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 2022-23

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

Institute Vision

To become a leading Institute in Technical education fostering innovation, research, ethical values, and sustainable development for the betterment of society.

Institute Mission

To impart high quality Technical Education through

1. Innovative and Interactive learning process and high quality globally recognized instructional programs.
2. Fostering a collaborative scientific temper among students with ethical responsibility towards the society.
3. Preparing students from diverse backgrounds to have aptitude for employment, entrepreneur ship and research with a spirit of Professionalism.
4. To contribute to nation's sustainable development.

Department Vision

Fostering technical excellence in Artificial Intelligence and Machine Learning through ethics, innovative research, and sustainable education.

Department Mission

1. Innovative and interactive learning processes with high-quality instructional programs in Artificial Intelligence and Machine Learning.
2. Fostering a collaborative scientific temper among students with ethical responsibility towards society in AI and ML applications.
3. Preparing students from diverse backgrounds to develop aptitude for employment, entrepreneurship, and research in AI and ML with a spirit of professionalism.

Programme Educational Objectives (PEOs)

1. Graduates will have proficiency in Artificial Intelligence and Machine Learning, with lifelong learning skills to advance their careers as professionals, entrepreneurs, and leaders.
2. Graduates will possess strong expertise in Artificial Intelligence and Machine Learning, coupled with lifelong learning abilities to excel as professionals, entrepreneurs, and leaders.
3. Graduates will apply AI and ML knowledge to solve real-world problems, contributing to sustainable development and societal benefit.

Program Specific Outcomes (PSOs)

1. Apply programming, machine learning, statistics, data analysis, and cloud computing skills to develop efficient AI-driven solutions.
2. Graduates will excel in Computer Vision, Deep Learning, Natural Language Processing, and Cyber Security while respecting societal values.

Semester-III(w.e.f. 2022-23)														
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	BSAI3010T	Engineering Mathematics-III	4	1		20	15	15	15	65	100	5	5
2	PC	PCAI3020T	Data Structures and Algorithms	3			20	15	15	15	65	100	3	4
	PC	PCAI3020L	Data Structures and Algorithms Laboratory			2	25				25	50	1	
3	PC	PCAI3030T	Database Management Systems	3			20	15	15	15	65	100	3	4
	PC	PCAI3030L	Database Management Systems Laboratory			2	25				25	50	1	
4	PC	PCAI3040T	Discrete Structures	3	1		20	15	15	15	65	100	4	4
5	PC	PCAI3050T	Operating Systems	3			20	15	15	15	65	100	3	4
	PC	PCAI3050L	Operating Systems Laboratory			2	25				25	50	1	
6	PC	PCAI3060L	Programming Laboratory(Python Programming)			2	25				25	50	1	1
7	PJ	PJAI3070L	Semester Project-I			2	25				25	50	1	1
8	MC	MCAI3080T	Constitution of India	1									Audit Course	
			Total	17	2	10	225			75	450	750	23	

Prepared by:
Dr.N. G. Shinde

Checked by:
Dr. S.P. Patil

Prof. Dr. D. R. Patil
BOS Chairman

Prof. S. P. Shukla
C.O.E.

Prof. Dr. P. J. Deore
Dean Academics/Dy. Director

Prof. Dr. J. B. Patil
Director

R. C. Patel Institute of Technology, Shirpur
SES
Autonomous

Semester-IV(w.e.f. 2022-23)

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	PCAI4010T	Statistics for Engineers	4			20	15	15	15	65	100	4	5
	PC	PCAI4010L	Statistics for Engineers Laboratory			2	25					25	1	
2	PC	PCAI4020T	Artificial Intelligence	3			20	15	15	15	65	100	3	4
	PC	PCAI4020L	Artificial Intelligence Laboratory			2	25				25	50	1	
3	PC	PCAI4030T	Machine Learning-I	3			20	15	15	15	65	100	3	4
	PC	PCAI4030L	Machine Learning-I Laboratory			2	25				25	50	1	
4	PC	PCAI4040T	Computer Networks and Security	3			20	15	15	15	65	100	3	4
	PC	PCAI4040L	Computer Networks and Security Laboratory			2	25				25	50	1	
5	PC	PCAI4050L	Programming Laboratory-II (Java and Advanced Java Programming)			4	25				25	50	2	2
6	HM	HMAI4060T	Universal Human Values	2	1		20	15	15	15	65	100	3	3
7	PJ	PJAI4070L	Semester Project-II			2	25				25	50	1	1
8	HM	HMAI4080	Employability Skill Development Program-I			2	50					50	1	1
			Total	15	1	16	300			75	450	825	24	

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Engineering Mathematics - III (BSAI3010T)

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 Fourier Series, its complex form and enhance the problem solving skill 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 vector spaces using linear transformations which is used in computer graphics and inner product spaces.	L3	Apply
CO3	Apply the concepts of eigenvalue, eigenvectors and diagonalization in linear systems.	L3	Apply
CO4	Expand the periodic function by using Fourier series and complex form of Fourier series.	L3	Apply
CO5	Apply the concept of Linear &Non-Linear Programming Problem to the engineering problems.	L3	Apply

Course Contents

Unit-I Vector Space and Inner Product Spaces 12 Hrs.

Vector Space and Inner Product Spaces: Definition of vector space over R, Subspaces.

Linear combinations, Linearly dependent and independent vectors, Basis, Dimension.

Inner Product Spaces: Dot product in R^n , 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-II Linear Transformations 10 Hrs.

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-III Matrices 08 Hrs.

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-IV Calculus 04 Hrs.

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

Unit-V Optimization 10 Hrs.

Unconstrained and Constrained optimization.

Unconstrained optimization techniques: Newtons method, Quasi Newton method.

Constrained optimization techniques: Gradient descent, stochastic gradient descent, Penalty function method, Lagrange multiplier method, KarushKuhnTucker method, Simplex method, Penalty and Duality, Dual simplex method, Downhill simplex method.

Unit-VI Fourier series 08 Hrs.

Dirichlets conditions, Fourier series of periodic functions with period 2Π and 2L and Fourier series for even and odd functions.

Half range sine and cosine Fourier series, Parsevals identities (without proof).

