Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure and Syllabus

Second Year B. Tech

Artificial Intelligence and Machine Learning

With effect from Year 2023-24

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

Semester-III(w.e.f. 2023-24)

Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	
							Continuous Assessment (CA)							
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best of (TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1	BS	22BSAI3010T	Engineering Mathematics-III	4	1		20	15	15	15	65	100	5	5
2	PC	22PCAI3020T	Data Structures	3			20	15	15	15	65	100	3	4
	PC	22PCAI3020L	Data Structures Laboratory			2	25				25	50	1	
3	PC	22PCAI3030T	Database Management Systems	3			20	15	15	15	65	100	3	4
	PC	22PCAI3030L	Database Management Systems Laboratory			2	25				25	50	1	
4	PC	22PCAI3040T	Operating Systems	3			20	15	15	15	65	100	3	4
	PC	22PCAI3040L	Operating Systems Laboratory			2	25				25	50	1	
5	PC	22PCAI3050L	Programming Laboratory-I(Python Programming)			2	25				25	50	1	1
6	PJ	22PJAI3060L	Semester Project-I			2	25				25	50	1	1
7	MC	22MCAI3070T	Constitution of India	1									Audit Course	
			Total	14	1	10	205			60	385	650	19	

Prepared by:
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Checked by:
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Prof. Dr. R. B. Wagh
BOS Chairman

Prof. S. P. Shukla
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Dean Academics/Dy. Director

Prof. Dr. J. B. Patil
Director

R. C. Patel Institute of Technology, Shirpur
Autonomous

Semester-IV(w.e.f. 2023-24)

Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	
							Continuous Assessment (CA)							
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best of (TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1	PC	22PCAI4010T	Statistics for Engineers	3			20	15	15	15	65	100	3	4
	PC	22PCAI4010L	Statistics for Engineers Laboratory			2	25					25	1	
2	PC	22PCAI4020T	Artificial Intelligence	3			20	15	15	15	65	100	3	4
	PC	22PCAI4020L	Artificial Intelligence Laboratory			2	25				25	50	1	
3	PC	22PCAI4030T	Data Mining and Analytics	3			20	15	15	15	65	100	3	4
	PC	22PCAI4030L	Data Mining and Analytics Laboratory			2	25				25	50	1	
4	PC	22PCAI4040T	Design and Analysis of Algorithms	3			20	15	15	15	65	100	3	4
	PC	22PCAI4040L	Design and Analysis of Algorithms Laboratory			2	25				25	50	1	
5	PC	22PCAI4050L	Programming Laboratory-II (Web Development)			4	25				25	50	2	2
6	PC	22PCAI4060L	Design Thinking Laboratory			4	25				25	50	2	2
7	HM	22HMAI4070T	Universal Human Values	2	1		20	15	15	15	65	100	3	3
8	PJ	22PJAI4080L	Semester Project-II			2	25				25	50	1	1
9	HM	22HMAI4090L	Employability Skill Development Program-I			2	50					50	1	1
			Total	14	1	20	325			75	475	875	25	

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Engineering Mathematics - III (22BSAI3010T)

Teaching Scheme
Lectures : 04 Hrs./week
Tutorial : 01 Hr/week
Credits : 05

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of

1. Solving a simultaneous linear equation using concept of matrices.
2. Calculus

Course Objectives:

1. Understanding basic concepts of linear algebra.
2. Apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
3. To understand the concept of Optimization and enhance the problem solving skills and Optimization techniques.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Learn the basic notation of vector spaces and subspaces.	L3	Apply
CO2	Apply the concept of inner product spaces to the engineering problems.	L3	Apply
CO3	Apply the concept of vector spaces using linear transformations which is used in computer graphics and inner product spaces.	L3	Apply
CO4	Apply the concepts of eigenvalue and eigenvectors and diagonalization in linear systems.	L3	Apply
CO5	Apply the concept of Linear &Non-Linear Programming Problem to the engineering problems.	L3	Apply

Course Contents

Unit-I

04 Hrs.

Vector Spaces:

Preview: Linear combinations of vectors, Linearly dependent and independent vectors.

Definition of vector space over R, Subspaces.

Basis and Dimension.

Unit-II

05 Hrs.

Inner Product Spaces:

Dot product in R, Definition of general inner product on a vector space over R.

Norm of a vector in an inner product space. Cauchy-Schwarz inequality. Orthogonal sets and orthonormal sets in an inner product space. Orthogonal and orthonormal bases. Gram-Schmidt orthogonalization process simple examples in R^2, R^3

Unit-III

08 Hrs.

Linear Transformations: Definition and properties.

Kernel and image of a linear transformation, Rank-Nullity Theorem.

Invertible Linear Transformation, Relation between matrices and Linear Transformations, Change of bases.

Unit-IV

08 Hrs.

Matrices:

Eigen values, Eigen vectors and their properties.

Cayley-Hamilton theorem (without proof) and its application.

Similar matrices, diagonalization of matrix.

Functions of square matrix.

Singular value decomposition.

Unit-V

04 Hrs.

Calculus: Gradient, directional derivatives, Jacobian, Hessian, convex sets, convex functions, and its properties.

Unit-VI

10 Hrs.

Optimization:

Unconstrained optimization techniques: Newton's method, Quasi Newton method.

Constrained optimization techniques: gradient descent, stochastic gradient descent, Penalty

function method, Lagrange multiplier method, Karush– Kuhn–Tucker method, Simplex method, Penalty and Duality, Dual simplex method, Downhill simplex method.

Tutorials :

Term work shall consist of minimum 8 Tutorials covering the entire modules.

List of Tutorials:

1. Vector Space.
2. Inner Product Space.
3. Gram-Schmidt orthogonalization process.
4. Linear Transformation.
5. Eigen Value and Eigen Vector and Similarity of Matrices.
6. Cayley-Hamilton Theorem, Functions of square matrix.
7. Singular value decomposition.
8. Calculus
9. Unconstrained Optimization Techniques.
10. Constrained Optimization Techniques.

Minimum eight tutorials from the above suggested list or any other tutorial based on syllabus will be included, which would help the learner to apply the concept learnt.

Text Books:

1. Jin Ho Kwak and Sungpyo Hong, "Linear Algebra", 2^{nd} Edition, Springer, 2004.
2. Bernard Kolman and David, R. Hill, "Introductory Linear Algebra- An applied first course", 9^{th} Edition, Pearson Education, 2011.
3. Hira and Gupta, "Operation Research", S Chand.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 10^{th} Edition, John Wiley India, 2015.

Reference Books:

1. Stephen Andrilli and David Hecker, "Elementary Linear Algebra", 5^{th} Edition, Academic Press, 2016.
2. Rudolf Lidl, Guter Pilz,"Applied Abstract Algebra", 2^{nd} Edition, Springer 2004.
3. Howard Anton, Robert C Busby, "Contemporary linear algebra", Wiley 2003.
4. Gilbert Strang, "Introduction to Linear Algebra", 5^{th} Edition, Cengage Learning, 2015.

5. S.D. Sharma Kedar Nath, Ram Nath & Co. Meerat, "Operations Research".

6. Singiresu S.Rao, "Engineering optimization (Theory and Practice)", New Age International publication.

7. B. S. Grewal, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, India, 2015.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Data Structures (22PCAI3020T)

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs./week	Term Test : 15 Marks
Credits : 03	Teacher Assessment : 20 Marks
	End Sem Exam : 65 Marks
	Total Marks : 100 Marks

Prerequisite: C – Programming

Course Objectives:

The objective of the course is to introduce and familiarize students with linear and non-linear data structures, their use in fundamental algorithms and design & implementation of these data structures. To introduce students to the basics of algorithms and time complexity. To familiarize students with various sorting and searching techniques, and their performance comparison.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the concept of time complexity for algorithms.	L2	Understand
CO2	Assimilate the concept of various linear and non-linear data structures.	L2	Understand
CO3	Solve the problem using appropriate data structure.	L3	Apply
CO4	Implement appropriate searching and sorting algorithms for a given problem.	L3	Apply

Course Contents

Unit-I

04 Hrs.

Basics of Algorithms: Algorithms, Characteristics of an Algorithm, Time and Space Complexities, Order of Growth functions, Preliminary Asymptotic Notations.

Data Structures: Introduction, need of Data Structures, Types of Data Structures, Abstract Data Types (ADT)

Unit-II

06 Hrs.

Linear Data Structures – LIST: List as an ADT, Array-based implementation, Linked List implementation, singly linked lists, circularly linked lists, doubly-linked lists, All operations (Insertion, Deletion, Merge, Traversal, etc.) and their analysis, Applications of linked lists - (Polynomial Addition).

Unit-III

04 Hrs.

Linear Data Structure – STACK: Stack as an ADT, Operations, Array and Linked List representation of Stack, Applications – Reversing data, Conversion of Infix to prefix and postfix expression, Evaluation of postfix and prefix expressions, balanced parenthesis, etc.

Unit-IV

04 Hrs.

Linear Data Structure – QUEUE: Queue as an ADT, Operations, Implementation of Linear Queue, Circular and Priority Queue using arrays and Linked List, DEQueue, Applications – Queue Simulation.

Unit-V

10 Hrs.

Non-Linear Data Structure – TREES: Tree Terminologies, Tree as an ADT, Binary Tree - Operations, Tree Traversals, Binary Search Tree (BST) - Operations, Expression Trees

Height Balanced Tree: Creation of AVL Tree

Heap: Operations on heap

Applications: Huffman coding

Unit-VI

03 Hrs.

Non-Linear Data Structure – GRAPHS: Graph Terminologies, Types of Graphs, Representation of Graph using arrays and Linked List, Breadth-First Search (BFS), Depth–First Search (DFS), Applications of Graphs -Topological sorting.

