PRINCIPLES OF ARTIFICIAL INTELLIGENCE
(Effective from the Academic Year 2023 - 2024)
IV SEMESTER

Course Code	**AM422I1A**	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40L + 20P	Exam Hours	03

CREDITS – 4

COURSE PREREQUISITES:

- Fundamental knowledge of mathematical concepts, analytical skills and programming.

COURSE OBJECTIVES:

- Gain a historical perspective of AI and its foundations.
- Learn the methods of solving problems using AI.
- Learn the knowledge representation techniques, logic concepts and planning.
- Investigate applications of AI techniques in expert systems.

TEACHING - LEARNING STRATEGY:

Following are some sample strategies that can be incorporate for the Course Delivery

1. Chalk and Talk Method/Blended Mode Method
2. Power Point Presentation
3. Expert Talk/Webinar/Seminar
4. Video Streaming/Self-Study/Simulations
5. Peer-to-Peer Activities
6. Activity/Problem Based Learning
7. Case Studies
8. MOOC/NPTEL Courses
9. Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE - I

Introduction to AI: Intelligent systems, Foundations and Sub area of AI, Applications, Tic-Tac-Toe Game playing, Currents trend and developments of AI, General problem solving, Characteristics of problem, Constraint satisfaction.	**8 Hours**

MODULE - II

Search Techniques and Game playing: Exhaustive searches, Heuristic search techniques, AO* Algorithm, Game playing, Bounded look-ahead strategy, Alpha-beta pruning, Two-player perfect information games.	**8 Hours**

MODULE - III

Logic concepts and Prolog Programming concepts: Propositional calculus, Propositional logic, Natural deduction system, Axiomatic system, Semantic tableau system in Propositional logic, Prolog program, Control strategy of prolog, Programming techniques in prolog, List manipulation in prolog, Structuring of data in prolog, Recursive data types in prolog.	**8 Hours**

MODULE - IV	
Planning and Knowledge Representation: Types of planning systems, Block world problem, Logic based planning, Linear planning using Goal stack, Means-Ends analysis, Approaches to knowledge representation, Knowledge representation using semantic network, Knowledge representation using frames.	**8 Hours**
MODULE - V	
Expert system and Applications: Phases in building expert systems, Architecture of expert system, Expert system versus traditional systems, Rule-based expert systems, Blackboard systems, Truth maintenance systems, Application of expert systems.	**8 Hours**

COURSE OUTCOMES

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

CO No.	Course Outcome Description	Bloom's Taxonomy Level
CO1	Demonstrate the fundamental understanding of AI and its foundations.	CL3
CO2	Apply the knowledge of AI in search techniques and game playing.	CL3
CO3	Demonstrate the Logic concepts and Logic programming in AI.	CL3
CO4	Apply principles of AI in knowledge representation and planning.	CL3
CO5	Apply AI techniques to develop intelligent systems.	CL3

LABORATORY COMPONENTS

Exp. No.	Experiment Description	CO No.	Bloom's Taxonomy Level
1	Design and implement Tic-Tac-Toe game using Python programming.	CO1	CL3
2	Demonstrate Nim game using Python programming.	CO2	CL3
3	Write a program to implement A* Algorithm.	CO2	CL3
4	Write a python program to demonstrate the working of Alpha-Beta Pruning.	CO2	CL3
5	Demonstrate the Union and Intersection of two fuzzy Sets using python programming.	CO3	CL3
6	Write a program in Prolog to implement simple arithmetic.	CO3	CL3
7	Design and implement a Cross word puzzle using Python programming.	CO4	CL3
8	Demonstrate a simple Chatbot with minimum 10 conversations.	CO5	CL3

CO-PO-PSO MAPPING

CO No.	Programme Outcomes (PO)												Programme Specific Outcome (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2		2				1	1		1		
CO2	3	3	2	1	2				1	1		1		
CO3	3	3	2		2				1	1				

CO4	3	3	2		2				1	1				
CO5	3	3	2		2				1	1		1		
3: Substantial (High)					**2: Moderate (Medium)**					**1: Poor (Low)**				

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Practical Session (Laboratory Component)	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT DETAILS

Continuous Internal Assessment (CIA) (50%)				
Continuous Internal Evaluation (CIE) (60%)			**Practical Sessions (40%)**	**Semester End Exam (SEE) (50%)**
I	**II**	**III**		
Syllabus Coverage			**Syllabus Coverage**	**Syllabus Coverage**
40%	**30%**	**30%**	**100%**	**100%**
MI			MI	MI
MII	MII		MII	MII
	MIII		MIII	MIII
		MIV	MIV	MIV
		MV	MV	MV

NOTE:

- Assessment will be both CIA and SEE.
- The practical sessions of the IPCC shall be for CIE only.
- The Theory component of the IPCC shall be for both CIA and SEE respectively.
- The questions from the practical sessions shall be included in Theory SEE.

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

SEE QUESTION PAPER PATTERN:

1. The question paper will have **TEN** full questions from **FIVE** Modules
2. There will be 2 full questions from each module. Every question will carry a maximum of 20 marks.
3. Each full question may have a maximum of four sub-questions covering all the topics under a module.
4. The students will have to answer FIVE full questions, selecting one full question from each module.

REFERENCE BOOKS:

1. Saroj Kaushik, Artificial Intelligence, Cengage Learning India Private Limited, 1st Edition, 2011, ISBN: 978-8131510995.

2. Elaine Rich and Kevin Knight, Artificial Intelligence, Tata McGraw Hill Publications, 3rd Edition, 2019, ISBN: 9780070087705.
3. Stuart Jonathan Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Publications, 3rd Edition, 2016, ISBN: 9781292153964.

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

1. https://onlinecourses.nptel.ac.in/noc22_cs56
2. https://onlinecourses.nptel.ac.in/noc23_ge40

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

1. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=17&lesson=18
2. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=26&lesson=27
3. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=43&lesson=44
4. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=52&lesson=53
5. https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=75&lesson=76

OPERATING SYSTEMS
(Effective from the Academic Year 2023 - 2024)
IV SEMESTER

Course Code	**CS422I2C**	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40L + 20P	Exam Hours	03

CREDITS – 4

COURSE PREREQUISITES:

1. C Programming, Data Structures, Object Oriented Programming, Computer Organization

COURSE OBJECTIVES:

The course will enable the student to

1. Obtain awareness on concepts of operating systems and structures.
2. Understand and implement the concept of Process and threads
3. Demonstrate the common synchronization problems arising in the Operating systems and provide solutions to them
4. Demonstrate the issue of deadlock and handle them effectively.
5. Understand the concept of Memory and demonstrate its management using various strategies.
6. Know the various storage mechanisms available and discuss the management of storage space.

TEACHING - LEARNING STRATEGY:

Following are some sample strategies that can be incorporate for the Course Delivery

1. Chalk and Talk Method/Blended Mode Method
2. PowerPoint Presentation
3. Expert Talk/Webinar/Seminar
4. Video Streaming/Self-Study/Simulations
5. Peer-to-Peer Activities
6. Activity/Problem Based Learning
7. Case Studies
8. MOOC/NPTEL Courses
9. Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE - I

Operating Systems and Structures: Introduction, user view, system view, Single processor systems, multiprocessors systems, clustered systems, multiprogramming and multitasking, dual mode and multimode operations, Distributed systems, Computing environments, Operating System services, System Calls, Linkers and Loader, Operating system design and	**8 Hours**

implementation, Operating System Structures **Process Management:** Process concept, process state, process control block, context switch; operations on processes, inter process communication.	

