture, and edge computing integration.	**K3**
CO3	Analyze and apply the architecture and functionalities of microcontrollers (e.g. ATMega328P) for IoT-based edge computing applications.	**K3**
CO4	Explore the role of sensors and network connectivity in IoT, enabling the development of efficient and responsive smart systems.	**K3**
CO5	Design and implement IoT solutions by integrating embedded systems, sensors, and edge computing for real-world applications	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3													
CO2	2													
CO3	3	3	3	3		2						3		
CO4	3	3	3	3		2						3	3	
CO5	3	3	3	3		2						3	3	

Course content

Module1: Introduction to IoT

Module 2: Embedded Systems

- Embedded System Design and Edge Computing
- Basic Computer Architecture

Module 3: Processor Architecture and Edge Computing

- Microcontroller (ATMega328P) Architecture
- Edge Computing Principles in IoT

Module 4: Sensors and Network Connectivity

- Sensors, Smart Connected Systems

Course code	Course Name	L	T	P	C
10215CS953	Exploring Machine Learning Tools, Techniques, and Trends	1	0	2	2

Course Category

Industry / Institute Higher Learning

Resource persons

PROF. TS. DR. AFIZAN BIN AZMAN, School of Computer Science, Faculty of Innovation & Technology, Taylor's University, Malaysia

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamental concepts of data analytics, including the differences between supervised and unsupervised learning, and the importance of data preprocessing in machine learning workflows.	**K2**
CO2	Apply regression techniques and regularization methods to develop predictive models for data-driven decision-making.	**K3**
CO3	Analyze and implement clustering algorithms and address challenges such as class imbalance to enhance model accuracy.	**K3**
CO4	Design and evaluate classification models, including ensemble methods, to improve prediction performance in diverse datasets.	**K3**
CO5	Explore the architecture and applications of neural networks while addressing ethical considerations and biases in intelligent systems.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	3													
CO2	2	2	2	2	2									
CO3	3	3	2	2	2	2						3		
CO4	3	3	2	3	2	2						3	3	2
CO5	3	3	3	3	2	2						3	3	2

Course content

- Introduction to Data Analytics
- Supervised vs Unsupervised Learning & Data Preprocessing
- Regression| Regularisation
- Clustering |Class Imbalance
- Classification | Ensemble Models
- Neural Networks, Ethical from Intelligent Systems

Course code	Course Name	L	T	P	C
10215CS919	Computer Vision with Deep Learning	1	0	1	1

Course Category

Industry / Institute Higher Learning

Resource persons

Prof.Sandeep Singh Sengar, Lecturer, Cardiff Metropolitan University, Wales, UK

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the foundational concepts of deep learning and explore various architectures, including Convolutional Neural Networks (CNN), for computer vision tasks.	K2
CO2	Apply techniques such as data augmentation and transfer learning to optimize deep learning models for improved performance and generalization.	K3
CO3	Design and implement strategies for developing successful deep learning models in computer vision, addressing practical challenges in real-world applications.	K3
CO4	Explore the principles and applications of Generative Adversarial Networks (GANs) for creating synthetic data and enhancing model robustness.	K3
CO5	Investigate real-time computer vision applications in the medical domain, demonstrating the potential of deep learning for healthcare advancements.	K3

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2													
CO2	2	2	2	2	2									
CO3	3	3	2	2	2	2						3		
CO4	3	3	2	3	2	2						3	3	2
CO5	3	3	3	3	2	2						3	3	2

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 Name	L	T	P	C
10215CS952	Medical image analysis with AI and ML	1	0	1	1

Course Category

Industry / Institute Higher Learning

Resource persons

Prof.Sandeep Singh Sengar, Lecturer, Cardiff Metropolitan University, Wales, UK

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamental concepts of machine learning and deep learning, and their relevance to solving complex problems in medical imaging.	**K2**
CO2	Analyze various data formats in medical imaging and apply deep learning techniques to process and interpret medical data effectively.	**K3**
CO3	Explore real-world case studies and implement practical applications of machine learning and deep learning in medical imaging for diagnostic and analytical purposes.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2													
CO2	2	2	2	2	2								2	
CO3	3	3	2	2	2	2						3	2	2

Course content

Module 1: Machine Learning Concepts
Module 2: Deep Learning Concepts
Module 3: Introduction to Medical Imaging
Module 4: Data Formats in Medical Imaging
Module 5: Case Studies and Practical Applications