Unit-VII

08 Hrs.

Searching: Linear Search, Binary Search and Fibonacci search.

Sorting: Bubble Sort, Selection Sort, Heap Sort, Insertion Sort, Radix Sort, Merge Sort, Quick Sort. Analysis of Searching and Sorting Techniques.

Hashing: Hash Functions, Overflow handling, Collision & Collision Resolution Techniques, Linear hashing, Hashing with chaining, Separate Chaining, Open Addressing, Rehashing and Extendible hashing.

Text Books:

1. R. F. Gilberg and B. A. Forouzan, "Data Structures – A Pseudocode Approach with C", 2^{nd} Edition, Cengage Learning, 2005.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2^{nd} Edition, W. H. Freeman, and Company 2008.

Reference Books:

1. Mark A. Weiss, "Data Structures and Algorithm Analysis in C", 4^{th} Edition, Pearson, 2014.
2. M. T. Goodritch, R. Tamassia, D. Mount, "Data Structures and Algorithms in C++", Wiley, 2^{nd} Edition, 2011.
3. Kruse, Leung, Tondo, "Data Structures and Program Design in C", 2^{nd} Edition, Pearson Education, 2013.
4. Tenenbaum, Langsam, Augenstein, "Data Structures using C", 2^{nd} Edition Pearson, 2015.
5. J. P. Tremblay and P. G. Sorenson, "Introduction to Data Structures and its Applications", 2^{nd} Edition, McGraw-Hill, 1984.
6. Aho, Hopcroft, Ullman, "Data Structures and Algorithms", Addison-Wesley, 2010.
7. Reema Thareja, "Data Structures using C", Oxford, 2017.
8. Seymour Lipschutz, "Data Structures, Schaum's Outline Series", 1^{st} Edition, Tata McGraw-Hill, 2014.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.

2. Total duration allotted for writing the paper is 2 hrs.

Data Structures Laboratory (22PCAI3020L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

The course intends to introduce and familiarize students with data structures, their use in solving real time complex problems and implementation of these data structures. The course also aims to provide mathematical approach for analyzing algorithms using asymptotic notation and for measuring efficiency of algorithms. Finally, the course intends to make students learn various sorting and searching techniques and choose efficient one based on their efficiency.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand of stack and Demonstrate its operations.	L2	Understand
CO2	Demonstrate different types of queue and its operations.	L2	Understand
CO3	Demonstrate various Linked list types and its operations.	L2	Understand
CO4	Demonstrate heap-sort and compare Hashing techniques	L2, L4	Understand, Analyze
CO5	Understand and compare various searching and sorting techniques.	L2, L4	Understand, Analyze

List of Laboratory Experiments(At Least 10)

Suggested Experiments:

1. Implementation of Linked List using menu driven approach.
2. Implementation of different operations on linked list –copy, concatenate, split, reverse, count no. of nodes etc.
3. Implementation of polynomials operations (addition, subtraction) using Linked List.
4. Implementation of stack using menu driven approach.
5. Implementation of Infix to Prefix. Transformation and its evaluation program.
6. Implementation of prefix and postfix evaluation using menu driven approach.
7. Implementation of parenthesis checker using stack.
8. Implementation of Linear queue using menu driven approach.
9. Implementation of circular queue using menu driven approach.
10. Implementation of double ended queue menu driven program.
11. Implementation of Priority queue program using array and Linked list.
12. Implementation of Binary Tree using menu driven approach.
13. Implementation of Binary Tree Traversal.
14. Implementation of BST using following operations – create, delete, display.
15. Implementation of various operations on tree like – copying tree, mirroring a tree, counting the number of nodes in the tree, counting only leaf nodes in the tree.
16. Implementation of Graph traversal using menu driven program (DFS & BSF).
17. Implementations of Selection sort, Radix sort using menu driven.
18. Implementation of Heap & Heap Sort using menu driven program.
19. Implementation of Advanced Bubble Sort and Insertion Sort using menu driven Program.
20. Implementation of searching methods (Index Sequential, Fibonacci search, Binary Search) using menu driven program.
21. Implementation of hashing functions with different collision resolution techniques.

A minimum of 10 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI3020T with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Database Management Systems
(22PCAI3030T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Course Objectives:

The course intends to introduce the students to the management of database systems, with an emphasis on how to design, organize, maintain and retrieve information efficiently and effectively from a database.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Design an optimized database.	L6	Create
CO2	Construct SQL queries to perform operations on the database.	L6	Create
CO3	Demonstrate appropriate transaction management and recovery techniques for a given problem.	L2	Understand
CO4	Apply indexing mechanisms for efficient retrieval of information from database.	L3	Apply

Course Contents

Unit-I Introduction to Database Concepts — 03 Hrs.

Introduction, Characteristics of Databases, File System v/s Database System, Users of Database System, Schema and Instance, Data Independence, DBMS System Architecture, Database Administrator.

Unit-II Relational Data Model — 09 Hrs.

The Entity-Relationship (ER) Model: Entity Types: Weak and Strong Entity Sets, Entity Sets, Types of Attributes, Keys, Relationship Constraints: Cardinality and Participation.

Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation.

Relational Model: Introduction to the Relational Model, relational schema and concept of keys, Mapping the ER and EER Model to the Relational Model, Introduction to Object-Relational Databases, ORDBMS Vs Relational Databases

Relational Algebra: Unary and Set operations, Relational Algebra Queries

Unit-III Structured Query Language (SQL) — 09 Hrs.

Overview of SQL, Data Definition Commands, Data Manipulation commands, Integrity constraints - key constraints, Domain Constraints, Referential integrity, check constraints, Data Control commands, Transaction Control Commands, Set and String operations, aggregate function - group by, having, Views in SQL, joins, Nested and complex queries, Triggers, Security and authorization in SQL

Unit-IV Relational Database Design — 05 Hrs.

Pitfalls in Relational-Database Designs, Concept of Normalization, Functional Dependencies, Normal Forms- 1NF, 2NF, 3NF, BCNF

Unit-V Transaction Management and Recovery — 09 Hrs.

Transaction Concept, ACID properties, Transaction States, Implementation of atomicity and durability, Concurrent Executions, Serializability, Concurrency Control Protocols: Lock-based, Timestamp based, Validation Based, Deadlock Handling, Recovery System: Failure classification, Log based recovery, Shadow Paging, ARIES recovery algorithm.

Unit-VI Indexing Mechanism — 04 Hrs.

Hashing Techniques, Types of Indexes: Single Level Ordered Indexes, Multilevel Indexes, Overview of B-Trees and B+ Trees.

Text Books:

1. Korth, Silberchatz, Sudarshan, "Database System Concepts", 7th Edition, McGraw – Hill, 2019.
2. Elmasri and Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016.
3. Peter Rob and Carlos Coronel, "Database Systems Design", Implementation and Management, 5th Edition, Thomson Learning, 2002.
4. G. K. Gupta, "Database Management Systems", 3rd Edition, McGraw – Hill, 2018.

Reference Books:

1. Dr. P.S. Deshpande, "SQL and PL/SQL for Oracle 10g", Black Book, Dreamtech Press, 2012.
2. Sharaman Shah, "Oracle for Professional", Shroff Publishers & Distributers Private Limited, 1st Edition, 2008
3. Raghu Ramkrishnan and Johannes Gehrke, "Database Management Systems", 3rd Edition, McGraw – Hill, 2014.
4. Patrick Dalton, "Microsoft SQL Server Black Book", Coriolis Group,U.S., 11th Edition, 1 July 1997
5. Lynn Beighley, "Head First SQL", O'Reilly Media, 1st Edition (28 August 2007)

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Database Management Systems Laboratory (22PCAI3030L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

1. Define the basics of Database Management Systems.
2. Understand the key concepts of DBMS.
3. Understand the fundamentals and essentials of SQL.
4. Construct a relational database and retrieve information from the database by formulating SQL queries.
5. Explain the concepts of transaction, concurrency and recovery
6. Understand the Advance Concepts of ADBMS.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Build ER diagram for the given Application.	L3	Apply
CO2	Utilize ER/EER Concepts to Convert into Relational Schema Model.	L3	Apply
CO3	Design & Create Database for given application using DDL & DML Commands and apply various integrity Constraints.	L6	Create
CO4	Apply string, Join operation, nested queries on given application database.	L3	Apply
CO5	Examine the consistency of database using concurrency control technique (Locks).	L4	Analyze

List of Laboratory Experiments(At Least 08)

1. To draw an ER diagram for a problem statement.
2. Map the ER/EER to relational schema.
3. To implement DDL and DML commands with integrity constraints.
4. To access & modify Data using basic SQL.
5. To implement Joins and Views.
6. To implement Subqueries.
7. To implement triggers.
8. Examine the consistency of database using concurrency control technique (Locks)
9. To simulate ARIES recovery algorithm.
10. To implement B-trees/B+ trees.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI3030T with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Operating Systems (22PCAI3040T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Programming Language C and Basics of Hardware, i.e., ALU, RAM, ROM, HDD, etc

Course Objectives:

The objective of this course is to familiarize students with the functionality of an Operating System, its basic components & interaction among them. The course will also expose students to analyze and evaluate different policies for scheduling, deadlocks, memory management, synchronization, file management & I/O and implement these policies using a suitable programming language.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the role of Operating System in terms of process, memory, file and I/O management.	L2	Understand
CO2	Apply appropriate process scheduling, memory mapping and disk scheduling methods.	L3	Apply
CO3	Identify the need of concurrency and apply the appropriate method to solve the concurrency or deadlock problem.	L3	Apply
CO4	Apply and analyze different techniques of file and I/O management.	L3, L4	Apply, Analyze

Course Contents

Unit-I Introduction to Operating System — 08 Hrs.

