



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



B.Tech – INFORMATION TECHNOLOGY

CBCS CURRICULUM

(With effect from 2021-2022)



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



Information Technology

VISION

To evolve as a center of academic excellence in providing globally standard education and research in the field of Information Technology and to mould young graduates into competitive, innovative, self disciplined and visionary computer professionals while maintaining a commitment to diversity and humanity.

MISSION

- M1:** To design and update an outcome-based curriculum that equips students with modern computing knowledge to solve real-world problems.
- M2:** To strengthen conceptual understanding and analytical capability through innovative, ICT-enabled and learner-cantered pedagogical practices.
- M3:** To build a vibrant research environment that enables faculty and students to advance innovation in computing.
- M4:** To nurture ethical, competent, and industry-ready professionals capable of pursuing diverse career paths and contributing responsibly to society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs for IT)

After 3 to 5 years of professional accomplishment in the program, the graduates will be able to

- PEO1:** Formulate and apply mathematical, scientific, and engineering principles to solve problems in the Information Technology domain.
- PEO2:** Leverage modern IT technologies to address societal expectations and fulfill professional responsibilities.
- PEO3:** Showcase problem-solving ability along with strong communication, teamwork, leadership, and ethical values to work effectively in the Information Technology domain.
- PEO4:** Pursue higher studies at reputed institutions globally, build careers in IT core companies and commit to lifelong learning.



PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, natural science, computing, and engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, and analyze complex engineering problems, reaching substantiated conclusions with consideration for the holistic nature of the problem.

PO3. Design/development of solutions: Design creative solutions for complex engineering problems and design systems, components, or processes to meet identified needs with consideration for public health and safety, and cultural, societal, and environmental factors. Sustainability is now intrinsic to design.

PO4. Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

PO5. Engineering tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6. The Engineer and the World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems, considering their impact on sustainability with reference to economy, health, safety, legal frameworks, culture, and the environment.

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

PO8. Individual and Collaborative Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.



PO9. Communication: Communicate effectively and inclusively within the engineering community and with society at large comprehending and writing effective reports and design documentation, and making effective presentations considering cultural, language, and learning differences.

PO10. Project management and finance: Apply knowledge and understanding of engineering management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects in multi-disciplinary environments.

PO11. Life-long learning: Recognize the need for, and have the preparation and ability for, independent and life-long learning, adaptability to new and emerging technologies, and critical thinking in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

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

PSO1: Mathematical Concepts: Build a strong foundation to model and solve Information Technology problems through mathematical concepts, data structures, and algorithm design techniques.

PSO2: Software Development: Enhance technical proficiency to design and develop software applications using modern tools and emerging Information Technologies.

PSO2: Professional Competency: Transform technical knowledge into practical solutions through industry-oriented training and hands-on experience.

COURSE OUTCOMES (COs)

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.



**B.Tech – INFORMATION TECHNOLOGY
CURRICULUM
(CBCS)
(Specialization)
(With effect from 2021-2022)**

**Credits required for regular students in various course categories for
B.Tech (IT) - VTR UGE 2021**

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

Program Structure

Course Category	Minimum Credits Required
Foundation Courses (FC)	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 Information Technology 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. Information Technology 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 Information Technology with Honors subject to the regulations.

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	Catego	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)
(2022-2023) Admitted batch onwards

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

S.No	Course Code	Course Name	L	T	P	C	Sem. No
		Theory Courses					
1	10211IT117	Data Structures and Algorithms	3	0	0	3	III
2	10211IT118	Modern Computer Architecture	3	0	0	3	III
3	10211IT119	Fundamentals of Computer Networks	3	0	0	3	III
4	10211IT120	Operating Systems Concepts	3	0	0	3	IV
5	10211IT121	Software Engineering	2	0	0	2	V
		Integrated Courses					
6	10211IT201	Database System Concepts	3	0	2	4	III
7	10211IT202	Introduction to Design and Analysis of Algorithms	3	0	2	4	IV
8	10211IT203	Programming using Python	2	0	2	3	IV
9	10211IT204	Artificial Intelligence Techniques	3	0	2	4	IV
10	10211IT205	Programming Using Java	3	0	2	4	V
11	10211IT206	Machine Learning Techniques	3	0	2	4	V
12	10211IT207	Big Data Analytics	3	0	2	4	V
13	10211IT208	Web and Mobile Application Development	3	0	2	4	VI
14	10211IT209	IoT and Cloud Computing	3	0	2	4	VI
15	10211IT210	Cyber Security	3	0	2	4	VI
		Laboratory Courses					
16	10211IT311	Data Structures and Algorithms Laboratory	0	0	2	1	III
17	10211IT312	Computer Networks Laboratory	0	0	2	1	III
18	10211IT313	Operating System Concepts Laboratory	0	0	2	1	IV
19	10211IT314	Competitive Coding-I	0	0	2	1	IV
20	10211IT315	Competitive Coding-II	0	0	2	1	V
Total Credits						58	

Tutorial hour is not considered for credit calculation of the course



B.Tech – INFORMATION TECHNOLOGY

CBCS CURRICULUM

Minimum credits required for Lateral Entry students in various course categories for

B.Tech(IT) – VTR UGE 2021

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

Program Structure

Course Category	Minimum Credits Required
Foundation Courses (FC)	22
Program Core (PC)	48
Program Elective (PE)	18
Open Elective (OE)	12
Independent Learning(IL)	14
Industry / Higher Institute Learning Interaction(IHL)	2
Professional Proficiency Courses (PPC)	4
TOTAL	120



B.Tech – INFORMATION TECHNOLOGY

CBCS CURRICULUM

VTR UGE 2021

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

Foundation Core (22 Credits)

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

S.No	Course Code	Subject Title	Catego	L	T	P	C
Lecture Courses							
1	10210MA103	Probability, Statistics and Queuing Theory	BSC	3	1	0	4
2	10210PH101	Semiconductor Physics	BSC	3	0	0	3
3	10210CS101	Problem Solving using C	ESC	3	0	0	3
4	10210ME101	Design thinking	ESC	2	0	0	2
5	10210ME103	Innovation & Entrepreneurship	ESC	2	0	0	2
6	10210ME102	Universal Human Values	HSC	3	0	0	3
7	10210ME104	Project Management & Finance	HSC	2	0	0	2
8	10210ME105	Engineers and Society	HSC	1	0	0	M
9	10210BL101	Constitution of India	HSC	1	0	0	M
Integrated Courses							
10	10210EN201	Professional Communication – I	HSC	1	0	2	2
Laboratory Courses							
11	10210CS301	Problem Solving using C Lab	ESC	0	0	2	1
Total Credits							22



B.Tech – INFORMATION TECHNOLOGY

CBCS CURRICULUM

VTR UGE 2021

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

Foundation Core (22 Credits)

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

S.No	Course Code	Subject Title	Catego	L	T	P	C
Lecture Courses							
1	10210CH104	Environmental Science and Sustainability	BSC	3	0	0	3
2	10210MA103	Probability, Statistics and Queuing Theory	BSC	3	1	0	4
3	10210ME101	Design thinking	ESC	2	0	0	2
4	10210BM101	Biology for Engineers	ESC	2	0	0	2
5	10210ME103	Innovation & Entrepreneurship	ESC	2	0	0	2
6	10210ME102	Universal Human Values	HSC	3	0	0	3
7	10210ME104	Project Management & Finance	HSC	2	0	0	2
8	10210ME105	Engineers and Society	HSC	1	0	0	M
9	10210BL101	Constitution of India	HSC	1	0	0	M
Integrated Courses							
10	10210EE204	Introduction to Engineering	ESC	1	0	4	3
Laboratory Courses							
11	10210EE301	Engineering Products Lab	ESC	0	0	2	1
Total Credits							22



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

Program Core (48 Credits)

S.No	Course Code	Course Name	L	T	P	C	Sem. No
		Theory Courses					
1	10211IT117	Data Structures and Algorithms	3	0	0	3	III
2	10211IT118	Modern Computer Architecture	3	0	0	3	III
3	10211IT119	Fundamentals of Computer Networks	3	0	0	3	III
		Integrated Courses					
4	10211IT201	Database System Concepts	3	0	2	4	III
5	10211IT202	Introduction to Design and Analysis of Algorithms	3	0	2	4	IV
6	10211IT203	Programming using Python	2	0	2	3	IV
7	10211IT204	Artificial Intelligence Techniques	3	0	2	4	IV
8	10211IT205	Programming Using Java	3	0	2	4	V
9	10211IT206	Machine Learning Techniques	3	0	2	4	V
10	10211IT207	Big Data Analytics	3	0	2	4	V
11	10211IT208	Web and Mobile Application Development	3	0	2	4	VI
12	10211IT209	IoT and Cloud Computing	3	0	2	4	VI
		Laboratory Courses					
13	10211IT311	Data Structures and Algorithms Laboratory	0	0	2	1	III
14	10211IT312	Computer Networks Laboratory	0	0	2	1	III
15	10211IT314	Competitive Coding-I	0	0	2	1	IV
16	10211IT315	Competitive Coding-II	0	0	2	1	V
Total Credits						48	



Program Electives (18 Credits)

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

L-Lecture T-Tutorial P-Practical C-Credits

S. No	Course Code	Course Name	L	T	P	C
1	10212IT101	Cryptography and Network Security	3	0	0	3
2	10212IT103	Artificial Intelligence	3	0	0	3
3	10212IT104	High Performance Computing	3	0	0	3
4	10212IT105	Data Science in Python	3	0	0	3
5	10212IT108	Robotic Process Automation	3	0	0	3
6	10212IT110	Optimization Techniques	3	0	0	3
7	10212IT113	Reinforcement Learning	3	0	0	3
8	10212IT1xx	Information Coding Techniques*	3	0	0	3
9	10212IT1xx	Cognitive Computing*	3	0	0	3
10	10212IT1xx	Cryptocurrency and Blockchain Technologies*	3	0	0	3
11	10212IT1xx	Cyber Security Policy, Law & Ethics*	3	0	0	3
12	10212IT1xx	Software Testing and Automation*	3	0	0	3
13	10212IT1xx	Service Oriented Architecture*	3	0	0	3
14	10212IT1xx	UI and UX Design*	3	0	0	3
15	10212IT1xx	DevOps*	3	0	0	3
		Integrated Courses				
16	10212IT214	Data Visualization	3	0	2	4
17	10212IT215	Deep Learning	3	0	2	4
18	10212IT216	Natural Language Processing	3	0	2	4
19	10212IT218	Modelling for Data Science	3	0	2	4
20	10212IT224	Computer Vision	3	0	2	4
21	10212IT225	Ethical Hacking	3	0	2	4
22	10212IT244	Computer Graphics	3	0	2	4



23	10212IT2xx	Web Security*	3	0	2	4
24	10212IT2xx	Virtual and Augmented Reality*	3	0	2	4
25	10212IT2xx	Internetworking With TCP/IP*	3	0	2	4
26	10212IT2xx	Full Stack Web Development*	3	0	2	4

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-Credits

S.No	Course Code	Course Name	L	T	P	C
1	XXX1	Course Name - 1	3		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

These courses offered to the other departments by school of Computing under open elective category

L-Lecture T-Tutorial P-Practical C-Credits

S.No	Course Code	Course Name	L	T	P	C
1	10213IT101	Object Oriented Programming using Java	3		0	3
2	10213IT102	Data Structures	3	0	0	3
3	10213IT103	Operating Systems	3		0	3
4	10213IT104	Database Management Systems	3	0	0	3
5	10213IT105	Computer Networks	3		0	3

Independent Learning (14 Credits)

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

L-Lecture T-Tutorial P-Practical C-Credits

S.No	Course Code	Course Name	L	T	P	C
1	10214IT501	Community Service Project	-	-	-	1
2	10214IT601	Minor Project-I	0	0	4	2
3	10214IT602	Minor Project-II	0	0	4	2
4	10214IT701	Major Project	-	-	-	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-Credits

S.No	Course Code	Course Name	L	T	P	C
1	10215IT901	Internship	-	-	-	2
2	10215IT902	Industry Expert Lecture-1	-	-	-	1
3	10215IT903	Industry Expert Lecture-2	-	-	-	1
4	10215IT951	Higher Institute Learning Interaction-1	-	-	-	1
5	10215IT952	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-Credits

S.No	Course Code	Course Name	L	T	P	C
1	10216GE901	Soft Skills-I	2	0	0	1
2	10216GE902	Soft Skills- II	2	0	0	1
3	10216GE903	Aptitude Skills- I	2	0	0	1
4	10216GE904	Aptitude Skills- II	2	0	0	1



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

Track: Cloud Computing

S.No	Course Code	Course Name	L	T	P	C
1	10212IT101	Cryptography and Network Security	3	0	0	3
2	10212IT126	Distributed Computing	3	0	0	3
3	10212IT251	Virtualization Techniques	2	0	2	3
4	10212IT127	Network Fundamentals for Cloud	3	0	0	3
5	10212IT128	Cloud Computing: Tools and Techniques*	3	0	2	4
6	10212IT129	Cloud Security	3	0	0	3
7	10212IT130	Cloud Infrastructure and Services	3	0	2	4
8	10212IT131	IoT Deployment in Cloud	3	0	2	4

Track: Artificial Intelligence and Machine Learning

S.No	Course Code	Course Name	L	T	P	C
1	10212IT110	Optimization Techniques	3	1	0	3
2	10212IT113	Reinforcement Learning	3	1	0	3
3	10212IT214	Data Visualization	3	0	2	4
4	10212IT215	Deep Learning	3	1	2	4
5	10212IT216	Natural Language Processing	3	0	2	4
6	10212IT224	Computer Vision	3	0	2	4

Track: Cloud Infrastructure Management (ATOS)

S.No	Course Code	Course Name	L	T	P	C
1	10212IT251	Virtualization Techniques	2	0	2	3
2	10212IT252	Windows Client Administration Operating System	2	0	2	3
3	10212IT253	Windows Server Administration Operating System	2	0	2	3
4	10212IT254	Cloud Fundamentals using Azure	2	0	2	3
5	10212IT255	Administering Microsoft Exchange Server*	2	0	2	3
6	10212IT256	Office 365 Administration.	2	0	2	3



Track: Network and Server management (ATOS)

S.No	Course Code	Course Name	L	T	P	C
1	10212IT257	Data Center Hosting – Windows Operating System	2	0	2	3
2	10212IT258	Data Center Hosting – Unix Operating System*	2	0	2	3
3	10212IT259	Advanced Switching and Networking Techniques	2	0	2	3
4	10212IT260	Advanced Routing Techniques and Security*	2	0	2	3
5	10212IT261	Juniper Networking Techniques*	2	0	2	3
6	10212IT262	Storage Management*	2	0	2	3

Track: Application Modernization Service Specialization (ATOS)

S.No	Course Code	Course Name	L	T	P	C
1	10212IT263	IIS Web Server Technologies	2	0	2	3
2	10212IT264	Application Server Technologies*	2	0	2	3
3	10212IT265	Web Sphere Application Server.*	2	0	2	3
4	10212IT266	WebSphere MQ*	2	0	2	3
5	10212IT267	Middleware Technologies*	2	0	2	3
6	10212IT268	Database Administration Using MSSQL Server*	2	0	2	3
7	10212IT269	Oracle Database Administration *	2	0	2	3



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PROGRAM CORE



COURSE CODE	COURSE TITLE	L	T	P	C
10211IT117	Data Structures and Algorithms	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	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	-	1	3	2	1
CO2	3	3	2	2	2	-	-	-	-	-	1	3	2	-
CO3	3	3	3	2	2	-	-	-	-	-	1	3	3	-
CO4	3	3	3	3	2	-	-	-	-	-	1	3	3	1
CO5	3	3	2	2	2	-	-	-	-	-	1	3	3	1

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”, Schaum’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
10211IT118	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

10210CS101 -Problem Solving Using C

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		

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



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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]
<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
10211IT119	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 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				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 Impairment Transmission 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 detection and 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 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/SSH -EMAIL– DNS – FTP/TFTP– IPsec - HTTP/HTTPS – SDN

Total: 45 Hours

G. Learning Resources

i. Text Books:

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

ii. Reference Books:

- 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
10211IT120	Operating System Concepts	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

10211IT117 - Data Structures and Algorithms

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	Discuss the 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
10211IT121	Software Engineering	2	0	0	2

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

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	Course Outcomes	K - Level
CO1	Identify the suitable process model for software development.	K3
CO2	Prepare the SRS document with project estimation and plan.	K3
CO3	Design the UML Diagrams to develop a software application.	K3
CO4	Apply the software design heuristics for quality improvement	K3
CO5	Build Test cases using various testing strategies.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	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

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.



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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
10211IT201	Database System Concepts	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 as 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
CO2	Design a database schema for a given problem	K3
CO3	Apply normalization for the given database.	K3
CO4	Use the properties of transaction and recovery management.	K2
CO5	Implement CRUD operations in modern database.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of Cos with Program Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
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

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

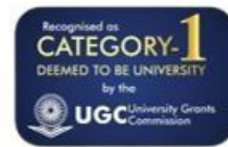
Perform the advanced query processing and test its heuristics using the designing of optimizing complex queries and their equivalence queries

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 of writes 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://infyqtq.onwingspan.com/en/viewer/web_module/lex_a



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



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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
10211IT202	Introduction to 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

10211IT117 – Data Structures and Algorithms

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.	K2
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 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		

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



3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction

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

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 with a 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

9 Hours

Dynamic Programming: Principle of optimality – Rod cutting problem - Computing Binomial Coefficient - Warshall's and Floyd's 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:** Assume the 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

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

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: 45 Hours

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) $(\log n)^{\log n}$

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

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

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

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

Ex2.3: $6n^3$, $n \log_6 n$, $4n$, $8n^2$, $\log_6 n$, $n \log_2 n$, $\log_3 n$, 64 , 8^{2n}

Solution: 64 , $\log_3 n$, $\log_2 n$, $4n$, $n \log_6 n$, $n \log_2 n$, $8n^2$, $6n^3$, 8^{2n}

Task 3: D&C – Quick Sort

Sort a given set of elements using the Quicksort method and determine the time 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: 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 $S = \{s_1, s_2, \dots, s_n\}$ 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.

Test Case 1: Apply Ford-Fulkerson algorithm and find whether the augmenting path exists or not in the graph.

Test Case 2: Apply Ford-Fulkerson algorithm and find the updated residual capacity of a graph.

H. Learning Resources

i. 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
10211IT203	Programming using Python	2	0	2	3

A. Course Description

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.

Pre-requisite: 10210CS101 -Problem Solving Using C

B. Course Educational Objective

Students are able 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.

C. Course Outcomes

CO Nos.	Course Outcomes	K- Level
CO1	Experiment with data types, operators, statements and functions in python.	K3
CO2	Construct the file handling, string handling and regular expression functions in python	K3
CO3	Use the Exception handling to handle errors and multithreading mechanism for parallel execution.	K3
CO4	Demonstrate the use of python libraries for data analysis.	K3
CO5	Apply python modules for Graphical User Interface and game design	K3

D. Correlation of COs with Programme 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	2										2	
CO2	2		2										2	
CO3	2	2	2										2	
CO4	2	2	2	3	3							3	3	2
CO5			2		3								3	2

3- High; 2-Medium; 3-Low



I. Course Content

L-1, T-1, P-2, C-2

Unit 1 Introduction

6 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-build-in functions-Lambda functions-python iterator and generator.