MODULE - II	
Multi-Threaded Programming: Overview of threads, multithreading models, thread libraries, threading issues. **CPU Scheduling:** Schedulers, Pre-emptive and non-pre-emptive scheduling, dispatcher; Scheduling Criteria. **Scheduling Algorithms:** FCFS, SJF, SRTF, RR, Priority, HRRN, multi-level feedback Queue scheduling, Multiprocessor scheduling.	**8 Hours**
MODULE - III	
Process Synchronization: Background, critical section problem, Peterson's solution; synchronization hardware- mutex, semaphores, monitors. **Deadlocks:** System model, necessary conditions for deadlocks, methods for handling deadlocks, deadlock prevention, deadlock avoidance -resource allocation graph algorithm, banker's algorithm, deadlock detection, recovery from deadlock	**8 Hours**
MODULE - IV	
Memory Management: Background, contiguous memory allocation, paging, swapping. **Virtual Memory Management:** Background; demand paging: copy-on-write; page replacement algorithms - FIFO, Optimal, LRU; thrashing **File System Interface and Operations:** Access methods, Directory structures, Protection, File system structure, Directory implementation, Allocation methods, Free space management.	**8 Hours**
MODULE - V	
Storage Management and Security: Mass storage structures; Disk scheduling algorithms, Swap space management. **Protection:** Goals, Principles and Domains of protection, Access matrix, Implementation of access matrix, Revocation of access rights, Access control.	**8 Hours**

COURSE OUTCOMES

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

CO No.	Course Outcome Description	Bloom's Taxonomy Level
CO1	Identify the structure of an operating system and concept of Process along with inter- process communication.	CL3
CO2	Apply the concepts of multi-threading and CPU scheduling algorithms by considering different scheduling criteria.	CL3
CO3	Demonstrate the concepts of Process synchronization and Identify root causes of deadlock to provide the solution for deadlock elimination.	CL3
CO4	Explore the concept of memory management, working of various page replacement algorithms and file system operations.	CL3
CO5	Analyze Disk Storage Structures and the concepts of OS protection.	CL4

Mandatory Experiment (for practice only, not to be included for exam):

1. Demonstrate the system assembly and disassembly of computer hardware components
2. Demonstrate the OS installation with Multi Booting and Virtual Machine platform.

Exp. No.	Experiment Description	CO No.	Bloom's Taxonomy Level
1	Write C programs to implement basic UNIX system calls - read(), write(), open(), close(), lseek(), create().	CO5	CL3
2	Write C programs to implement UNIX Directory API's - opendir, closedir, readdir, mkdir.	CO5	CL3
3	Demonstrate the Process creation and Termination using System calls –fork (), vfork (), getpid (), waitpid (), exec, exit (), return 0.	CO1	CL3
4	Write C programs to simulate Inter – Process Communication (IPC) techniques: Pipes, Messages Queues, and Shared Memory.	CO1	CL3
5	Simulate the following CPU scheduling algorithms 1. FCFS 2. SJF 3. Priority 4. Round Robin.Calculate Average Waiting Time, Average Turn-Around Time, Average Response time for each algorithm.	CO2	CL3
6	Demonstrate the following Classical problems of synchronization using semaphores. a. Producer-Consumer b. Dining Philosopher	CO3	CL3
7	Demonstrate following page replacement algorithms: a. FIFO, b. LRU, c. OPTIMAL.	CO4	CL3
8	Analyze the seek time for the following Disk scheduling algorithms – 1. FCFS; 2. SCAN; 3. LOOK	CO5	CL4

CO-PO- PSO MAPPING

CO No.	Programme Outcomes (PO)												Programme Specific Outcome (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	1								2	2	2
CO2	3	3	3	1								2	2	2
CO3	3	3	3	1								2	2	2
CO4	3	3	3	1								2	2	2
CO5	3	3	3	1								2	2	2

3: Substantial (High)	2: Moderate (Medium)	1: Poor (Low)

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Practical Session (Laboratory Component)	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT DETAILS

Continuous Internal Assessment (CIA) (50%)				Semester End Exam (SEE) (50%)
Continuous Internal Evaluation (CIE) (60%)			Practical Sessions (40%)	
I	II	III		
Syllabus Coverage			Syllabus Coverage	Syllabus Coverage
30%	30%	40%	100%	100%
MI			MI	MI
MII	MII		MII	MII
	MIII		MIII	MIII
		MIV	MIV	MIV
		MV	MV	MV

NOTE:

1. Assessment will be both CIA and SEE.
2. The practical sessions of the IPCC shall be for CIE only.
3. The Theory component of the IPCC shall be for both CIA and SEE respectively.
4. The questions from the practical sessions shall be included in Theory SEE.

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

SEE QUESTION PAPER PATTERN:

- The question paper will have **TEN** full questions from **FIVE** Modules
- There will be 2 full questions from each module. Every question will carry a maximum of 20 marks.
- Each full question may have a maximum of four sub-questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.
- The paper shall mandatorily contain the questions from the laboratory component of the course

REFERENCE BOOKS:

- Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Principles", 10th edition, Wiley-India, 2021
- M. Morris Mano, "Computer System Architecture", PHI, 3rd Edition
- Ann McHoes, Ida M Fylnn, "Understanding Operating System", Cengage Learning, 6th Edition
- D.M Dhamdhere, "Operating Systems: A Concept Based Approach", 3rd Edition, McGraw- Hill, 2013.
- P.C.P. Bhatt, "An Introduction to Operating Systems: Concepts and Practice", 4th Edition, PHI(EEE), 2014.
- William Stallings, "Operating Systems: Internals and Design Principles", 6th Edition, Pearson.

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

1. https://www.geeksforgeeks.org/operating-systems/
2. https://www.youtube.com/watch?v=RozoeWzT7IM&list=PLdo5W4Nhv31a5ucW_S1K3-x6ztBRD-PNa
3. https://en.wikipedia.org/wiki/Operating_system
4. https://www.youtube.com/watch?v=By6lWjiPpVI&list=PLG9aCp4uE-s17rFjWM8KchGlffXgOzzVP
5. https://www.youtube.com/watch?v=bkSWJJZNgf8&list=PLxCzCOWd7aiGz9donHRrE9I3Mwn6XdP8

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COMPUTER ORGANIZATION AND ARCHITECTURE

(Effective from the Academic Year 2023 - 2024)

IV SEMESTER

Course Code	**CS422T3C**	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

1. Fundamental knowledge of basic logic design principles and various function of digital computer..

COURSE OBJECTIVES:

2. Understand the organization and architecture of computer systems, their structure and operation
3. Illustrate the concept of machine instructions and programs
4. Demonstrate different ways of communicating with I/O devices
5. Describe different types memory devices and their functions
6. Explain arithmetic and logical operations with different data types
7. Demonstrate processing unit with parallel processing and pipeline architecture

TEACHING - LEARNING STRATEGY:

Following are some sample strategies that can be incorporate for the Course Delivery

1. Chalk and Talk Method/Blended Mode Method
2. Power Point Presentation
3. Expert Talk/Webinar/Seminar
4. Video Streaming/Self-Study/Simulations
5. Peer-to-Peer Activities
6. Activity/Problem Based Learning
7. Case Studies
8. MOOC/NPTEL Courses
9. Any other innovative initiatives with respect to the Course contents

COURSE CONTENTS

MODULE - I

Basic Structure of Computers: Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes **Textbook 1: Chapter1 – 1.3, 1.4, 1.6 (1.6.1-1.6.4, 1.6.7), Chapter2 – 2.2 to 2.5**	**8 Hours**

MODULE - II

Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits **Textbook 1: Chapter4 – 4.1, 4.2, 4.4, 4.5, 4.6**	**8 Hours**

MODULE - III

Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Virtual memories **Textbook 1: Chapter 5 – 5.1 to 5.4, 5.5 (5.5.1, 5.5.2)**	**8 Hours**

MODULE - IV

Arithmetic: Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers Basic Processing Unit: Fundamental Concepts, Execution of a Complete Instruction, Hardwired control, Microprogrammed control **Textbook 1: Chapter2-2.1, Chapter6 – 6.1 to 6.3 Textbook 1: Chapter7 – 7.1, 7.2,7.4, 7.5**	**8 Hours**

MODULE - V

Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Vector Processing, Array Processors **Textbook 2: Chapter 9 – 9.1, 9.2, 9.3, 9.4, 9.6, 9.7**	**8 Hours**