Complex form of Fourier series, Orthogonal and Orthonormal set of functions.

Tutorials :

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

List of Tutorials:

1. Vector Space.
2. Inner Product Space.
3. Linear Transformation.
4. Eigen Value and Eigen Vector and Similarity of Matrices.
5. Cayley-Hamilton Theorem, Functions of square matrix.
6. Singular value decomposition.
7. Calculus.
8. Unconstrained Optimization Techniques.
9. Constrained Optimization Techniques.
10. Fourier Series.
11. Half-Range Fourier Series
12. Complex Form of Fourier Series.

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, 43^{rd} 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 3 hrs.

Data Structures and Algorithms (PCAI3020T)

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 Fundamentals

Course Objectives:

1. To understand the basic concepts of data structures and algorithms
2. To differentiate linear and non-linear data structures and the operations upon them.
3. Ability to perform sorting and searching in a given set of data items.
4. To comprehend the necessity of time complexity in algorithms

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Illustrate details analysis of algorithm and Time complexity of recursive and non recursive algorithm.	L2	Understand
CO2	Explain and examine all type of linear data structure and its operations : Stack, Queue, Linked List.	L2, L4	Understand, Analyze
CO3	Construct and examine all type of Non linear data structure and its operations : Tree, Graph.	L3, L4	Apply, Analyze
CO4	Construct of Heap, AVL tree and B tree and its operation.	L3	Apply
CO5	Illustrate and examine of different searching and sorting algorithms.	L2, L4	Understand, Analyze
CO6	Explain various hashing techniques.	L2	Understand

Course Contents

Unit-I Introduction to Algorithms and Analysis 03 Hrs.

Overview and importance of algorithms and data structures. Fundamentals of algorithm analysis, Space and time complexity of an algorithm, Types of asymptotic notations and orders of growth, Algorithm efficiencybest case, worst case, average case, Analysis of non-recursive and recursive algorithms, Asymptotic analysis for recurrence relation Recursive Tree Method, Master Theorem.

Unit-II Linear Data Structures 10 Hrs.

Stack Stack Operations, Applications of stack: Expression Evaluation-Conversion of Infix to postfix and prefix expression.

Queue- Queue Operations, Types of Queues: Circular Queue, Double Ended Queue, Applications Priority Queue using Arrays.

List-Singly linked lists, Doubly linked lists, Circular linked lists, Operations on Singly Linked List, Stack and Queue implementation using Linked Lists.

Unit-III Non-Linear Data Structures 14 Hrs.

Tree- Terminology, Binary Tree Terminology and Properties, Tree Traversals, Expression Trees Binary Search Trees operations in BST insertion, deletion, finding min and max, Applications Dictionary.

Graph Basic definition and Terminology Representation of GraphGraph Traversal: Breadth First Search (BFS), Depth First Search (DFS) Minimum Spanning Tree: Prim's, Kruskal's- Single Source Shortest Path: Dijkstra s Algorithm, Bellman Ford, Multistage graph, All Pair Shortest Path, Travelling salesperson problem, Least-cost answer node-15-puzzle problem.

Unit-IV Heaps and Balanced Binary Search Trees 04 Hrs.

Heaps- Heapsort, Applications- Priority Queue using Heaps, AVL treesTerminology- basic operations (rotation, insertion, and deletion), B Tree

Unit-V Searching and Sorting 06 Hrs.

Searching- Linear Search and binary search, Fibonacci Search, Analysis Applications- Finding square root of n - Longest Common Prefix.

Sorting Insertion sort- Selection sort, Quicksort, Merge sort, Analysis.

Unit-VI Hashing 02 Hrs.

Hash functions, open hashing-separate chaining, closed hashing -linear probing, quadratic probing, double hashing, random probing, rehashing, extendible hashing, ApplicationsDictionary-Telephone

directory.

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.
3. Narasimha Karumanchi, Data Structures and Algorithms Made Easy, Career Monk Publications, 2^{nd} Edition, 2011
4. Thomas H. Cormen, C.E. Leiserson, R L. Rivest and C. Stein, Introduction to Algorithms, 3^{rd} Edition, MIT Press, 2009.

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, 2004.
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, Pearson, 2004.
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, 2010.

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 3 hrs.

Data Structures and Algorithms Laboratory (PCAI3020L)

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 introduce student concept of various data structure and algorithms their operations and applications for solving real time Problems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Illustrate 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	Illustrate and Construct different form of trees and graphs.	L2, L3	Understand, Apply
CO5	Demonstrate heap-sort and compare Hashing techniques.	L2, L4	Understand, Analyze
CO6	Demonstrate & compare various searching and sorting techniques.	L2, L4	Understand, Analyze

List of Laboratory Experiments(At Least 10)

Suggested Experiments:

- Implementation of stack to find the just next greater number which can be formed using digits of given number.
- Implementation of multi-stack in one array.
- Using a stack find the length of the longest prefix of each of the given parenthesis's expressions that is valid, or 0 if there's no such prefix.
- Implementation of Infix to Postfix. Transformation and its evaluation program.
- Implementation of Infix to Prefix. Transformation and its evaluation program.
- Using a queue find if the love mobiles can be brought into the order that the organizers want them to be.
- Using the concepts of stack and queue sort the elements of a given array.
- Implementation of circular queue menu driven program.
- Implementation of double ended queue menu driven program.
- Implementation of queue menu driven program.
- Implementation of Priority queue program using array.
- Implementation of Linked Lists menu driven program.
- Implementation of different operations on linked list copy, concatenate, split, reverse, count no. of nodes etc.
- Implementation of polynomials operations (addition, subtraction) using Linked List.
- Implementation of Linked Lists menu driven program (stack and queue).
- Implement merging of even and odd positioned nodes into new linked list.
- Implementation of construction of expression tree using postfix expression.
- Implementation of BST program.
- Write a program to verify whether the given 3 traversals are of the same tree or not.
- Implementation of various operations on trees like copying tree, mirroring trees, counting the number of nodes in the tree, counting only leaf nodes in the tree.