Course code	Course Name	L	T	P	C
10215CS929	Generative AI	1	0	1	1

Course Category

Industry / Institute Higher Learning

Resource persons

Prof.Sandeep Singh Sengar, Lecturer, Cardiff Metropolitan University, Wales, UK

Course Outcomes

CO Nos	Course Outcomes	Skill Level (Based on revised Bloom's Taxonomy)
CO1	Understand the foundational concepts of deep learning, including Convolutional Neural Networks (CNN) and their applications in various domains.	**K2**
CO2	Explore the principles and applications of Generative AI, Transformers, and the BERT model for natural language processing and other advanced tasks.	**K3**
CO3	Design and implement solutions using Generative Pre-Trained Transformers (GPT) to address real-world problems requiring AI-driven automation and creativity.	**K3**

Correlation of COs with Program outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
CO1	2	2	2	2	2									
CO2	2	2	2	2	2	2						2	2	
CO3	3	3	2	2	2	2						3	2	2

Course content

- Introduction to Deep Learning and Convolutional Neural Networks (CNN)
- Generative AI
- Transformers
- BERT Mode
- lGenerative Pre- Trained Transformer

Course code	Course Name	L	T	P	C
10215CS955	Data modeling and design factors	1	0	1	2

Course Content

- Introduction to Data Modeling and Database Design
- Understanding the Data Requirements
- Advanced Data Modeling Techniques
- Relational Data Modeling
- Database Design
- Performance and Scalability in Data Modeling
- Data Security and Privacy
- Implementing Data Models in Databases
- Real-World Data Modeling Applications
- Best Practices in Data Modeling and Design

Resource person:

Dr Husna Sarirah Binti Husin, Senior Lecturer, Taylor's University, Malaysia.

Course code	Course Name	L	T	P	C
10215CS957	Cyber Threat Intelligence using Splunk	1	0	0	1

Course Content

- Network Security and Linux, Networking Basics, Common Network Threats
- TCP Communications, UDP Communications, TCP Header Flags, Encryption, Authentication, and Integrity

- Social Engineering, Phishing, Security Awareness, Security Assessment and Audit
- HTTPS Everywhere, TLS Handshake, TLS Session Resumption, Chain of Trust and Certificate Authorities
- Social Engineering, Phishing, Security Awareness, Security Assessment and Audit
- Introduction to Splunk and its role in enterprise security, Splunk Enterprise vs. Splunk Cloud
- Ingesting data into Splunk (log files, network data, etc.), Collecting and analyzing log data.
- Cybersecurity threats: Phishing, ransomware, SQL injection.

- Incident handling process: Detection, response, recovery.
- Case study on using Splunk for a real-world cybersecurity incident response
- Monitoring and analyzing network traffic using Splunk to identify suspicious activities and threats.
- Techniques for wireless hacking, including sniffing and spoofing traffic
- Web application vulnerabilities like XSS, SQL injection, and cross-site request forgery
- Testing and securing web applications using tools. Conducting penetration testing/reporting

Resource person:

Mr. Sankarraj Subramanian, Founder CEO, Prompt infotech

Course code	Course Name	L	T	P	C
10215CS946	Entrepreneurs Essentials	1	0	0	1

Course Content

- Becoming An Entrepreneur
- Identify characteristics of successful entrepreneurs
- Recognize the importance of entrepreneurship in the economy.
- Entrepreneurship occurs in all areas of life. In business, academy, government, And NGOs.

- Describe the opportunities and risks of entrepreneurship.
- Entrepreneurship
- Entrepreneurs Essentials

Resource person:

Ms. Kalaiarasi, Founder & CEO, Thremear Pvt Ltd

Course code	Course Name	L	T	P	C
10215CS958	Radar Signal Processing ML/AI Framework for Radars	1	0	1	2

Course Content

- Fundamentals of Radar
- Operating principle of radar detection and ranging
- Mathematical foundations of Machine Learning
- Review of linear algebra concepts
- Review of Machine Learning and Deep Learning Algorithms
- Machine learning process and methods
- Deep Learning for Single-Target Classification in Sar Imagery
- SAR open datasets
- Deep Learning for Multiple-Target Classification in Sar Imagery
- Challenges in multiple-target classification

Resource person:

Dr. Mercy Latha, Principal, Scientist, CSIR – CEERI

Course code	Course Name	L	T	P	C
10215CS960	Agile project management and methodologies	1	0	0	1