Case Study: Shuffling a Deck of Card

Unit 2 File Manipulation, String Handling and Regular Expression

6 Hours

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

6 Hours

Exception handling: try, catch 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

6 Hours

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 5 UI and Game design using Python libraries

6 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 Studies: Angry bird game and UI design

Total : 30 Hours

Laboratory Experiments

Total : 30 Hours

Part-1

- | | |
|---------------|---|
| TASK 1 | Running Python Script and various expressions in an interactive interpreter
Tool:IDLE,pycharm |
| TASK 2 | Implement conditional, control and looping statements.
Tool:Python Tutor (or) pycharm (or) IDLE |
| TASK 3 | Importing Python modules and packages in python programming.
Tool:Jupyter,pandas, numpy,scipy |
| TASK4 | Use various data types, List, Tuples and Dictionary in python programming
Tool: Python Tutor (or) pycharm (or) IDLE |
| TASK5 | Implement various Searching and Sorting Operations in python programming
Tool: Python Tutor (or) pycharm (or) IDLE |
| TASK6 | Implement various text file operations.
Tool: Python Tutor (or) pycharm (or) IDLE |



- TASK7** Utilizing 'Functions' concepts in Python Programming.
Tool: Python Tutor (or) pycharm (or) IDLE
- TASK8** Implement python generator and decorators.
Tool: Python Tutor (or) pycharm (or) IDLE
- TASK9** Implement Exceptions and Exceptional handling in Python.
Tool: Python Tutor (or) pycharm (or) IDLE
- TASK10** Use Matplotlib module for plotting in python.
Tool:matplotlib
- TASK11** Use Tkinter module for UI design.
Tool:Tkinter, jupyter
- TASK12** Simulate Gaming concepts using Pygame
Tool:Pygame

Part-2

Use Cases:

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

Total: 60 Hours

E. Text Books

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, 5th edition, Addison-Wesley Professional,, 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
10211IT204	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	Interpret the problem-solving techniques by using State Space search and heuristic search approach	K2
CO2	Use evolutionary and advanced search techniques to provide optimized solution.	K3
CO3	Solve unified planning approach and Constraint-satisfaction problems.	K3
CO4	Apply Logical knowledge representation for rules and fact-based approach.	K3
CO5	Apply the logic of Uncertainty and Reasoning using resolution methods.	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	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-Cryptarithmic- 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.

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

The n Queens Chessboard.

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.

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
10211IT205	Programming Using Java	3	0	2	4

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
CO2	Apply the concepts of java inheritance and exception handling mechanisms for real world problem.	K3
CO3	Develop Java applications using Streams, Collections, JavaFX, and multithreading concepts.	K3
CO4	Develop simple web applications using JSP, Servlet with JDBC and Hibernate Framework	K3
CO5	Develop enterprise 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	PSO1	PSO2	PSO3
CO1	3	3	1	-	2	-	-	-	-	-	-	3	2	-
CO2	3	3	3	2	3	-	-	-	-	-	-	3	3	-
CO3	3	3	3	2	3	-	-	-	-	-	2	3	3	2
CO4	3	3	3	2	3	-	-	-	-	-	2	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	2	3	3	3

3- High; 2-Medium; 1-Low



F. Course contents

Unit 1 Basics of OOP and JAVA

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 and string

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

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

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

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: 45 Hours

Total: 30 Hours

G. Laboratory Experiments

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 case 1: 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 case 2: 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 case 3: 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 case 4: 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.



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



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
10211IT206	Machine Learning Techniques	3	0	2	4

A.Preamble

This course introduces students to new and actively evolving interdisciplinary field of modern data analysis. The interplay between known data and unknown ones give rise to complex pattern structures and machine learning methods that are the focus of the study. In the course we will consider methods of Machine Learning and Data Mining Learning. It also includes dimensionality reduction techniques which help to deal with huge datasets.

B.Prerequisite Courses

10210MA103- Probability, Statistics and Queuing theory

C. Course Objectives

Students are exposed to

- Apply the concepts of supervised and unsupervised learning algorithms for real time applications.
- 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	Design and evaluate the dimensionality reduction algorithms using real world datasets.	K3
CO3	Apply various algorithms of Classification and Association	K3
CO4	Demonstrate experiments to evaluate and compare different unsupervised learning algorithms	K3
CO5	Use the concept of neural networks for learning linear and non-linear activation functions	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

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

Cos	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	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	2	2	-	-	-	-	-	2	2	2	-
CO3	3	3	3	2	2	-	-	-	-	-	2	2	2	-
CO4	3	3	3	2	2	-	-	-	-	-	2	2	2	-
CO5	3	2	2	2	2	1	-	-	-	-	2	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– 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 Pre-processing

L-9 Hours

Data Pre-processing- Needs Pre-processing the Data- Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation- Dimensionality Reduction – Feature Extraction- Variable Selection- Variable ranking- Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis –Cross Validation – Resampling methods

Unit 3 Association and Classification

L-9 Hours

Association Rule Mining- Mining Multilevel Association Rules- Mining Multidimensional Association Rule-Constraint Based Association Mining –Decision Tree Induction - Bayesian Classification –Support Vector Machines – Linear Regression - Logistic Regression- Decision Trees – Univariate Tree – Multivariate Tree –Regression Trees –ID3- Random forest- Probability and Learning – Gaussian Mixture Models – Nearest Neighbor Methods

Unit 4 Clustering Techniques

L-9 Hours

Cluster Analysis - Types of Clustering methods – Partitioning Clustering- K-means, K-Medoid, K Mode- Density-Based Clustering-DBSCAN Algorithm - Distribution Model Based Clustering-Maximum likelihood Estimation- Expectation-Maximization Algorithm- Hierarchical Clustering- Agglomerative Hierarchical algorithm- Fuzzy Clustering- Fuzzy C-means algorithm Agglomerative and Divisive Clustering –BRICH - ROCK- Chameleon

Unit 5 Neural Networks

L-9 Hours

ANN- Simple Perceptron- Gate implementation- Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation- Optimization- Hyper parameter tuning

Total:45 Hours
Total : 30 Hours

G. Laboratory Experiments

Part - 1

Task 1 Apply and demonstrate the FIND-S algorithm for finding the most specific Hypothesis based on a given set of training data samples.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator

Task 2 Implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator



- Task 3** Apply LDA algorithm to select the appropriate data from the given data set. Use XG boost algorithm for classification.
Tools: Rapid Miner, Python, Scikitlearn, Anaconda navigator
- Task4** Build a classification model that can effectively analyze and extract features from an image. Apply PCA algorithm to find the appropriate feature.
Tools: Rapid Miner, Python, Scikitlearn, Anaconda navigator
- Task 5** Write a program to demonstrate the working of the decision tree based on ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample
Tools: Weka, Python, Scikitlearn, Anaconda navigator
- Task 6** Write a program to implement the Gaussian mixture model. Compute the accuracy of the classifier, considering few test data sets.
Tools: Rapid Miner, Python, Scikitlearn, Anaconda navigator
- Task 7** Apply unsupervised learning to implement K – means clustering to perform cluster analysis, find the optimal number of clusters, identify appropriate features and interpret results.
Tools: Weka, Python, Scikitlearn, Anaconda navigator
- Task 8** Apply unsupervised learning to implement Hierarchical clustering to perform cluster analysis, find the optimal number of clusters, identify appropriate features and interpret results.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator
- Task 9** Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator
- Task 10** Apply back propagation neural network on image data. The idea is to build a Artificial Neural Network model that can effectively analyze and extract features from an image.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator
- Task 11** Assuming a set of documents that need to be classified, use the Radial basis function Classifier model to perform this task. Calculate the classification rate, accuracy, precision, and recall for your data set.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigator
- Task 12** Write a program to implement artificial neural network with back propagation.
Tools: Google co-lab, Python, Scikitlearn, Anaconda
- Task 13** Create a perceptron with appropriate number of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights.
Tools: Google co-lab, Python, Scikitlearn, Anaconda navigato



Part-2

Use Cases:

1. Medical Data Diagnosis
2. Text Classification
3. Biometrics pattern analysis
4. Climatic prediction
5. Credit Card Fraud Detection

H. Learning Resources

i.Text Books:

1. Ethem Alpaydin,, “Introduction to Machine Learning”, 4th edition, MIT Press, 2020 (Unit 1 to 4)
2. Christopher M Bishop, “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>
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
10211IT207	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

10211IT201 - Database System Concepts

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	Design and implement data warehouse model and ETL process for various applications.	K3
CO2	Develop big data applications using Hadoop, MapReduce, and Apache Spark.	K3
CO3	Design memory-efficient storage and processing solutions for Big Data applications using distributed frameworks.	K3
CO4	Develop Big Data analytics solutions using Pig, Hive and NoSQL databases.	K3
CO5	Apply cloud computing and optimization techniques to develop Big Data solutions for 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	2	2	3	–	–	–	–	–	2	3	3	1
CO2	3	3	3	2	3	–	–	–	–	–	2	3	3	2
CO3	3	3	3	3	3	–	–	–	–	–	3	3	3	2
CO4	3	3	3	3	3	2	–	–	–	–	3	3	3	2
CO5	3	3	3	3	3	2	–	–	–	–	3	3	3	2



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 kafka.
Tools: kafka
- 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

Use Cases:

Use case 1:

Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together.

Write a single Spark application that:

- a. Transposes the original Amazon food dataset, obtaining a PairRDD of the type: user-id – list of the product-ids reviewed by user-id
- b. Counts the frequencies of all the pairs of products reviewed together;
- c. Writes on the output folder all the pairs of products that appear more than once and their frequencies.
- d. The pairs of products must be sorted by frequency.

Use case 2:

Construct MapReduce program to perform data analysis on weather dataset.

Dataset is available at:

<https://www.kaggle.com/datasets/zaraavagyan/weathervsv>

Use case 3:

Apache Hive for Real-time 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 analyzing 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 be 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.

G. 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. W.H. Inmon, “Building the Data Warehouse”, John Wiley & Sons, Inc, 4th Edition, 2005-(Online Publication : 2014).
2. Capriolo, E., Wampler, D., & Rutherglen, J., “Programming Hive”, O’Reilly Media, Inc., 2012

iii. 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.html
4. “Apache Camel Tutorial”, Accessed on Oct 28, 2022 [online]. Available:
https://www.tutorialspoint.com/apache_camel/apache_camel_quick_guide.html



COURSE CODE	COURSE TITLE	L	T	P	C
10211IT208	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

10211T205- Programming using Java

C. Course Objectives:

Learners are exposed to:

- Design the interactive and responsive web application.
- Build the efficient server-side applications.
- Develop the single page MVC application.
- Construct and deploy the Microservices.
- Conversion of web apps to Mobile apps using Angular.

D. Course Outcomes:

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

CO No's	Course Outcomes	K - Level
CO1	Design web applications using Hypertext Mark-up Language and Cascading style sheets through bootstrap.	K3
CO2	Build the interactive and dynamic web page using Java Script Technology.	K3
CO3	Implement the server-side business logic to handle client request using NodeJS and PHP.	K3
CO4	Develop responsive single-page applications using Angular framework.	K3
CO5	Develop mobile-ready web applications using microservices and Angular technologies.	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	3	1	3	–	–	–	–	–	2	3	2	1
CO2	2	3	3	2	3	–	–	–	–	–	3	3	3	2
CO3	3	3	3	2	3	–	–	–	–	–	3	3	3	2
CO4	3	3	3	2	3	–	–	2	–	–	3	3	3	3
CO5	3	3	3	3	3	2	–	2	–	–	3	3	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 Scrapping 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

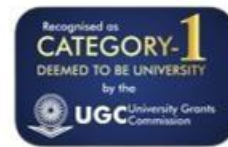
Total: 45 Hours

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 taxis we prefer to have our own vehicle for rent. Using this system vehicle owner can register as sellers and customers who want to take bikes on rent can register them as renters and can take any bike on rent. Address of the both are required as the customer can only take bike by going to the address provided and the vehicle owners can know the address that a customer is verified or not. The customer also has to upload some proofs to take the bike on rent. Proofs like license, pan card and identity card are compulsory so that no one could run taking the bike. Any customer whose proofs are not uploaded and are not valid will not be allowed to take any bike on rent. This has one admin account who verifies the registering user and two types of the user account. One for bike sellers and one for customers who take the bike on rent. This system has only one admin account and cannot have more than one admin account. There will be simple chat room needs to be added to make instant interactions between customer and admin. Admin can verify and register the user who is registering. If the admin does not verify, the user cannot register.

Tools: HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, JQuery

Use Case 2: Clinic Management Service

This system is named as Clinic management service. This system is made to keep the records about the patients, doctors and other staff members working at a clinic or hospital receptionist. One can login into the clinic management service using the email id or the user id and password. After signing in into this system there are the options to add new patients, new doctors and other new staff members like nurses and ward boys etc. This system is designed to easily maintain the data of the patients specifically. Daily many new patients visit the clinic so adding the new patient's details and keeping the records using it is very easy. There is also an option to add and delete doctors and other staff member's details. New and unique ids are given to everyone who gets registered over this system. There are also the options to check the patient's disease and course the patient is going through. Fees paid by any customer or patient can be saved on it and it is easy to calculate daily that the money is collected. Doctors and another staff member like nurses, ward boys, janitor and maid leaves can be deducted from their salary and rest of the salary can be paid easily using this clinic management service. It is easy to calculate money and handle account on monthly basis also. This system also has an option to use the backup that means if we are backing up the database it can never be lost. So, overall, this clinic management service is a solution to all the problems that we face in a clinic or hospital.

Tools: HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, Java Script

Use Case 3: E-commerce service



Online shopping is a process in which people (specifically customers) are being provided with the option of purchasing goods and services directly from the seller, all in real-time environment. Online shopping is an application of the internet as electronic commerce (Like Amazon). From the business perspective, customers usually find the products more attractive, on websites, as they get all the details available there. People in large number are doing online shopping today, and it is not only because it is convenient as one can shop from home, but also because there are ample amount of varieties available, with high competition of prices, and also it is easy to navigate for searching regarding any particular item. For sellers, their products have access to World Wide market, which also increases the number of customers and enhances the customer relationships. Also the web stores are a means for the small scale companies to launch their products at global level. The main objective behind this project is to develop a web oriented application which can provide an online shopping feature to the users. In other words, the project aimed at creating a virtual shop environment for users, in some handy form, which will be available to them through internet. This system has been designed keeping in mind all the aspects such as loading the data, complexity and maintaining the security of user credentials.

Here in this system, complexity refers to the total number of features being provided to users, and their smooth arrangement and functioning required. Following are some of the key features of our system, which distinguishes it from others:

- Display of all the available categories for shopping on the home page.
- Display all the sub-categories on the home page; those are associated with any particular item.
- Admin has the authority to add new particulars to the items list whenever needed.
- Permission to administrator to remove items, anytime.
- Allows the admin to modify the price of each item, whenever required or felt like.
- Admin has the authority to update the description of each item.
- Permission to the admin to view information about each customer who checkouts the items list.

Tools: HTML5, CSS3, BOOTSTRAP, Angular, NodeJS, Java Script

Use Case 4: College management service

This application college management system based on Internet that aims to all the levels of management providing information within an organization. This system can be used as an information management system for the college. For a given student/staff (Technical / Non-technical) the Administrator creates login id & password, using these student/ staff (Technical / Non-technical) can access the system to either upload or download some information from the database. Not only will this added user also get to know about the events and extra curriculum activities which will hold into the college campus.

The main menu will contain six parts which are as follow:

- Student Login
- Teacher login
- Deposit Fee
- Ask Queries Forum
- About Us
- Contact Us

Now, we can see that nearly everything is very much possible to perform with a single click, so this application will help you to computerize the system of college management so that student and other staff members can access the system online.

These are some key features of the system which is as follow:



- ✓ To reduce the headache of maintaining the record of students and teachers related documents.
- ✓ To reduce the cumbersome job of maintaining several documents 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-to-angular-2/>
2. “Server-side Development with NodeJS, Express and Mongo DB”, Accessed on: May. 06, 2021 [Online], Available: <https://www.coursera.org/learn/server-side-nodejs>
3. “Node.js Micro services for beginners”, Accessed on: May. 06, 2021 [Online], Available: <https://www.udemy.com/course/nodejs-microservices-for-beginners/>



COURSE CODE	COURSE TITLE	L	T	P	C
10211IT209	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:

10211IT118 – 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
CO2	Choose appropriate physical devices to develop IoT applications.	K3
CO3	Apply appropriate IoT communication and device management protocols for IoT applications.	K3
CO4	Apply cloud computing technologies and services for IoT data processing and application deployment.	K3
CO5	Develop a smart application using IoT and Cloud.	K3

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	2	1	–	–	–	–	2	3	2	1
CO2	3	3	2	2	3	1	–	–	–	–	2	3	2	2
CO3	3	3	2	2	3	1	–	–	–	–	3	3	3	2
CO4	3	3	3	3	3	2	–	–	–	–	3	3	3	3
CO5	3	3	3	3	3	2	–	2	–	–	3	3	3	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 Protocols, 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 Hours

H. Learning Resources

i. 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]

ii. 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. "Thingspeak 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>



COURSE CODE	COURSE TITLE	L	T	P	C
10211IT210	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

10211IT119 - Fundamentals of Computer Network

C. Course Objectives:

Learners are exposed to:

- Assess threat models and their influence on an organization
- Compare the various uses and approaches to cryptography
- Prepare for and respond to security incidences
- Design effective and efficient password schemes
- Plan environments that are resistance to malware

D. Course Outcomes:

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

CO No's	Course Outcomes	K - Level
CO1	Understand the basic concepts of cyber security and its principles.	K2
CO2	Interpret the attacks, security issues, and management standards in wireless devices.	K2
CO3	Apply the tools and methods to detect cyber attacks	K3
CO4	Identify the phishing techniques and associated vulnerabilities.	K3
CO5	Utilize the preventive measures for cyber security safeguards.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

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

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

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.

H. Learning Resources

i. Text Books:

1. Nina Godbole, Sumit Belapure, "Cyber Security", Wiley 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", Apress, 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
10211IT311	Data Structures and Algorithms 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

10211IT117- Data Structures and Algorithms

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.	K3
CO2	Develop an appropriate algorithm using tree data structure to specified problem definition.	K3
CO3	Utilize appropriate hashing techniques and develop solutions for a range of problems.	K3
CO4	Apply Graph data structure and implement appropriate algorithm for given problem.	K3
CO5	Implement appropriate sorting and searching techniques for solving the problem.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

F. Correlation of Cos with Program Outcomes and 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, minimum difference 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 are the 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 Priority Queue)
- iv) Find Minimum Spanning Tree using Kruskal's algorithm - using Disjoint subsets 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

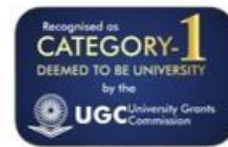
- i) Implementation of Linear Search
- ii) Implementation of Binary Search

Part II

Use Cases

Use Case 1: Railroad Car

Imagine a railroad switching circuit such as the one below. Railroad cars are given unique numbers, from 1 onwards. Cars come in from the right in a random order, and the goal 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 2 would be switched on to the siding. Then car numbered 1 would be moved on to the siding and then to the left. Next car numbered 2 would be moved up from the siding and assembled behind car 1. Finally, car numbered 3 would be moved from the right to the left, via the siding. Notice that the cars in the siding work as a stack, since if a car is moved on to a nonempty siding the existing cars cannot be accessed until the new car is removed. 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 $1, 2, \dots, N$ 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 L_1 -th card from the top and ending at the R_1 -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 L_2 -th card and ending this one at the R_2 -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 L_M -th card and ending this one at the R_M -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 the cards 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:

- For a given set of segments ($[L_1, R_1], [L_2, R_2], \dots, [L_M, R_M]$) 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.
- For a given set of segments ($[L_1, R_1], [L_2, R_2], \dots, [L_M, R_M]$) and a given Q , Determine the order of the cards after the shuffling algorithm above.