- Implementation of Graph menu driven program (DFS & BFS).
- Implementations of Heap & Heap Sort menu driven program.
- Implementation of Advanced Bubble Sort, Insertion Sort and Selection Sort menu driven Program.
- 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 PCAI3020T 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 (PCAI3030T)

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 Fundamentals

Course Objectives:

1. Explain data modelling using Entity-Relationship modelling and developing database by applying normalization.
2. Understand the use of Structured Query Language (SQL) and learn SQL syntax.
3. Identify techniques for controlling the consequences of concurrent data access.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Design an Optimized Database.	L6	Create
CO2	Construct SQL queries to perform operations on database.	L5, L6	Evaluate, Create
CO3	Demonstrate appropriate transaction recovery techniques for a given problem.	L2	Understand
CO4	Design an application using advanced database.	L6	Create

Course Contents

Unit-I 03 Hrs.

Introduction Database Concepts: Introduction, Characteristics of databases, File system v/s Database system, Users of Database system, Data Independence, DBMS system architecture, Database Administrator.

Unit-II 06 Hrs.

EntityRelationship Data 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.

Relational Algebra: Unary and set operations, Relational Algebra Queries.

Unit-III 08 Hrs.

Structured Query Language (SQL): Overview of SQL, Data Definition Commands, and Data Manipulation commands, Data Control commands, Transaction Control Commands.

Integrity constraints: key constraints, Domain Constraints, Referential integrity, check constraints, set and string operations, aggregate function, group by clause, having Clause, Views in SQL, joins, Nested and complex queries, Triggers.

Introduction to PL/SQL: Procedures and Functions.

Unit-IV 06 Hrs.

RelationalDatabase Design: Pitfalls in Relational Database designs, Concept of normalization, Functional Dependencies, First Normal Form, 2NF, 3NF, BCNF.

Unit-V 06 Hrs.

Transactions Management and Concurrency: Transaction concept, Transaction states, ACID properties, Concurrent Executions, Serializability Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols, Deadlock Handling.

Recovery System: Introduction to Recovery system, Log based Recovery, Shadow paging.

Unit-VI 10 Hrs.

Advance Databases: Why NoSQL? SQL vs NoSQL, Types of NoSQL databases: Key-value store, Document database, Column-oriented database, Graph database.

MongoDB: Key features, MongoDB Query Language: Data Types, Create database- Collections

and Documents, Updating and Querying database, Querying through Indexes.

Rocksdb: Overview, Opening/closing, Read/Write, Rocksdb Block Based Table Format, Log File Format, Benefits and Limitations.

Introduction: Time Series databases, Spatial and Temporal Databases.

Text Books:

1. Korth, Silberchatz, Sudarshan, Database System Concepts, 7^{th} Edition, McGraw Hill, 2019.
2. Elmasri and Navathe, Fundamentals of Database Systems, 7^{th} Edition, Pearson education, 2016.
3. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management, Thomson Learning, 5^{th} Revised Edition, 2002.
4. G. K. Gupta, Database Management Systems, 3^{rd} Edition, McGraw Hill, 2018.
5. Xun (Brian) Wu, Sudarshan Kadambi, Devram Kandhare, Aaron Ploetz Seven, NoSQL Databases in a Week, Packt Publishing Limited, 2018.

Reference Books:

1. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press, 2012.
2. Gillenson, Paulraj Ponniah, Introduction to Database Management, 1^{st} Edition, Wiley Publication, 2007.
3. Sharaman Shah, Oracle for Professional, Shroff Publishers & Distributers Private Limited, 1^{st} Edition, 2008.
4. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3^{rd} Edition, McGraw Hill, 2014.
5. Lynn Beighley, Head First SQL, O'Reilly Media, 2007.
6. Gaurav Vaish, Getting started with NoSQL, Packt Publishing Limited, 2013.
7. https://www.mongodb.com/

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 3 hrs.

Database Management Systems Laboratory (PCAI3030L)

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	Identify, analyze and evaluate the Mini project developed for an application.	L3, L4, L5	Apply, Analyze, Evaluate

List of Laboratory Experiments(At Least 08)

Suggested Experiments:

1. Identify the case study and detail statement of problem. Design an Entity-Relationship (ER) /Extended Entity-Relationship (EER) Model.
2. Mapping ER/EER to Relational schema model.
3. Create and populate database using Data Definition Language (DDL) and DML Commands (Apply various Integrity Constraints).
4. Perform Simple queries, string manipulation operations.
5. Nested queries and Complex queries.
6. Perform Join operations.
7. Views and Triggers.
8. Procedures (PL/SQL).
9. Examine the consistency of database using concurrency control technique (Locks).
10. Perform CRUD operations in MongoDB.
11. Mini project using any given/recent database. (RDBMS, Rocksdb, Cassandra, MongoDB, Redis, Neo4J, InfluxDB/KairosDB, PostgreSQL etc.)

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 PCAI3030T 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.

Discrete Structures(PCAI3040T)

Teaching Scheme	**Examination Scheme**
Lectures : 03 Hrs./week	Term Test : 15 Marks
Tutorial : 01 Hr/week	Teacher Assessment : 20 Marks
Credits : 04	End Sem Exam : 65 Marks
	Total Marks : 100 Marks

Prerequisite: Basic Mathematics

Course Objectives:

1. To cultivate clear thinking and creative problem solving.
2. To thoroughly train in the construction and understanding of mathematical proofs. Exercise common mathematical arguments and proof strategies.
3. To thoroughly prepare for the mathematical aspects of other Computer Engineering courses.

CO	**Course Outcomes**	**Blooms Level**	**Blooms Description**
CO1	Identify the correctness of an argument using propositional and predicate logic and truth tables.	L3	Apply
CO2	Illustrate relations, Diagraph and lattice, functions.	L2	Understand
CO3	Apply principles and concepts of graph theory in practical situations.	L3	Apply
CO4	Demonstrate the ability to solve problems using counting techniques and combinatorics in the context of discrete probability.	L2	Understand
CO5	Define the different Algebraic structures and demonstrate use of groups and codes in Encoding and Decoding.	L1, L2	Remember, Understand

Course Contents

Unit-I Sets and Logic 12 Hrs.