Course Content

- Foundational Concepts
- Agile Methodologies
- Team Roles and Responsibilities
- Agile Planning
- Agile Execution
- Risk Management
- Stakeholder Engagement
- Tools and Technologies
- Scaling Agile
- Continuous Improvement

Resource person:

Mr. Anil kumar, Associate Director- IT/Cloud consulting, Kyndryl

Course code	Course Name	L	T	P	C
10215CS961	Innovation & Design Thinking	1	0	0	1

Course Content

- Introduction to Innovation & Design Thinking
- Human-Centered Design Approach
- Design Thinking Process - Empathize & Define
- Ideation Techniques for Innovation
- Prototyping & Rapid Experimentation
- Design Validation & User Testing
- Business Model Innovation
- Emerging Technologies & Responsible AI in Innovation
- Innovation Strategy & Scaling Ideas
- Capstone Project & Industry Insights

Resource person:

B.Senthil Kumar, Managing Director, IyarKai Tech Lab. Pvt. Ltd.

Course code	Course Name	L	T	P	C
10215CS962	Data scraping and data wrangling	1	0	0	1

Course Content:

- Data Scraping
- Web Scraping Overview
- Popular Tools & Libraries used for Web Scraping
- Components of Web Scraping
- Data Wrangling
- Get to know Python Important Libraries
- Sentiment Analysis
- Problem Statement
- Data Inspection
- Data Cleaning

Resource person:

Mr.Kolla Ravikanth Yadav, Data Scientist APAC Business Operations, Cepheid Hyderabad

Course code	Course Name	L	T	P	C
10215CS959	Cellular interception Technologies	1	0	0	1

Course Content:

- Localization/Location fixing of Mobile Users
- Localization/Location fixing of Mobile Base Station/Tower
- Explore precise Location of Mobile Users using GPS
- Estimate Mobile Base Station/Tower to Mobile User distance
- Target Following of Mobile User
- Denial of Service for Mobile Communications up to 20 Km
- Smart Jamming Techniques for Mobile Communications up to 20 Km
- lnterception of 4G and 5G voice (including volte , voip)and data
- Passive A5/3 Decryption for 2G
- Metadata Extraction from 4G and 5G communication for users' identification and linking to permanent identities (lMSl, lMEl).
- Denial of service of 5G and 5G

Resource person:

Mrs. Vijayalakshmi, Engineer, ISRO

Course code	Course Name	L	T	P	C
10215CS963	AI ML support for command-and-control applications in Disaster Management	1	0	0	1

Course Content:

- Predictive Modelling and Early Warning
- Forecasting and Early Warning Systems
- Disaster Response
- Real-time Decision Support
- Optimized Logistics
- Communication and Information Sharing
- Recovery
- Damage Assessment
- Specific Applications of AI in Disaster Management
- Challenges and Considerations

Resource person:

Mr.Vivek Saxena, Senior Scientist, DGRE, DRDO

Course code	Course Name	L	T	P	C
10215CS967	Predictive analytics and business forecasting	1	0	0	1

Course Content:

- Introduction to Predictive Analytics
- Data Preparation and Exploration
- Statistical Foundations for Predictive Analytics
- Time Series Forecasting Techniques
- Business Applications of Predictive Analytics
- Big Data and Cloud-Based Predictive Analytics
- Business Forecasting and Decision-Making
- Implementation and Case Studies
- Capstone Project

Resource person:

Mr. Sabarinathan Muthu, Senior Technical Manager.

Course code	Course Name	L	T	P	C
10215CS966	Structured problem-solving skills	1	0	0	1

Course Content:

- Understanding Problem-Solving Frameworks
- Industrial Problem Assignment & Team Formation
- Developing the Solution Blueprint
- Prototyping & Validation
- Refinement & Industry Alignment
- Final Presentation & Evaluation

Resource person:

Deepak Chandrasekaran, Director & CEO, Modern Molecular Diagnostics

Course code	Course Name	L	T	P	C
10215CS968	IT Project Delivery Essentials: From Concept to Completion	1	0	0	1

Course Content:

- Project Management Fundamentals
- Stakeholder Management
- Scope Management
- Risk Management
- Communication Management
- Project Budgeting and Scheduling
- Change Management
- Quality Management
- Project Closure

Resource person:

Mr. Vijayarajan Ramanathan, Project Manager, Hogarth Worldwide