COURSE OUTCOMES

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

CO No.	Course Outcome Description	Bloom's Taxonomy Level
CO1	Explain the organization and architecture of computer systems with machine instructions and programs	CL2
CO2	Analyse the input/output devices communicating with computer system	CL3
CO3	Demonstrate the functions of different types of memory devices	CL3
CO4	Apply different data types on simple arithmetic and logical unit	CL3
CO5	Analyze the functions of basic processing unit, Parallel processing and pipelining	CL3

CO-PO-PSO MAPPING

CO No.	Programme Outcomes (PO)												Programme Specific Outcome (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2														
CO3														
CO4														
CO5														

3: Substantial (High)	2: Moderate (Medium)	1: Poor (Low)

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect

methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT DETAILS

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus Coverage			**Syllabus Coverage**	**Syllabus Coverage**
40%	**30%**	**30%**	**100%**	**100%**
MI			MI	MI
MII	MII		MII	MII
	MIII		MIII	MIII
		MIV	MIV	MIV
		MV	MV	MV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity Based Learning	50 %	10
7	Project Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

1. The question paper will have **TEN** full questions from **FIVE** Modules
2. There will be 2 full questions from each module. Every question will carry a maximum of 20 marks.
3. Each full question may have a maximum of four sub-questions covering all the topics under a module.
4. The students will have to answer FIVE full questions, selecting one full question from each module.

TEXT BOOKS:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th Edition, Tata McGraw Hill
2. M. Morris Mano, Computer System Architecture, PHI, 3rd Edition

REFERENCE BOOKS:

1. William Stallings: Computer Organization & Architecture, 9th Edition, Pearson

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

1. http://www.nptelvideos.in/2012/11/computer-organization.html
2. https://nptel.ac.in/courses/106/103/106103068/
3. https://nptel.ac.in/content/storage2/courses/106103068/pdf/coa.pdf
4. https://nptel.ac.in/courses/106/105/106105163/
5. https://nptel.ac.in/courses/106/106/106106092/
6. https://nptel.ac.in/courses/106/106/106106166/
7. http://www.nptelvideos.in/2012/11/computer-organization.html

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DESIGN AND ANALYSIS OF ALGORITHMS
(Effective from the Academic Year 2023 - 2024)
SEMESTER - IV

Course Code	**CS422T4C**	CIA Marks	50
Number of Contact Hours/Week(L:T:P:S)	3:0:0:2	SEE Marks	50
Total Hours of Pedagogy	40 L + 20 S	Exam Hours	03

CREDITS – 3

Prerequisites:

1. Fundamental knowledge of Mathematics, Data Structures.

Course Objectives:

This course will enable students to:

- Describe the techniques for analyzing algorithms and how to evaluate their performance. Indicate the effectiveness of the method using asymptotic notations.
- Utilize algorithm design techniques including the brute force approach, greedy approach, divide-and-conquer strategy, decrease-and-conquer strategy, transform-and-conquer strategy, dynamic programming, backtracking, and branch-and-bound to solve issues.
- Decide on the best data structure and algorithm design technique for the given application.
- Recognize the fundamental ideas behind NP-complete and NP-hard class issues.

Teaching - Learning Strategy:

These are some sample strategies, which course faculty members can incorporate in the Teaching Learning Process:

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses

COURSE CONTENTS

MODULE - 1

Module Contents	Lecture Hours
Introduction to Algorithms- Properties, Specification, Fundamentals of Algorithmic Problem solving, Analysis Framework. **Performance Analysis:** Estimating Space complexity and Time complexity of algorithms. Asymptotic Notations with examples, Basic efficiency classes, Mathematical analysis of Non-Recursive and Recursive Algorithms with Examples. **Brute force design techniques:** Selection sort, sequential search and String-matching algorithm with complexity Analysis.	**8 Hours**

MODULE - 2	
Divide and Conquer: General method, Recurrence equation for divides and conquers, solving it using Master's theorem. Divide and Conquer algorithms and complexity Analysis of Finding the maximum & minimum, Binary search, Merge sort, Quick sort. **Decrease and Conquer Approach:** Introduction, Insertion sort, Topological Sorting and efficiency analysis.	**8 Hours**
MODULE - 3	
Greedy Method: General method, Coin Change Problem, Knapsack Problem, Job sequencing with deadlines, Minimum cost spanning tree algorithms: Prim's Algorithm, Kruskal's Algorithm. **Single source shortest paths:** Dijkstra's Algorithm. **Optimal Tree problems:** Huffman Trees and Codes. **Transform and Conquer Approach:** Heaps and Heap Sort.	**8 Hours**
MODULE - 4	
Dynamic Programming: General method with Examples, Multistage Graphs. **Transitive Closure:** Warshall's Algorithm. All Pairs Shortest Paths: Floyd's Algorithm, Knapsack problem, Optimal Binary Search Trees, Travelling Sales Person problem. **Space-Time Tradeoffs:** Sorting by Counting, Input Enhancement in String Matching Harspool's algorithm.	**8 Hours**
MODULE - 5	
Backtracking: General method, N-Queens problem, Sum of subsets problem, Hamiltonian cycles Problems. **Branch and Bound:** Basic concepts, Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem. **NP-Complete and NP-Hard problems:** Basic concepts, non-deterministic algorithms, P, NP, NP-Complete, and NP-Hard classes.	**8 Hours**

COURSE OUTCOMES

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

CO No.	Course Outcome Description	Bloom's Taxonomy Level
CO1	Solve the time complexity of recursive, non-recursive and brute force algorithms using asymptotic notations.	CL3
CO2	Solve the recurrence relation to obtain the performance of divide-and-conquer, decrease-and conquer approach.	CL3
CO3	Apply greedy technique, transform and conquer strategy to solve the problem for optimal solution.	CL3
CO4	Determine the time complexity for Dynamic-Programming paradigm and String-matching techniques.	CL3
CO5	Apply backtracking and branch-and-bound approach on combinatorial	CL3

	problems and categorize algorithms as P, NP, NP-complete and NP-hard classes.	

CO-PO-PSO MAPPING

CO No.	Programme Outcomes (PO)												Programme Specific Outcome (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	1		1						3		
CO2	3	3	2	1		1						3		
CO3	3	3	3	1		1						3		
CO4	3	3	3	1		1						3		
CO5	3	3	3	1		1						3		

3: Substantial (High)	2: Moderate (Medium)	1: Poor (Low)

CO - Assessment Mapping:

Course Outcomes	Continuous Internal Assessment (CIA) (50%)				Semester End Exam (SEE) (50%)
	Continuous Internal Evaluation (CIE) (60%)			Assignment/Activities (40%)	
	I	II	III		
	Syllabus Coverage				
	40%	30%	30%	100%	100%
CO1	x			x	x
CO2	x			x	x
CO3		x		x	x
CO4		x	x	x	x
CO4			x	x	x

Assessment Strategy:
Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CI)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments*	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

Assignment Types:

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	5
2	Quiz	25 %	5
3	Field Visits/Survey/Case Studies	50 %	10
4	Model / Prototype Development	100 %	20
5	Project Based Learning		
6	Seminar/Presentation	25 %	5
7	Peer - to -Peer Learning	25 %	5

SEE Question Paper Pattern:

1. The question paper will have **TEN** full questions.
2. Each full question consisting of 20 marks.
3. There will be 2 full questions from all the FIVE modules.
4. Each full question will have a maximum of four sub-questions covering all the topics under a module.
5. The students will have to answer 5 full questions, selecting one full question from each module.

Reference Books:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin: 3rd Edition, Pearson.
2. Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, Universities Press.
3. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
4. Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education).