Set Theory: Introduction to Set Theory, Venn diagrams, Operations on Sets, Power sets, Laws of set theory, Cartesian Product, Partitions of sets, The Principle of Inclusion and Exclusion. Introduction to Fuzzy sets, Properties of Fuzzy sets, Fuzzy set operations, Fuzzy Cartesian product

Mathematical Logic: Propositions and Logical operations, Truth tables, Laws of Logic, Logical Equivalence, Normal Forms, Predicates, Fallacies, Quantifiers, Mathematical induction.

Introduction to First Order Predicate Logic, Inference Rules: Universal and Existential instantiation, Universal and Existential generalization, Universal Modus Ponens, Universal Modus Tollens, Multiple Quantifiers, Negation of more than one variable

Unit-II Relations, Posets and Lattices 10 Hrs.

Introduction: Relations and their properties, Paths and Digraphs, Types of binary relations, Operations on relations, Equivalence relations: Closures, Warshalls algorithm, Composition of relations.

Introduction to Fuzzy Relations, Properties of Fuzzy relations, Fuzzy composition of relations: Max-min composition and Max-product composition.

Posets and Lattices: Partial ordered sets, Hasse diagram, Lattice and its types, Boolean algebra.

Unit-III Functions 04 Hrs.

Functions: Types of functions- Injective, Surjective and Bijective, Composition of functions, Identity and Inverse function, Pigeon hole principle

Unit-IV Graphs and Trees 04 Hrs.

Introduction to Graph theory: Definitions, Paths, circuits, connectivity, Types of Graphs, Eulerian and Hamiltonian Graph, Sub Graphs, Planar Graphs, Chromatic number, Graph coloring, Isomorphism of graphs.

Introduction to Trees: Trees, rooted trees, path length in rooted trees, Prefix codes and optimal prefix codes.

Unit-V Generating Function and Recurrence relation 04 Hrs.

Recurrence Relation: Linear recurrence relation with constant coefficients, Homogeneous and non-homogeneous recurrence relation, Generating function.

Unit-VI Number Theory and Algebra 05 Hrs.

Groups: Binary operations, Group, Semigroup, Monoid, Sub-group, Cyclic group, Homomorphism and Isomorphism of groups, Cosets.

Coding theory: Group codes, Parity-check and Generator matrix, Hamming codes, Maximum likelihood technique.

Rings and Fields: Definition, Sub rings, Integral domain, Field, Integer modulo n, Ring homomorphism.

Tutorials:

1. Students need to solve minimum eight tutorials.
2. All tutorials to be taken as prescribed in Course: Discrete Structure (Course Code:PCAI3040T).

List of Tutorials:

1. Problems on Set Theory.
2. Problems on Mathematical Logic.
3. Problems on Relations.
4. Problems on Posets and Lattices.
5. Problems on Functions.
6. Problems on Graph theory.
7. Problems on Trees.
8. Problems on Generating Function.
9. Problems on Recurrence relation.
10. Problems on Groups.
11. Problems on Coding theory.
12. Problems on Rings and Field.

Text Books:

1. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, Discrete Mathematical Structures, 6^{th} Edition, Pearson Education, 2015.
2. C. L. Liu, D P Mohpatra, Elements of Discrete Mathematics, 4^{th} Edition, McGraw-Hill, 2012.
3. Douglas B West., Introduction to Graph Theory, 2^{nd} Edition, Eastern Economy Edition published by PHI Learning Pvt. Ltd.
4. Ralph Grimaldi, Discrete and Combinatorial Mathematics, 5^{th} Edition, Pearson Education.
5. S.N. Sivanandam, S. N. Deepa, Principles of Soft Computing, 2^{nd} Edition, Wiley India Pvt. Ltd., 2011.

Reference Books:

1. Y. N. Singh, Discrete Mathematical Structures, 1st Edition, Wiley-India, 2010.
2. J. L. Mott, A. Kandel, T. P. Baker, Discrete Mathematics for Computer Scientists and Mathematicians, 2nd Edition, Prentice Hall of India, 2008.
3. J. P. Trembley, R. Manohar Discrete Mathematical Structures with Applications to Computer Science, 2nd Edition, McGraw-Hill, 2017.
4. Seymour Lipschutz, MarcLipson, Discrete Mathematics, Schaums Outline Series, 3rd Edition, McGraw Hill Education, 2017.

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 3 hrs.

Operating Systems (PCAI3050T)

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: Computer Fundamentals.

Course Objectives: The objective of this course is to understand the structure, functions and characteristics of computer system and operating systems.

1. Provide basics of Operating System in terms of process, thread,process synchronization, memory, file and I/O management.
2. Evaluate performance of process scheduling algorithms.
3. Apply and analyse the concepts of memory management techniques and algorithms.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the fundamental organization of a computer system.	L1,L2	Remember, Understand
CO2	Apply appropriate memory mapping, process scheduling and disk scheduling methods.	L3,L5	Apply, Evaluate
CO3	Identify the need of concurrency and apply appropriate method to solve the concurrency or deadlock problem.	L3	Apply
CO4	Demonstrate different disk scheduling algorithms.	L2	Understand

Course Contents

Unit-I Operating System Architecture 08 Hrs.

Operating System Objectives and Functions and services, System calls, Evolution and types of operating system : Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real -time O.S. Operating System structures, System Calls, Case Study on Linux OS, OS Design Considerations for Multiprocessor architectures

Unit-II Process Management 08 Hrs.

Process Concept, Process states, Process control block.

Threads: Definition and Types, Concept of Multithreading, Multi core processors and threads.

Scheduling: Uni-processor Scheduling, Types of scheduling: Pre-emptive, Non pre-emptive, Scheduling algorithms: FCFS, SJF, RR, Priority.

Unit-III Memory Management 08 Hrs.

Memory Management: Memory Management Requirements, Memory partitioning: Fixed and Variable Partitioning, Memory Allocation: Allocation Strategies (First Fit, Best Fit, and Worst Fit), Fragmentation, Swapping.

Virtual Memory: Demand Paging, Structure of Page Tables, Page Replacement Strategies: FIFO, Optimal, LRU, LFU, Thrashing.

Unit-IV Concurrency control Concurrency 07 Hrs.