Operating System Objectives, basic functions and services, Evolution of operating system, Operating System structures (monolithic, microkernel), Types of Operating Systems: Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real-time O.S., Linux OS, Mobile OS, System calls.

Unit-II Process Management — 08 Hrs.

Concept of a Process, Process States, Process Description, Process Control Block, Operations on Processes.

Threads: Definition and Types, Concept of Multithreading

Scheduling: Types of Scheduling: Preemptive and, Non-preemptive, Scheduling algorithms and their performance evaluation: FCFS, SJF, SRTF, Priority based, Round Robin.

Unit-III Process Synchronization — 08 Hrs.

Concurrency: Principles of Concurrency, Inter-Process Communication, Process/Thread Synchronization.

Mutual Exclusion: Requirements, Hardware and Software Support, Semaphores and Mutex, Monitors, Classical synchronization problems: Producer and Consumer problem, Readers/Writers Problem.

Unit-IV Deadlock — 07 Hrs.

Principles of deadlock, Conditions for deadlock, Resource Allocation Graph, Deadlock Prevention, Deadlock Avoidance: Banker's Algorithm for Single & Multiple Resources, Deadlock Detection and Recovery. Dining Philosophers Problem.

Unit-V Memory Management — 04 Hrs.

Memory Management Requirements, Memory Partitioning: Fixed Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Next Fit, Relocation, Paging, Segmentation. Virtual Memory: Demand Paging, Structure of Page Tables, Page Replacement Strategies: FIFO, Optimal, LRU, LFU, Thrashing.

Unit-VI File and I/O management — 04 Hrs.

File Management: Overview, File Organization and Access, Secondary Storage Management: File Allocation Methods

Input /Output Management: I/O Management and Disk Scheduling: I/O Devices, I/O Buffering, Disk Scheduling algorithm: FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK. RAID

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 8th Edition, John Wiley & Sons, Inc., 2018.
2. Tanenbaum, "Modern Operating System", 4th Edition, Pearson Education, 2014.
3. William Stallings, "Operating System: Internals and Design Principles", 8th Edition, Prentice Hall, 2014. ISBN-10: 0133805913 • ISBN-13: 9780133805918
4. Andrew Tannenbaum, "Operating System Design and Implementation", 3rd Edition, Pearson, 2015.
5. Randal. K. Michael, "Mastering Shell Scripting", 2nd Edition, Wiley Publication, 2008.

Reference Books:

1. Maurice J. Bach, "Design of UNIX Operating System", 2nd Edition, PHI, 2004.
2. Achyut Godbole and Atul Kahate, "Operating Systems", 3rd Edition, McGraw Hill Education, 2017.
3. Remy Card, Eric Dumas, Frank Mevel,"The Linux Kernel Book", 1st Edition, Wiley Publications, 2013.
4. Phillip A. Laplante, Seppo J. Ovaska, "Real Time Systems Design and Analysis", 4th Edition, Wiley-IEEE Press,Dec 2011.
5. Naresh Chauhan, "Principles of Operating Systems", 1st Edition, Oxford University Press, 2014. Prepared

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Operating System Laboratory (22PCAI3040L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

1. To implement CPU scheduling algorithms and memory management strategies and demonstrate working through simulation.
2. To demonstrate working of deadlock handling mechanism through simulation.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate basic operating system commands.	L1,L2	Remember, Understand
CO2	Implement and analyze different process scheduling algorithms.	L3	Apply
CO3	Implement and analyze different memory management algorithms and disk scheduling.	L4	Analyze
CO4	Evaluate process management techniques and deadlock handling using simulator.	L5	Evaluate

List of Laboratory Experiments(At Least 08)

Suggested Experiments:

1. Explore the internal commands of linux and Write shell scripts to do the following: Display top 10 processes in descending order Display processes with highest memory usage. Display current logged in user and logname. Display current shell, home directory, operating system type, current path setting, current working directory. Display OS version, release number, kernel version. Illustrate the use of sort, grep, awk, etc.
2. System calls for file manipulation.
3. CPU scheduling algorithms like FCFS, SJF, Round Robin etc.
4. There is a service counter which has a limited waiting queue outside it. It works as follows:
   - The counter remains open till the waiting queue is not empty.
   - If the queue is already full, the new customer simply leaves.
   - If the queue becomes empty, the outlet doors will be closed (service personnel sleep) item Whenever a customer arrives at the closed outlet, he/she needs to wake the person at the counter with a wake-up call.
   - Implement the above-described problem using semaphores or mutexes along with threads. Also show how it works, if there are 2 service personnel, and a single queue. Try to simulate all possible events that can take place, in the above scenario.
5. Implement Banker's Algorithm for deadlock avoidance.
6. Implement Placement algorithms (Best, First, Worst fit).
7. Implement various page replacement policies (LRU, FIFO, Optimal).
8. Implement File allocation techniques (Sequential, Indexed, Linked).
9. Implement disk scheduling algorithm FCFS, SSTF, SCAN, CSCAN etc.
10. Using the CPU-OS simulator analyze and synthesize the following:
    - Process Scheduling algorithms.
    - Thread creation and synchronization.
    - Deadlock prevention and avoidance.
11. Building a scheduler in XV6
12. Building own file system.

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI3040T with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including the practicals performed during laboratory sessions.

Programming Laboratory-I (Python Programming)(22PCAI3050L)

Teaching Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Prerequisite: C Programming

Course Objectives:

1. To learn the basic and OOP concepts of Python.
2. To study various advanced python concepts like inheritance, exception handling, modules etc.
3. Learn to develop GUI based standalone and web application.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand basic and object-oriented concepts, data structure implementation in python.	L2	Understand
CO2	Apply file, directory handling and text processing concepts in python.	L3	Apply
CO3	Apply database connectivity, client-server communication using python.	L3	Apply
CO4	Develop python-based application (web/Desktop) using using Django web framework/Tkinter.	L6	Create

Course Contents

Unit-I Python basics — 04 Hrs.

Data types in python, Operators in python, Input and Output, Control statement, Arrays in python, String and Character in python, Functions, List and Tuples, Dictionaries, Limitations of Python.

Unit-II Control Statements and Functions — 04 Hrs.

If statement, if-elif-else, Repetition using while loop, for loop, defining a Function, Checking & Setting Your Parameters, Default arguments, Variable length arguments, Defining and calling functions within a function, Layers of Functions, Lambda and Filter, Zip (), Map (), Reduce () function, recursion, Function Decorators.

Unit-III Introduction to OOP — 06 Hrs.

Creating a Class, Self-Variables, Constructors, Types of Methods, Constructors in Inheritance, Polymorphism, the super () Method, Method Resolution Order (MRO), Operator Overloading, Method Overloading & Overriding, Interfaces in Python. **Exceptions Handling:** Exceptions, Exception Handling, Types of Exceptions, Except Block, assert Statement, User Defined Exceptions.

Unit-IV Advanced Python — 03 Hrs.

Building Modules, Packages: Python Collections Module, Opening and Reading Files and Folders, Python OS Module, Python Datetime Module, Python Math and Random Modules, Text Processing, Regular expression in python.

Unit-V Python Integration Primer Graphical User interface using Tkinter — 03 Hrs.

Form designing, Networking in Python: Client Server socket programming, Python database connectivity: Data Definition Language (DDL), and Data Manipulation Language (DML).

Unit-VI Python advance Modules — 06 Hrs.

Numpy: Working with Numpy, Constructing Numpy arrays, Printing arrays, Arithmetic Operations on matrix's, numpy zeros() Matplotlib: Matplotlib- Plot different charts, **Pandas:** Data Processing, Pandas-Data structure, Pandas-Series data, Data Frames, Introduction to data processing using pandas.

List of Laboratory Experiments

1. Write a python program to understand Expressions, Variables, Quotes, Basic Math operations.
2. Write a python program to demonstrate applications of different decision-making statements.
3. Write a python program to implement Basic String Operations & String Methods.
4. Write a python program to implement functions of List, Tuples, and Dictionaries.
5. Write a Python program to implement Arrays (1D, 2D) applications.
6. Write a python program to implement Functions and Recursion.
7. Write a python program to implement Lambda, Map, and Reduce Functions.
8. Write a python program to implement concept of Function decorators.
9. Write a python program to implement Classes & objects, Constructors.
10. Write a python program to implement Inheritance & Polymorphism.
11. Write a python program to implement Exception handling.
12. Write a python program to understand different File handling operations with exception handling.
13. Write a python program to implement database connectivity and DDL and DML commands in python using SQLite.
14. Write a python program to understand GUI designing (Programs based on GUI designing using Tkinter).
15. Implement different Machine learning packages like numpy, pandas and matplotlib.

Minimum 08 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Text Books:

1. Dr. R. Nageswara Rao, "Core Python Programming", 3rd Edition, Dreamtech Press, 2018.
2. Mark Lutz, "Learning Python", 5th Edition", Oreilly Publication, 2013.
3. E Balagurusamy, "Introduction to computing and problem-solving using Python", McGraw Hill Education, 2018.