Use Case 3: Multiuser Environment

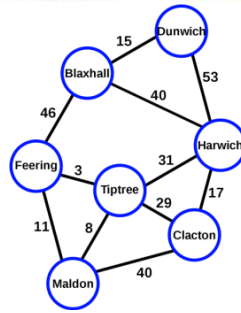
Linux is designing a new OS to operate in a multiuser environment. All the users would be connected to a central machine. This central machine can allocate or de-allocate resources to the connected users in order to maximize overall performance. The OS has a limitation. If a particular program is running 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:



- Modify the graph ADT to store weights in the arc nodes.
- Implement a program, when given the start and destination and display the shortest route between them.

Total: 30 Hours

H. Learning Resources

i. Text Books:

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

ii. Reference Books:

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

iii. Online References:

- "Data Structures using C" 2003- 2021. Accessed on: Apr. 15, 2021 [Online]. Available: <http://www.academictutorials.com/data-structure/>
- "Linked List" 2015, Accessed on: Apr. 15, 2021 [Online]. Available: <http://www.c4learn.com/mcq/data-structure-mcq/linked-list-mcq-general-questions/>
- "Advanced Data Structures" 1999 – 2021. Accessed on: Apr. 15, 2021 [Online]. Available: <http://randu.org/tutorials/c/ads.php>
- "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
10211IT312	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. 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	K3
CO2	Examine the frame analysis and routing in layer2 network.	K3
CO3	Apply the routing technique and create the subnetting in layer3 network.	K3
CO4	Demonstrate the Socket programming and datagram approaches.	K3
CO5	Explain the application layer protocols for a given real-time scenario.	
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
CO2	2	2	3		3									2
CO3	2	2	3		3									2
CO4	2	2	3		3									2
CO5	2	2	3		3									2

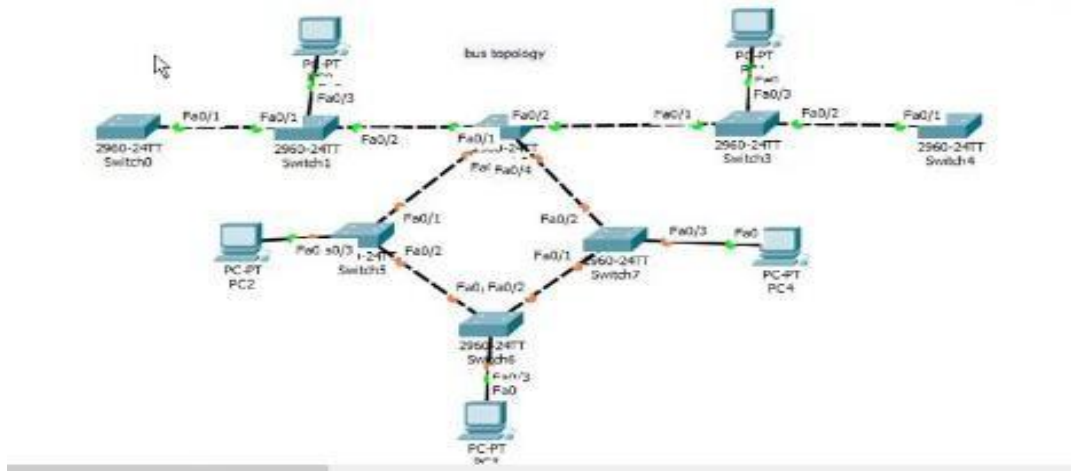
3- High; 2-Medium; 1-Low

F. Course Contents

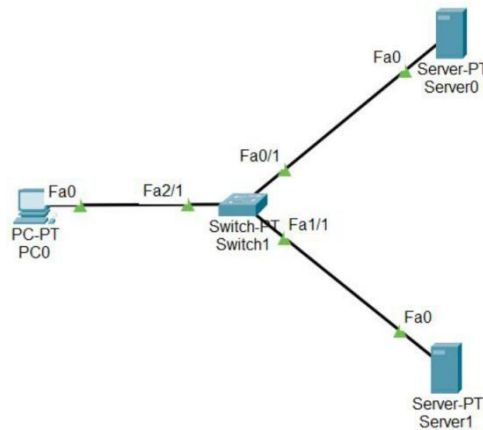
Part-1

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**



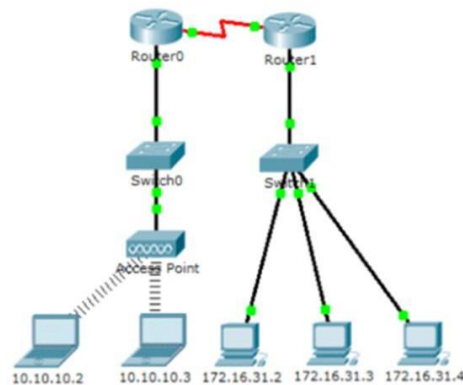
Data Link Layer:

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.

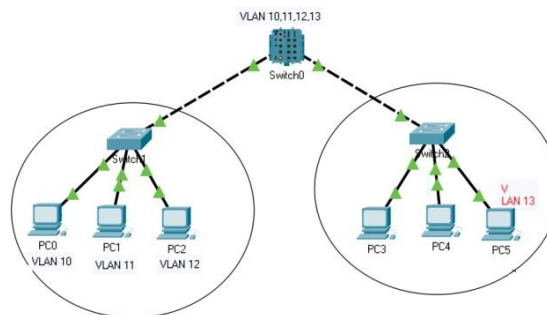
Task 4: Examine the MAC table using ARP **CO2, K3**



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.



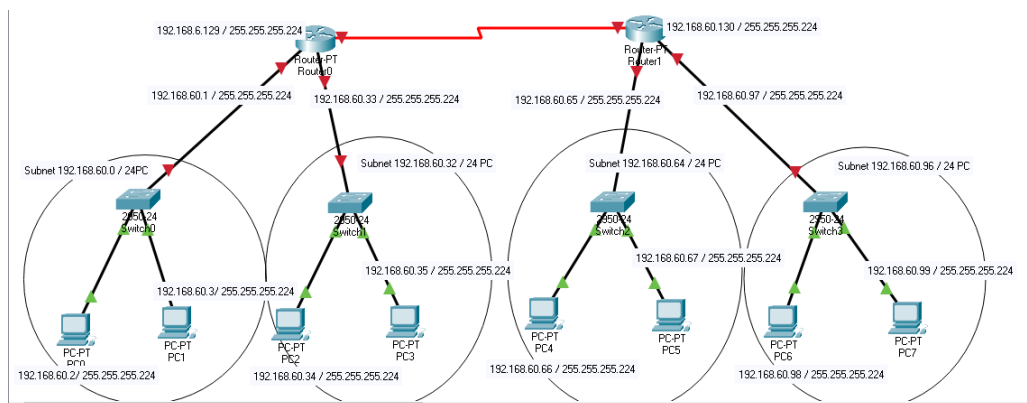
Execute the ping command from 'PC2' to 'PC5' successfully.

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/NS3.



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

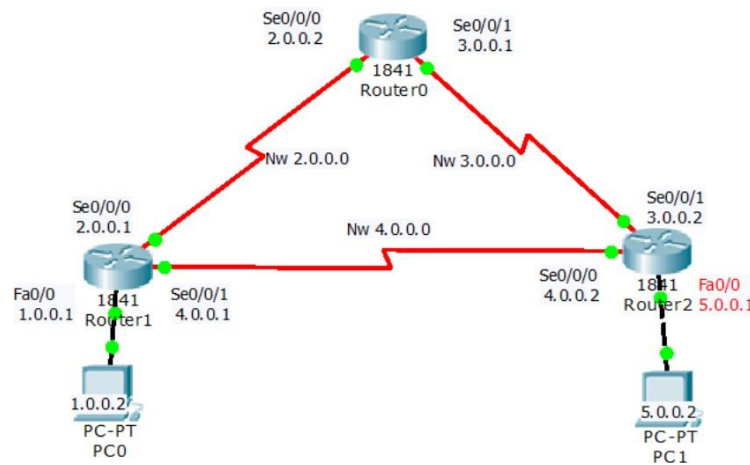
I) Device ID / name II) Device Password III) SSID IV) Wi-Fi Password

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

Task 8: Configuring RIP:

CO3, K3

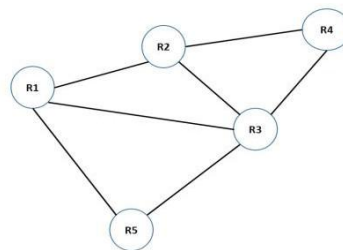
Implement to update routing information protocol table for the given network.



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



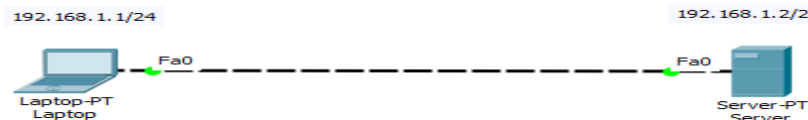
i) Missing VLANs ii) Switch Trunk Port Issues iii) Switch Access Port Issues iv) Router Configuration Issues v) Remote management issue vi) restoring a managed switch with earlier configuration.

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

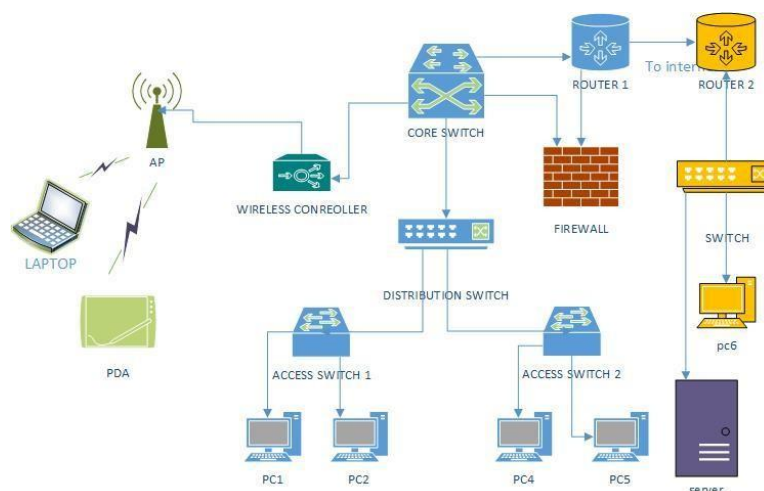
Use Case1: Designing LAN for an Operating Centre

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 be 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



COURSE CODE	COURSE TITLE	L	T	P	C
10211IT313	Operating System Concepts 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

10211IT117 - Data Structures and Algorithms

C. Corequisite Course

10211IT120 - Operating Systems Concepts

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	K3
CO2	Apply the process management techniques and scheduling algorithms for the given problem.	K3
CO3	Make use of Banker's algorithm to detect and avoid dead lock	
CO4	Implement various memory management strategies and page replacement algorithm.	
CO5	Implement the various disk scheduling algorithms	
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:30 Hours

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 termination of 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.

Use case 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.

Use case 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

Use case 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 System Concepts”, 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 scripting” 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
10211IT314	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.	K3
CO2	Analyze the functional, logic and programming paradigm.	K3
CO3	Apply number theory and mathematical concepts to solve the computational problem.	K3
CO4	Implement algorithm for real word problems using elementary data structures.	K3
CO5	Analyze the given partial code / Pseudocode and find correct solution.	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	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 course describes 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 Substring:-<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:

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

ii. Reference Books:

- Marty Erickson, Anthony Vazzana, David Garth, "Introduction to Number Theory", Chapman and Hall, CRC; Copyright year 2016.
- Thomas H. Cormen, "Introduction to Algorithms", 3rd Edition, 2009, MIT Press Cambridge.

iii. Online References:

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



COURSE CODE	COURSE TITLE	L	T	P	C
10211IT315	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

10211IT314 – Competitive Coding

C. Course Objectives

Learners are exposed to:

- Understand the basic concepts for solving real world problems
- Impart and implement the concepts of data structures
- Identify the basic properties of Trees and Graphs.
- Hands on Experience in analysis of algorithms for various algorithmic techniques
- Implement algorithm design methods such as dynamic programming and greedy method

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Apply advanced Array, String and mathematical algorithms for problem solving	K3
CO2	Demonstrate stack, queue and sorting algorithms to solve the problems.	K3
CO3	Implement classical algorithms for trees and graphs with backtracking concepts, being aware of their trade-offs in terms of complexity in time/space	K3
CO4	Analyse and implement efficient algorithms for challenging computational problems on advanced data structures, in practice, quickly and correctly.	K3
CO5	Solve complex problems using dynamic programming and greedy algorithm.	K3



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:

- Sqrt(x): <https://leetcode.com/problems/sqrtx/>
- Trapping rain water: <https://leetcode.com/problems/trapping-rain-water-ii/>
- Permutation sequence: <https://leetcode.com/problems/permutation-sequence/>
- Ugly Number: <https://leetcode.com/problems/ugly-number-ii/>
- Allocate Mailboxes: <https://leetcode.com/problems/allocate-mailboxes/>

Additional Problems:

- Sum of square numbers: <https://leetcode.com/problems/sum-of-square-numbers/>
- Next permutation: <https://leetcode.com/problems/next-permutation/>
- Product of array: <https://leetcode.com/problems/product-of-array-except-self/>
- Trapping rain water: <https://leetcode.com/problems/trapping-rain-water/>
- Find the median problem: <https://www.hackerrank.com/challenges/find-the-median/problem>
- Straight Line: <https://leetcode.com/problems/check-if-it-is-a-straight-line/>
- Number of digit one: <https://leetcode.com/problems/number-of-digit-one/>
- Largest component size by common factor: <https://leetcode.com/problems/largest-component-size-by-common-factor/>
- Reaching Points: <https://leetcode.com/problems/reaching-points/>
- Beautiful Numbers: <https://codeforces.com/problemset/problem/300/C>
- Number Expression: <https://practice.geeksforgeeks.org/problems/check-if-a-number-can-be-expressed-as-xy1606/1>
- Pairs of Prime Numbers: <https://practice.geeksforgeeks.org/problems/pairs-of-prime-number/0>
- Fibonacci number: <https://practice.geeksforgeeks.org/problems/check-if-the-number-is-fibonacci4654/1/>



- xiv) Maximum product of three numbers: <https://leetcode.com/problems/maximum-product-of-three-numbers/>
- xv) Count all valid options: <https://leetcode.com/problems/count-all-valid-pickup-and-delivery-options/>
- xvi) Largest divisible subset: <https://leetcode.com/problems/largest-divisible-subset/>

Task 2: Advanced concept on Arrays – Two Pointer problem One maintains two pointers (indices) into either one array or two arrays, and move the pointers based on values at the pointers.

Practice Problems:

- i) Interval list intersections: <https://leetcode.com/problems/interval-list-intersections/>
- ii) Merge Intervals: <https://leetcode.com/problems/merge-intervals/>
- iii) Merge sorted array: <https://leetcode.com/problems/merge-sorted-array/>
- iv) Three sum: <https://leetcode.com/problems/3sum/>
- v) Smallest range covering element: <https://leetcode.com/problems/smallest-range-covering-elements-from-k-lists/>

Additional Problems:

- i) Longest substring without repeating characters: <https://leetcode.com/problems/longest-substring-without-repeating-characters/>
- ii) Push dominoes: <https://leetcode.com/problems/push-dominoes/>

Task 3: Advanced concept on String – String searching, Knuth–Morris–Pratt algorithm, Boyer–Moore string-search algorithm, Manacher's algorithm and z-function, suffix and prefix.

Practice Problems:

- i) Longest Prefix Suffix: <https://practice.geeksforgeeks.org/problems/longest-prefix-suffix2527/1>
- ii) Palindrome substring: <https://codeforces.com/gym/101806/problem/Q>
- iii) Password problem: <https://codeforces.com/problemset/problem/126/B>
- iv) Prefixes and suffixes: <https://codeforces.com/problemset/problem/432/D>
- v) Pattern find: <https://www.spoj.com/problems/NAJPF/>

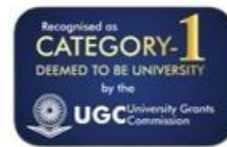
Additional Problems:

- i) Palindrome: https://onlinejudge.org/index.php?option=com_onlinejudge&Itemid=8&category=26&page=show_problem&problem=2470
- ii) Chef and String: <https://www.codechef.com/problems/CHSTR>
- iii) Anthem of Berland: <https://codeforces.com/contest/808/problem/G>

Task 4: Stacks and Queues

Practice Problems:

- i) Sort characters by frequency: <https://leetcode.com/problems/sort-characters-by-frequency/>
- ii) Valid Anagram: <https://leetcode.com/problems/valid-anagram/>
- iii) Stack using Two queue : <https://practice.geeksforgeeks.org/problems/stack-using-two-queues/1>
- iv) Bag of numbers : <https://www.hackerearth.com/practice/data-structures/stacks/basics-of-stacks/practice-problems/algorithm/bag-of-numbers/>



- v) Disk tower : <https://www.hackerearth.com/practice/data-structures/queues/basics-of-queues/practice-problems/algorithm/disk-tower-b7cc7a50/>

Additional Problems:

- i) Queries with fixed length
problem: <https://www.hackerrank.com/challenges/queries-with-fixed-length/problem>
- ii) Eerie Planet : <https://www.hackerearth.com/practice/data-structures/queues/basics-of-queues/practice-problems/algorithm/weird-planet-2000a170/>
- iii) Number of atoms: <https://leetcode.com/problems/number-of-atoms/>

Task 5: Linked List-Single linked list, Doubly linked list, operations on linked list.