Principles of Concurrency, Inter-Process Communication, Process/Thread Synchronization, Mutual Exclusion: Requirements, S/W approaches, H/W Support, Semaphores, Monitors, Classical Problems of Synchronization: Readers-Writers and Producer Consumer problems and solutions, Case Study.

Unit-V Deadlock 04 Hrs.

Principles of deadlock, Conditions and Resource Allocation Graphs, Deadlock Prevention, Deadlock Avoidance, Bankers Algorithm for Single & Multiple Resources, Deadlock Detection, Dining Philosopher problem.

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

File Overview, File Organization and access 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. William Stallings, Operating System: Internals and Design Principles, 8^{th} Edition, Prentice Hall, 2014. ISBN-10: 0133805913 ISBN-13: 9780133805918
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, 9^{th} Edition, John Wiley & Sons, Inc., 2016. ISBN 978-81-265-5427-0
3. Andrew Tannenbaum, Operating System Design and Implementation, 3^{rd} Edition, Pearson, 2015.

Reference Books:

1. Maurice J. Bach, Design of UNIX Operating System, 2^{nd} Edition, PHI, 2004.
2. Achyut Godbole and Atul Kahate, Operating Systems, 3^{rd} Edition, McGraw Hill Education, 2017.
3. Remy Card, Eric Dumas, Frank Mevel,The Linux Kernel Book, 1^{st} Edition, Wiley Publications, 2013.

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 3 hrs.

Operating System Laboratory (PCAI3050L)

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.	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 basic commands of Linux. pwd, cd, ls, cp, mv, mkdir, rmdir, rm, touch, grep, sudo, chmod, chown

   Display current shell, home directory, current path setting, current working directory. Illustrate the use of sort, grep, awk, etc.

2. Implement file system calls in linux.
3. Implement CPU scheduling algorithms like FCFS, SJF, Round Robin etc.
4. Implement Multithreading.
5. Implement Best Fit, First Fit and Worst Fit Memory allocation policy
6. Implement various page replacement policies.
7. Implement Producer -Consumer problem with Semaphore.
8. Implement order scheduling in supply chain using Bankers Algorithm.
9. Implement Disk Scheduling Algorithm.
10. Using the CPU-OS simulator analyze and synthesize the following:
    - Process Scheduling algorithms.
    - Thread creation and synchronization.
    - Deadlock prevention and avoidance.

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 PCAI3050T 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)(PCAI3060L)

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 explain the basic and OOP concepts of Python.
2. To use various advanced python concepts like inheritance, exception handling, modules etc.
3. 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 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 06 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 matrixs, 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 implement Basic String Operations & String Methods.
3. Write a python program to implement functions of List, Tuples, and Dictionaries.
4. Write a Python program to implement Arrays (1D, 2D) applications.
5. Write a python program to demonstrate applications of different decision-making statements.
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, AddisonWesley Publication, 2014.
2. Laura Cassell, Alan Gauld, Python Projects, Wrox Publication, 2015.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PCAI3060L 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 (PJAI3070L)

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 (MCAI3080T)

Teaching Scheme **Audit Course**

Lectures : 01 Hr/week

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.

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 (PCAI4010T)

Teaching Scheme
Lectures : 04 Hrs./week
Credits : 04

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

Prerequisite: Calculus, Measure of Central Tendency, 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	Interpret data using descriptive statistics.	L2	Understand
CO2	Demonstrate sampling distributions and estimate statistical parameters.	L2	Understand
CO3	Develop hypothesis based on data and perform testing using various statistical techniques.	L6	Create
CO4	Perform analysis of variance on data.	L3	Apply
CO5	Examine relations between data.	L4	Analyze

Course Contents

Unit-I Introduction to Statistics 08 Hrs.

Introduction to Statistics: Types of statistics, population vs sample, Measures of Central Tendency.

Measures of dispersion: Range, quartile deviation, mean deviation, standard deviation, properties, variance, empirical relations between measures of dispersion, absolute and relative dispersion, coefficient of variation, outlier, moments, Pearsons and coefficients, skewness, kurtosis, population parameters and sample statistics.

Measures of position: quartiles, interquartile range, semi-interquartile range, percentiles, percentile rank, 1090 percentile range, box and whisker plot.

Correlation: Scatter plot, covariance, Karl Pearsons coefficient of correlation.

Unit-II Probability and Random variables 08 Hrs.

Probability: Conditional probability, mutually and pair wise independent events, Bayes theorem.

Random variables: Discrete random variable, probability mass function, discrete distribution function, continuous random variable, probability density function, continuous distribution function, mathematical expectation, moment generating function, two-dimensional random variable and its joint probability mass and density function, marginal distribution function, conditional distribution functions, covariance, joint moments.

Unit-III Probability distributions 10 Hrs.

Discrete probability distribution: Binomial distribution, Poisson distribution, Hypergeometric distribution.

Continuous probability distribution: Uniform distribution, Exponential distribution, Normal distribution, Beta distribution, Gamma distribution.

Unit-IV Sampling distribution and Estimation 07 Hrs.

Sampling distribution: Central limit theorem, population distribution, Chi-square distribution, Z - distribution, Student's t-distribution, F-Distribution.

Statistical Estimation: 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.

Unit-V Hypothesis Testing for data driven decision making 12 Hrs.

Hypothesis testing: 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.

Confidence interval: Population mean, difference between two population means, population proportion, difference between two population proportions, variance, ratio of variances of two populations. Goodness of fit test using Kolmogorov-Smirnov test.

Tests using z-statistics: Difference between sample proportion and population proportion, difference between two sample proportion, difference between sample mean and population mean with known and unknown , difference between two sample means, one tailed and two tailed tests.

Test using t-statistics: Difference between sample mean and population mean, difference between two independent sample means, difference between means from the same group.

Test using F-statistics: Equality of population variance.

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

Unit-VI Analysis of Variance (ANOVA) for data analysis 07 Hrs.

Analysis of Variance (ANOVA) for data analysis: Sample size calculation, one way ANOVA, POST-HOC Analysis (Tukeys Test), randomized block design, two-way ANOVA.