Reference Books:

1. Zed A. Shaw, "Learn Python the Hard Way", 3rd Edition, Addison–Wesley Publication, 2014.

2. Laura Cassell, Alan Gauld, "Python Projects", Wrox Publication, 2015.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI3050L with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks

2. Journal Submission: 05 Marks

3. Viva-voce: 05 Marks

4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Semester Project-I (22PJAI3060L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

Students are expected to design, simulate/implement a project based on the knowledge acquired from current semester subjects.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Conduct a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Demonstrate various/alternate approaches to complete a project.	L2	Understand
CO3	Ensure a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Present their project work in the form of a technical report / paper and thereby improve the technical communication skill.	L3	Apply
CO5	Demonstrate the ability to work in teams and manage the conduct of the research study.	L2	Understand

Semester Project:

The purpose of semester project is to provide exposure to students with a variety of projects based on the knowledge acquired from the semester subjects. This activity is supposed to enrich their academic experience and bring enough maturity in student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation and discussion of technical ideas/topics. Therefore, proper attention shall be paid to the content of semester project report which is being submitted in partial fulfillment of the requirements of the Second Year and it is imperative that a standard format be prescribed for the report.

Each student shall work on project approved by departmental committee approved by the Head of Department, a group of 03 to 05 students (max allowed: 5 students in extraordinary cases, subject to the approval of the department committee and the Head of the department) shall be allotted for each Semester Project. Each group shall submit at least 3 topics for the Semester Project. The departmental committee shall finalize one topic for every group. Semester Project Title or Theme should be based on knowledge acquired during semester. The project work shall involve sufficient work so that students get acquainted with different aspects of knowledge acquired from semester subjects.

Student is expected to:

- Select appropriate project title based on acquired knowledge from current semester subjects.
- Maintain Log Book of weekly work done(Log Book Format will be as per Table 1).
- Report weekly to the project guide along with log book.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).

Prescribed project report guidelines:

Size of report shall be of minimum 25 pages. Project Report should include appropriate content for:

- Introduction
- Literature Survey
- Related Theory
- Implementation details

- Project Outcomes
- Conclusion
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress and marks allocation will be as per Table 2.

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

Departmental committee (including project guide) will evaluate project as per Table 3.

Each group shall present/publish a paper based on the semester project in reputed/peer reviewed Conference/Journal/TechFest/Magazine before end of the semester.

Table 1: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 2: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintenance	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 3: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Simulation/ Logic	Hardware/ Programming	Result Verification	Presentation	Total
			5	5	5	5	5	25

Constitution of India (22MCAI3070T)

Teaching Scheme
Lectures : 01 Hr/week

Audit Course

Course Objectives:

1. To provide basic information about Indian constitution.
2. To identify individual role and ethical responsibility towards society.
3. To understand human rights and its implications.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Have general knowledge and legal literacy and thereby to take up competitive examinations.	L2	Understand
CO2	Understand state and central policies, fundamental duties.	L2	Understand
CO3	Understand Electoral Process, special provisions.	L2	Understand
CO4	Understand powers and functions of Municipalities, Panchayats and Co-Operative Societies.	L2	Understand
CO5	Understand Engineering ethics and responsibilities of Engineers.	L2	Understand
CO6	Understand Engineering Integrity & Reliability	L2	Understand

Course Contents

Unit-I Introduction to the Constitution of India — 02 Hrs.

The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.

Unit-II Directive Principles of State Policy — 03 Hrs.

Relevance of Directive Principles State Policy Fundamental Duties.

Union Executives – President, Prime Minister Parliament Supreme Court of India.

Unit-III State Executives — 03 Hrs.

Governor, Chief Minister, State Legislature High Court of State.

Electoral Process in India, Amendment Procedures, 42^{nd}, 44^{th}, 74^{th}, 76^{th}, 86^{th} & 91^{st} Amendments.

Unit-IV Special Provisions — 03 Hrs.

For SC & ST Special Provision for Women, Children & Backward Classes, Emergency Provisions.

Human Rights:

Meaning and Definitions, Legislation Specific Themes in Human Rights- Working of National Human Rights Commission in India Powers and functions of Municipalities, Panchyats and Cooperative Societies.

Unit-V Scope & Aims of Engineering Ethics — 03 Hrs.

Responsibility of Engineers Impediments to Responsibility.

Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.

Text Books:

1. Durga Das Basu, "Introduction to the Constitution on India", (Student Edition) Prentice –Hall EEE, 19^{th}/ 20^{th} Edition, 2001.
2. Charles E. Haries, Michael S Pritchard and Michael J. Robins, "Engineering Ethics", Thompson Asia, 2003-08-05.

Reference Books:

1. M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
2. M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice – Hall of India Pvt. Ltd. New Delhi, 2004.
3. Brij Kishore Sharma, "Introduction to the Constitution of India", PHI Learning Pvt. Ltd., New Delhi, 2011.

4. Latest Publications of Indian Institute of Human Rights, New Delhi.

Web Resources

1. www.nptel.ac.in
2. www.hnlu.ac.in
3. www.nspe.org
4. www.preservearticles.com

Evaluation Scheme:

1. Student should submit a report on the case study declared by teacher.
2. Audit point shall be awarded subject to submission of report of the case study declared by teacher.

Statistics for Engineers (22PCAI4010T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Calculus, Descriptive Statistics, Basics of probability.

Course Objectives:

To build the strong foundation in statistics which can be applied to analyze data and make predictions.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the concepts of probability and distributions to some case studies.	L3	Apply
CO2	Interpret and predict the basic statistical model for given data using simple linear regression.	L3	Apply
CO3	Demonstrate sampling distributions and estimate statistical parameters.	L2	Understand
CO4	Develop hypothesis based on data and perform testing using various statistical techniques.	L6	Create
CO5	Perform analysis of variance on data.	L3	Apply
CO6	Apply the concept of Markov Process.	L3	Apply

Course Contents

Unit-I — 08 Hrs.

Random Variables and Probability Distributions:

Concept of a Random Variable, Discrete Probability Distributions, Continuous Probability Distributions, Statistical Independence.

Discrete Probability Distributions: Binomial Distribution, Poisson distribution.

Continuous Probability Distributions: Normal Distribution, Areas under the Normal Curve, Applications of the Normal Distribution, Normal Approximation to the Binomial.

Unit-II — 05 Hrs.

Simple Linear Regression and Correlation:

Introduction to Linear Regression, The Simple Linear Regression Model, Least Squares and the Fitted Model, Properties of the Least Squares Estimators, Inferences Concerning the Regression Coefficients, Prediction, Simple Linear Regression Case Study.

Unit-III — 04 Hrs.

Sampling distribution:

Random Sampling, Sampling Distributions, Sampling Distribution of Means and the Central limit theorem, population distribution, Z - distribution, Student's t-distribution, F-Distribution, Chi-square distribution.

Unit-IV — 11 Hrs.

Statistical Estimation and Test of Hypothesis:

Estimation Theory: Characteristics of estimators, consistency, unbiasedness, unbiased estimates, efficient estimates, sufficient estimators, point estimates, interval estimates, determination of sample size for estimating mean and proportions, estimates of population parameters, probable error.

Confidence interval: Population mean, difference between two population means, population proportion, difference between two population proportions, variance, ratio of variances of two populations.

Test of Hypothesis: Test of significance, null and alternative hypothesis, type I and type II error, factors affecting Type II error, probability of Type II error, power of test, p Value, critical region, level of significance.

Parametric Test: Test the difference between sample proportion and population proportion, difference between two sample proportion, difference between sample mean and population mean with known σ and unknown σ, difference between two sample means, one tailed and two tailed tests using z-statistics and t-statistics. Test the equality of population variance using F-statistics.

Non-parametric Test: Test of independence, goodness of fit using chi-square statistics.

Unit-V

05 Hrs.

Analysis of Variance (ANOVA) for data analysis:

Sample size calculation, one way ANOVA, POST-HOC Analysis (Tukey's Test), randomized block design, two-way ANOVA

Unit-VI

06 Hrs.

Stochastic Processes and Markov Chains:

Introduction to Stochastic processes- Markov process. Transition Probability, Transition Probability Matrix, First order and Higher order Markov process, n step transition probabilities, Markov chain, Steady state condition, Markov analysis.

Text Books:

1. S. P. Gupta,"Statistical Methods", 46th Edition, Sultan Chand, 2021.
2. T. Veerarajan, "Probability - Statistics and Random Processes", McGraw Hill Education, 3rd Edition, 2017.
3. Allen B. Downey, "Think Stats: Probability and Statistics for Programmers", Green Tea Press, 2011.
4. E. L. Lehmann, Joseph P. Romano, "Testing Statistical Hypotheses", 3rd Edition, Springer, 2008.
5. Thomas Hasalwanter,"An Introduction to Statistics with Python", Springer, 2016.

Reference Books:

1. S. C. Gupta, V. K. Kapoor,"Fundamentals of Mathematical Statistics", 12th Edition, Sultan Chand, 2020.
2. Peter Bruce, Andrew Bruce, Peter Gedeck,"Practical Statistics for data scientists 50+ Essential Concepts Using R and Python", 2nd Edition, Orelly, 2020.
3. Freedman, David, Robert Pisani, Roger Pervis, W. W. Norton, "Statistics", 2007.
4. Sheldon M Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, 5th Edition, 2014.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.

2. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.