Practice Problems:

- i) Add two Numbers: <https://leetcode.com/problems/add-two-numbers/>
- ii) Remove nth Node: <https://leetcode.com/problems/remove-nth-node-from-end-of-list/>
- iii) Merge two sorted list: <https://leetcode.com/problems/merge-two-sorted-lists/>
- iv) Insertion sort list: <https://leetcode.com/problems/insertion-sort-list/>
- v) Remove element: <https://leetcode.com/problems/remove-linked-list-elements/>

Additional Problems:

- i) Sort List: <https://leetcode.com/problems/sort-list/>
- ii) Reverse nodes in k groups: <https://leetcode.com/problems/reverse-nodes-in-k-group/>
- iii) Remove duplicates: <https://leetcode.com/problems/remove-duplicates-from-sorted-list-ii/>
- iv) Linked List cycle ii: <https://leetcode.com/problems/linked-list-cycle-ii/>
- v) Odd Even linked list: <https://leetcode.com/problems/odd-even-linked-list/>
- vi) Add two numbers II: <https://leetcode.com/problems/add-two-numbers-ii/>
- vii) Swap nodes in pairs: <https://leetcode.com/problems/swap-nodes-in-pairs/>

Task 6: Sorting- Counting sort, Radix sort, Heap sort, Bucket sort

Practice Problems:

- i) First nonrepeating character in a stream: <https://practice.geeksforgeeks.org/problems/first-non-repeating-character-in-a-stream/0/>
- ii) LRU Cache: <https://leetcode.com/problems/lru-cache/>
- iii) Finding pairs: <https://www.hackerearth.com/practice/algorithms/sorting/counting-sort/practice-problems/algorithm/finding-pairs-4/>
- iv) Cube change : <https://www.hackerearth.com/practice/algorithms/sorting/heap-sort/practice-problems/algorithm/cube-change-qualifier2/>
- v) Descending Weights :
<https://www.hackerearth.com/practice/algorithms/sorting/bucket-sort/practice-problems/algorithm/sort-the-array-5/>

Additional Problems:

- i) Binary Land: <https://www.codechef.com/MAY20A/problems/BINLAND>
- ii) Divide Apples : <https://www.hackerearth.com/practice/algorithms/sorting/heap-sort/practice-problems/algorithm/divide-apples/>



iii) Shil and birthday present :

<https://www.hackerearth.com/practice/algorithms/sorting/counting-sort/practice-problems/algorithm/shil-and-birthday-present/>

Task 7: Trees: Introduction, tree traversal (in-order, pre-order, post-order), Binary search tree

Practice Problems:

- i) Longest Uni value Path: <https://leetcode.com/problems/longest-univalue-path/>
- ii) Path Sum-III: <https://leetcode.com/problems/path-sum-iii/>
- iii) Distinct count : <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/distinct-count/>
- iv) MST revisited : <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/mst-revisited-3f9d614c/>
- v) Vertical order: <https://leetcode.com/problems/vertical-order-traversal-of-a-binary-tree/>

Additional Problems:

- i) Level order traversal: <https://leetcode.com/problems/binary-tree-zigzag-level-order-traversal/>
- ii) Level order traversal -ii: <https://leetcode.com/problems/binary-tree-level-order-traversal-ii/>
- iii) Preorder and inorder: <https://leetcode.com/problems/construct-binary-tree-from-preorder-and-inorder-traversal/>

Task 8: Graph - Introduction Adjacency Matrix and List, Depth First search, Breadth First Search, Manacher's algorithm

Practice Problems:

- i) Decode string: <https://leetcode.com/problems/decode-string/>
- ii) Cheapest Flights: <https://leetcode.com/problems/cheapest-flights-within-k-stops/>
- iii) Network delay time: <https://leetcode.com/problems/network-delay-time/>
- iv) Keys and rooms: <https://leetcode.com/problems/keys-and-rooms/>
- v) Minimum cost to connect: <https://leetcode.com/problems/minimum-cost-to-connect-two-groups-of-points/>

Additional Problems:

- i) Clone Graph: <https://leetcode.com/problems/clone-graph>
- ii) Find the town judge: <https://leetcode.com/problems/find-the-town-judge>
- iii) Bipartite: <https://leetcode.com/problems/is-graph-bipartite/>
- iv) Path with minimum effort: <https://leetcode.com/problems/path-with-minimum-effort/>

Task 9: Backtracking-Introduction, Backtrack vs Divide and Conquer

Practice Problems:

- i) Letter combination: <https://leetcode.com/problems/letter-combinations-of-a-phone-number/>
- ii) Regular expression matching: <https://leetcode.com/problems/regular-expression-matching/>
- iii) Generate parentheses: <https://leetcode.com/problems/generate-parentheses/>
- iv) Combination sum: <https://leetcode.com/problems/combination-sum/>
- v) Sequential digits: <https://leetcode.com/problems/sequential-digits/>



Additional Problems:

- i) Permutations:<https://leetcode.com/problems/permutations/>
- ii) Subsets:<https://leetcode.com/problems/subsets/>
- iii) Path with maximum gold:<https://leetcode.com/problems/path-with-maximum-gold/>

Task 10: Heap Introduction, min-max heap, Segment tree & Trie

Practice Problems:

- i) Find k pairs with smallest sums:<https://leetcode.com/problems/find-k-pairs-with-smallest-sums/>
- ii) Last stone weight:<https://leetcode.com/problems/last-stone-weight/>
- iii) Kth largest element in an array:<https://leetcode.com/problems/kth-largest-element-in-an-array/>
- iv) K-closest points to origin:<https://leetcode.com/problems/k-closest-points-to-origin/>
- v) Sliding window maximum:<https://leetcode.com/problems/sliding-window-maximum/>
- vi) Range sum Query:<https://leetcode.com/problems/range-sum-query-mutable/>
- Maximum number of events: <https://leetcode.com/problems/maximum-number-of-events-that-can-be-attended/>
- viii) Minimum number of increments: <https://leetcode.com/problems/minimum-number-of-increments-on-subarrays-to-form-a-target-array/>
- ix) Cost of Data : [https://www.hackerearth.com/practice/data-structures/advanced-data-](https://www.hackerearth.com/practice/data-structures/advanced-data-structures/trie-keyword-tree/practice-problems/algorithm/cost-of-data-11/)

x) [structures/trie-keyword-tree/practice-problems/algorithm/cost-of-data-11/](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:



- i) Lemonade change: <https://leetcode.com/problems/lemonade-change/>
- ii) Water bottles: <https://leetcode.com/problems/water-bottles/>
- iii) Best time to buy and sell stock: <https://leetcode.com/problems/best-time-to-buy-and-sell-stock-with-transaction-fee/>
- iv) Couples holding hands: <https://leetcode.com/problems/couples-holding-hands/>
- v) Wildcard matching: <https://leetcode.com/problems/wildcard-matching/>

Additional Problems:

- i) Partition labels: <https://leetcode.com/problems/partition-labels/>
- ii) Queue reconstruction: <https://leetcode.com/problems/queue-reconstruction-by-height/>
- iii) Reorganize string: <https://leetcode.com/problems/reorganize-string/>
- iv) Jump game II: <https://leetcode.com/problems/jump-game-ii/>
- v) Minimum number of taps: <https://leetcode.com/problems/minimum-number-of-taps-to-open-to-water-a-garden/>

Total: 30 Hours

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 edition, 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/problems/all/>



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PROGRAM ELECTIVE



COURSE CODE	COURSE TITLE	L	T	P	C
10212IT101	Cryptography and Network Security	3	0	0	3

A. Preamble

The purpose of this course is to understand principles of encryption algorithms, conventional and public key cryptography. It also includes knowledge of authentication, hash functions and also application level of security mechanisms.

B. Prerequisite course

10211IT119 – Fundamentals of Computer Networks

C. Course Objectives:

Learners are exposed to:

- Understand the basics of cryptography, its techniques and principles
- Make use of mathematical concepts to apply the public key cryptography
- Utilize the authentication hash functions and digital signatures for security
- Organize various cryptographic standards to apply over security applications
- Identify the preventive security mechanisms for efficient security management

D. Course Outcomes:

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

CO No's	Course Outcomes	K - Level
CO1	Understand the encryption and decryption techniques using block ciphers.	K2
CO2	Apply key exchange and management schemes using public key cryptography	K3
CO3	Demonstrate techniques to sign and verify messages using signature generation and verification algorithms.	K3
CO4	Implement cryptographic algorithm for various network security applications	K3
CO5	Illustrate the technologies to protect cyberspace against security threats	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

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

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



High- 3; Medium-2; Low-1

F.Course contents

Unit 1 Introduction to Cryptography

9 Hours

OSI Security Architecture - Classical Encryption techniques – Cipher Principles – Data Encryption Standard – Block Cipher Design Principles and Modes of Operation - Evaluation criteria for AES –AES Cipher – Triple DES – Placement of Encryption Function – Traffic Confidentiality-Case study on Barclays Bank

Unit 2 Public Key Cryptography

9 Hours

Number Theory concepts:Primes and Prime Factorization –Congruent modulo n, equivalent class modulo n, Integer modulo n, Multiplicative inverse, Relatively prime, Euler's theorem, Fermat's little theorem, Extended Euclidean Algorithm, Chinese Remainder Theorem. Confidentiality using Asymmetric Encryption – Public Key Cryptography and RSA- Key Management - Diffie-Hellman key Exchange – Elliptic Curve Architecture and Cryptography – Case study on Elan Financial Services

Unit 3 Authentication and Hash Function

9 Hours

Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm – Secure Hash Algorithm – RIPEMD – HMAC Digital Signatures – Authentication Protocols – Digital Signature Standard- Case study on Swedbank

Unit 4 Network Security Applications

9 Hours

Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security –PGP – S/MIME - IP Security- Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange, Authentication Header.

Unit 5 Security Management

9 Hours

Intrusion detection and Prevention System – password management – Viruses and related Threats – Virus Countermeasures- Worms Security Risks – Firewall Design Principles – Trusted Systems- Log Management. Case study on Biometric deployment for secure password management.

Total: 45 Hours

G.Learning Resources

i.Text Books:

1. William Stallings, —Cryptography And Network Security – Principles and Practices, Prentice
2. Hall of India, Eighth Edition, 2020 [Unit 1-5].
3. David Kim and Michael G.Solomon, “Fundamentals of Information Systems Security”, Jones and Bartlett Publishers, Third Edition, 2018 [Unit 1-5].

ii. References Books:

1. AtulKahate, —Cryptography and Network Security, Tata McGraw-Hill, 2011.
2. Bruce Schneier, —Applied Cryptography, John Wiley & Sons Inc, 2011.
3. Charles B. Pfleeger, Shari Lawrence Pfleeger, —Security in Computing, Third Edition, Pearson Education, 2010.

iii. Online References

1. “Cryptography techniques”, Accessed on: July 2022, [online]. Available: <http://Cryptographywilliamstallings.com/Extras/Security-Notes/>



2. “Authentication algorithms”, Accessed on: July 2022 [online]. Available:
<http://www.cs.bilk.ent.edu.tr/~selcuk/teaching/cs519/>
3. “Network security concepts”, Accessed on: July 2022[online]. Available:
<http://freevideolectures.com/Course/3027/Cryptography-andNetwork-Security>



COURSE CODE	COURSE TITLE	L	T	P	C
10212IT103	Artificial Intelligence	3	0	0	3

A. Preamble:

Artificial intelligence (AI) is the intelligence exhibited by machines or software. It is also the name of the academic field of study which studies how to create computers and computer software that are capable of intelligent behavior

B. Course Outcomes

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

COs	Course Outcomes	Knowledge Level
CO1	Use various symbolic knowledge representation to specify domains and reasoning tasks of a situated software agent to solve a problem	K2
CO2	Use different logical systems for inference over formal domain representations, and trace how a particular inference algorithm works on a given problem specification	K2
CO3	Analyze a problem, and plan according to solve those problems	K2
CO4	Discuss the uncertainty by using various models	K2
CO5	Demonstrate learning from observation using various methods	K2

C. 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	3	1	1	-	1	-	2	3	2	1
CO2	3	3	2	3	3	-	1	-	1	-	2	3	2	1
CO3	3	3	3	2	3	1	1	1	1	1	2	3	3	2
CO4	3	3	2	3	3	1	1	-	1	-	2	3	3	2
CO5	3	3	3	3	3	3	1	1	2	1	3	3	3	3

H- High; M-Medium; L-Low

D. Course Contents:

UNIT I PROBLEM SOLVING

9 Hours

Introduction – Agents – Problem formulation – uninformed search strategies – heuristics – informed search strategies – constraint satisfaction

UNIT II LOGICAL REASONING

9 Hours

Logical agents – propositional logic – inferences – first-order logic – inferences in first order logic – forward chaining – backward chaining – unification – resolution

UNIT III PLANNING

9 Hours

Planning with state-space search – partial-order planning – planning graphs – planning and acting in the real world

UNIT IV UNCERTAIN KNOWLEDGE AND REASONING

9 Hours

Uncertainty – review of probability - probabilistic Reasoning – Bayesian networks –



inferences in Bayesian networks – Temporal models – Hidden Markov models

UNIT V LEARNING

9 Hours

Learning from observation - Inductive learning – Decision trees – Explanation based learning
– Statistical Learning methods - Reinforcement Learning.

Total : 45 Hours

E. Learning Resources

i. TEXT BOOK:

1. S. Russel and P. Norvig, “Artificial Intelligence – A Modern Approach”, Second Edition, Pearson Education, 2003.

ii. REFERENCES:

1. David Poole, Alan Mackworth, Randy Goebel, ”Computational Intelligence : a logical approach”, Oxford University Press, 2004.
2. G. Luger, “Artificial Intelligence: Structures and Strategies for complex problem solving”, Fourth Edition, Pearson Education, 2002.
3. J. Nilsson, “Artificial Intelligence: A new Synthesis”, Elsevier Publishers, 1998.



COURSE CODE	COURSE TITLE	L	T	P	C
10212IT104	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

10211IT118 - Modern Computer Architecture

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	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		

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	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

F. 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- Multithreaded 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 coherence- 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, Multiplication in 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



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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
10212IT105	Data Science in Python	3	0	0	3

A. Preamble

This course provides a comprehensive introduction to the principles and practices of Data Science. It equips learners with the knowledge and skills required to collect, preprocess, analyze, and visualize data using Python and modern analytical tools. The course also introduces machine learning techniques, Big Data technologies, and effective data presentation methods to enable students to derive meaningful insights and support data-driven decision-making in real-world applications.

B. Course Objectives

Learners are exposed to:

- Understand the fundamental concepts of Data Science, data preprocessing techniques, and Big Data analytics frameworks.
- Apply Python programming, data analysis libraries, and machine learning techniques for extracting insights from data.
- **Develop** skills in data visualization, model evaluation, and communicating analytical results for real-world decision-making.

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, roles, stages, and processes involved in Data Science projects.	K1
CO2	Explain data acquisition, preprocessing, cleaning, sampling, and data management techniques used in Data Science.	K2
CO3	Describe Python programming concepts, data structures, and libraries such as NumPy and Pandas for data analysis.	K2
CO4	Explain machine learning techniques, Big Data concepts, Hadoop ecosystem, and MapReduce algorithms used in data analytics.	K2
CO5	Explain machine learning techniques, Big Data concepts, Hadoop ecosystem, and MapReduce algorithms used in data analytics.	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	3	2	1	1	2	-	-	-	1	-	1	3	2	1
CO2	3	3	2	2	3	1	-	-	1	-	1	3	3	2
CO3	3	2	2	1	3	-	-	1	1	-	2	3	2	2
CO4	3	3	2	2	3	2	-	1	1	1	2	3	3	2
CO5	2	2	2	1	3	1	1	2	3	1	2	2	3	2

3-High; 2-Medium; 1-Low



B. Course Content:

UNIT – I INTRODUCTION TO DATA SCIENCE

(9 hours)

Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation .

UNIT – II PYTHON FOR DATA SCIENCE

(9 hours)

Functions - Types and Sequences – Strings - Reading and Writing CSV files - Dates and Times –Objects - map(), Lambda and List Comprehensions - Python libraries for Data science :NumPy, Pandas

UNIT – III DATA SCIENCE TECHNIQUES

(9 hours)

Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods.

UNIT – IV BIG DATA ANALYTICS

(9 hours)

Distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce - Apache Hadoop & Hadoop Ecosystem – Moving Data in and out of Hadoop.

UNIT – V DATA VISUALIZATION

(9 hours)

Documentation and deployment – producing effective presentations – Introduction to graphical analysis – plot() function – displaying multivariate data – matrix plots – multiple plots in one window - exporting graph - using graphics parameters. Case studies.

Total hours: 45

C.Learning Resources

Learning Recourses:

i. Text Book:

1. Ivan Idris, “Python Data Analysis”, Packt Publishing Limited, 2014
2. Noreen Burlingame and Lars Nielsen, “A Simple Introduction to DATA SCIENCE”, 2012
3. Paul Zikopoulos, Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, *Understanding Big Data: Analytics for Enterprise Class Hadoop and streaming Data*, The McGraw-Hill Companies, 2012



COURSE CODE	COURSE TITLE	L	T	P	C
10212IT108	Robotic Process Automation	3	0	0	3

A. Preamble

Enhance the students understanding on business process identification and its automation.
Provide the students with an environment in which they can explore the usage and usefulness of software development to increase efficiency in business processes. Induce a realistic and industry driven view of software development for business process automation related concepts and their inherent benefits.

B. Prerequisite Course

10211IT205- Programming Using Java

C. Course Objectives

Learners are exposed to:

- create capitalization of own potential, while respecting principles and rules for professional ethics.
- Identification of suitable learning tasks to which adequate software systems development methodologies can be applied.
- Appreciation of some of the current limitations real time project, testing and deployment techniques.

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Apply rules to organized and efficient work, responsibilities of didactical and scientific activities and creative capitalization of own potential, while respecting principles and rules for professional ethics.	K2
CO2	Identify adequate software systems development methodologies.	K2
CO3	Use efficient methods and techniques for learning, knowledge gaining, and research and develop capabilities for capitalization of knowledge, accommodation to society requirements and communication in English.	K2
CO4	Identify models and methods adequate to real life problem solving.	K2
CO5	Develop the real time project, testing and deployment.	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			2							1		
CO2	2	2			2							1	2	
CO3	2	2			2							2	2	
CO4	2	2			2							2	2	
CO5	2	2			2							2		



Unit 1 Introduction

L-9 Hours

Basic concepts - UiPath Platform Architecture-Business Process - Business Process Identification Introduction to UiPath Studio-Variables, Data types - Control flow structures. Data processing Operations on Data - Entry, Update, Validation –Migration- Data manipulation - Scalar variables, Collections. Tables - Text manipulation- Gathering and assembling data

Unit 2 User Events and Recorder

L-9Hours

Desktop recording- Web recording - Input/output methods - Screen scraping -Data scraping - Selectors - Definition and access - Customization and debugging - Dynamic selectors

Unit 3 Image and Test Automation

L-9 Hours

Basic Citrix Automation – Keyboard Automation – Information Retrieval - Advanced Citrix Automation - Best Practice Rules – Starting Applications – Excel, Data Tables – Basic Interactions - Data Process, PDF and E-mail – Data Extraction - Anchor base Activity - E-mail interaction -E-mail sending.