Reference Web Links and Video Lectures (e - Resources):

. https://www.youtube.com/watch?v=gY0MwGLq9W8&list=PLyqSpQzTE6M9DKhN7z2fOpKTJWu-639_P
. https://www.youtube.com/watch?v=5Y8Lfsreeck&list=PL7DC83C6B3312DF1E
. https://www.youtube.com/watch?v=S47aSEqm_0I&list=PLgj_V-ZKxRKrxgFyOutPJpoLFBaQMOpK-

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DESIGN AND ANALYSIS OF ALGORITHMS LAB
(Effective from the Academic Year 2023 -2024)
SEMESTER - IV

Course Code	**CS422L5C**	CIA Marks	50
Number of Contact Hours/Week (L:T:P:S)	0:0:2:1	SEE Marks	50
Total Hours of Pedagogy	24 P+ 12 S	Exam Hours	3

CREDITS –1

Prerequisites:

1. Knowledge of Mathematics, Data Structures and java Programming
2. Usage of IDEs Eclipse, Netbeans and VS studio

Course Objectives:

This course will enable students to:

1. Design, analyze, and implement various algorithms in Java
2. Make use of different algorithmic design techniques to solve problems.
3. Analyze and contrast the effectiveness of various algorithms.

Descriptions:

Installation procedure of the required software must be demonstrated, carried out in groups and documented in the journal.

Algorithm Implementation using Python Programming (Max. Marks: 50)

1. Design, develop, and implement the specified algorithms using java Programming under LINUX/Windows environment.

LIST OF EXPERIMENTS

Exp. No.	Experiment Description
1	Design an application to create a list of TV channels (minimum 10) that includes the numbers of viewers and viewing time. Rate the channels based on the number of viewers (1 High - 6 low). Plot graphs to analyze the running times of different sorting algorithms.
2	Design and implement an application that considers the problem of scheduling n jobs of known durations t1, t2,..., tn for execution by a single processor. The jobs can be executed in any order, one job at a time. Find and display the schedule that minimizes the total time spent by all the jobs in the system by maximizing the profit.
3	Develop an optimal route for a scenario where a person wants to buy a ticket to a baseball game. Along the way from the house to reaching the destination, some known person who lives on that street might give money. Visit towns for the collection of more money to buy a ticket.
4	Design an application for a thermal power station and electrical lines that are connected among various power stations. The costs of electrification involved appear as weights on the edges.

	Obtain the minimum possible connection among the thermal stations so that any two thermal stations can be linked with the minimum cost involved.
5	Develop a program for the following: 1. To construct a Huffman code for a given English text and encode it. 2. To decode an English text which has been encoded with a Huffman code?
6	The owner of a gourmet coffee shop wishes to mix a 10-pound bag of coffee using various types of coffee beans in such a way to produce the coffee blend at the maximum cost. The weights of the objects in the problem correspond to the quantity in pounds available of each type of coffee bean. The value of each quantity of coffee beans is the total cost of that quantity in rupees. Apply the Knapsack algorithm to maximize the profit.
7	Design an application for drilling an optimal printed circuit board. To drill two holes of different diameters consecutively, the head of the machine has to move to a toolbox and change the drilling equipment. This is quite time consuming. Thus, it is clear that one has to choose some diameter, drill all holes of the same diameter, change the drill, drill the holes of the next diameter, etc. Thus, this drilling problem has to minimize the travel time for the machine head. Find the optimal time to drill the circuit board.
8	Design and implement Java Program to find all Hamiltonian Cycles in a connected undirected Graph G of n vertices using backtracking principle.
9	Design and implement for a given chess board having N×N cells, place *N* queens on the board in such a way that no queen attacks any other queen. If it is possible to place all the *N* queens in such a way that no queen attacks another queen, then print *N* lines having *N* Queens. If there is more than one solution of placing the queens, print all of them. If it is not possible to place all *N* queens in the desired way, then print "Not possible".

COURSE OUTCOMES

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

CO No.	Course Outcome Description	Bloom's Taxonomy Level
CO1	Implement Python data structures – lists, tuples & dictionaries to represent compound data.	CL3
CO2	Design, analyze and implement the brute force, divide and conquer algorithms and compare their time complexity.	CL4
CO3	Design and implement the greedy technique algorithms to solve the problem for optimal solution.	CL3
CO4	Apply dynamic programming techniques to solve Traveling Salesperson Problem and Knapsack problem.	CL3

CO-PO-PSO MAPPING

CO No.	Programme Outcomes (PO)	Programme Specific

													Outcome (PSO)	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	1	3			2	2	1	2	2		
CO2	3	3	3	1	3			2	2	1	2	2		
CO3	3	3	3	1	3			2	2	1	2	2		
CO4	3	3	3	1	3			2	2	1	2	2		
3: Substantial (High)					**2: Moderate (Medium)**					**1: Poor (Low)**				

Assessment Strategy:

- Assessment will be both CIA and SEE.
- All laboratory experiments should be included for practical examination.
- Students are allowed to pick one experiment from the lot.
- Lab test should be conducted for 25 Marks.
- Marks Distribution: Procedure + Conduction + Viva = 05 + 15 + 05 = 25 Marks.
- Change of experiment is allowed only once and marks allotted to the procedure part to be made zero.

Sl. No.	**Assessment Description**	**Weightage (%)**	**Max. Marks**
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Weekly Assessment	50 %	25
	Lab Test	50 %	25
2	**Semester End Examination (SEE)**	**100 %**	**50**

Learning Resources:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin: 3rd Edition, Pearson.
2. Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, Universities Press.

Reference Web Links and Video Lectures (e - Resources):

3. https://nptel.ac.in/courses/106106182.

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ADVANCED GRAPH THEORY

(Effective from the Academic Year 2023 -2024)

SEMESTER - IV

Course Code	**MA422T6CA**	CIA Marks	50
Number of Contact Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40 hrs	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Basic knowledge of Graph Theory.

COURSE OBJECTIVES:

To learn fundamental concepts and to explore modern applications of Graph Theory for problem-solving and network analysis

TEACHING - LEARNING STRATEGY:

These are some sample strategies, which course faculty members can incorporate in the Teaching Learning Process:

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses

COURSE CONTENTS

Module Contents	**Lecture Hours**
MODULE - 1	
Graphs and Subgraphs: Definitions and Examples, Subgraphs, Operations on graphs, Connected and Disconnected	**8 Hours**

Graphs, Complements, Graph Isomorphism, Vertex Degree, Euler Trails and Circuits, Hamiltonian paths and circuits.	
MODULE - II	
Matrices, Coloring and Directed Graph Matrix Representation, Adjacency matrix, Incidence matrix, Circuit matrix, Path Matrix, Properties - Related Theorems. Graph Coloring, Chromatic Polynomial, Chromatic Partitioning, Matching, Covering - Related Theorems.	**8 Hours**
MODULE - III	
Trees: Trees, Properties of trees, Distance and centres in tree, Rooted and binary trees. Spanning trees of a graph and Spanning trees in a weighted graph. Traversal of Binary Tree, Pre-order and Post-order Traversal. Prefix codes, optimal tree. Fundamental Circuits and Cut sets, Network Flows. Max- flow Min- cut Theorem (Statement only and problems).	**8 Hours**
MODULE - IV	
Planar, Dual Graphs: Planar Graphs. Kuratowski's graphs. Different representation of planar graph. Detection of planar graphs. Euler's polyhedral formula (No proof). Geometrical Dual (no theorems) problems. **Dominating sets:** Dominating set. Minimal Dominating set. Domination number. Independent dominating set. Finding minimal dominating sets. Some applications of domination theory.	**8 Hours**
MODULE - V	
Graph Theoretic Algorithms and Graph theory in Electrical networks: Computer representation of a graph. Algorithm on spanning trees: Kruskal's and Prim's Algorithm. Shortest path algorithms: Dijkstra's algorithm, Warshall's algorithm. Graphs in switching and coding Theory. Contact networks, analysis of contact networks, Sequential switching networks. Electrical network analysis, Kirchhoff's current and voltage networks, Loop currents and node voltages, LRC networks.	**8 Hours**
COURSE OUTCOMES	
Upon completion of this course, the students will be able to:	