2. Total duration allotted for writing the paper is 2 hrs.

Statistics for Engineers Laboratory (22PCAI4010L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
Total : 25 Marks

Course Objectives:

To build the strong foundation in Statistics which can be applied to analyze data and make predictions.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Outline different types of data and its visualization.	L2	Understand
CO2	Choose appropriate descriptive statistics measures for statistical analysis.	L3	Apply
CO3	Solve Confidence Interval for different parameters.	L3	Apply
CO4	Examine hypothesis test using various statistics.	L4	Analyze
CO5	Discuss nonparametric tests of hypotheses.	L6	Create
CO6	Solve Correlation and Regression Data Analytical Methods.	L3	Apply

List of Laboratory Experiments(At Least 08 using Python)

Suggested Experiments:

1. To perform descriptive statistics on data.
2. To visualize descriptive statistics on data.
3. To calculate probability using probability distribution.
4. To perform correlation and simple regression analysis on given data.
5. To verify central limit theorem.
6. To study sampling distributions and their parameters.
7. To perform statistical estimation tests on data.
8. To calculate confidence interval for different parameters.
9. To perform hypothesis test using Z statistics and t statistics.
10. To perform hypothesis test using F statistics.
11. To perform hypothesis test using Chi square.
12. To perform ANOVA on given data.
13. To perform POST-HOC Analysis (Tukey's Test) on given data.
14. To perform Markov Analysis on given data.

Minimum 08 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI4010T with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Artificial Intelligence (22PCAI4020T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Basic knowledge of any programming language.

Course Objectives:

To expose the student to the fundamental concepts of Artificial Intelligence and Machine Learning with its applications

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.	L2	Understand
CO2	Understanding about the basic concepts of Intelligent agent's ad representation of knowledge.	L2	Understand
CO3	Demonstrate awareness and a fundamental understanding of various applications of AI techniques.	L2	Understand
CO4	Apply basic principles of AI in solutions that require problem solving, knowledge representation, and learning.	L3	Apply

Course Contents

Unit-I

07 Hrs.

Introduction to Artificial Intelligence:

Introduction to AI, Components of AI, AI Problems and AI Techniques, solving problems by searching, Problem Formulation, State Space Representation, Applications of AI.

Intelligent Agents:

Structure of Intelligent agents, Types of Agents, Agent Environments PEAS representation for an Agent

Unit-II

07 Hrs.

Problem solving: Solving problems by Searching: Problem Solving Agent, Formulating Problems, Example Problems. Search Methods: Uninformed search: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Methods: Greedy best first Search, A* Search, Memory bounded heuristic Search.

Unit-III

07 Hrs.

Local Search Algorithms and Optimization Problems: Hill climbing search, Simulated annealing, Local beam search, Genetic algorithms, Ant Colony Optimization. Adversarial Search: Games, Optimal strategies, The minimax algorithm, Alpha-Beta Pruning.

Unit-IV

07 Hrs.

Knowledge Representation and Reasoning: A Knowledge Based Agent, Knowledge representation technique: Logical Representation, Semantic Network Representation Frame Representation, Production Rules. Overview of Propositional Logic, First Order Predicate Logic, Inference in First Order Predicate Logic: Forward and Backward Chaining, Resolution.

Unit-V

06 Hrs.

Uncertain Knowledge and Reasoning: Acting under uncertainty, - Conditional Independence, Bayes Rule, Naïve Bayes Classifier, Bayesian Belief network, Inference in Bayesian Belief network, making decision in Complex environments, Markov decision processes.

Unit-VI

05 Hrs.

Planning: Domain independent planning, Forward and Backward search, Goal Stack Planning, Plan Space Planning, Means Ends Analysis, Graph plan, algorithm AO*.

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach", 4^{th} Edition, Pearson Education, 2022.
2. "Artificial intelligence a modern approach", Mikan Ltd ISBN- No 978-1914063183, 2020.
3. Deepak Khemani, "A First Course in Artificial Intelligence", 6^{th} reprint Edition (1 July 2017), McGraw Hill Education (India).

Reference Books:

1. Ela Kumar, "Artificial Intelligence", Dreamtech Press. Ltd, 2020.
2. Elaine Rich, Kevin Knight, Shivshankar B Nair, "Artificial Intelligence", McGraw Hill, 3^{rd} Edition, 2017.
3. Gerhard Welss, "Multi Agents Systems, Publisher", MIT Press, 2^{nd} Edition, 2013.
4. NilsJ. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.
5. M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", 1^{st} Edition, Jones and Bartlett Publishers Inc.;, 2008.

Online References:

1. https://onlinecourses.swayam2.ac.in/aic20_sp06/preview
2. https://onlinecourses.swayam2.ac.in/arp19_ap79/preview

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Artificial Intelligence Laboratory (22PCAI4020L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

Provide understanding of various techniques and algorithms of AI used in problem solving, optimization problems and game programming.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand Intelligent Agents and PEAS for a given problems.	L2	Understand
CO2	Identify and apply searching algorithms to solve problems.	L3	Apply
CO3	Build knowledgebase for a problem.	L3	Apply

List of Laboratory Experiments

Suggested Experiments:

1. Exercise for
   - Design of Intelligent System using PEAS.
   - Problem Definition with State Space Representation.
2. Identify and analyze uninformed search Algorithm to solve the problem. Implement BFS/DFS/DFID search algorithms to reach goal state.
3. Program to implement Local Search algorithm: Hill climbing search.
4. Implement A* search algorithm to reach goal state.
5. Implement minimax algorithm for a two-player game.
6. Program on any nature inspired algorithm to solve a optimization problem in AI.
7. Program on Genetic Algorithm to solve a optimization problem in AI.
8. Implement examples of Predicate Logic, for forward and backward reasoning and resolution.
9. Identify, analyze, implement a planning problem/Rule based Expert System in a real-world scenario.
10. Implementation on any AI Problem: Tic-tac-toe, 8-Queens Problem.
11. A literature survey on any Intelligent system based on IEEE/Scopus-Indexed Publication.

Minimum 10 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI4020T with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Data Mining and Analytics (22PCAI4030T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of basic probability and statistics.

Course Objectives:

1. To understand the significance of data preprocessing, EDA, and feature selection in machine learning.
2. To acquire the knowledge and skills needed to prepare, clean, and transform data.
3. To introduce students to the fundamental concepts and terminology of machine learning.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply data preprocessing techniques to clean and prepare datasets for machine learning.	L3	Apply
CO2	Conduct exploratory data analysis to understand data distributions, relationships, and outliers.	L4	Analyze
CO3	Effectively use graphical representations to visualize data and communicate insights.	L3	Apply
CO4	Implement dimensionality reduction techniques to manage and analyze high-dimensional data.	L4	Analyze

Course Contents

Unit-I — 07 Hrs.

Review of Probability:

Populations and samples, Parameters describing distributions, Central tendency: mean, median and mode, Spread: variance and standard deviation, Skewness and kurtosis, Covariance and Correlation, sampling distributions, Central limit theorem.

Data Preprocessing:

Data Quality, Data Cleaning: Missing Values, Noisy Data, Data Cleaning as a Process.

Data Integration: The Entity Identification Problem, Redundancy and Correlation Analysis, Tuple Duplication, Detection and Resolution of Data Value Conflicts.

Data Transformation and Data Discretization: Data Transformation by Normalization, Discretization by Binning, Discretization by Histogram Analysis.

Unit-II — 06 Hrs.

Introduction to visualization:

Quantitative vs. Qualitative data, Types of Quantitative data: Continuous data, Discrete data, Types of Qualitative data: Categorical data, Binary data, Ordinary data, plotting data using Bar graph, Pie chart, Histogram, Stem and Leaf plot, Dot plot, Scatter plot, box plot, Time-series graph, Exponential graph, Frequency distribution graph, Quantile Plots.

Unit-III — 07 Hrs.

Exploratory Data Analysis (EDA):

Introduction to exploratory data analysis, Typical data formats. Types of EDA, Graphical/Non graphical Methods, Univariate/multivariate methods Correlation and covariance, Degree of freedom, Density plots and estimates Data Visualization (Matplotlib, Seaborn), Identifying Outliers and Anomalies.

Unit-IV — 09 Hrs.

Mining Frequent Patterns:

Market Basket Analysis – Apriori Algorithm – Mining Frequent Itemsets without Candidate Generation –Mining Frequent Itemsets Using Vertical Data Format – Mining Closed Frequent Itemsets – Mining Multilevel Association Rules – Mining Multidimensional Association Rules – Correlation Analysis –Constraint-Based Association Mining.

Spatial and Web Mining:

Spatial Data, Spatial Vs. Classical Data Mining, Spatial Data Structures, Mining Spatial Association and Co-location Patterns, Spatial Clustering Techniques: CLARANS Extension, Web Mining: Web

Content Mining, Web Structure Mining, Web Usage mining, Applications of Web Mining.

Unit-V

07 Hrs.

Introduction to Tableau:

Features of Tableau, Installation of Tableau Desktop/Public, Interface of Tableau (Layout, Toolbars, Data pane, Analytics pane etc), connecting to the various file type, Tableau Charts, Tableau Calculations & Filters, Joins in Tableau, Tableau Advanced Reports, Dashboard Design

Unit-VI

03 Hrs.

Introduction to Machine Learning:

Machine Learning, Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps in developing a Machine Learning Application.

Text Books:

1. Peter Bruce, Andrew Bruce, Peter Gedeck, "Practical Statistics for Data Scientists", 2nd Edition, OReilly Publisher, 2020.
2. Howard J. Seltman, "Experimental Design and Analysis", July 11, 2018.
3. Tom Mittchell, "Machine Learning", McGraw Hill,2017.