Unit 4 Debugging and Exception Handling

L-9 Hours

UiPath debugging tools - Input issues - Error catching – Orchestrator- Basics - Features Jobs scheduler - Queues

Unit 5 Project Organization and Final Consideration

L-9 Hours

Project Organization - Best practices - Invoke Command – Examples – Testing and Deployment - Testing the RPA Solution - Deploying an RPA Solution – Final considerations - ROI with RPA - Emerging and Future Trends in RPA

Total: 45 Hours

G. Learning Resources

i. Text Books:

1. Alok Mani Tripathi, “Learning Robotic Process Automation”, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940(1-5 Unit).

ii. Reference books:

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), “Introduction to Robotic Process Automation: a Primer”, Institute of Robotic Process Automation.
2. Richard Murdoch, “Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant”.
3. Srikanth Merianda, “Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation”

iii. Online References:

1. <https://www.uipath.com/rpa/robotic-process-automation>
2. <https://academy.uipath.com/learn/course/external/view/elearning/640/RPADeveloper-ProductionReadyEssentials>
3. https://academy.uipath.com/learn/public/learning_plan/view/35/RPADeveloper



COURSE CODE	COURSE TITLE	L	T	P	C
10212IT110	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

10211IT206- Machine Learning Techniques

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	PSO 3
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- 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: 45 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 Machine Learning, 8(3-4): 231-357, 2015.
3. T. Hastie, R. Tibshirani and M. J. Wainwright, Statistical Learning with Sparsity: the



Lasso and Generalizations, Chapman and Hall/CRC Press, 2015.

iii. Online Resource

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
10212IT113	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 problems

B. Prerequisite Course

10210CS103- 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 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



F. Course Contents

Unit 1 Introduction to Reinforcement Learning

L-9 Hours

Introduction and Basics of RL- Defining RL Framework- Elements and History of RL- Markov Decision Process- Policies, 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-9 Hours

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-9 Hours

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

iv. Text Books:

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

v. Reference books:

4. D.P.Bertsekas, Dynamic Programming and Optimal Control, Vol. I, Athena Scientific, 2017
5. 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.

vi. Online References:

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



COURSE CODE	COURSE TITLE	L	T	P	C
10212IT214	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

10211IT201-Database System Concepts

C. Course Objectives

- Overview and brief history of the practice of data visualization.
- Exposure on principles and techniques for visualizing various types of data.
- Understanding of the fundamentals of communication and alignment around concepts that are required for effective data presentation.
- Overview and develop an introductory level of competency on the use of several available software tools that can be used for data visualization.

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	K2
CO2	Apply various visualization techniques for Exploratory Data Analysis	K3
CO3	Explore visualization techniques Trees, Graphs, Networks, Text and documents	K3
CO4	Utilize various visualization techniques for spatial and Geospatial data	K3
CO5	Make use of different visualization tools for various applications	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

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

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

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 Network 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



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



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
10212IT215	Deep Learning	3	1	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

10211IT206 - 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
CO2	Build and train Convolutional Neural Network (CNN) model for real time applications.	K3
CO3	Use various Convolutional Neural Network architectures for model building.	K3
CO4	Demonstrate Recurrent Neural Networks and LSTM Networks	K3
CO5	Choose the appropriate optimization technique to improve the accuracy of a model.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

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

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

3- High; 2-Medium; 1-Low



F. Course Contents

Unit 1- Data Processing and Deep Learning Framework

L-9+T-3 Hours

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-9+T-3 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+T-3 Hours

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+T-3 Hours

Introduction to Recurrent 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-9+T-3 Hours

Optimization in deep learning – Model Optimization, Non-convex optimization for deep networks- Stochastic Optimization. Generalization in neural networks- Spatial Transformer Networks.

Total: 60 Hours

G. Laboratory Experiments:

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). |
| Task 4 | 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:90 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
10212IT216	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

10211IT117-Data Structures and Algorithms

C. Course Objectives

Student will be able to

- Provide the student with knowledge of various levels of analysis involved in NLP
- Understand the applications of NLP
- Gain knowledge in automated Natural Language Generation and Machine Translation
- Understand Deep learning concepts for NLP.

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Comprehend the fundamental concepts of Natural Language Processing.	K3
CO2	Use the concept of Probabilistic model of defining language and POS tagging for NLP applications	K3
CO3	Develop the Syntactic parser and Semantic Parser for Translation for word forms	K3
CO4	Interpret the concept of text analysis, summarization and extractions for Information Extraction.	K3
CO5	Apply the concepts of machine translation and deep learning for NLTK Modelling.	K3

Knowledge Level (Based on revised Bloom's Taxonomy)

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

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

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	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	3				2	3	2	2
CO5	3	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

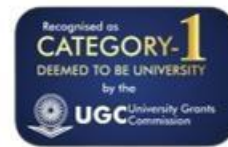
Tools: Python, NLTK, spaCy, Libraries

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 the 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, seaborn**

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

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 Indurkha 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
10212IT218	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

10210CS103- Probability, Statistics and Queuing theory

C. Course Objectives

Learners are exposed to:

- Apply statistical methods to hypotheses testing and inference problems.
- Interpret the results in a way that addresses the question of interest.
- Use data to make evidence-based decisions that are technically sound.

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Apply fundamental statistical modeling techniques to interpret linear regression model	K3
CO2	Perform least square procedure to find the best fit for set of data points	K3
CO3	Build interference in Linear regression to fit a linear equation to observed data	K3
CO4	Analyze the linear regression and predict the data through R studio	K3
CO5	Apply the Regression analysis and investigate the assumptions made about the data and the model	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

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

Cos	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

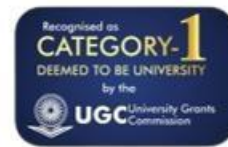
G. Laboratory Experiments

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.

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
10212IT224	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

10211IT206 –Machine Learning Techniques

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
CO2	Use hough transform for line and object detection	K3
CO3	Perform various segmentation techniques on images	K3
CO4	Implement known methods to process 2D images to obtain 3D representations.	K3
CO5	Explore state-of-the-art techniques for digital video processing	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

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

Cos	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

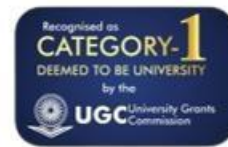
Total : 45 Hours

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
10212IT225	Ethical Hacking	3	0	2		4

A. Preamble

This course enables to provide skills in ethical hacking techniques, methodologies, tools, tricks, and security measures to secure an organization's IT systems. Starting from basics of networking, network security, and cryptography, the course will cover various attacks, vulnerabilities, and ways to secure them. There will be hands-on demonstrations that will implement the security frameworks including preventive and detective controls which be helpful to the students.

B. Prerequisite Courses

10211IT119–Fundamentals of Computer Networks

C. Course Objectives

Learners are exposed to:

- Understand the concepts of ethical hacking with terminologies.
- Familiarize the tools to help competitive intelligence, DNS zone, and port scanning.
- Mitigate enumeration in the system and its vulnerabilities.
- Understand how to hack the server and applications, procure knowledge of attacks, and standards in technology.
- Analyze different attacks, and avalanche analysis viz IDS and NPS.

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Identify and classify attacks and threat vectors	K2
CO2	Execute reconnaissance on a target network using a variety of scanning and probing techniques.	K3
CO3	Explore Microsoft and Linux Operating Systems, Network vulnerabilities.	K3
CO4	Demonstrate various web application vulnerabilities and wireless network attacks.	K3
CO5	Operate cryptography and hashing methods, Intrusion Detection and Prevention System	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		



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

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

3- High; 2-Medium; 1-Low

F. Course Contents

Unit – 1 Ethical Hacking Overview

L-9 Hours

Introduction to Ethical Hacking – Types of hackers – Attack Types, and Vectors – Threat categories – Malicious Software - Protecting against malware attacks – Intruder Attacks – Physical Security

Unit – 2 Reconnaissance and Scanning

L-9 Hours

Introduction to Reconnaissance, Types of Reconnaissance - Footprinting – Web Tools – DNS Zone Transfers – Social Engineering – Port Scanning – Types of Port Scanning – Port Scanning tools – Ping Sweeps – Scripting

Unit – 3 Enumeration

L-9 Hours

Introduction to Enumeration Tools and Techniques – Windows, Unix Operating System – NetBIOS – NetBIOS Null Session, NetBIOS Enumeration Tools– Windows OS Vulnerabilities – Hardening Windows OS- Linux OS Vulnerabilities, Network Vulnerabilities.

Unit – 4 Web Server and Wireless Hacking

L-9 Hours

Understanding Web Application – Web Application vulnerabilities –OWASP - Web Application Injection Attacks - Code injection, SQL injection, cross-site scripting -Tools for Web Attackers and Security Testers – Wireless Technology – Wireless network standard – Authentication – Wardriving – Wireless Hacking

Unit – 5 Cryptography Attacks and Network Protection Systems

L-9Hours

Basics of Cryptography attacks – Brute Force Attacks, Replay Attack, Frequency Analysis and the Ciphertext Only Attack, Network Protection systems: Routers – Firewalls – Intrusion Detection and Prevention System - Honey pots.

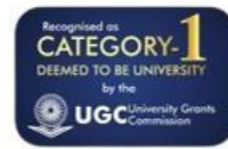
Total: 45 Hours

G. Laboratory Experiments

Total: 30 Hours

Part - 1

Task 1 Installation of VM work station and Kali Linux/Parrot Operating System.



Task 2 Scan and identify the network range, different types of ports available on different networks, and Operating systems used by the target system/network.

Tools: Nmap

Task 3 Test the different web applications on the internet and write about security issues found for each website. Demonstration of man-in-the-middle attack

Tools: Burpsuite

Task4 Perform the vulnerability scan and identify the different types of vulnerabilities present in the network.

Tool: OpenVAS

Task5 Perform a vulnerability Scan, Exploitation, and Hardening on Windows/Linux OS using Shell Script/C/Python Program.

Task6 Perform code injection attacks on any Database and take over it.

Tools: SQL Map

Task7 Gain access to the WIFI router without having a password and modify configurations.

Tools: Aircrack ng, Airtsnort, Ettercap

Task8 Configure Windows and Linux firewalls/Snort and manage user permissions by writing firewall rules.

Tools: Windows firewall, Snort

Task9 Install and Configure IDS system and identify the attacks performed on it. Mitigate the attacks by modifying the rules.

Tools: Snort, Suricata, Sagan

Task10 Configure, Perform, and Detect attacks on Honeypot.

Tools: Cowrie

Part-2

Use Cases:

Use Case 1: On April 11th 2011, at nine in the evening, Barracuda Networks posted a grim entry on their blog. Their network had been hacked. Thousands of their confidential customer and employee records were stolen. In an ironic twist of fate, the company that advocates security through its own Web Application Firewall were victims to the most common and oldest type of attack against web servers. Explain the different tools used by the Hacker. To analyze the effect that different training regimens have on player performance

Use Case 2: A while back, the IT Help Desk received several complaints that one of the employee's computers was sending out spam. They checked it out, and the reports were true: a hacker had installed a program on the computer that made it automatically send out tons of spam email without the computer owner's knowledge. Explain the hacker's technique to get into the computer to set this up.



Use Case 3: Contactless technology was developed by Visa card and Mastercard with the mindset of never sacrificing security for convenience. The cards and devices contain an embedded chip and a radio frequency (RFID) antenna that provide a wireless link with the contactless reader. When the card or device is tapped against the reader, information is transmitted in a highly secure manner within a fraction of a second. Investigate how card payment frauds are occurring in Retail and Online shopping.

H. Learning Resources

i. Text Books:

1. Michael T. Simpson, Kent Backman, James Corley - Hands-On Ethical Hacking and Network Defense, Cengage Learning, Second Edition, 2012 (Unit I-III,V)
2. “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
10212IT244	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
CO2	Use the basics concepts of Illumination and various projection techniques	K3
CO3	Experiment with Illumination model and basic representation of image	K3
CO4	Explore the abstractions of models for specifying complex objects and introduction to Multimedia.	K3
CO5	Illustrate about the types of compression and advanced multimedia environments	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:

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: Bresenham's algorithm, Midpoint line algorithm, DDA algorithm, Circle drawing algorithm: Bresenham'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 Modelling and 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 – image compression - fractal and wavelet compressions - image file types - animation - capture and playback techniques. Multimedia environments, multimedia programming, advanced multimedia 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
TASK 4	Develop a C/C++ program to draw a two-dimensional object and perform translation, rotation, and scaling transformations. Tools: Code Block
TASK 5	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>



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PROGRAM ELECTIVE

Specialization



COURSE CODE	COURSE TITLE	L	T	P	C
10212IT126	Distributed Computing	3	0	0	3

A. Preamble

The purpose of this course is to understand the system models, algorithms and protocols that allow computers to communicate and coordinate their actions to solve a problem. This course helps the learner to understand the distributed computation model and various concepts like global state, termination detection, mutual exclusion, deadlock detection, shared memory, failure recovery, consensus, file system. It helps the learners to develop solutions to problems in distributed computing environment.

B. Prerequisite Course

10211IT103 - Operating Systems

C. Course Objectives

Learners are exposed to:

- Introduce the computation and communication models of distributed systems
- Illustrate the issues of synchronization and collection of information in distributed systems
- Describe distributed mutual exclusion and distributed deadlock detection techniques
- Elucidate agreement protocols and fault tolerance mechanisms in distributed systems
- Explain the cloud computing models and the underlying concepts

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 foundations of distributed systems	K2
CO2	Solve synchronization and state consistency problems	K3
CO3	Use resource sharing techniques in distributed systems	K3
CO4	Apply working model of consensus and reliability of distributed systems	K3
CO5	Explain the fundamentals of cloud computing	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	3	1			2	1	3	3	2	1	1
CO2	1	3	2	1	2			2	2	2	2	1	3	2
CO3	2	2	1	3	3			3	2	1	1	1	2	1
CO4	1	2	2	3	1			3	3	2	1	3	1	1
CO5	3	3	1	2	3			3	3	3	1	3	2	3

3- High; 2-Medium; 1-Low

F. Course Contents

Unit 1 Introduction

L-9 Hours

Introduction: Definition-Relation to Computer System Components – Motivation – Message -Passing Systems versus Shared Memory Systems – Primitives for Distributed Communication – Synchronous versus Asynchronous Executions – Design Issues and Challenges; A Model of Distributed Computations: A Distributed Program – A Model of Distributed Executions – Models of Communication Networks – Global State of a Distributed System.

Unit 2 Logical Time and Global State

L-9 Hours

Logical Time: Physical Clock Synchronization: NTP – A Framework for a System of Logical Clocks – Scalar Time – Vector Time; Message Ordering and Group Communication: Message Ordering Paradigms – Asynchronous Execution with Synchronous Communication – Synchronous Program Order on Asynchronous System – Group Communication – Causal Order – Total Order; Global State and Snapshot Recording Algorithms: Introduction – System Model and Definitions – Snapshot Algorithms for FIFO Channels.

Unit 3 Distributed Mutex and Deadlock

L-9 Hours

Distributed Mutual exclusion Algorithms: Introduction – Preliminaries – Lamport's algorithm – Ricart- Agrawala's Algorithm – Token-Based Algorithms – Suzuki-Kasami's Broadcast Algorithm; Deadlock Detection in Distributed Systems: Introduction – System



Model – Preliminaries – Models of Deadlocks – Chandy-Misra-Haas Algorithm for the AND model and OR Model.

Unit 4 Consensus and Recovery

L-9 Hours

Consensus and Agreement Algorithms: Problem Definition – Overview of Results – Agreement in a Failure-Free System(Synchronous and Asynchronous) – Agreement in Synchronous Systems with Failures; Checkpointing and Rollback Recovery: Introduction – Background and Definitions – Issues in Failure Recovery – Checkpoint-based Recovery – Coordinated Checkpointing Algorithm - Algorithm for Asynchronous Checkpointing and Recovery

Unit 5 Distributed Computing in Cloud

L-9 Hours

Fundamentals of cloud computing and distributed systems – System Models for Distributed Systems and Cloud Computing – Software Environments for Distributed Systems and Clouds – Virtualization and cloud architectures – Distributed algorithms for resource management –Distributed data management in the cloud – Cloud platforms for distributed data storage and analysis – Performance of Distributed Systems and the Cloud – Security challenges in distributed cloud systems

Total: 45 Hours

G.Learning Resources

i. Text Books:

1. Kshemkalyani Ajay D, Mukesh Singhal, “Distributed Computing: Principles, Algorithms and Systems”, Cambridge Press, 2011.
2. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.

i. Reference Books:

1. George Coulouris, Jean Dollimore, Time Kindberg, “Distributed Systems Concepts and Design”, Fifth Edition, Pearson Education, 2012.
2. Pradeep L Sinha, “Distributed Operating Systems: Concepts and Design”, Prentice Hall of India, 2007.
3. Tanenbaum A S, Van Steen M, “Distributed Systems: Principles and Paradigms”, Pearson Education, 2007.
4. Liu M L, “Distributed Computing: Principles and Applications”, Pearson Education, 2004.
5. Nancy A Lynch, “Distributed Algorithms”, Morgan Kaufman Publishers, 2003.



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6. Arshdeep Bagga, Vijay Madiseti, “ Cloud Computing: A Hands-On Approach”, Universities Press, 2014.

ii. Online References:

1. “Distributed Computing Systems” IIT Madras [Online]. Available: <https://nptel.ac.in/courses/106106107/>.
2. “Cloud Computing and Distributed Systems”, IIT Patna [Online]. Available: <https://nptel.ac.in/courses/106104182/> .
3. “Distributed Programming in Java” [Online]. Available: <https://www.coursera.org/learn/distributed-programming-in-java>
4. “Distributed Systems & Cloud Computing with Java” [Online]. Available: <https://www.udemy.com/course/distributed-systems-cloud-computing-with-java/?couponCode=ST19MT121224>



COURSE CODE	COURSE TITLE	L	T	P	C
10212IT127	Network Fundamentals for Cloud	3	0	0	3

A. Preamble

Networking is the backbone of cloud computing, enabling data transfer, connectivity, and resource sharing across distributed systems. It involves essential concepts like IP addressing, VPNs, software-defined networking (SDN), and network virtualization, which are critical for cloud services such as IaaS, PaaS, and SaaS. This unit explores key networking principles, focusing on their role in cloud environments, protocols, security, and emerging technologies, providing the foundation to design, optimize, and troubleshoot cloud networks effectively.

B. Prerequisite Courses

10211IT119- Fundamentals of Computer Networks

C. Course Objectives

Learners are exposed to

- To provide students with a solid understanding of networking principles and protocols required for cloud environments.
- To explore network architectures and technologies essential for cloud computing.
- To understand the role of networking in ensuring scalability, reliability, and performance in cloud systems.
- To develop practical skills in configuring and managing network components in a cloud environment.
- To foster an understanding of emerging trends like edge computing, AI-driven networks, and their applications in cloud systems.

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 foundational concepts of networking and cloud integration, including the role of virtualization and VPCs.	K2
CO2	Analyze various network protocols and their applications in IaaS, PaaS, and SaaS environments for efficient cloud networking.	K4
CO3	Design scalable, reliable, and high-performance network architectures for cloud-based systems using multi-region and multi-AZ strategies.	K3



CO4	Apply security best practices, monitoring tools, and advanced architectures like Zero Trust to protect cloud networks.security.	K3
CO5	Explore emerging trends in cloud networking, such as 5G, IoT, and AI-driven management, and implement hands-on configurations using leading cloud platforms.	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	PSO2	PSO 3
CO1	3	2	1		2									
CO2	3	3		1		1		1					2	
CO3	2	2	3		2	2								2
CO4		2		3	3	1	2							
CO5	3	2			2	2				3			2	

High- 3; Medium-2; Low-1

F.Course Contents

UNIT I Basics of Networking and Cloud Integration

L-9 Hours

Overview of Networking: Layers, OSI Model, and TCP/IP Model- Network Components: Switches, Routers, Firewalls, and Load Balancers- Overview of Software-Defined Networking (SDN)-Role of Virtualization in Networking for Cloud -Introduction to Cloud Networking and Virtual Private Cloud (VPC).

UNIT II Network Protocols and Cloud Networking Essentials

L-9 Hours

Internet Protocols: IPv4, IPv6, ARP, ICMP- Transport Layer Protocols: TCP, UDP- Application Layer Protocols: HTTP, HTTPS, DNS, FTP, SMTP- Networking in IaaS, PaaS, and SaaS- Load Balancing and Autoscaling in Cloud Environments- Cloud Connectivity Options: Direct Connect, VPNs, and Peering.