CO No.	**Description**	**Bloom's Taxonomy**

		Level
CO1	Illustrate the Properties of Graphs and Subgraphs.	CL3
CO2	Classify the relationship between the properties of a matrix representation and the structure of the underlying graph.	CL3
CO3	Solve complex problems using properties of trees in Computer science.	CL3
CO4	Apply critical analysis to construct and interpret planar graphs and their duals in mathematical and engineering contexts.	CL3
CO5	Develop advanced graph algorithms to optimize electrical networks.	CL3

CO-PO-PSO MAPPING

CO No.	**Programme Outcomes (PO)**												**Programme Specific Outcome (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	3
CO1	3	3	1					1				1			
CO2	3	3						1				1			
CO3	3	3	1					1				1			
CO4	3	3			1			1				1			
CO5	3	3	1		1			1	1	1		1			

3: Substantial (High)	**2: Moderate (Medium)**	**1: Poor (Low)**

CO - Assessment Mapping:

Course Outcomes	**Continuous Internal Assessment (CIA) (50%)**				**Semester End Exam (SEE) (50%)**
	Continuous Internal Evaluation (CIE) (60%)			**Assignment/Activities (40%)**	
	I	**II**	**III**		
	Syllabus Coverage				
	40%	**30%**	**30%**	**100%**	**100%**
CO1	x			x	x
CO2	x	x		x	x
CO3		x		x	x

CO4			x	x	x
CO5			x	x	x

Assessment Strategy:

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments*	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

Assignment Types:

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	5
2	Quiz	25 %	5
3	Case Studies	25 %	5
4	Seminar/Presentation	15 %	3
5	Peer - to -Peer Learning	10 %	2

SEE Question Paper Pattern:

7. The question paper will have **TEN** full questions.
8. Each full question consisting of 20 marks.
9. There will be 2 full questions from all the FIVE modules.
10. Each full question will have a maximum of three sub-questions covering all the topics under a module.
11. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

12. Narsingh Deo, "Graph Theory with Application to Engineering and Computer Science", Printice Hall of India Private Limited, 2009.
13. Grimaldi R.P. “Discrete and Combinatorial Mathematics: An Applied Introduction”, Pearson

Addison Wesley, 5th edition, 2006.

Reference Books:

14. Bondy, J. A. and Murty, U.S.R., "Graph Theory with Applications", North Holland Publication,2008.

15. West, D. B., ―Introduction to Graph Theory‖, Pearson Education, 2011.

16. John Clark, Derek Allan Holton, ―A First Look at Graph Theory‖, World Scientific Publishing Company, 1991.

17. Rosen K.H., “Discrete Mathematics and Its Applications”, Mc Graw Hill, 2007.

Reference Web Links and Video Lectures (e - Resources):

18. http://users.utu.fi/harju/graphtheory/graphtheory.pdf.
19. https://www.maths.ed.ac.uk/~v1ranick/papers/wilsongraph.pdf
20. https://www.academia.edu/35284015/Graph_Theory_With_Applications_To_Engineering_And_Computer_Science_by_Narsingh_Deo
21. https://onlinecourses.nptel.ac.in/noc22_ma10/preview#:~:text=Graph%20theory%20is%20the%20core,primary%20methods%20in%20Graph%20Theory.

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REGRESSION STATISTICAL COMPUTING

(Effective from the Academic Year 2023 -2024)

SEMESTER - IV

Course Code	**MA422T6CB**	CIA Marks	50
Number of Contact Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40 L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES: Basic knowledge of statistics and programming**.**

COURSE OBJECTIVES:

1. Understand the fundamentals of regression analysis and its application in statistical computing.
2. Develop proficiency in implementing regression models, assessing model fit, and interpreting results.
3. Apply regression techniques to real-world datasets, solving complex problems in data analysis and prediction.

TEACHING - LEARNING STRATEGY:

These are some sample strategies, which course faculty members can incorporate in the Teaching Learning Process:

4. Chalk and Talk Method/Blended Mode Method
5. Power Point Presentation
6. Expert Talk/Webinar/Seminar
7. Video Streaming/Self-Study/Simulations
8. Peer-to-Peer Activities
9. Activity/Problem Based Learning
10. Case Studies
11. MOOC/NPTEL Courses

COURSE CONTENTS

MODULE - I

Introduction to Regression Analysis: Basics of regression analysis. Simple linear regression model. Assumptions, Estimation of model parameters, least squares method, Difference between descriptive and inferential statistics. Regression, Dependent and independent variables.	**8 Hours**
MODULE - II	
Simple Linear Regression: least squares method, Interpretation of Regression coefficient properties Correlation-Karl Pearson's coefficient of correlation regression analysis-lines of regression. Fitting of first and second-degree curve, exponential curve by the method of least squares after logarithmic transformation.	**8 Hours**
MODULE - III	
Multivariate data analysis 1: Multiple linear regression (3 variables only), Assumption, Estimation of Regression by least squares method. Estimation of regression coefficients. Partial, multiple correlation coefficients. Coefficient of Determination (R^2)	**8 Hours**
MODULE - IV	
Multivariate Data Analysis 2 - (Description of various multivariate methods to be given) Logistic regression, Factor Analysis, Structural Equation Modelling, Cluster Analysis, Discriminant Analysis, conjoint analysis, Correspondence Analysis	**8 Hours**
MODULE – V	
Statistical Computing: Packages, GGplot2 package, Likert package, correlation and regression analysis (bivariate and multivariate data), polynomial regression	**8 Hours**

COURSE OUTCOMES

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

CO No.	Course Outcome Description	Bloom's Taxonomy Level
CO1	Apply regression analysis to solve complex computer science problems.	CL3
CO2	Use statistical software tools proficiently for data analysis and modeling.	CL2
CO3	Interpret and communicate results effectively.	CL3
CO4	Apply regression techniques to enhance decision-making and prediction in computer science.	CL3
CO5	Demonstrate critical thinking and problem-solving skills in practical applications	CL3

CO-PO-PSO MAPPING

CO	Programme Outcomes (PO)	Programme Specific Outcome

No.													(PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	3	1		1		1								
CO2	3	3	2		1						1	1			
CO3	3	2			1					1		1			
CO4	3	2			2		1					1			
CO5	3	3	2		1		1				1				

3: Substantial (High)	2: Moderate (Medium)	1: Poor (Low)

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT DETAILS

Continuous Internal Assessment (CIA) (50%)				Semester End Exam (SEE) (50%)
Continuous Internal Evaluation (CIE) (60%)			Assignment/ Activities (40%)	
I	II	III		
Syllabus Coverage			Syllabus Coverage	Syllabus Coverage
40%	30%	30%	100%	100%
MI			MI	MI
MII	MII		MII	MII
	MIII		MIII	MIII
		MIV	MIV	MIV
		MV	MV	MV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped

to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity Based Learning	50 %	10
7	Project Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

12. The question paper will have **TEN** full questions from **FIVE** Modules
13. There will be 2 full questions from each module. Every question will carry a maximum of 20 marks.
14. Each full question may have a maximum of four sub-questions covering all the topics under a module.
15. The students will have to answer FIVE full questions, selecting one full question from each module.

TEXT BOOKS:

1) Gupta, S. C., & Kapoor, V. K. (2002). Fundamental of Mathematical Statistics. Sultan Chand & sons.

REFERENCE BOOKS:

1) Joseph Hair, F., Willium Black, C., Barry Babin, J., & Rolph Anderson, E. (2010). Multivariate Data Analysis, Seventh edition. Pearson Prentice Hall.

2) Kothari, C. R. (2004). Research methodology. New Age International Publishers.

3) Levin, R. (2013). Statistics for Management. Prentice Hall India.

4) Medhi, J. (2006). Statistical Methods: An Introductory Text. New Age International(P) Limited, New delhi.

5) Montgomery, D. C. (2007). Introduction to Linear Regression analysis. John Willey & sons.

6) Mukhopadhyay, P. (2000). Mathematical Statistics. Books & Allied Pvt. Ltd.

7) Robert Kabacoff, I. (2015). R in Action - Data Analysis and Graphics with R, second edition. dreamtech Press.