Text Books:

1. S. P. Gupta,"Statistical Methods", 46^{th} Edition, Sultan Chand, 2021.
2. Thomas Hasalwanter,"An Introduction to Statistics with Python", Springer, 2016.
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", 3^{rd} Edition, Springer, 2008.

Reference Books:

1. S. C. Gupta, V. K. Kapoor,"Fundamentals of Mathematical Statistics", 12^{th} Edition, Sultan Chand, 2020.
2. Peter Bruce, Andrew Bruce, Peter Gedeck,"Practical Statistics for data scientists 50+ Essential Concepts Using R and Python", 2^{nd} Edition, Orelly, 2020.
3. Freedman, David, Robert Pisani, Roger Pervis, W. W. Norton, "Statistics", 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 3 hrs.

Statistics for Engineers Laboratory (PCAI4010L)

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.	L5	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 perform correlation on given data.
4. To calculate probability using probability distribution.
5. To prove 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 goodness of fit using Kolmogorov-Smirnov test and Anderson Darling test.
10. To perform hypothesis test using Z statistics.
11. To perform hypothesis test using t statistics.
12. To perform hypothesis test using F statistics.
13. To perform hypothesis test using Chi square.
14. To perform ANOVA on given data.
15. To perform POST-HOC Analysis (Tukeys Test) on given data.

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 PCAI4010T 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 (PCAI4020T)

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

1. Basic Mathematics
2. Algorithms
3. Discrete Structures

Course Objectives:

1. Provide the basic ideas and techniques underlying the design of intelligent systems.
2. Impart the knowledge of various search techniques for problem solving.
3. Learn knowledge representation and reasoning.
4. Impart the knowledge of planning and forms of learning.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Classify given problem and identify the need of intelligent agent.	L2	Understand
CO2	Apply appropriate search-based method for a given problem.	L3	Apply
CO3	Analyze various AI approaches to knowledge intensive problem solving, reasoning and planning.	L4	Analyze
CO4	Design an expert system for a given AI problem.	L6	Create

Course Contents

Unit-I 06 Hrs.

Introduction to Artificial Intelligence: Introduction, History of Artificial Intelligence, Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Sub-areas of AI, Current trends in AI

Intelligent Agents: Agents and Environments, concept of rationality, nature of environment, the structure of Agents, Types of Agents, Learning Agent.

Unit-II 08 Hrs.

Problem solving: Solving Problem by Searching: Problem Solving Agent, Formulating Problems, Example Problems.

State Space Search Methods

Uninformed Search Methods: 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

Unit-III 06 Hrs.

Stochastic Local Search Algorithms: Hill climbing search, Simulated annealing.

Adversarial Search: Introduction to Game Theory, Algorithm Minimax, Alpha-Beta Pruning.

Unit-IV 08 Hrs.

Knowledge and Reasoning: Knowledge based Agents, The Wumpus World, Inference in FOL, Forward chaining, Backward chaining, Knowledge Engineering in First-Order Logic, Unification, Resolution, Logic programming (PROLOG)

Unit-V 06 Hrs.

Planning: The planning problem, Planning with State Space Search, STRIPS, Goal Stack Planning, Planning graphs, Partial order planning, Hierarchical planning.

Unit-VI 05 Hrs.

Expert System: Introduction, Phases in building Expert Systems, ES Architecture, Case Study on MYCIN Rule based system.

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach", 4^{th} Edition, Pearson Education, 2022.

2. Saroj Kaushik, "Artificial Intelligence", 1st Edition, Cengage Learning, 2011.

3. George F Luger, "Artificial Intelligence", 5th Edition, Low Price Edition, Pearson Education, 2005.

4. Deepak Khemani, "A First Course in Artificial Intelligence", 6th reprint Edition (1 July 2017), McGraw Hill Education (India).

Reference Books:

1. Ivan Bratko, "PROLOG Programming for Artificial Intelligence", 4th Edition, Addison-Wesley, 2011.

2. Elaine Rich and Kevin Knight, "Artificial Intelligence", 3rd Edition, 2017.

3. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.

4. Patrick Henry Winston, "Artificial Intelligence", 3rd Edition, Addison-Wesley, 1992.

5. Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers, 3rd Edition, 2011.

6. N.P.Padhy,"Artificial Intelligence and Intelligent Systems", Oxford University Press, 2005.

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 3 hrs.

Artificial Intelligence Laboratory (PCAI4020L)

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 knowledge base for a problem.	L3	Apply

List of Laboratory Experiments(At Least 08 using Python/PROLOG)

Suggested Experiments:

1. Select a problem statement relevant to AI. i) Identify the problem ii) PEAS Description iii) Problem formulation.
2. Identify and analyze uninformed search Algorithm to solve the problem.
3. Implement BFS/DFS/DFID search algorithms to reach goal state.
4. Identify and analyze informed search Algorithm to solve the problem.
5. Implement A* search algorithm to reach goal state.
6. Program to implement Local Search algorithm: World Block Problem using Hill climbing search.
7. Experiment to illustrate Game playing.
8. Implementation on any AI Problem: Wumpus world, Tic-tac-toe, 8-Queens Problem.
9. The laboratory will emphasize the use of PROLOG.(For example, Program to implement Family Tree in Prolog)
10. Case study on Planning Problem. Identify and analyze a planning problem.
11. Case study on an AI Application.

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 PCAI4020T 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.

Machine Learning-I(PCAI4030T)

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: Data Structures

Course Objectives:

1. To introduce the concepts of computation learning theory and techniques of Machine Learning.
2. To become familiar with regression, classification and clustering tasks.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Classify given problems into classification, clustering and regression problems.	L2	Understand
CO2	Apply machine learning techniques for a given problem.	L3	Apply
CO3	Examine the dataset, choose appropriate algorithm and evaluate the results.	L4	Analyze
CO4	Design applications using machine learning algorithms.	L6	Create

Course Contents

Unit-I 04 Hrs.

Introduction to Machine Learning: Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps involved in developing a Machine Learning Application, Hypothesis and Inductive Bias, Overfitting.

Unit-II 07 Hrs.