UNIT III Network Design for Cloud Environments

L-9 Hours

Design Principles for Cloud Networks: Scalability, Reliability, and Performance-Multi-Region and Multi-AZ Networking Strategies-High Availability (HA) and Disaster Recovery (DR) Solutions-Case Study: Designing a Scalable E-commerce Network on AWS/Azure.

UNIT IV Network Security and Monitoring in Cloud

L-9 Hours

Security Best Practices in Cloud Networking-Firewalls, Security Groups, and Network Access Control Lists (NACLs)-Traffic Monitoring and Analysis using CloudWatch, Azure Monitor-



Introduction to Zero Trust Architecture for Cloud Environments- Case Study: Securing a Multi-Region E-commerce Application- Use Case: Implementing Zero Trust Architecture for Remote Workforce.

UNIT V Emerging Trends and Hands-On Implementation

L-9 Hours

Edge Computing - Emerging Trends: 5G, IoT in Cloud Networking, and AI-driven Network Management -Practical Sessions: Configuring a Cloud-Based Network using AWS, Azure, or GCP- Case Study 1: Netflix's Scalable Cloud Network Architecture.

Total: 45 Hours

G.Learning Resources (in IEEE Format)

i. Text Books:

1. William Stallings , “Data and Computer Communications” 10th Edition, Pearson, 2014 ,ISBN: 978-0133506488, ISBN-10: 0133506487.
2. Thomas Erl, “Cloud Computing: Concepts, Technology & Architecture”, Pearson, 2013, ISBN: 978-0133387520.

ii. References

1. Behrouz A. Forouzan, “Data Communications and Networking” 5th Edition, McGraw Hill Education, 2017 ,ISBN: 978-1259064753.
2. David E. Y. Sarna, “Implementing and Developing Cloud Computing Applications”, Auerbach Publications, 2010, ISBN: 978-1-4398-3082-6

iii. Online References:

1. Data and Computer Communications , 2014 [online available] , https://api.pageplace.de/preview/DT0400.9781292014395_A24576961/preview-9781292014395_A24576961.pdf.
2. Cloud Computing , 2013, [online available] ,<https://www.oreilly.com/library/view/cloud-computing-concepts/9780133387568>.



COURSE CODE	COURSE TITLE	L	T	P	C
10212IT129	Cloud Security	2	0	2	3

A. Preamble

This course covers the basic concepts of cloud security along with the impacts and governance in infrastructure, data and systems, which are widely used in the design of cloud environment. The Infrastructure security has been categorized into Network, Host and application levels. The Identity and storage management in cloud along with the internal and external compliance of the cloud service providers. The issues related with multi-tenancy operation, virtualized infrastructure security and methods to improve virtualization security along with its applications along with examples are also dealt with in this course.

B. Prerequisite Courses

- 10211IT119/10211IT108–Fundamentals of Computer Networks/ Computer Networks

C. Course Objectives

Learners are exposed to

- Identify the basic concepts of cloud and its deployments
- Apply the different levels of security in cloud including Network, application and host level
- Utilize security and storage management principles along with the necessity of availability management
- Make use of the concepts of policies and governance associated with cloud and its associated applications
- Utilize the necessity of security as a cloud service and hypervisors

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Identify the basic concept of cloud computing.	K3
CO2	Apply the infrastructure security and data security in cloud	K3
CO3	Identify the concepts of security and storage management in cloud	K3
CO4	Make use of concepts about privacy, audit and compliance in cloud	K3
CO5	Utilize the security-as-a-cloud service and Hypervisor Risks-VM.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of Cos with Program Outcomes and Programme Specific Outcomes



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

High- 3; Medium-2; Low-1

F.Course Contents

UNIT I Cloud Computing fundamenta

L-6

Hours

Cloud Computing: SPI Framework for Cloud Computing - Traditional Software Model - Cloud Services Delivery Model - Cloud Deployment Models – Virtual Private Cloud - Key Drivers to Adopting the Cloud- Impact of Cloud Computing on Users - Governance in the Cloud.

UNIT II Infrastructure security at Network, Host and application level

L- 6Hours

Infrastructure Security: Web application security – Web attacks - The Network Level: Ensuring Data Confidentiality, Integrity and availability – Amazon RDS - Network-Level Mitigation: SaaS and PaaS Host Security. Host Level: Virtualization Software Security- Threats to the hypervisor - Virtual Server Security: The Application Level: Application Security features and requirements - DoS and EDoS - End User Security – PortSwigger

UNIT III Security and Storage Mangement in Cloud

L-6 Hours

Security issues: Unauthorized exposure – Data leakage - Security Management Standards Security Management in the Cloud – Identity and access management - Cloud Security Vulnerability - Patch and Configuration Management – Key Management in cloud - Availability Management: SaaS, PaaS, IaaS - Storage as a Service (STaaS) – Amazon EBS and S3

UNIT IV Privacy, Audit and Compliance

L- 6 Hours

Privacy: Data Life Cycle-Key Privacy Concerns- Responsible for Protecting Privacy-Changes to Privacy Risk Management and Compliance -Legal and Regulatory Implication-U.S. Laws and Regulations - International Laws and Regulations. Audit and compliance: Internal Policy Compliance -Governance, Risk, and Compliance - Control Objectives for Cloud Computing Cloud Security Alliance -Auditing the Cloud for Compliance

UNIT V Security-as-a-cloud-service

L-6 Hours

Security-as-a-[cloud] service: Origins -Email Filtering - Web Content Filtering - Vulnerability Management- Identity Management-As-a-Service-Impact of cloud computing in corporate-Security policy implementation and Types- Hypervisor Risks-VM Security Recommendations.



Total: 30 Hours

G.Laboratory Experiments

Part 1

Task 1: Install the Oracle VM Virtual box hosted hypervisor and mount an open virtual appliance School of Computing Department of Computer Science & Engineering file over the existing operating system. Tools: Oracle VM

Task 2: Import Kali Linux and mount the instance in the Oracle VM virtual box for implementing SQL map to detect SQL based vulnerabilities in web application. Tools: Oracle VM, Kali Linux

Task 3: Perform the security testing of web applications to identify its attack vectors, using burp suite package imported through kali Linux in Virtual machine. Tools: Oracle VM, Kali Linux

Task 4: Perform a 2FA (two factor authentication) bypass using a brute force attack mechanism using portswigger tool by burpsuite. Tools: Portswigger, Burpsuite

Task 5: Perform a Forced Open authentication profile linking by implementing CSRF attack using Portswigger tool by burpsuite. Tools: Portswigger, Burpsuite

Task 6: Implement URL based and Method based access control in the portswigger tool to circumvent the access control process. Tools: Portswigger, Burpsuite

Task 7: Build a Virtual private cloud in amazon web services environment and launch a web server in the sandbox module of AWS. Tools: Amazon web services

Task 8: Launch an Elastic cloud 2 instance in the amazon web service environment, and manage the instance by modifying the security group, resizing the instance and termination protection processes. Tools: Amazon web services

Task 9: Establish an Amazon EBS volume, attach it to an instance, apply a file system to the volume, and then take a snapshot back up in the sandboxed AWS environment. Tools: Amazon web services

Task 10: Launch an Amazon relational database service and configure the database instance to get interacted with a web application ensuring high availability. Tools: Amazon web services

Total: 30 Hours

G.Learning Resources (in IEEE Format)

i. Text Books:

1. Tim Mather, Subra Kumaraswamy, Shahed Latif, “Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance” O'Reilly Media; 1 edition [ISBN: 0596802765], 2009.



ii. Reference Books:

2. Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, 201

iii. Online References:

3. Bob Dill, David Smits. (2022, Nov.) [Online]. Available: <https://www.ibm.com/en/cloud/security> [Accessed on 25.11.22]
4. Rana Khalil, Michael Sommer (2023, May) Port Swigger[Online]. Available: <https://portswigger.net/web-security/sql-injection/lab-login-bypass> [Accessed on 18.5.23]



COURSE CODE	COURSE TITLE	L	T	P	C
10212IT130	Cloud Infrastructure and Services	3	0	2	4

A. Preamble

The course on Cloud Infrastructure and Services introduces students to the core concepts, components, and technologies that power modern cloud environments. It covers the architecture of cloud infrastructures, including compute, storage, and networking components, as well as the different service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid). Students will also gain practical experience with leading cloud platforms like AWS, Azure, and Google Cloud. Key topics such as cloud security, cost optimization, automation tools, and emerging trends like AI and IoT in the cloud are also explored. This course prepares students to design, implement, and manage cloud infrastructure solutions in real-world scenarios.

B. Prerequisite Course

10212IT128 Cloud Computing: Tools and Techniques

C. Course Objectives

Learners are exposed to:

- Understand the basic principles, definitions, and history of cloud computing, including various service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid, community).
- Exposure to the essential building blocks of cloud infrastructure.
- Exploration of leading cloud service providers like AWS, Microsoft Azure, focusing on their services, features, and differences in offering cloud solutions.
- Cloud Security Principles and Best Practices:

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Understanding of the fundamental concepts of cloud computing.	K3
CO2	Analyze the architecture of cloud computing and explain the role of its key components, including compute resources.	K2
CO3	Use the services and platforms offered by leading cloud providers (AWS, Azure, Google Cloud, etc.)	K2



CO4	Develop a comprehensive understanding of advanced cloud concepts while applying and analyzing their practical implications in cloud ecosystems.	K3
CO5	Apply advanced cloud computing concepts while addressing real-world challenges and future trends.	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					2		2		2		2
CO2		3	3	2	3		3	3	3		3	3	3	3
CO3	3	3		2			2	2	2	2	2	2	2	2
CO4	2	2								2				
CO5	2		2	3		2	2			2	2			

High- 3; Medium-2; Low-1

F. Course Contents

Unit 1: Cloud Computing

L-9 Hours

Definition and Evolution: Overview of cloud computing, historical development, and key characteristics, Cloud Service Models-Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Deployment Models- Public, Private, Hybrid, and Community clouds,



Benefits, Challenges and Risks.

Unit 2: Cloud Infrastructure Components

L-9 Hours

Cloud Computing Architecture, and role in cloud computing. Compute Resources-Virtual machines, containers, and serverless computing, Storage Services-Object, block, and file storage in the cloud, Networking in the Cloud- Virtual private networks (VPNs), load balancing, and content delivery networks (CDNs), Management and Monitoring- Cloud management platforms and monitoring tools.

Unit 3: Cloud Services and Platforms

L-9 Hours

Overview of Leading Cloud Providers-AWS, Azure, Google Cloud, and others, Compute Services-EC2, Lambda, App Engine, Aneka—Integration of Private and Public Clouds, etc, Storage Services-S3, Google Cloud Storage, Azure Blob Storage, Database Services-Relational, NoSQL, and serverless databases in the cloud, Cloud Security- Identity and access management (IAM), encryption, and compliance.

Unit 4: Cloud Concepts

L-9 Hours

Cloud Automation and Orchestration- Tools like Kubernetes, Terraform, and Ansible, DevOps in the Cloud- Continuous Integration/Continuous Deployment (CI/CD) and infrastructure as code (IaC), High Availability and Fault Tolerance -Concepts and implementation strategies, Edge Computing- Role and integration with cloud services, Emerging Technologies- AI, IoT, and Blockchain in the cloud

Unit 5: Cloud Security and Future Trends

L-9 Hours

Open Source and Commercial Clouds, Cloud Simulator, Research trend in Cloud Computing, Fog Computing, Case Studies: Real-world implementations of cloud infrastructure in various industries.

Cost Optimization-Strategies for efficient use of cloud resources. Ethical and Legal Aspects-Data privacy, sovereignty, and compliance, Future of Cloud Computing-Quantum computing, green cloud, and evolving architectures, Hands-on implementation or simulation of a cloud solution.

Total: 45 Hours

G. Laboratory Experiments

Total: 30 Hours

Task 1: Virtual Machine Creation and Configuration

Objective: Create a virtual machine (VM) on a public cloud platform (e.g., AWS, Azure, GCP) and configure it with specific operating systems and software applications.

Tools: AWS EC2, Azure Virtual Machines, Google Compute Engine.

Task 2: Setting Up a Cloud Database



Objective: Launch a cloud-based relational database (e.g., AWS RDS or Azure SQL Database) and perform CRUD (Create, Read, Update, Delete) operations using a sample application.

Tools: AWS RDS, Azure SQL Database, Cloud SQL (GCP).

Task 3: Implementing Load Balancing

Objective: Deploy multiple instances of an application and configure a load balancer to distribute traffic effectively across the instances.

Tools: AWS Elastic Load Balancing, Azure Load Balancer, GCP Cloud Load Balancing.

Task 4: Deploying a Serverless Application

Objective: Create a serverless application using AWS Lambda or Azure Functions, and integrate it with an API Gateway.

Tools: AWS Lambda, Azure Functions, API Gateway.

Task 5: Container Orchestration with Kubernetes

Objective: Set up a Kubernetes cluster on a cloud provider and deploy a multi-container application.

Tools: Google Kubernetes Engine (GKE), AWS EKS, Azure Kubernetes Service (AKS).

Task 6: Implementing Cloud Storage Solutions

Objective: Use cloud storage services to upload, retrieve, and manage files. Experiment with different storage classes and their cost implications.

Tools: AWS S3, Azure Blob Storage, Google Cloud Storage.

Task 7: Building a CI/CD Pipeline in the Cloud

Objective: Set up a Continuous Integration/Continuous Deployment (CI/CD) pipeline using cloud services to automate the application deployment process.

Tools: AWS Code Pipeline, Azure DevOps, Google Cloud Build.

Task 8: Setting Up a Virtual Private Network (VPN)

Objective: Create a secure VPN connection to the cloud environment and access resources privately.

Tools: AWS VPN, Azure VPN Gateway, Google Cloud VPN.

Task 9: Exploring Cloud Monitoring and Logging

Objective: Set up monitoring and logging for cloud resources using native tools, and create alerts for resource utilization metrics.

Tools: Amazon CloudWatch, Azure Monitor, Google Cloud Operations.



Task 10: Disaster Recovery and Backup Solutions

Objective: Implement a disaster recovery strategy using cloud services to back up data and simulate recovery.

Tools: AWS Backup, Azure Site Recovery, GCP Backup and DR.

Task 11: Creating a Dynamic Web Application using PaaS

Objective: Develop a dynamic web application using a Platform as a Service (PaaS) solution and deploy it to the cloud.

Tools: Heroku, Google App Engine, AWS Elastic Beanstalk.

Task: 12 Implementing Identity and Access Management (IAM)

Objective: Configure user roles and permissions for cloud resources using IAM features in a cloud environment.

Tools: AWS IAM, Azure Active Directory, Google Cloud IAM.

H. Learning Resources

1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski “Cloud Computing: Principles and Paradigms”, Wiley, 2011.
2. Gautam Shroff, “Enterprise Cloud Computing - Technology, Architecture, Applications” Cambridge University Press, 2010.
3. Barrie Sosinsky “Cloud Computing Bible”, Wiley-India, 2010
4. Ronald L. Krutz, Russell Dean Vines, “Cloud Security: A Comprehensive Guide to Secure Cloud Computing”, Wiley- India, 2010.



COURSE CODE	COURSE TITLE	L	T	P	C
10212IT131	IoT Deployment in Cloud	3	0	2	4

I. Preamble

This course provides a comprehensive introduction to the integration of Cloud Architectures with Internet of Things (IoT) systems. It covers key concepts in both fields, including cloud computing service models (IaaS, PaaS, SaaS) and their applications in IoT environments. Students will learn how to design scalable and secure IoT systems, utilizing cloud platforms for efficient data processing, storage, and real-time analytics. The course emphasizes cloud IoT architectures, data flow management, and the role of edge computing in optimizing IoT deployments. By the end of the course, students will be able to leverage cloud technologies to build robust, secure, and scalable IoT solutions.

J. Prerequisite Course:

10211IT119 - Fundamentals of Computer Networks

K. Course Objectives

Students are able to

- To understand IoT-Cloud integration, enabling effective storage, processing, and analysis of IoT data.
- To design scalable cloud architectures for secure and efficient IoT solutions.
- To implement cloud services using platforms like AWS IoT, Azure IoT Hub, Google IoT Core.
- To explore edge and serverless computing for enhanced IoT-cloud collaboration.
- To deploy and manage IoT applications in real-world cloud environments effectively.

L. Course Outcomes:

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

CO Nos.	Course Outcomes	K-Level
CO1	Understand cloud computing and its role in IoT, including deployment models and platforms.	K2
CO2	Design secure and scalable IoT cloud architectures using microservices, serverless, and edge computing.	K2



CO3	Utilize cloud services for IoT data management, focusing on storage, processing, and real-time analytics with security.	K2
CO4	Deploy, monitor, and manage IoT applications in the cloud, optimizing scalability and performance with CI/CD and edge computing.	K3
CO5	Address security, privacy, and compliance challenges in IoT cloud deployments, ensuring data protection and regulatory adherence.	K2

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

M. 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	2	
CO2	3	3											1	
CO3				1	3						3	3		2
CO4			2						3			2		
CO5	2		1	1		3	2						2	3

3- High; 2-Medium; 1-Low

N. Course Contents

Unit 1 Introduction to Cloud Computing in IoT

L-9 Hours

Cloud Computing: Characteristics, Service Models, Cloud Deployment Models: Public, Private, Hybrid, and Community Clouds, Cloud IoT Integration: Role of Cloud in IoT, Benefits of Cloud for IoT Systems, Cloud Platforms for IoT: Overview of AWS IoT, Azure IoT Hub, Google IoT Core, Cloud Data Flow in IoT: Data Collection, Transmission, and Storage in Cloud, Real-Time vs Batch Processing

Unit 2 Cloud Architecture for IoT

L-9 Hours

Cloud architecture, cloud layers, and IoT integration, Designing Scalable Cloud Solutions for IoT: Approaches for scalability, handling large volumes of data, and managing multiple devices, Introduction to microservices, benefits in IoT cloud deployment, Concept of serverless computing, use cases in IoT applications, Role of edge devices, edge-cloud collaboration for faster data processing, Security Architecture in Cloud for IoT: Ensuring data privacy, secure communication, and device authentication in IoT cloud deployments



Unit 3 Cloud Services and IoT Data Management

L-9 Hours

Cloud services in IoT, Types of cloud storage in IoT data management, Techniques for processing large IoT datasets - batch processing - stream processing, Tools and platforms for real-time analysis of IoT data - AWS Lambda - Azure Stream Analytics, Cloud-Based IoT Device Management: Managing device lifecycle, firmware updates, Data Security and Privacy in Cloud for IoT: Security mechanisms - encryption, access control - Integrating IoT with Cloud Machine Learning using cloud-based machine learning services

Unit 4 Deployment and Management of IoT Applications in the Cloud

L-9 Hours

Deploying IoT applications in the cloud architecture considerations, Cloud-Based IoT Deployment Models: Device-to-cloud, cloud-to-device, CI/CD for IoT Applications: Continuous integration and continuous deployment processes for IoT applications in the cloud, Monitoring and Managing IoT Applications: Tools and strategies for monitoring IoT devices, networks, and applications in the cloud, Techniques for auto-scaling IoT applications based on device data volume and user demand, Leveraging edge computing for optimized cloud deployments and reducing latency

Unit 5 Security, Privacy, and Compliance in Cloud IoT Deployments

L-9 Hours

Security challenges in IoT cloud environments, device authentication, identity management, access control, Techniques for securing data transmission between IoT devices and the cloud using TLS- SSL, Addressing data privacy issues, regulations - GDPR in IoT applications, Implementing cloud security measures - firewalls, intrusion detection systems, security monitoring tools, Understanding industry standards and regulations -ISO/IEC 27001, HIPAA for IoT deployment, Strategies for handling security breaches, data loss, and disaster recovery in IoT cloud environments.