Reference Books:

1. "Data Mining for Business Analytics, (An Indian Adaptation): Concepts, Techniques and Applications in Python", Cambridge University Press, ISBN NO. 978-1108727747, 2019.
2. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'reilly,2016.
3. Stephen Marsland, "Machine Learning an Algorithmic Perspective", CRC Press, 2015.
4. Han Kamber, "Data Mining Concepts & Techniques", Morgann Kaufmann Publishers, 2012.
5. Kevin P. Murphy, "Machine Learning — A Probabilistic Perspective", 2012.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview
2. https://www.datacamp.com/tutorial/tableau-tutorial-for-beginners
3. https://www.kaggle.com/code/ekami66/detailed-exploratory-data-analysis-with-python

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Data Mining and Analytics Laboratory (22PCAI4030L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

To analyze and visualize given data using various data analysis strategies.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Perform data pre-processing and identify techniques to handle categorical data.	L5	Evaluate
CO2	Identify outliers and prepare data model.	L6	Create
CO3	Apply visualization techniques to understand and analyse data.	L3	Apply

List of Laboratory Experiments

Suggested Experiments:

1. Data preparation using NumPy and Pandas
   - Collect data from a specific source (e.g., CSV file, API, database) and inspect its structure.
   - Generate summary statistics for a given dataset, including mean, median, standard deviation, and quartiles for numerical columns.
2. Data Preprocessing with pandas.
   - Identify the presence of missing values in a dataset and choose an appropriate method for handling them (e.g., removal, imputation).
   - Remove duplicate records from a dataset and assess the impact on data quality.
3. Handling Categorical Data: One-Hot Encoding.
   - Implement one-hot encoding using Pandas to convert categorical variables into a format suitable for modelling.
4. Data Transformation and Data Discretization. Do the following for the any field.
   - Standardize the variable.
   - Identify how many outliers there are and identify the most extreme outlier. Data Modelling a. Partition the data set, for example 75% of the records are included in the training data set and 25% are included in the test data set.
5. Outlier detection
   - Obtain a listing of all records that are outliers according to the any field. Print out a listing of the 10 largest values for that field.
   - Outlier detection with BoxPLot.
6. Data Visualization using matplotlib.
7. Implement association rule mining.
8. Perform Web Mining Analysis.
9. Tableau installation and basic data analysis with charts and filters.
10. Design interactive dashboard using tableau.

Minimum 08 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI4030T with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Design and Analysis of Algorithms (22PCAI4040T)

Teaching Scheme
Lectures : 03 Hrs./week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Computer Programming, Data structures.

Course Objectives:

1. The course's objective is to introduce important algorithmic design paradigms and approaches for effective problem solving.
2. To analyze the algorithm for its efficiency to show its effectiveness over the others.
3. In addition, the concepts of tractable and intractable problems and the classes P, NP and NP-complete problems will be introduced.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the performance of algorithms using asymptotic analysis.	L4	Analyze
CO2	Solve the problem using appropriate algorithmic design techniques.	L3	Apply
CO3	Able to prove that certain problems are NP-Complete.	L5	Evaluate

Course Contents

Unit-I

08 Hrs.

Introduction: Introduction to Asymptotic Analysis, Analysis of control statements and loops, solving recurrence relations using tree, substitution, master method, analysis of quick sort and merge sort. Problem Solving using divide and conquer algorithm - Max-Min problem, Strassen's Matrix Multiplication

Unit-II

07 Hrs.

Greedy Method: Introduction, control abstraction, Problem solving using - fractional knapsack problem, activity selection problem, job sequencing with deadline, find and union, Minimum Spanning trees (Kruskal's algorithm, Prim's algorithm), Graphs: Single source shortest path (Dijkstra's algorithm), coin change problem.

Unit-III

10 Hrs.

Dynamic Programming: Introduction, principle of optimality, Components of dynamic programming, characteristics of dynamic programming, Fibonacci problem, Coin Changing problem, 0/1 knapsack (table and set method), Multistage graphs, All pairs shortest paths (Floyd Warshall Algorithm), Single source shortest path (Bellman- Ford Algorithm), Matrix Chain Multiplication, Optimal binary search tree (OBST- successful and unsuccessful search), Travelling salesperson problem, Johnson' algorithm for Flow shop scheduling, Longest Common Subsequence (LCS), analysis of all algorithms.

Unit-IV

07 Hrs.

Backtracking: Introduction, Basics of backtracking, N–queen problem, Sum of subsets, Graph coloring, Hamiltonian cycles Generating permutation, Analysis of all algorithms.

Branch-and-Bound: Introduction, Control abstraction-LC BB, FIFO BB, LIFO BB, Properties, FIFO BB, LIFO BB, LC BB, Fifteen Puzzle problem, 0/1 Knapsack problem, Travelling Salesman problem, Job Sequencing with Deadline.

Unit-V

03 Hrs.

String Matching Algorithms: Introduction, The naive string-matching algorithm, The Rabin Karp algorithm, String matching with finite automata, The Knuth Morris Pratt algorithm

Unit-VI

04 Hrs.

Basics of Computational Complexity: Complexity classes: The class P and NP, Polynomial reduction, NP Completeness Problem, NP-Hard Problems, NPCompleteness problem using Travelling Salesman problem (TSP), Approximation algorithm using TSP

Text Books:

1. S. Sridhar, "Design and Analysis of Algorithms", 1st Edition, Oxford Education, 2018.
2. Ellis Horowitz , Sartaj Sahni, S. Rajsekaran, "Fundamentals of computer algorithms", University Press.

Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, "Introduction to Algorithms", 3rd Edition, The MIT Press, 2009.
2. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw- Hill Edition.
3. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI.
4. John Kleinberg, Eva Tardos, "Algorithm Design", Pearson.
5. Michael T. Goodrich, Roberto Tamassia, "Algorithm Design", Wiley Publication.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Design and Analysis of Algorithms Laboratory (22PCAI4040L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

1. Design and implement efficient algorithms for a specified application.
2. Strengthen the ability to identify and apply the suitable algorithm for the given real world problem.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Compare different algorithms based on divide and conquer approach.	L4	Analyze
CO2	Solve different real world problems using dynamic programming technique.	L3	Apply
CO3	Make use of Greedy method to find minimum cost path in graph.	L3	Apply
CO4	Understand and apply backtracking to solve N-Queens problem	L2, L3	Understand, Apply

List of Laboratory Experiments

Suggested Experiments:

1. Implementation of Min Max algorithm
2. Implementation of Strassen's Matrix Multiplication.
3. Implementation of Karatsuba algorithm for long integer multiplication.
4. Fractional Knapsack implementation using greedy approach.
5. Implementation of Activity selection using greedy approach.
6. Implementation of Kruskal's/ Prim's algorithm using greedy approach.
7. Implementation of job sequencing with deadline using greedy approach.
8. Implementation of other greedy algorithms eg: tree vertex split, subset cover, container loading, coin changing, optimal; merge patterns (Huffman tree).
9. Implementation of Single source shortest path (Dijkstra's algorithm).
10. Implementation of Bellman Ford algorithm using Dynamic programming.
11. Implementation of Longest Common Subsequence algorithm using Dynamic programming.
12. Implementation programming of Travelling Salesperson problem using Dynamic programming.
13. Implementation of multistage graphs/ all pair shortest path using dynamic programming.
14. Implementation of N-queen problem using Backtracking.
15. Implementation of 15 Puzzle problem using Backtracking.
16. Implementation of Knuth Morris Pratt string matching algorithm.

Minimum 10 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI4040T with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks

3. Viva-voce: 05 Marks

4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral/ Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Programming Laboratory-II (Web Development)(22PCAI4050L)

Teaching Scheme
Practical : 04 Hrs./week
Credit : 02

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Prerequisite: Python

Course Objectives:

1. To get familiar with the basics of Web fundamentals.
2. To acquire knowledge and skills for creation of web site considering both client and server-side programming.
3. To gain ability to develop responsive web applications.
4. To understand REST API and DB for Frontend and Backend Connectivity.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement interactive web page(s) using HTML5, CSS3 and Bootstrap.	L3	Apply
CO2	Apply JavaScript to add functionality to web page and construct front end development using React JS.	L3	Apply
CO3	Construct back-end development using Django.	L6	Create
CO4	Apply the knowledge of different libraries to establish connections with databases and perform CRUD operations.	L3,L6	Apply, Create
CO5	Implement API endpoints, handle incoming requests, validate data, and generate suitable responses.	L3,L6	Apply, Create

Course Contents

Unit-I — 08 Hrs.

HTML 5, CSS, Bootstrap

HTML: Anatomy of HTML syntax, Lists. Images, hyperlinks, tables, forms, Div

CSS: CSS selectors and properties, inline, internal and external CSS. CSS sizing methods, Class vs. Ids, layout. CSS static, relative and absolute positioning systems. Font styling, typography, combine CSS selectors and understand selector priority, Media Queries

Bootstrap: Introduction to Bootstrap, Bootstrap Grids, Bootstrap Themes, Bootstrap CSS, Bootstrap JS.

Unit-II — 08 Hrs.

Java Script: Introduction to JavaScript Language: Overview and Syntax JavaScript: Variables and Control Statements JavaScript: Functions and Prototypes JavaScript APIs Client-Side JavaScript: with HTML Client-Side JavaScript: with DOM JavaScript DOM Objects, Java script Regular expression, Event Handling, Manipulating DOM elements dynamically with JavaScript, Introduction to error handling, debugging in JavaScript coding, Building interactive web pages with JavaScript. TypeScript: Overview, TypeScript Internal Architecture, TypeScript Environment Setup, TypeScript Types, variables and operators, DecisionMaking and loops, TypeScript Functions, TypeScript Classes and Objects, TypeScript Module

Unit-III — 10 Hrs.