Regression: Linear Regression, Least Minimum Slope (LMS) algorithm, Gradient Descent, Lasso and Ridge Regression. Polynomial Regression. Logistic Regression, Maximum Likelihood Function.

Unit-III 07 Hrs.

Trees & Classification: Introduction to decision tree, Learning Decision tree using ID3 and Gini index; CART.

Ensemble methods: Bagging (Random Forest) and Boosting (XG Boost).

Unit-IV 09 Hrs.

Classification: Bayesian Learning, Nave Bayes, Bayesian Network: Representation in Bayesian, Belief Network, Inference in Bayesian Network, Applications of Bayesian Network.

Classification Model Evaluation & Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Subsampling, Cross Validation, Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on CostBenefit and ROC Curves.

Unit-V 06 Hrs.

Introduction to Support Vector Machine: Support Vectors, Kernels: Linear, Polynomial and Radial Basis Function (RBF) Kernel

Unit-VI 06 Hrs.

Clustering: Cluster Analysis and Requirements of Cluster Analysis Partitioning Methods: k-Means, k-Medoids Hierarchical Methods: Agglomerative, Divisive.

Dimensionality Reduction: Dimensionality Reduction Techniques: Principal Component Analysis

Text Books:

1. Tom M.Mitchell, "Machine Learning", McGraw Hill,2017.
2. Peter Harrington, "Machine Learning In Action", DreamTech Press,2012.
3. Ethem Alpaydn, "Introduction to Machine Learning", MIT Press, 2014.

Reference Books:

1. Han Kamber, "Data Mining Concepts & Techniques", Morgann Kaufmann Publishers, 2011.
2. Stephen Marsland, "Machine Learning An Algorithmic Perspective", CRC Press, 2015
3. Kevin P. Murphy, "Machine Learning A Probabilistic Perspective", 2012.
4. Andreas C. Mller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'reilly, 2016.

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 3 hrs.

Machine Learning-I Laboratory(PCAI4030L)

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 develop skills of using recent machine learning software for solving practical problems.
2. Make use of Data sets in implementing the machine learning algorithms.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply machine learning techniques for a given problem.	L3	Apply
CO2	Examine the dataset, choose appropriate algorithm and evaluate the results.	L4	Analyze
CO3	Design applications using machine learning algorithms.	L6	Create

List of Laboratory Experiments(At Least 08 using Python)

Suggested Experiments:

1. Perform Linear Regression.
2. Perform Logistic Regression.
3. Perform Decision Tree using GINI.
4. Perform CART decision tree algorithm.
5. Perform Ensemble methods.
6. Perform Bayesian Classification.
7. Compare performance of classification algorithms
8. Perform Support Vector Machine.
9. Perform K-means clustering.
10. Study a machine learning patent.
11. Mini project based on any machine learning application.

Minimum five 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 PCAI4030T 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.

Computer Networks and Security (PCAI4040T)

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 Mathematics and Algorithms.

Course Objectives:

To get familiar with contemporary issues and challenges of various protocol designing in layered architecture and performance analysis of various protocols and security issues.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the concepts of data communication and functionalities of ISO - OSI model & TCP/IP model.	L2	Understand
CO2	Illustrate the functions of Data link layer.	L3	Apply
CO3	Implement and simulate the working of network layer and networking protocols.	L6	Create
CO4	Demonstrate the working of transport and application layer protocols.	L3	Apply
CO5	Identify security vulnerabilities and explore various monitoring measures.	L1	Remember
CO6	Explore the fundamentals of security algorithms.	L4	Analyze

Course Contents

Unit-I 04 Hrs.

Introduction to computer network, Network topology, Networking devices, Reference models: OSI, TCP/IP

Unit-II 08 Hrs.

Physical and Data link Layer: Introduction, transmission medium, physical addressing, Error control (Hamming code, CRC), Flow control, Data-Link Layer Protocols: HDLC, Media Access Control: ALOHA, CSMA, Wired LANs: Ethernet, Wireless LANs

Unit-III 09 Hrs.

Network Layer: Services, Packet switching, ARP, RARP, Unicast Routing Algorithms-(DVR, LSR), IPv4 Addressing (Classfull and Classless), Subnetting, Supernetting design problems, IPv4 Protocol, IPV6 protocol.

Unit-IV 06 Hrs.

Transport & Application Layer: Services, sockets, Transport Layer Protocols - User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Application layer protocols-HTTP, SMTP, DNS.

Unit-V 04 Hrs.

Introduction to Security: Security Goals, Security threats and attacks, (Spoofing, Phishing, DOS, Virus, Worm, Trojans, Side-Channel Attack), Intrusion Prevention Systems Intrusion Detection System (IDS), Troubleshooting and monitoring tools, Wireshark, Kali Linux, Honeypot, Nmap, Kismet.

Unit-VI 08 Hrs.

Fundamentals of security algorithms: Cryptography: Symmetric (Substitution Ciphers, Caesar Cipher, Playfair Cipher, Hill Cipher, Block Ciphers, DES and AES), Asymmetric (PKI, RSA, Digital Signature), Key exchange (Diffie-Hellman), Hashing (MD5, SHA)

Text Books:

1. Andrew S. Tanenbaum, "Computer Networks", 6^{th} Edition, Pearson, 2022.
2. Behrouz A. Forouzan, "Data Communications and Networking", 5^{th} Edition, TMH, 2017.
3. Atul Kahate, "Cryptography and Network Security" , 3^{rd} Edition, Tata Mc Graw Hill, 2017.

4. William Stallings, "Computer Security Principles and Practice", 7th Edition, Pearson Education, 2017

5. Charles P. Pfleeger, "Security in Computing", 5th Edition, Pearson Education, 2015

6. Bernard Menezes, "Network Security and Cryptography", Cengage Learning, 2014.

7. Bible-Eric Cole, "Network Security", 2nd Edition, Wiley, 2011.

8. Deven Shah, "Mark Stamps Information Security: Principles and Practice", Wiley, 2009.

Reference Books:

1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", 7th Edition, Pearson Education, 2017.

2. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, 2013.

3. Nader F. Mir, "Computer and Communication Networks", 2nd Edition, Prentice Hall, 2014.

4. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, "Computer Networks: An Open-Source Approach", McGraw Hill Publisher, 2011.