Total: 45 Hours

O. Laboratory Experiments

Part-I

Total : 30 Hours

Task 1

Set up an IoT device (simulated using MQTT client) and connect it to AWS IoT Core.

Tools: AWS Free Tier, MQTT.fx, Python, AWS IoT Core



- Task 2** Implement a simple example comparing real-time and batch processing for IoT data.
- Tools: AWS IoT Core, AWS Lambda, Python**
- Task 3** Create a simple virtual machine in a public cloud and upload IoT data to the cloud.
- Tools: Google Cloud, AWS, Microsoft Azure**
- Task 4** Design a scalable cloud architecture that supports multiple IoT devices for data collection.
- Tools: AWS IoT Core, Python**
- Task 5** Set up a simple microservices-based system for managing IoT data.
- Tools: Docker, Kubernetes, AWS or Google Cloud**
- Task 6** Set up an edge device (e.g., Raspberry Pi) to process data locally and send results to the cloud.
- Tools: Raspberry Pi, AWS Greengrass, Python**
- Task 7** Store IoT data in the cloud and retrieve it using a cloud storage service.
- Tools: AWS S3, Microsoft Azure Blob Storage, Python**
- Task 8** Use AWS Lambda to process IoT data in real-time.
- Tools: AWS Lambda, AWS IoT Core, Python**
- Task 9** Implement encryption and secure communication for IoT data in transit.
- Tools: AWS IoT Core, TLS/SSL, Python**
- Task 10** Deploy a simple IoT application to AWS IoT Core and monitor the data flow.
- Tools: AWS IoT Core, Python**
- Task 11** Implement a basic CI/CD pipeline for an IoT application.
- Tools: GitHub, Jenkins, AWS IoT Core**
- Task 12** Secure IoT devices with proper authentication and access control.
- Tools: AWS IoT Core, Python, X.509 certificates**
- Task 13** Secure communication between IoT devices and the cloud using TLS/SSL.



Tools: OpenSSL, AWS IoT Core, MQTT

Part-II

Use Cases:

1. Smart Agriculture
2. Smart Manufacturing (Industrial IoT)
3. IoT in E-health Monitoring
4. Smart Grids for Energy Management
5. Autonomous Vehicles

P. Learning Resources

iii. Text Books:

1. Thomas, Erl, Mahmood Zaigham, and Puttini Ricardo. "Cloud computing concepts, technology & architecture." (2013), ISBN-13: 978-0-13-338752-0.
2. Vermesan, Ovidiu, and Peter Friess. Internet of things applications-from research and innovation to market deployment. Taylor & Francis, 2014, ISBN:9781032707167.

iv. Reference Books:

3. Bahga, Arshdeep. "Internet of Things: A Hands-On Approach." Bahga & Madisetti (2014), ISBN:978-8173719547.
4. Kavis, Michael. Architecting the cloud: design decisions for cloud computing service models (SaaS, PaaS, and IaaS). John Wiley & Sons, Inc., Hoboken, New Jersey, 2014, ISBN: 978-1118617618.
5. Gillam, Lee. Cloud Computing: Principles, Systems and Applications. springer, 2010, ISBN: 978-1-84996-241-4
6. Dr. Raj Kamal, INTERNET OF THINGS Architecture and Design Principles, McGraw Hill Education (India) Private Limited, ISBN: 978-93-5260-522-4.
7. Rajkumar Buyya, New Frontiers in Cloud Computing and Internet of Things, Springer, ISBN: 978-3031055300.
8. Mather, Tim. "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance." (2009), ISBN:978-0596802769.

iv. Online Resources:

7. IoT (Internet of Things) Wireless & Cloud Computing Emerging Technologies, Accessed on: December, 2024 [Online]. Available: [IoT \(Internet of Things\) Wireless & Cloud Computing Emerging Technologies | Coursera](#)
8. IoT Devices Architecture, Accessed on: December, 2024 [Online]. Available: [Introduction to Architecting Smart IoT Devices | Coursera](#)



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



9. NPTEL, Foundation of Cloud IoT Edge ML, Accessed on: December, 2024 [Online]
Available: [Foundation of Cloud IoT Edge ML - Course](#)
10. AWS IoT Documentation, Accessed on: December, 2024 [Online] Available: [AWS IoT Core Documentation](#)
11. Microsoft Azure IoT Hub Documentation: Accessed on: December, 2024 [Online]
Available: [Azure IoT Hub Documentation | Microsoft Learn](#)



COURSE CODE	COURSE TITLE	L	T	P	C
10212IT251	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

10211IT119/10211IT108–Fundamentals of Computer Networks/ 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 Hyper-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
CO2	Identify the various avenues of Virtualization and their Applications along with the different levels of implementation	K3
CO3	Examine the Hardware support for virtualization – hypervisors and outcomes of virtualized Data centers	K3
CO4	Construct and manage virtualized infrastructure using popular virtualization platforms.	K3
CO5	Organize the techniques to address security concerns in virtualized environments:	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				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 Install VMWare 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 Pro OS & 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 points in 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:



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



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
10212IT252	Windows Client Administration Operating System	2	0	2	3

A. Preamble

This course aims to equip students with a thorough comprehensive understanding of the Windows operating system and its key features. By means of a blend of theoretical lectures, practical exercises, and assignments, students will become proficient in navigating the Windows interface, managing files and folders, personalizing system settings, and resolving common problems. Upon completion of this course, students will be able to gain valuable technical skills, career opportunities, practical experience, certification preparation, and problem-solving skills students will have acquired the skills and expertise to utilize Windows proficiently, both in personal and professional settings.

B. Prerequisite Courses

- 10211IT119/10211IT108–Fundamentals of Computer Networks/ Computer Networks
- 10211IT120/ 10211IT108- Operating Systems Concepts/ Operating system

C. Course Objectives

Learners are exposed to

- Navigating the Windows user interface and Managing files and folders, including creating, renaming, moving, and deleting files and folders.
- Managing network connections, including configuring and troubleshooting network settings.
- Implementing security measures, including user authentication, password policies, and firewalls
- Troubleshooting hardware issues, including diagnosing and replacing faulty hardware components.

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Create and manage user accounts in Windows, including creating new accounts, modifying account settings, and managing user privileges.	K3
CO2	Manage disk storage in Windows, including creating and formatting partitions, extending or shrinking volumes, and managing disk quotas.	K3
CO3	Configure network settings in client operating systems, including IP addressing, subnetting, and DNS configuration.	K3
CO4	Configure and manage user accounts and permissions to enforce access control and minimize security risks.	K3
CO5	Develop skills in troubleshooting network connectivity and communication issues.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of Cos with Program Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	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)

iv. Text Books:

- [1] E. Bott and C. Siechert, "Windows 10 Inside Out," 3rd ed. Redmond, WA, USA: Microsoft Press, 2019.

v. 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.

vi. 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
10212IT253	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 monitoring the performance of servers at all times. By the end of this course, students will have developed the skills and knowledge necessary to use Windows effectively in a variety of personal and professional contexts.

B. Prerequisite Courses

- 10211IT119/10211IT108–Fundamentals of Computer Networks/ Computer Networks
- 10211IT120/ 10211IT108- Operating Systems Concepts/ Operating system

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	Understand the configuration and management of the Windows server administration and power shell.	K2
CO2	Apply Domain Control technique to store and manage the objects using AD DS and TCP/IP on window server.	K3
CO3	Demonstrate with Filter, Restore, Backup and Common issues in windows server using DHCP DORA and DNS Server.	K2
CO4	Implementation of group policy, files, print server, troubleshooting and also classify data using FSRM.	K3
CO5	Use IIS and WDS to deploy and manage web application and network based installation through windows server and backup.	K3
Knowledge Level (Based on revised Bloom's Taxonomy)		



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

E. Correlation of Cos with Program Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	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 and DHCP

6 Hours

DHCP DORA Process, Configuring Scopes Reservation and Exclusion. Overview of DHCP Configuration files, DHCP Filters, DHCP Backup and restore, Common Issues in DHCP Server. Introduction to DNS, Name Resolution Methods- Hierarchy - Records. DNS Working and Query Process. Common issues in DNS Server

Unit 4 Implementing Group Policy, File and Print Services

6 Hours

Introducing Group Policy, Implementing and administering GPOs, Scope and Group Policy processing (LSDOU), Troubleshooting the application of GPOs, Implementing administrative templates, Configuring Folder Redirection, Software installation, and scripts Configuring Group Policy preferences. Overview of FSRM, Using FSRM to Manage Quotas, File Screens and Storage Reports. Overview of DFS and DFS Replication

Unit 5 IIS, WDS and WDUS

6 Hours

Overview of IIS and Components, Overview of WDS, WDS Server Roles, WDS Multicasting, PXE booting, Windows Images, Overview Of Patch management Process, Data Protection Overview, Implementing Windows Server Backup.

Total: 30 Hours



G. Laboratory Experiments

- Task 1.** Add\remove 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)

vii. 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)

viii. 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)

ix. 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
10212IT254	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

10211IT119/10211IT108–Fundamentals of Computer Networks/ 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
CO2	Construct Architectural components of Azure	K2
CO3	Experiment with Storage and Deployment tools in Microsoft Azure to design Cloud applications	K3
CO4	Apply the concepts of Windows Azure to create and manage virtual machines	K3
CO5	Develop services using various Cloud computing programming models with Azure.	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	P O1	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									
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



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 Subscription, 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 Subscription, 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 Subscription, Azure Portal, SQL SSMS, DMA

Task 4 Create an Azure Storage Account and Provisioning Azure Storage services.

Tools: Azure Subscription, 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 Subscription, 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 Subscription, 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 Subscription, 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 Subscription, 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 Subscription, Azure Portal, Azure Active Directory(AD), Azure RBAC

Task 10 Create a web based Campus Events Calendar application using Microsoft Azure.

Tools: Azure Subscription, 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 Subscription, 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 Subscription, 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.

G. Learning Resources

Total: 60 Hours

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, Rahul Rai, “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](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
10212IT256	Office 365 Administration	2	0	2	3

A. Preamble

This course focuses on the administration, configuration, troubleshooting and operations of the Microsoft Office 365 platform. It also make us to learn how to adjust user and subscription settings, configure Exchange mailboxes and groups, set up SharePoint sites, manage Microsoft Teams, and perform advanced configurations, such as multifactor authentication and PowerShell scripting.

B. Prerequisite Courses

- 10212I253 - 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 AccessControl (RBAC)	K3
CO2	Analyze and identify gaps in current Microsoft 365 security posture using Secure Score.	K3
CO3	Compute Advanced Threat Analytics and learn to identify attacks using attack simulator in Microsoft 365.	K3
CO4	Manage and configure devices with MDM and domains for MDM.	K3
CO5	Create useful retention tags and retention policy.	K3
Knowledge Level (Based on revised Bloom's Taxonomy) K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create		

E. Correlation of Cos with Program Outcomes and Programme Specific Outcomes



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

UNIT I User and Group Protection

L-6

User and Group Protection: Identity and Access Management Concepts-Zero Trust Security- User Accounts -Administrator Roles and Security Groups - Password Management in Microsoft 365-**Identity Synchronization:**Azure AD Connect-Planning- Implementation- Identity Protection -Managing Synchronized Identities - Federated Identities-**Access Management:**Conditional access-Manage device access-Role Based Access Control (RBAC)- Solutions for external access.

UNIT II Security in Microsoft 365

L-6

Threat vectors and data breaches-Security strategy, principles and solutions -Microsoft Secure Score.**Advanced Threat Protection:**Exchange Online Protection- Azure -Microsoft Defender- Advanced Office365 Threat Protection-Manage Safe Attachments and Links-**Threat Management:**Threat investigation and response-Azure Sentinel.

UNIT III Mobility and Information Protection

L-6

Mobility: Plan for Mobile Application Management-**Mobile Device Management:**Plan, Deploy and Enroll Devices -**Information Protection:** Concepts - Azure protection-Advance Windows Information Protection.

UNIT IV Rights Management and Encryption

L- 6

Rights Management and Encryption: Information Rights Management- S/MIME-Office 365 Message Encryption, **Data Loss Prevention:** An Overview- Create and Customize Policies- Policy Tips, **Cloud Application Security:** An Overview.

UNIT V Compliance in Microsoft

L-6

Compliance in Microsoft 365: Plan for compliance requirements- Build ethical walls in Exchange Online-Manage Retention in Email-Troubleshoot Data Governance, **Archiving and Retention:** Archive-Retention and its policies -In-place Records Management in SharePoint-**Content Search and Investigation-** Overview-Audit Log Investigations-Advanced eDiscovery.

Total: 30 Hours

3. Laboratory Experiments

TASK 1 To Discover and Manage Azure Resources to create, update, and delete resources in your Azure account.



- Assign Directory Roles
 - Activate and Deactivate PIM Roles
 - Directory Roles (General)
 - PIM Resource Workflows
 - View audit history for Azure AD roles in PIM.
- TASK 2** Use Conditional Access to enable MFA to make the right decisions as well as to enforce effective organizational policies.
- MFA Authentication Pilot (require MFA for specific apps)
 - MFA Conditional Access (complete an MFA roll out)
- TASK 3** Use Microsoft Secure Score to measure an organization's security posture, with a higher number indicating more recommended actions taken.
- Improve your secure score in the Microsoft 365 Security Center.
- TASK 4** Manage Microsoft 365 Security Services to assist organizations to detect threats early and help minimize the impact of a breach.
- Implement ATP Policies.
- TASK 5** Using Attack Simulator
- Conduct a simulated Spear phishing attack to recognize and respond to these types of cyber threats.
 - Conduct simulated password attacks to assess the security posture of an organization's user accounts and identify potential vulnerabilities.
- TASK 6** Configure Azure AD for Intune to establish a secure and streamlined environment for managing and protecting devices, applications, and data within an organization.
- Enable Device Management to manage and secure the devices used by the employees to access O365 resources.
 - Create Intune Policies to manage and protect corporate data, applications, and resources on various types of devices, including Windows, iOS, Android, and macOS.
- TASK 7** Implement Azure Information Protection and Windows Information Protection
- Implement Azure Information Protection to enhance data protection and control by classifying, labeling, and protecting sensitive information in an organization
 - Implement Windows Information Protection to protect sensitive data on Windows devices by applying security controls and preventing data leakage or unauthorized access.
- TASK 8** Configure Advanced Threat Analytics to detect and prevent attacks.
- TASK 9** Configure Office 365 Message Encryption to protect sensitive information in emails and other communications by encrypting them and ensuring that only authorized recipients can access them.
- Validate Information Rights Management
- TASK 10** Implement Data Loss Prevention policies to protect an organization's sensitive and confidential data from being disclosed or lost.
- Manage DLP Policies
 - Test MRM and DLP Policies



- TASK 11** Compliance and Retention to ensure that an organization's data is managed, retained, and disposed of in a compliant and secure manner.
- Initialize Compliance
 - Configure retention tags and policies
- TASK 12** Manage Search and Investigation to ensure that an organization is in compliance with data protection regulations and to fulfill the rights of data subjects.
- Investigate your Microsoft 365 Data
 - Conduct a Data Subject Request

Part-2

Use cases:

1. Initialize your trial tenant: Set up your Microsoft 365 tenant

An IT administrator for a small company has decided to migrate their email, document management, and collaboration tools to Microsoft 365. The goal is to set up the Microsoft 365 tenant to ensure that all users have access to the tools they need and can work together seamlessly.

Technologies used: Microsoft 365 Admin Center, Azure Active Directory (AD), Exchange Online, SharePoint Online.

2. Configure Privileged Identity Management

A large organization uses Azure for their cloud infrastructure management. The security administrator has given goal to configure PIM to manage privileged access to Azure resources, assign directory roles, activate and deactivate PIM roles, and view audit history for Azure AD roles in PIM.

Technologies used: Azure Active Directory (Azure AD), Azure AD Privileged Identity Management (PIM), Microsoft Cloud App Security, Azure Security Center, Azure Sentinel.

3. Set up your organization for identity synchronization

A medium-sized organization uses both the on-premises Active Directory (AD) and Microsoft 365 cloud services. The goal is to set up identity synchronization between on-premises AD and Microsoft 365 to ensure that users can access all necessary resources with a single set of credentials.

Technologies used: Azure Active Directory Connect, Active Directory Federation Services (AD FS), Azure Active Directory Domain Services (Azure AD DS), Microsoft Identity Manager (MIM), Azure AD Connect Health.

4. Use Conditional Access to enable MFA-MFA Authentication Pilot (require MFA for specific apps) and MFA Conditional Access (complete an MFA roll out).



A large organization that uses Microsoft 365 for their cloud services wants to improve its security posture by enabling multi-factor authentication (MFA) for all users accessing Microsoft 365, but wants to do so in a phased approach.

Technologies used: Azure Active Directory (Azure AD), Azure AD Identity Protection, Microsoft Endpoint Manager.

5. Improve your secure score in the Microsoft 365 Security Center

John is the IT manager for a medium-sized company that uses Microsoft 365 for its email, document management, and collaboration needs. He has been tasked by the company's CEO to ensure that their Microsoft 365 environment is secure and compliant with industry regulations.

Technologies used: Microsoft Defender for Endpoint, Azure Active Directory (Azure AD), Microsoft Cloud App Security, Microsoft Secure Score, Microsoft Compliance Manager.

6. Manage Microsoft 365 Security Services - Implement ATP Policies.

A large organization that uses Microsoft 365 for their cloud services wants to improve its security posture by managing Microsoft 365 security services and implementing ATP policies.

Technologies used: Microsoft 365 Defender, Microsoft Azure Security Center, Microsoft Intune, Azure Active Directory (Azure AD), Microsoft Cloud App Security.

7. Conduct a simulated Spear phishing attack and Conduct simulated password attacks Using Attack Simulator

XYZ Corporation is a large multinational company with a workforce of over 10,000 employees. The company has experienced several cybersecurity breaches in the past, which have resulted in the loss of sensitive data and intellectual property. To improve its cybersecurity defenses, the company has decided to use Attack Simulator to conduct simulated spear phishing and password attacks.

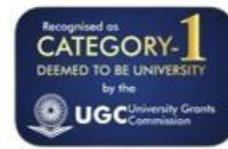
Technologies used: Microsoft Defender for Office 365, Exchange Online Protection (EOP), Azure Active Directory (Azure AD), Multi-Factor Authentication (MFA), Attack Simulator.

8. Azure AD for Intune to Enable Device Management and Create Policies

ABC Corp is a large enterprise organization with a diverse mobile workforce. The organization has recently implemented a new mobile device management solution, Microsoft Intune, to help manage its mobile devices and protect sensitive company data.

Technologies used: Azure Active Directory (Azure AD), Microsoft Intune, Microsoft Endpoint Manager, Group Policy, PowerShell.

9. Implementing Azure Information Protection and Windows Information Protection



XYZ Corp is a medium-sized organization that handles sensitive customer data, financial information, and intellectual property. To ensure the security and confidentiality of this data, XYZ Corp has decided to implement Azure Information Protection (AIP) and Windows Information Protection (WIP).