8) Sudha Purohit, G., Sharad Gore, D., & Shailaja Deshmukh, R. (2008). Statistics Using R. Narosa Publishing House.

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

16. https://www.youtube.com/watch?v=8Kg21jBCm-k

17. https://www.youtube.com/watch?v=Wa6kaCwyYRk

18. http://nptel.ac.in/courses.php?disciplineID=111

19. http://www.class-central.com/subject/math(MOOCs)

20. http://academicearth.org/

21. http://www.bookstreet.in.

22. VTU e- Shikshana ProgramVTU e-Shikshana Program

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OPTIMIZATION TECHNIQUES

(Effective from the Academic Year 2023 -2024)

SEMESTER - IV

Subject code	**MA422T6CC**	CIA Marks	50
Number of Contact Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40 L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

Basics of Statistics, Probability distributions. Multiple integration

COURSE OBJECTIVES:

23. Study the techniques of complex variables and functions together with their derivatives, Contour integration and transformations
24. Enable the students to apply basic concepts of graph theory on developing algorithms
25. Understand the concept of probability and enable the students to predict the outcome of simple experiments
26. Enable the students to use various tests of significance in engineering problems
27. Understand the concept of optimization techniques

TEACHING - LEARNING STRATEGY:

These are some sample strategies, which course faculty members can incorporate in the Teaching Learning Process:

28. Chalk and Talk Method/Blended Mode Method
29. Power Point Presentation
30. Expert Talk/Webinar/Seminar
31. Video Streaming/Self-Study/Simulations
32. Peer-to-Peer Activities
33. Activity/Problem Based Learning
34. Case Studies
35. MOOC/NPTEL Courses

COURSE CONTENTS

MODULE - I

Joint Probability Distribution Functions: Discrete and Continuous Random variables, Probability mass function, Probability density functions. Cumulative distribution functions.	**8 Hours**

Lab Components: Finding joint Probability using R-software	
MODULE - II	
Stochastic Process and Estimation: Regular stochastic matrices. Transition Probability matrices. Markov Process. Estimation of Parameters, Interval Estimation, Central Limit Theorem. Maximum Likelihood functions.	**8 Hours**
MODULE - III	
Linear Programming Problem: Components of LPP, Characteristics of LPP Advantages of LPP Simplex method, Big M method, Duality in LPP. Lab Components: Solving LPP using R-software	**8 Hours**
MODULE - IV	
Transportation and Assignment Problem: Balanced TP. Components of TP, Northwest corner method. Least. cost cell method. Objectives of AP. Hungarian method of solving AP.	**8 Hours**
MODULE – V	
Game Theory: Introduction of game theory, Two-person zero sum game with two or more number of players. Payoff matrix. Optimal strategy. Minimax-Maxmin Principle .Games with and without Saddle point.	**8 Hours**

COURSE OUTCOMES

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

CO No.	Course Outcome Description	Bloom's Taxonomy Level
CO1	Illustrate random variables and Joint probability distribution functions to analyse the probability models in engineering field.	CL3
CO2	Construct Markov models to predict probability for a problem statement.	CL3
CO3	Solve Linear Programming Problem to get optimal solutions of a Mathematical model.	CL3
CO4	Ability to solve balanced Transportation and Assignment problems	CL3
CO5	Develop the technique of best strategic planning using Game theory.	CL3

CO-PO-PSO MAPPING

CO No.	Programme Outcomes (PO)												Programme Specific Outcome (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	3		1	2					1		1			
CO2	2	3			1				1	1		1			

CO3	3	3	1	1				1							
CO4	3	3	1	1	1				1			1			
CO5	3	3		1				1	1						

3: Substantial (High)	**2: Moderate (Medium)**	**1: Poor (Low)**

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT DETAILS

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus Coverage			**Syllabus Coverage**	**Syllabus Coverage**
40%	**30%**	**30%**	**100%**	**100%**
MI			MI	MI
MII	MII		MII	MII
	MIII		MIII	MIII
		MIV	MIV	MIV
		MV	MV	MV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03

5	Peer - to - Peer Learning	10 %	02
6	Activity Based Learning	50 %	10
7	Project Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

36. The question paper will have **TEN** full questions from **FIVE** Modules
37. There will be 2 full questions from each module. Every question will carry a maximum of 20 marks.
38. Each full question may have a maximum of four sub-questions covering all the topics under a module.
39. The students will have to answer FIVE full questions, selecting one full question from each module.

TEXT BOOKS:

1. V.K Kapoor and S.C Gupta "Mathematical Statistics" 11th edition, S. Chand Publications
2 .B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.

REFERENCE BOOKS:

40. C Ray Wylie, Louis C Barrett: "Advanced Engineering Mathematics", 6th Edition,
41. B.V Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill,
3. Dr. K. Chandrashekar: " Complex analysis, Probability and Statistical Methods" Sudha Publications,2021

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

42. https://www.youtube.com/watch?v=8Kg21jBCm-k
43. https://www.youtube.com/watch?v=Wa6kaCwyYRk
44. http://nptel.ac.in/courses.php?disciplineID=111
45. http://www.class-central.com/subject/math(MOOCs)

46. http://academicearth.org/

47. http://www.bookstreet.in.

48. VTU E Shikshana Program

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METRIC SPACES

(Effective from the Academic Year 2023 -2024)

SEMESTER - IV

Course Code	**MA422T6CD**	CIA Marks	50
Number of Contact Hours/Week (L:T:P:S)		SEE Marks	50
Total Hours of Pedagogy	50 L	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

Basic knowledge of Set theory and Group theory

COURSE OBJECTIVES:

Introduce computer engineering students to metric theory, emphasizing its application in analyzing and optimizing data structures, algorithms, and network performance.

TEACHING - LEARNING STRATEGY:

These are some sample strategies, which course faculty members can incorporate in the Teaching Learning Process:

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies

49. MOOC/NPTEL Courses

COURSE CONTENTS

MODULE - I

Introduction to Metric Spaces: Definition of metric space. Examples of metric spaces. Metrics and Distance Functions: Properties of metrics. Common distance functions. Open and Closed Sets, Definitions and properties.	**8 Hours**

MODULE - II

Topology of a Metric Space: Topological concepts, Convergence and Limit Points, Convergence of sequences and series. Limit points, limit set. **Continuity in Metric Spaces**: Continuous functions in metric spaces. Properties of continuous	**8Hours**

functions.	
MODULE - III	
Compactness and Completeness: Connectedness, separated sets, Connected and disconnected sets, Components of metric spaces, Connectedness of product of connected metric spaces. Bounded sets and Compactness, Other Characterizations of Compactness, Continuous Functions on Compact Spaces, Locally Compact Spaces.	**8 Hours**
MODULE - IV	
Cauchy Sequences and Completeness: Cauchy sequences and completeness. Applications in analysis. **Compactness and Bolzano-Weierstrass Theorem**:Bolzano-Weierstrass theorem.Compactness and its applications.	**8 Hours**
MODULE - 5	
Applications in Computer Networks: Routing algorithms using metrics. Latency and distance metrics in network design. Metric Spaces in Geometry and Graphics: Geometric interpretations of metric spaces. Graphics algorithms and spatial metrics.	**8 Hours**

COURSE OUTCOMES

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

CO No.	Course Outcome Description	Bloom's Taxonomy Level
CO1	Describe Metric space concepts in computer science engineering, enhancing problem-solving skills and algorithm optimization.	CL2
CO2	Apply topological concepts and continuous functions in metric spaces to enhance problem-solving skills in computer science.	CL3
CO3	Demonstrate compactness and apply concepts of Metric space to optimize network design and data compression.	CL3
CO4	Apply Cauchy sequences, completeness, and compactness to solve problems in mathematical analysis and optimization."	CL3
CO5	Interpret routing algorithms' effectiveness through metrics in computer network design, enhancing network performance and reliability."	CL3

CO-PO-PSO MAPPING

CO No.	Programme Outcomes (PO)												Programme Specific Outcome (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2		1							1		1			

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

3: Substantial (High)	**2: Moderate (Medium)**	**1: Poor (Low)**

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT DETAILS

Continuous Internal Assessment (CIA) (50%)				**Semester End Exam (SEE) (50%)**
Continuous Internal Evaluation (CIE) (60%)			**Assignment/ Activities (40%)**	
I	**II**	**III**		
Syllabus Coverage			**Syllabus Coverage**	**Syllabus Coverage**
40%	**30%**	**30%**	**100%**	**100%**
MI			MI	MI
MII	MII		MII	MII
	MIII		MIII	MIII
		MIV	MIV	MIV
		MV	MV	MV

Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05

4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity Based Learning	50 %	10
7	Project Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

50. The question paper will have **TEN** full questions from **FIVE** Modules
51. There will be 2 full questions from each module. Every question will carry a maximum of 20 marks.
52. Each full question may have a maximum of four sub-questions covering all the topics under a module.
53. The students will have to answer FIVE full questions, selecting one full question from each module.