Angular: Introduction to Angular, Angular Application Architecture, what is Ng Module, Angular Components, Angular Templates, Data Binding, Types of Data Binding Modules, Directives, Structure Directives. Advanced Angular: Template Routing, Theme Implementation in Angular Framework, Angular Forms, Services,Inject Services, Angular Server Communication with Backend Server, Working of API's (GET, POST,PUT, DELETE), Complete Web application in Angular Framework JavaScript library

Unit-IV — 16 Hrs.

Introduction to Django: Features of Django, Dhango web server, understanding Django environment, Understanding Django the model-view-Template (MVT) architectural pattern, Django project directory, Creating a Django Project, Defining models in Django using Python classes, ORM, Django's built-in database migration functionality to create and apply database schema changes, Using and Customizing the admin interface. Building Views and Templates in Django: Django CRUD function based views, handle HTTP requests and generate HTTP responses in Django, Django URL mapping, GET Vs POST, Templates. Forms and User Authentication in Django: Django's built-in form han-

dling, Creating, validating and handling forms in Django, user authentication

Unit-V

06 Hrs.

Building RESTful APIs with Python: Understanding RESTful architecture, Using Django to build RESTful APIs using JSON, including handling requests, routing, authentication, and authorization, writing tests for APIs to ensure their functionality and documenting APIs using Postman.

Unit-VI

04 Hrs.

Sessions and Cookies: Difference between session and cookie, Creating sessions and cookies in Django, Using Other Databases In Django, Configuring MySQL database, Working with MySQL in Django.

List of Laboratory Experiments

1. Using HTML5 layout tags develop informative page with sections which include various images, links to other pages for navigation, make use of all possible formatting (for example font, color etc.).
2. Develop and demonstrate the usage of inline, internal and external style sheet using CSS.
3. Design a web page using Bootstrap.
4. Design a web page showing applicability of DOM.
5. Write JavaScript to validate the following fields of the Registration page. 1. First Name (Name should contains alphabets and the length should not be less than 6 characters). 2. Password (Password should not be less than 6 characters length). 3. E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com) 4. Mobile Number (Phone number should contain 10 digits only). 5. Last Name and Address (should not be Empty).
6. Design a web page using Type script.
7. Create an application for Students Record using AngularJS.
8. Set up a Django development environment: Install Django, create a new Django project, and set up a virtual environment.
9. Creating a Django app: Learn how to create a new app within a Django project, configure the app's settings, and add the app to the project's URL configuration.
10. Building views and templates: Build a set of views and templates for your app, including a homepage, an about page, and a detail page for the blog post model you created.
11. Handling user authentication and authorization: Add user authentication to your app, allowing users to create accounts, log in, and log out.
12. Building RESTful APIs with Django.
13. Program to manage the session.
14. Creating a Django App with Database Connection.
15. Mini project

Minimum 12 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Text Books:

1. "Django for APIs: Build Web APIs with python and Django (Welcome to Django)", publication date: August 10. Publisher:WelcomeToCode, ,2020.
2. John Dean, "Web Programming with HTML5, CSS3 and JavaScript", Jones & Bartlett Learning Edition, 2019.
3. Venkat Subramaniam ,"Rediscovering JavaScript, Master ES6, ES7, and ES8", 2018.

Reference Books:

1. Glenn Johnson, "Programming in HTML5 with JavaScript and CSS3", Microsoft Press, 2013 Edition.
2. William Vincent, "Django for beginners: Build websites with Python & Django", 2018.
3. "HTML and CSS: The Comprehensive Guide", Publisher: Rheinwerk, Computing Edition: 1st Edition, Publication Date: April 24,2023.

Online Resources:

1. https://www.udemy.com/course/crash-course-html-and-css/
2. https://nptel.ac.in/courses/106106156
3. https://www.coursera.org/learn/django-build-web-apps
4. https://www.coursera.org/learn/developing-applications-with-sql-databases-and-django
5. https://www.coursera.org/projects/django-for-beginners-creating-applications-and-views
6. https://www.coursera.org/specializations/django

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI4050L with minimum 12 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Design Thinking Laboratory(22PCAI4060L)

Teaching Scheme
Practical : 04 Hrs./week
Credit : 02

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total Marks : 50 Marks

Course Objectives:

1. To familiarize students with fundamentals of design thinking and principles.
2. To ensure students can practice the methods, processes and tools of design thinking.
3. To emphasize the role of design thinking in creating innovative and socially impactful solutions using design thinking tools.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Develop an application using fundamentals of Design Thinking.	L3, L6	Apply, Create
CO2	Acquire hands-on proficiency in applying design thinking methodologies, processes.	L3	Apply
CO3	Develop a proactive attitude towards addressing societal challenges using design thinking.	L3,L6	Apply, Create
CO4	Work efficiently as a team member.	L5, L6	Evaluate, Create

Course Contents

Unit-I — 10 Hrs.

Foundation of Design Thinking: Introduction to Design Thinking, Introduction to Design Thinking, Significance of Design Thinking, Key Tenets of Design Thinking, Design Thinking Process- 4 Critical Questions, Design Thinking Process, Human-Centered Design (HCD) process - Empathize, Define, Ideate, Prototype and Test and Iterate or Empathize, Analyse, Solve and Test.

Unit-II — 09 Hrs.

Stage 1 Empathy: Foundation and Tools of Empathy Foundation of Empathy, Purpose of empathy, Observation as a tool of empathy, Methods of Observation Empathetic Interview, Stakeholder maps, Jobs to be done, Empathy Maps.

Unit-III — 09 Hrs.

Define- Foundation and tools: Rules of Defining, Importance of Defining, Models of Framing Problem, Customer Journey Map, Customer experience, Persona, big picture thinking through function modelling.

Unit-IV — 09 Hrs.

Ideate: Introduction to Ideation, Double Diamond, Silent brainstorming, Rules for Brainstorming, Mind Mapping, metaphors for ideation, CREATE and What-If tool for ideation, introduction to TRIZ, Inventive principles and their applications

Unit-V — 10 Hrs.

Prototype & Test -Foundation: Concept of Prototyping, Paper prototype, Story Board prototype, Scenario prototype, Low fidelity and high fidelity, Test Assumptions during the design thinking **Testing phase:** Necessity to test, user feedback, conducting a user test, guidelines for planning a test, how to test, desirable, feasible and viable solutions, iterate phase

Unit-VI — 05 Hrs.

Design Innovation: Benefits of iteration in the design thinking process, taking the idea to the market, introduction to innovation management in a company.

List of Laboratory Experiments

1. Use online survey tools like Typeform or virtual collaboration tools like Zoom to assess students' understanding of the design thinking process.
2. Design relevant products/services using Smaply, Userforge, or MakeMyPersona to understand user needs.
3. Thirty circle Exercise —ideation.
4. Implement Human-Centered Design (HCD) methodology for developing AI-ML products or services.
5. Apply Ideation Techniques with SessionLab/Stormboard/IdeaFlip.
6. Exercise: Rewarding Creativity and Risk Taking.
7. Construct empathy maps for a given case study-1.
8. Perform the steps for practical prototyping in AI-ML projects using digital tools like Boords/Mockingbird/POP.
9. Test and validate AI-ML solutions using user testing and feedback with HotJar/PingPong.
10. Design thinking using sprint base software.

Minimum 08 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Text Books:

1. Pavan Soni, "Design Your Thinking The Mindsets, Toolsets and Skill Sets for Creative Problem-solving", 2020.
2. Michael Lewrick, Patrick Link, Larry Leifer, "Design Thinking Playbk: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems", 2018.
3. Idris Mootee, "Design Thinking For Strategic Innovation: What They Can't Teach You at Business or Design School", 2014.

Reference Books:

1. Dr. Bala Ramadurai, "Karmic Design Thinking - A Buddhism-Inspired Method to Help Create Human- Centered Products & Services", Self-Published (1 January 2020).

2. Michael G. Luchs, Scott Swan, Abbie Griffin, "Design Thinking: New Product Development Essentials from the PDMA", 1st Edition, Wiley-Blackwell; (25 September 2015).

3. Tom Kelley and David Kelley, "Creative Confidence: Unleashing the Creative Potential Within Us All".

4. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation".

5. Jake Knapp, John Zeratsky, and Braden Kowitz,"Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days".

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_mg32/preview

2. https://archive.nptel.ac.in/courses/110/106/110106124/

3. Design and Innovation:

   - https://openstax.org/books/entrepreneurship/pages/4-suggested-resources

4. Overview of Design Thinking:

   - https://www.interaction-design.org/literature/topics/design-thinking
   - https://www.interaction-design.org/literature/article/what-is-design-thinking-and-why-is-it-so-popular
   - https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process
   - https://www.karelvredenburg.com/home/2016/8/29/design-vs-design-thinking-explained
   - 10 Models for Design Thinking. In 2004, business consultants Hasso... — by Libby Hoffman — Medium
   - https://www.tcgen.com/design-thinking/#What_is_Design_Thinking_and_How_Does_it_Relate_to_Prod
   - https://www.interaction-design.org/literature/topics/wicked-problems

5. Understand, Observe and Define the Problem:

   - https://uxdesign.cc/the-purpose-of-a-journey-map-and-how-can-it-galvanize-action-9a628b7ae6e
   - https://www.interaction-design.org/literature/article/personas-why-and-how-you-should-use-them
   - https://userpilot.com/blog/empathy-map-vs-persona/

6. Ideation and Prototyping:

   - https://www.interaction-design.org/literature/topics/prototyping

- https://www.uxmatters.com/mt/archives/2019/01/prototyping-user-experience.php
- https://qpsoftware.net/blog/pros-and-cons-prototyping-complex-projects

7. Testing and Implementation:
   - https://www.interaction-design.org/literature/article/test-your-prototypes-how-to-gather-feedback-and-maximise-learning
   - https://www.futurelearn.com/info/courses/ux-design-fundamentals-management-business-model/0/steps/245286
8. Design Thinking in Various Sectors:
   - https://online.hbs.edu/blog/post/design-thinking-examples

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI4060L with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Universal Human Values (22HMAI4070T)

Teaching Scheme
Lectures : 02 Hrs./week
Tutorial : 01 Hr/week
Credits : 03

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Course Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society, and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society, and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability.	L2	Understand
CO2	Become sensitive to their commitment towards what they have understood (human values, human relationship, and human society).	L5	Evaluate
CO3	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.	L3	Apply

Course Contents

Unit-I

05 Hrs.

Introduction: Need, Basic Guidelines, Content and Process for Value Education Purpose and motivation for the course. Self-Exploration–whatis it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilmentof aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations:understanding and living in harmony at various levels.