Technologies used: Azure Information Protection, Microsoft 365 E5 or Enterprise Mobility + Security (EMS) E5, Windows 10, Active Directory Rights Management Services (AD RMS), PowerShell.

10. Configure Office 365 Message Encryption and Validate Information Rights Management

LMN Corp is a large organization that deals with confidential information such as client data, employee information, and financial reports. To ensure the confidentiality and privacy of this information, LMN Corp has decided to configure Office 365 Message Encryption and validate Information Rights Management (IRM).

Technologies used: Office 365 Message Encryption, Azure Information Protection, Exchange Online, Information Rights Management, PowerShell.

11. Implement Data Loss Prevention policies

ABC Corp is a large organization that handles sensitive data such as customer information, financial data, and confidential business strategies. To ensure the protection of sensitive data, ABC Corp has decided to implement Data Loss Prevention (DLP) policies and test both the DLP and Messaging Records Management (MRM) policies.

Technologies used: Microsoft 365 Compliance Center, Azure Information Protection, Exchange Online, SharePoint Online, PowerShell

12. Initialize Compliance and Configure retention tags and policies

XYZ Corp is a large organization that deals with a large amount of data, including confidential customer information and financial records. To ensure compliance with data protection regulations and to manage data effectively, XYZ Corp has decided to initialize compliance and configure retention tags and policies.

Technologies used: Microsoft 365 Compliance Center, Exchange Online, SharePoint Online, Azure Information Protection, PowerShell.

13. Manage Search and Investigate your Microsoft 365 Data and Conduct a Data Subject Request

DEF Corp is a large organization that handles a large amount of data, including customer data and financial records. To manage data effectively and ensure compliance with data protection regulations, DEF Corp has decided to manage search and investigation, investigate Microsoft 365 data, and conduct a data subject request.



Technologies used: Microsoft 365 Security & Compliance Center, Microsoft 365 Compliance Manager, Microsoft 365 Audit Logs, Azure Information Protection, Third-party eDiscovery and compliance solutions.

Total: 30 Hours

G. Learning Resources (in IEEE Format)

x. Text Books:

3. Thomas, Orin. ‘Windows server 2019 inside out’. Microsoft Press, 2020.
4. Jordan Krause, “Mastering Windows Server 2019”, Packt Publishing Limited; 2nd edition (18 March 2019)

xi. 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)

xii. 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
10212IT257	DCH_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. Prerequisite Courses

10211CS105/10211IT120 -Operating Systems/ Operating Systems Concepts

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
CO2	Implement IP network connectivity, name resolution using DNS , remote management and access for a Windows-based system.	K3
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
CO4	Experiment with Backup , Restore and Troubleshooting Windows Server	K3
CO5	Solve troubleshoot network connectivity issues and Manage and control Configuration Management Database (CMDB) to meet	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	PO1 1	PSO1	PSO2	PSO3
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 Repair 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 Devices knowledge 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) Configuring 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, administrator find 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

G.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
10212IT259	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

10211IT119/10211IT108–Fundamentals of Computer Networks/ 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	Course Outcomes	K - Level
CO1	Design subnets and calculate the IP addresses to fulfill network requirements of an organization	K3
CO2	Evaluate the performance of Ethernet LAN and Wireless LAN through simulation	K3
CO3	Configure the VLAN Network and VLAN device settings	K3
CO4	Analyzing VTP Ethernet LAN Switching Configuration	K3
CO5	Assessing Network performance and using STP to track every connection in the specific network	K3
Knowledge Level (Based on revised Bloom's Taxonomy)		

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 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.

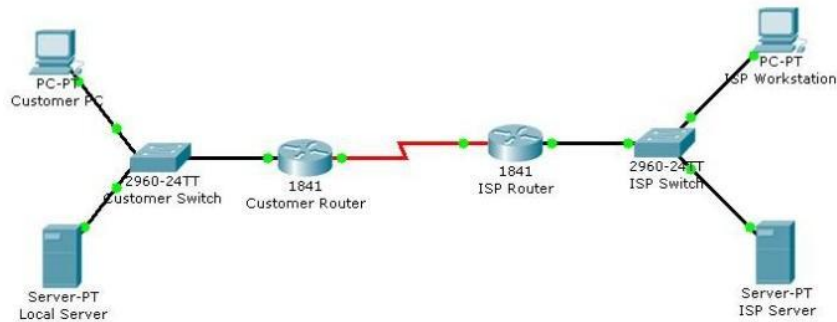
Total: 30 Hours

Laboratory Task: Total: 30 Hours

Task 1: Study of basic network command and Network configuration commands.

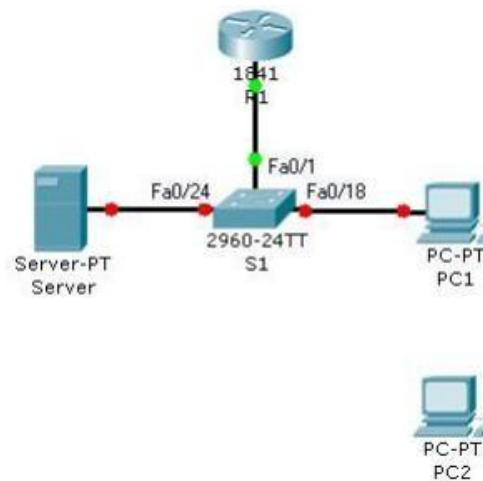
Task 2: Connect the computers in Local Area Network

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.

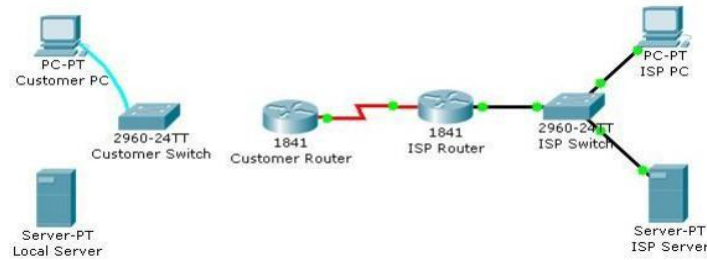


Task 5: Connecting a Switch for the given topology diagram

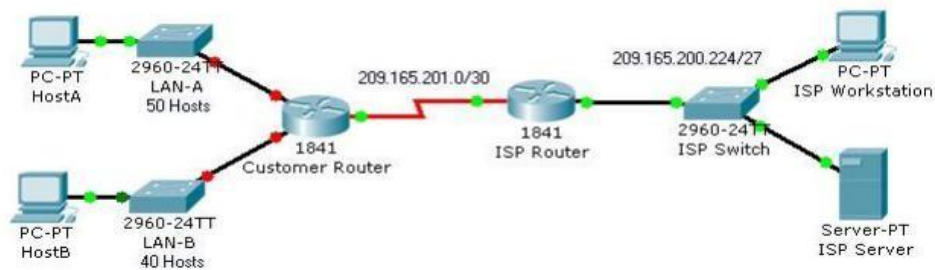
- Connect a switch to the network.



- Verify the configuration on the switch



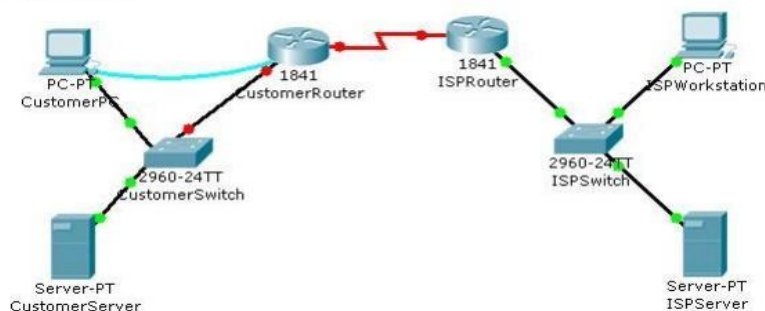
Task 6: Implementing an IP Addressing Scheme for the below topology diagram



- Subnet an address space based on the host requirements.
- Assign host addresses to devices.
- Configure devices with IP addressing.
- Verify the addressing configuration

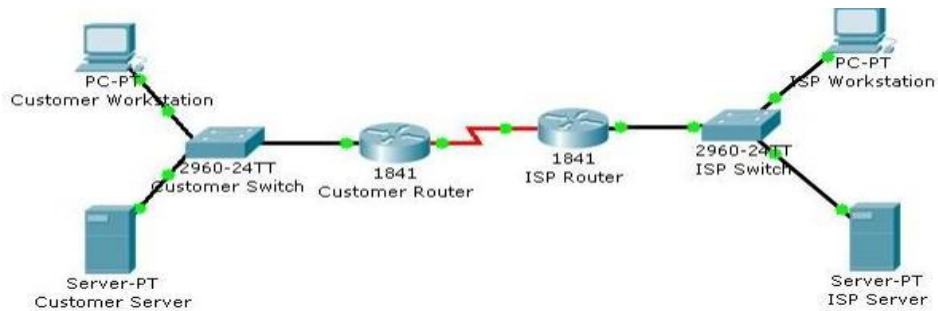
Task 7: Configuring Ethernet and Serial Interfaces

Topology Diagram



- 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

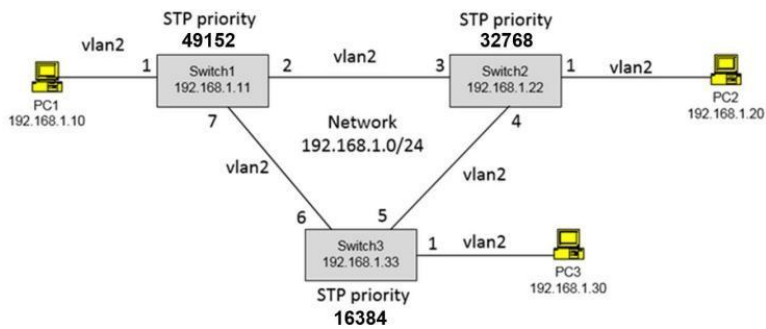
Task 10. Configure Port to VLAN Interface Settings on a Switch.

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
10212IT263	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

10211IT119/10211IT108–Fundamentals of Computer Networks/ Computer Networks

10211CS105/10211IT120 -Operating Systems/ Operating Systems Concepts

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
CO2	Build an interactive client-server environment to fetch the active web page migration using Web Site Deployment console application.	K3
CO3	Create, manage and configure SSL Certificate in IIS web server application to secure client server communication using ASP.NET Web page handler.	K3
CO4	Make use of monitoring connection, components and respective action for optimizing the IIS web server application.	K3



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
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	PO2	PO	PO	P	PO	PO	PO	PO	PO1	PO1	PSO	PSO	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

F. 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 Hill Internet 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
10212IT270	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

10211IT120-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	Explain System 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	PS O1	PS O2	PS O3
CO1					3							3	
CO2	2	3	3	3	3							3	213
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 to JES and 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 member and 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>



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



OPEN ELECTIVES



COURSE CODE	COURSE TITLE	L	T	P	C
10213IT101	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
CO 1	Explain the fundamentals of Java and Object Oriented Programming (OOP) concepts to solve problems.	K2
CO 2	Apply the concepts of java inheritance and exception handling mechanisms for real world problem.	K3
CO 3	Solve the problems using Java Streams, Collections, UI Design and Threads	K3
CO 4	Develop simple web applications using JSP, Servlet with JDBC and Hibernate Framework	K3
CO 5	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 AND STRING

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: 45 Hours

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
10213IT102	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”, Schaum’s outlines, Tata McGraw Hill, 2017. [Unit 4,5]

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
10213IT103	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

10213IT102 - 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



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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
10213IT104	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 as well lightweight databases.

B. Prerequisite Courses

10213IT102 – 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-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

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_0130542736573808641006_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
10213IT105	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

10213IT102 - 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

[illegible]



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 LayerL- 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, 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/>



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VALUE ADDED COURSES

COURSE CODE	COURSE TITLE	L	T	P	C
10218IT916	Code X	3	0	0	0

A. Preamble

This course offers a holistic understanding and hands-on designed to provide with a comprehensive practice in C programming, Data Structures and Python Programming in which the inspiration of programming is trained for the student to solve the real-world problems of Information technology and software.

B. Prerequisite Course: NIL

C. Course Objectives

Learners are exposed to:

- Understand the foundation and application of C Programming.
- Implement the concepts of linear Data structures.
- Solve programming problems using Python Concepts

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Understand control instructions, sequential program control, and selection control.	K2
CO2	Demonstrate knowledge of structure-related concepts, including nested structures, pointers to structures, and dynamic allocation.	K2
CO3	Utilize storage classes, file operations, and I/O functions to develop and implement advanced file handling in real-world programming scenarios.	K3
CO4	Apply knowledge of pointers, arrays, and multidimensional arrays to solve real-world programming problems and understand memory mapping.	K3
CO5	Solve the complex problems using python collections, file manipulation, string handling, exception handling, and multi-threading.	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:

[illegible]



3 - High; 2 - Medium; 1 – Low

F. Course Contents

Unit 1 Control Structures and Functions

L-9 hours

Control Instructions-Sequential Program control-selection Control-Decisions Expression-Cascading selection statement-loop control-input validation-counting. Sequence of functions-call by value-call by reference-pointer notation-back to function calls-applications of actual parameters and formal parameters-Recursion

Unit 2 Structures and Unions

L-9 hours

Structure accessing-nested-array of structures-passing structures from and to functions-pointers to structures-dynamic allocation and enumeration-Applications of structures-Unions-accessing-size of unions-nested-use case for unions-unions and pointers-bit field with unions –unions vs structures-Advantages & disadvantages of unions.

Unit 3 Preprocessor and File Handling

L-9 hours

Macros vs Functions-Conditional Compilation-Solve problems using command line arguments. Storage Classes-auto-extent-static-register-applications of storage classes-Macros with arguments- File Operations-Record I/O Files-Stringline I/O-Low level File I/O-standard I/O-Sequential and Random-access file Functions.

Unit 4 Array, Stack and Queue

L-9 hours

Pointers and Arrays-Two-Dimensional Array-Passing 2-D Array to a Function-Memory map of 2D Array-Array of Pointers -Three-Dimensional Array-Application of 1D and 2D Arrays. Stacks-Operations on Stacks-Applications of Stacks-Balanced parenthesis-expression conversion-expression evaluation-function call management-undo/redo-memory management-Tower of Hanoi-Backtracking-Depth First Search. Queues: Operations and its types-Applications of Queue-Process Scheduling-Breadth-First Search-buffer management-job scheduling-Bounded Buffer-Transaction management.

Unit 5 Python Programming

L-9 hours

Python Collections-File Manipulation- String Handling- Exception Handling and Multi-Threading in Python- Data Frame-Panel-descriptive statistics function- iterating data frames-statistical functions-aggregations-visualization- plotting graphs using plotly Library, Event Handling- Database connectivity.

Total: 45 Hours

G. Learning Resources

Text Books:

- 1.E. Balagurusamy, “Programming in ANSI C”, 8th Edition” MC Graw Hill Publishing, 2019.



2. Narasimha Karumanchi, "Data Structures and Algorithms made Easy" 5th Edition, Career Monk Publication, Print Replica, 2020.
3. Guido van Rossum, Learning Python: Crash Course Tutorial, The Python development team publishers, 2020.



COURSE CODE	COURSE TITLE	L	T	P	C
10218IT917	Code Dakshah	3	0	0	0

A. Preamble

This course has been meticulously designed to prepare learners with foundational expertise in java programming, data structures and algorithms, and database management system principles to hone their problem-solving skills for a wide array of employment prospects.

B. Prerequisite Course: NIL

C. Course Objectives

Learners are exposed to:

- Get more familiarity with various concepts of java to solve the advanced problems leading to the readiness for employment opportunities.
- Equip learners with a strong foundation in data structures and algorithms to enhance their problem-solving skills for cracking coding interviews.
- Excel in database management systems concepts, a valuable asset in today's job market.

D. Course Outcomes

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

CO No's	Course Outcomes	K - Level
CO1	Develop Java proficiency, encompassing object-oriented programming, I/O, threading, and database connectivity.	K3
CO2	Apply data structures concepts including graph operations, for problem-solving.	K3
CO3	Build algorithms based on time and space complexity, focusing on various algorithmic techniques to solve complex problems.	K3
CO4	Make use of database concepts, from ER modeling to SQL, and optimize data organization and retrieval.	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	PO12	PSO 1	PSO 2
CO1	3	3	3	3	2							3	3	3
CO2	3	3	3	3								3	3	3
CO3	3	3	3	3								3	3	3
CO4	3	3	2	3	2							3	3	3

3 - High; 2 - Medium; 1 - Low



F. Course Contents

Unit 1 Java Programming

L-12 Hours

Classes and Objects – Constructors – importance of this keyword - Garbage Collection - Access Control - Use of static and final - Nested and Inner Classes – Varargs - Inheritance and its types - polymorphism (Overriding vs. Overloading) – Packages - abstract classes and methods - Interfaces - Exception Handling - Multithreaded Programming – Enumerations - Wrapper classes, I/O stream and Annotations – Generics - Collections Framework - Storing User-Defined Classes in Collections –Collection Algorithms to solve relevant problems- Unit testing using Junit - importing Junit - MVC Pattern and its advantages.

Unit 2 Data Structures

L-15 Hours

Need of Stack - Implementation of Stack (LIFO) - Advantages and its limitations - Application of Stack; Need of Queue - Implementation of Queue (FIFO) - Advantages and its limitations - Application of Queue; Need of linked list - Creation and traversal (SLL, DLL, CLL) - advantage of linked list over array - Applications of Linked list; Implementation of binary search tree - Applying tree traversal techniques for search operation - Advantages and limitations - Applications of tree; Implementation of Graph Traversal Techniques - Advantages - limitations and applications; Solve problems using sorting and searching algorithms.

Unit 3 Algorithmic Analysis

L-10 Hours

Run time analysis using asymptotic notation - Need for Big Oh - time complexity - space complexity; Algorithm approaches and its implementation: Recursive and iteration solutions for the problem - Divide and conquer - Greedy approach - Dynamic programming & memorization - Back tracking.

Unit 4 Database Management Systems

L-8 Hours

Data Models (Hierarchical – Network – ER – Relational - Object-Oriented - Document Data Model (NoSQL); SQL (Joins – DML – DCL - TCL); Normalization (1NF - 2NF - 3NF - BCNF); Transaction management with concurrency control and recovery (locking, isolation levels, ACID properties). Mongo DB: Documents – Collections - Schema-Free – Naming – Databases - Running the Shell - Embedded Documents - `_id` and `ObjectId` – Methods - Operators - Working with Documents and Collections - CRUD operations – indexing -aggregation; Applications of MongoDB.

Total: 45 Hours

G. Learning Resources

Text Books:

1. Daniel Liang, “Introduction to Java Programming and Data Structures”, 13th Edition Pearson, 2023. [Unit 1].
2. Narasimha Karumanchi, “Data Structures and Algorithms made Easy”, 5th Edition, Career Monk Publication, Print Replica, 2020. [Unit 2].
3. Elmasri Ramez, Navathe S, “Fundamentals of Database System”, 7th Edition, Pearson, 2017. [Unit 3].
4. Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, “MongoDB: The Definitive Guide - Powerful and Scalable Data Storage”, 3rd Edition, O’Reilly, 2020. [Unit 4].