TEXT BOOKS:

54. Elements of Real Analysis,Shanti Narayan,Dr.M.D. Raisinghania,(2016)
55. Topology of Metric Spaces by S. Kumareshan, Alpha Science International Limited(2005)

REFERENCE BOOKS:

56. Metric Spaces by Satish Shirali and Harikrishan L Vasudeva Springer, (2006)
57. Metric Spaces by P.K. Jain and Khalil Ahmad ,Alpha Science International, (2004)
58. Elements of Metric spaces by M.N. Mukherjee, Academic Publishers (2005)

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

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Competitive Programming using GO

(Effective from the Academic Year 2022 - 2023)

IV SEMESTER

Course Code	**CS42297CD**	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	20P	Exam Hours	03

CREDITS – 1

COURSE PREREQUISITES:

- Basic Knowledge of C.

COURSE OBJECTIVES:

-

TEACHING - LEARNING STRATEGY:

Following are some sample strategies that can be incorporate for the Course Delivery

59. Chalk and Talk Method/Blended Mode Method
60. Power Point Presentation
61. Expert Talk/Webinar/Seminar
62. Video Streaming/Self-Study/Simulations
63. Peer-to-Peer Activities
64. Activity/Problem Based Learning
65. Case Studies
66. MOOC/NPTEL Courses
67. Any other innovative initiatives with respect to the Course contents

LIST OF EXPERIMENTS

Sl. No.	Description
1	Write a go program to find Even Fibonacci numbers
2	Write a go program to find Largest prime factor
3	Write a go program to find Largest palindrome product
4	Write a go program to find Special Pythagorean triplet
5	Write a go program to illustrate Maps

6	Write a go program to Illustrate Interfaces
7	Write a go program to build a Simple Webserver
8	Write a go program to illustrate Dining Philosophers Problem
9	Write a go program to illustrate Checkpoint Synchronization
10	Write a go program to illustrate HTTP requests

COURSE OUTCOMES

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

CO No.	Course Outcome Description	Bloom's Taxonomy Level
CO1	Demonstrate the usage of flow control and looping.	CL3
CO2	Apply the ability to write optimized code using basic data types and functions.	CL3
CO3	Apply the usage of methods and interfaces.	CL3
CO4	Apply Go routines and channels for directory traversals	CL3
CO5	Usage of all the packages and Go tools required to write optimized code.	CL3

CO-PO-PSO MAPPING

CO No.	Programme Outcomes (PO)												Programme Specific Outcome (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3			3			2	2	1	3	3	2	3
CO2	3	3			3			2	2	1	3	3	2	3
CO3	3	3			3			2	2	1	3	3	2	3
CO4	3	3			3			2	2	1	3	3	2	3
CO5	3	3			3			2	2	1	3	3	2	3

3: Substantial (High)	2: Moderate (Medium)	1: Poor (Low)

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

68. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

69. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).
    Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).
70. In Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
71. A Laboratory Test, similar to the SEE exam is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

    The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

72. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)
73. The respective course instructor will design the assessment criteria for the said assessment components.
74. The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.

In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

5. All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
6. SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
7. General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
8. Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

REFERENCE WEB LINKS AND VIDEO LECTURES (E – RESOURCES):

79. https://www.AUTOSAR.org/standards/
80. https://www.comasso.org/
81. AUTOSAR Architecture (Learn from Scratch with Demo) - https://www.udemy.com/course/AUTOSAR-architecture/

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Data Analytics with Excel

(Effective from the Academic Year 2023 - 2024)

VI SEMESTER

Course Code	**21CS4XX**	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24	Exam Hours	03

CREDITS – 1

COURSE PREREQUISITES:

- Basic Knowledge of Computer Programming.

COURSE OBJECTIVES:

- Apply Macros and Auto filter to solve the given real world scenario
- Learn how to use Pivot Tables and Pivot Charts to streamline your workflow in Excel
- Understand and Identify the principles of data analysis
- Become adept at using Excel functions and techniques for analysis
- Build presentation ready dashboards in Excel

TEACHING - LEARNING STRATEGY:

Following are some sample strategies that can be incorporate for the Course Delivery

82. Chalk and Talk Method/Blended Mode Method
83. Practical Based Learning
84. Power Point Presentation
85. Expert Talk/Webinar/Seminar
86. Video Streaming/Self-Study/Simulations
87. Peer-to-Peer Activities
88. Activity/Problem Based Learning
89. Case Studies
90. MOOC/NPTEL Courses
91. Any other innovative initiatives with respect to the Course contents

List of Experiments	
Sl. No.	
1	**Getting Started with Excel:** Creation of spread sheets, Insertion of rows and columns, Drag & Fill, use of Aggregate functions.
2	**Working with Data** **92.** Importing data, Data Entry & Manipulation, Sorting & Filtering **93.** Data Validation, Pivot Tables & Pivot Charts.
3	**Data Analysis Process:** Conditional Formatting, What-If Analysis, Data Tables, Charts & Graphs.
4	**Cleaning Data** 1. With Text Functions: use of UPPER and LOWER, TRIM function, Concatenate. 2. Containing Date and Time Values: use of DATEVALUE function, DATEADD and DATEDIF, TIMEVALUE functions.
5	Conditional Formatting: formatting, parsing, and highlighting data in spreadsheets during data analysis.
6	Working with Multiple Sheets: work with multiple sheets within a workbook is crucial for organizing and managing data, perform complex calculations and create comprehensive reports.
7	Create worksheet with following fields: Empno, Ename, Basic Pay(BP), Travelling Allowance(TA), Dearness Allowance(DA), House Rent Allowance(HRA), Income Tax(IT), Provident Fund(PF), Net Pay(NP). Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.
8	Create worksheet on Inventory Management: Sheet should contain Product code, Product name, Product type, MRP, Cost after % of discount, Date of purchase. Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.
9	Create worksheet on Sales analysis of Merchandise Store: data consisting of Order ID, Customer ID, Gender, age, date of order, month, online platform, Category of product, size, quantity, amount, shipping city and other details. Use of formula to segregate different categories and perform a comparative study using pivot tables and different sort of charts.
10	Generation of report & presentation using Autofilter &macro.

COURSE OUTCOMES

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

CO No.	Course Outcome Description	Bloom's Taxonomy

		Level
CO1	Use advanced functions and productivity tools to assist in developing worksheets.	CL3
CO2	Manipulate data lists using Outline and PivotTables.	CL3
CO3	Use Consolidation to summarise and report results from multiple worksheets.	CL3
CO4	Apply Macros and Autofilter to solve the given real world scenario	CL3
CO5	Use Autofilter to evaluate the real world scenario	CL3

CO-PO-PSO MAPPING

CO No.	Programme Outcomes (PO)												Programme Specific Outcome (PSO)	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	3		3							1		
CO2	3	2	3		3							1		
CO3	3	2	3		3							1		
CO4	3	2	3		3							1		
CO5	3	2	3		3							1		

3: Substantial (High)	**2: Moderate (Medium)**	**1: Poor (Low)**

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

3. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

   Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

4. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

   Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

5. In Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
6. A Laboratory Test, similar to the SEE exam is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

   The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

7. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)
8. The respective course instructor will design the assessment criteria for the said assessment components.
9. The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.