Unit-II

06 Hrs.

Understanding Harmony in the Human Being - Harmony in Myself! Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrumentof 'I' (I am being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding theharmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health

Unit-III

06 Hrs.

Understanding Harmony in the Family and Society: Harmony in Human-Human Relationship. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society,Undivided Society, Universal Order- from family to world family.

Unit-IV 05 Hrs.

Understanding Harmony in the Nature and Existence: Whole existence as Coexistence Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all pervasive space. Holistic perception of harmony at all levels of existence.

Unit-V 06 Hrs.

Understanding Harmony in the Nature and Existence: Whole existence as Coexistence Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of naturerecyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all pervasive space. Holistic perception of harmony at all levels of existence.

Text Books:

1. R R Gaur, R Sangal, G P Bagaria ,"Human Values and Professional Ethics", Excel Books, New Delhi, 2010

Reference Books:

1. A Nagaraj, "Jeevan Vidya: EkParichaya" Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi, "Human Values," New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi,"The Story of My Experiments with Truth" .
5. E. F Schumacher, "Small is Beautiful".
6. Cecile Andrews, "Slow is Beautiful".
7. J C Kumarappa, "Economy of Permanence".
8. PanditSunderlal, "Bharat Mein Angreji Raj".
9. Dharampal, "Rediscovering India".
10. Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule".
11. Maulana Abdul Kalam Azad, "India Wins Freedom".
12. Romain Rolland , "Vivekananda".
13. Romain Rolland, "Gandhi".

Tutorials:

The tutorials could be conducted as per the following topics: -

1. Activity No 1: Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony, and coexistence) rather than as arbitrariness in choice based on liking-disliking.

2. Activity No 2: Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

3. Activity No 3: Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

4. Activity No 4: Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

5. Activity No 5: Practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.

2. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.

2. Total duration allotted for writing the paper is 2 hrs.

Semester Project-II (22PJAI4080L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

Students are expected to design, simulate/implement a project based on the knowledge acquired from current semester subjects.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Conduct a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Demonstrate various/alternate approaches to complete a project.	L2	Understand
CO3	Ensure a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Present their project work in the form of a technical report / paper and thereby improve the technical communication skill.	L3	Apply
CO5	Demonstrate the ability to work in teams and manage the conduct of the research study.	L2	Understand

Semester Project:

The purpose of introducing semester project at second year level is to provide exposure to students with a variety of projects based on the knowledge acquired from the semester subjects. This activity is supposed to enrich their academic experience and bring enough maturity in student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation and discussion of technical ideas/topics. Therefore, proper attention shall be paid to the content of semester project report which is being submitted in partial fulfillment of the requirements of the Second Year and it is imperative that a standard format be prescribed for the report.

Each student shall work on project approved by departmental committee approved by the Head of Department, a group of 03 to 05 students (max allowed: 5 students in extraordinary cases, subject to the approval of the departmental committee and the Head of the department) shall be allotted for each Semester Project. Each group shall submit at least 3 topics for the Semester Project. The departmental committee shall finalize one topic for every group. Semester Project Title or Theme should be based on knowledge acquired during semester. The project work shall involve sufficient work so that students get acquainted with different aspects of knowledge acquired from semester subjects.

Student is expected to:

- Select appropriate project title based on acquired knowledge from current semester subjects.
- Maintain Log Book of weekly work done(Log Book Format will be as per Table 4).
- Report weekly to the project guide along with log book.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).

Prescribed project report guidelines:

Size of report shall be of minimum 25 pages. Project Report should include appropriate content for:

- Introduction
- Literature Survey
- Related Theory
- Implementation Details

- Project Outcomes
- Conclusion
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress and marks allocation will be as per Table 5.

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

Departmental committee (including project guide) will evaluate project as per Table 6.

Each group shall present/publish a paper based on the semester project in reputed/peer reviewed Conference/Journal/TechFest/Magazine before end of the semester.

Table 4: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 5: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintenance	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 6: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Simulation/ Logic	Hardware/ Programming	Result Verification	Presentation	Total
			5	5	5	5	5	25

Employability Skill Development Program-I (22HMAI4090L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 50 Marks
Total : 50 Marks

Course Objectives:

1. To enhance the problem solving skills.
2. To improve the basic mathematical skills for solving real life examples.
3. Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems.
4. Demonstrate an understanding of computer programming language concepts.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the basic concepts of Quantitative Ability i.e. profit, loss, time, work and geometry.	L2	Understand
CO2	Apply the concepts of Quantitative Ability for the problem solving.	L3	Apply
CO3	Illustrate the concept of Variables and Functions.	L3	Apply
CO4	Illustrate the concept of Multithreading and string handling	L3	Apply
CO5	Understand and describe the fundamental of object-oriented programming	L2	Understand
CO6	Understand the concepts of distributed database.	L2	Understand

Course Contents

Unit-I Aptitude

Quantitative Aptitude : Algebra, Profit and Loss, Average & Allegation / Mixture, Time and Work, Geometry Mensuration, Numbers , Percentage, Permutation and Combination, Probability, Ratios & Proportion, Time and Distance. Reasoning : Analytical, Puzzles, Blood relationship, Data Interpretation, Data sufficiency

Unit-II Fundamental of Programming

Variables: Local variables, Global variables, 'global' keyword, Rules of Identities, **Functions** : Introduction, Prototype, Classification of functions, No arguments and No return values, With arguments and With return values. **No arguments and With return values** : With arguments and No return values, Recursion, Argument type functions, Default arguments functions, Required arguments functions, Keyword arguments functions, Variable arguments function. **Operators** : Arithmetic Operators, Relational operators, Logical operators, Bitwise operators, Shift operators. **Control Statements** : Conditional Control Statements, if, if-else, if-elif-else, nested-if, Loop Control Statements, While, For. **Branching Statements**: Break, Continue, pass, return, exit. **Exception Handling**: Introduction, The need of exception handling, Getting exceptions, Default exception handler, Handling exception, Try, Except, Try with multiple except blocks Handling exceptions using Exception class, Finally, block, Releasing resources using Finally block, Raise, Creating a user exception class., Raise exception manually, Exceptions based application. **Multithreading** : Introduction, Multitasking, Multi tasking v/s Multithreading, threading module, Thread class introduction, Creating thread, The life cycle of a thread, Single-threaded application, Multi-threaded application, Sleep() method. Sleep() v/s run(), Join() v/s Sleep(), Multiple custom threads creation, The execution time of single-threaded application, The execution time of multi-threaded application, Synchronization of threads. Inner classes basic syntax of inner class, Advantages of Inner classes, Access class level members of inner classes, Access object level members of inner classes, Local inner classes, Complex inner classes, Accessing data of inner classes. **Regular expressions**:'re' module, Match(), Search(), find() etc, and actual projects web scrapping Mail extraction Date extraction, Mobile number extraction, Vehicle number extraction, zoom chat analysis, Expressions using operators and symbols: Split string into characters, Split string into words, Lambda expressions. **String handling using regex**: Introduction to Strings, Indexing and Slicing, Special operators in String handling, Old style String formatting, String library methods, Quotes and Escape characters in a String representation, String Immutability, Logical programs using Strings. **Object Oriented Programming** : Introduction to OOPs, Classes, Objects, Structure to OOP application, Contexts of OOP application, Class level members, Object level members, self variable, Constructor and Initialization of object. Access modifiers : Private, Protected, Public, Program codes. Encapsulation Rules, Implementation, Abstraction,

Polymorphism Inheritance Introduction, Types of Inheritance, Single inheritance, Multi-Level inheritance, Method overriding, Object initialization using constructor, Multiple inheritances, Hierarchical inheritance, Method overriding in Multi level inheritance.

Reference Books:

1. Dr. R S Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publication
2. M. G. Venkateshmurthy, Programming Techniques through C, Pearson Publication.
3. Behrouz Forouzan, A Computer Science Structure Programming Approaches using C, Cengage Learning.
4. Yashwant Kanetkar, Let Us C, BPB Publication.

Evaluation Scheme:

1. The Teacher Assessment is based on the following criteria defined in autonomous rules and regulation R 9.3
2. For Laboratory courses, 100% assessment shall be based on CA.

Teacher Assessment(TA): For Laboratory courses the CA shall have one component i.e. Teacher Assessment (TA), Completion of experiment, Viva- voce, Journal submission, Assignments, Experiments performance, and any other component recommended by BOS and approved by Dean Academics. The distribution of marks for term work shall be as follows:

1. MCQ Test based on Aptitude: 20 Marks
2. MCQ Test based on Programming skills: 30 Marks
3. Total Marks: 50 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.