In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

0. All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
1. SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
2. General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
3. Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

Suggested Learning Resources:

14. Version Control with Git, 3rd Edition, by Prem Kumar Ponuthorai, Jon Loeliger Released October 2022, Publisher(s): O'Reilly Media, Inc.
15. Pro Git book, written by Scott Chacon and Ben Straub and published by Apress, https://gitscm.com/book/en/v2
16. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094443347369984278 2_shared/overview
17. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013301347121774592119 26_shared/overview

REFERENCE WEB LINKS AND VIDEO LECTURES (E – RESOURCES):

18.

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DATA VISUALIZATION USING R

(Effective from the Academic Year 2022 - 2023)

IV SEMESTER

Course Code	**CS42297CC**	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	20P	Exam Hours	03

CREDITS – 1

COURSE PREREQUISITES:

19. Basic Knowledge R programming and data manipulation concepts.

COURSE OBJECTIVES:

20. Understand the basic plots and major packages available for plotting graphs in R.
21. To develop small applications using R Programming

TEACHING - LEARNING STRATEGY:

Following are some sample strategies that can be incorporate for the Course Delivery

22. Chalk and Talk Method/Blended Mode Method
23. Power Point Presentation
24. Expert Talk/Webinar/Seminar
25. Video Streaming/Self-Study/Simulations
26. Peer-to-Peer Activities
27. Activity/Problem Based Learning
28. Case Studies
29. MOOC/NPTEL Courses
30. Any other innovative initiatives with respect to the Course contents

LIST OF EXPERIMENTS

Exp. No.	Experiment Description	CO No.	Bloom's Taxonomy Level
	PART-A		
1	For a given set of training data examples stored in a .CSV file, compute the Mean, Median, Variance, Standard Deviation, Range and Quartiles of one of the attributes using R programming.		

2	For a given set of training data examples stored in a .CSV file, compute the Mean, Median, Variance, Standard Deviation, Range and Quartiles of one of the attributes using R programming.		
3	Write an R program to perform the following operations on strings: Concatenate two strings, compare two strings, Reverse the string and Check if a given string is a palindrome or not.		
4	Write an R program to demonstrate the use of the following String manipulation functions in R: nchar, toupper, tolower, substr, grep, paste, strsplit, sprintf, cat and sub functions.		
PART-B			
1	Write an R program to create the following basic plots: Scatter plot, Line graph, Bar plot and Histogram.		
2	Write an R program to create a 2D and 3D Pie chart with slice percentage & legend.		
3	Using the in-build Iris dataset and ggplot2 package, write an R program to create Scatter plot, Line graph and Bar plot with chart titles and axis titles.		
4	Write an R program to create Histogram and Box plots using ggplot2 package in R.		
5	Using the in-build mtcars dataset and lattice package, write an R program to create Bar plot, Scatter plot, Histogram and Density plot.		

COURSE OUTCOMES

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

CO No.	**Course Outcome Description**	**Bloom's Taxonomy Level**
CO1		
CO2		
CO3		
CO4		
CO5		

CO-PO-PSO MAPPING

CO No.	**Programme Outcomes (PO)**	**Programme Specific Outcome (PSO)**

	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2														
CO3														
CO4														
CO5														

3: Substantial (High)	**2: Moderate (Medium)**	**1: Poor (Low)**

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

31. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).
    Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

32. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).
    Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).
33. In Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
34. A Laboratory Test, similar to the SEE exam is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

    The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

35. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)
36. The respective course instructor will design the assessment criteria for the said assessment components.
37. The assessment components will be made known to the students by the respective Course Coordinators

prior to the commencement of the Laboratory Work.

In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

8. All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
9. SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
0. General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.

Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

REFERENCE WEB LINKS AND VIDEO LECTURES (E – RESOURCES):

1. Essentials of R with Data Analytics, Saroj Dahiya Ratnoo, Himmat Singh Ratnoo, Wiley (India), Low price edition.
2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/data-visualization-with-r/

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GitHub : AI-Powered Developer Platform

(Effective from the Academic Year 2023 - 2024)

IV SEMESTER

Course Code	**CS42297CA**	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24	Exam Hours	03

CREDITS – 1

COURSE PREREQUISITES:

- Basic Knowledge of Programming.

COURSE OBJECTIVES:

- To familiar with basic command of Git
- To create and manage branches
- To understand how to collaborate and work with Remote Repositories
- To familiar with virion controlling commands

TEACHING - LEARNING STRATEGY:

Following are some sample strategies that can be incorporate for the Course Delivery

41. Chalk and Talk Method/Blended Mode Method
42. Practical Based Learning
43. Power Point Presentation
44. Expert Talk/Webinar/Seminar
45. Video Streaming/Self-Study/Simulations
46. Peer-to-Peer Activities
47. Activity/Problem Based Learning
48. Case Studies
49. MOOC/NPTEL Courses
50. Any other innovative initiatives with respect to the Course contents

List of Experiments

Sl. No.	
1	**Setting Up and Basic Commands** Initialize a new Git repository in a directory. Create a new file and add it to the staging area and commit the changes with an appropriate commit message.
2	**Creating and Managing Branches** **51.** Create a new branch named "feature-branch." Switch to the "master" branch. Merge the "feature-branch" into "master." **52.** Write the commands to stash your changes, switch branches, and then apply the stashed changes.
3	**Collaboration and Remote Repositories** 53. Clone a remote Git repository to your local machine. 54. Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch. 55. Write the command to merge "feature-branch" into "master" while providing a custom commit message for the merge.
4	**Git Tags and Releases** Write the command to create a lightweight Git tag named "v1.0" for a commit in your local repository.
5	**Advanced Git Operations** Write the command to cherry-pick a range of commits from "source-branch" to the current branch.
6	**Analysing and Changing Git History** **56.** Given a commit ID, how would you use Git to view the details of that specific commit, including the author, date, and commit message? 57. Write the command to list all commits made by the author "JohnDoe" between "2023-01-01" and "2023-12-31." 58. Write the command to display the last five commits in the repository's history. 59. Write the command to undo the changes introduced by the commit with the ID "abc123".

COURSE OUTCOMES

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

CO No.	Course Outcome Description	Bloom's Taxonomy Level

CO1	Use the basics commands related to git repository	CL3
CO2	Create and manage the branches	CL3
CO3	Apply commands related to Collaboration and Remote Repositories	CL3
CO4	Use the commands related to Git Tags, Releases and advanced git operations	CL3
CO5	Analyse and change the git history	CL3

CO-PO-PSO MAPPING

CO No.	Programme Outcomes (PO)												Programme Specific Outcome (PSO)	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	3		3							1		
CO2	3	2	3		3							1		
CO3	3	2	3		3							1		
CO4	3	2	3		3							1		
CO5	3	2	3		3							1		

3: Substantial (High)	**2: Moderate (Medium)**	**1: Poor (Low)**

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Laboratory Work (A)	50 %	25
	Laboratory Test (B)	30 %	15
	Open Ended Experiments /Mini Projects (C)	20 %	10
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT STRATEGY:

60. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

    Assessment Mode: Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

61. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

Assessment Mode: The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

62. In Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
63. A Laboratory Test, similar to the SEE exam is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)

The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

64. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)
65. The respective course instructor will design the assessment criteria for the said assessment components.
66. The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.

In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

SEE QUESTION PAPER PATTERN:

7. All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
8. SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
9. General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
0. Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

Suggested Learning Resources:

71. Version Control with Git, 3rd Edition, by Prem Kumar Ponuthorai, Jon Loeliger Released October 2022, Publisher(s): O'Reilly Media, Inc.
72. Pro Git book, written by Scott Chacon and Ben Straub and published by Apress, https://gitscm.com/book/en/v2
73. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094443347369984278 2_shared/overview
74. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0133013471217745921 1926_shared/overview