5. Richard Steven, "UNIX Network Programming", Addison Wesley, 2003.

6. B. A. Forouzan, "TCP/IP Protocol Suite", 4th Edition, Tata Mc Graw Hill, 2017.

7. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan Kaufmann Publishers Inc., 2012.

8. Bruce Schneier, "Applied Cryptography, Protocols Algorithms and Source Code in C", 2nd Edition / 20th Anniversary Edition, Wiley, 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 3 hrs.

Computer Networks and Security Laboratory(PCAI4040L)

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 become familiar with network, protocol, security tools and network simulator like NS2/OPNET /Wireshark.
2. To introduce the concepts of Encryption and Decryption using various cipher techniques and attacks applied on it.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Summarize the different topologies and use in Network Simulator.	L2	Understand
CO2	Implement an error detection code and distance vector routing algorithm.	L6	Create
CO3	Check the applications of TCP socket.	L5	Evaluate
CO4	Utilize the different open source tools for network security and analysis.	L3	Apply
CO5	Identify most common network attacks.	L4	Analyze
CO6	Demonstrate the data integrity using various cryptographic algorithms.	L3	Apply

List of Laboratory Experiments(At Least 08)

Suggested Experiments:

1. Installation & Configuration of Network Simulator (NS2) in Linux environment. -Study of different topologies and create duplex link in NS2.
2. Implementation of an error detection code using CRC.
3. Implementation of Distance Vector/ Link State Routing algorithm.
4. Study of Network simulator (NS) and performance evaluation of Routing protocols using Simulation tool.
5. Applications using TCP sockets like:
   - Echo client and echo server.
   - Chat
   - File Transfer
6. Demonstration of security tools.
7. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer.
8. Design and Implement Caesar cipher cryptographic algorithm by considering letter [A... Z] and digits [0...9]. Apply Brute Force Attack to reveal secret.
9. Design and Implement Encryption and Decryption algorithm using Simple Columnar Transposition cipher technique. Study how dictionary attack can be applied on it.
10. Implement RSA Cryptosystem using RSA Algorithm / Implement Elliptical Curve Digital Signature Algorithm (ECDSA)
11. Demonstrate the data integrity using various cryptographic algorithms viz. MD-5, SHA-1 using VLAB, IIT Bombay.

C/C++/JAVA/Equivalent compiler.

Network Simulator like NS2/OPNET/Wireshark

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 PCAI4040T 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-II (Java and advanced Java Programming) (PCAI4050L)

Teaching Scheme
Practicals : 04 Hrs./week
Credits : 02

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

Prerequisite: Knowledge of Programming Language C.

Course Objectives:

1. Make students familiar with basic, Object Oriented features of JAVA and SOLID principles.
2. Expose students to analyse a problem statement, develop suitable logic and implement it in JAVA.
3. Enable students to design and develop GUI applications.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Develop applications by applying SOLID principles as well as appropriate Object-Oriented concepts and APIs.	L2	Understand
CO2	Debug a given code, rectify the errors to get the desired output.	L3,L5	Apply, Evaluate
CO3	Make suitable modifications to programs as per user requirements for solving real world problems.	L5, L6	Evaluate, Create
CO4	Develop GUI applications using modern APIs (JAVAFX, swings, etc.)	L3	Apply
CO5	Work effectively as a member of a team.	L3	Apply

Course Contents

Unit-I Fundamental of Java Programming 08 Hrs.

Overview of procedure and object-oriented Programming, Java Designing Goals, Features of Java Language. Introduction to the principles of object-oriented programming.

SOLID principles for designing Keywords: Single Responsibility Principle, Open-Closed Principle, Liskov Substitution Principle, Interface Segregation Principle, Dependency Inversion Principle, Data types, Variables, Operators, Expressions, Types of variables and methods. Control Statements, Iteration Statements, Arrays: Irregular arrays, I/O Basics.

Unit-II Classes, Objects and Array of Object 06 Hrs.

Classes & Objects: Class Fundamentals, Assigning Object Reference Variables, passing parameters to Methods and Returning parameters from the methods, pass by value, reference, static and non-static members Nested and Inner Classes, Recursion, finalize ()

Method overloading Constructors: Parameterized Constructors, copy constructor, default, non-parameterized, Constructors overloading.

Unit-III Inheritance, Interface and Packages 08 Hrs.

Inheritance Basics, Types of Inheritance in Java, Concept of Super and sub class, inheriting Data members and Methods, Role of Constructors in inheritance, making methods and classes final, Method overriding, Dynamic Method Dispatch (static and dynamic polymorphism), Abstract classes and methods. Interface and implementation, Interfaces vs. Abstract classes. Packages Steps for defining, creating and accessing a Package, importing packages, java.util.Vector.

Unit-IV Exception Handling and Multithreading 06 Hrs.

Exception handling Mechanism: try, catch, throw, throws and finally, user defined exceptions.

Multithreading: Need of Multithreading, Java thread Model, thread Lifecycle, thread class Methods, Implementing Runnable, extending thread, synchronizing threads, synchronized Statement, Critical Factor in Thread Deadlock

Unit-V Java Swings and Event Handling 08 Hrs.

Introducing Swing: AWT vs Swings, Components and Containers, Swing Packages, A Simple Swing Application, Painting in Swing, Designing Swing GUI Application using Buttons, JLabels, Checkboxes, Radio Buttons, JScrollPane, JList, JComboBox, Trees, Tables Scroll pane Menus and Toolbars.

Event-Driven Programming in Java: Event-Handling Process, Event Handling Mechanism, The Delegation Model of Event Handling, Event Classes, Event Sources, Event Listeners, Adapter Classes

as Helper Classes in Event Handling.

Unit-VI Java Collections 12 Hrs.

Collections Framework List, Set, Sorted Set, Queue, Deque, Map, Iterator, List Iterator, and Enumeration. Array List, Linked List, HashSet, Linked HashSet, Tree Set, Array Deque, Priority Deque, Enum Set, Abstract Collection, Abstract List, Abstract Queue, Abstract Set, and Abstract Sequential List. Map, Map Entry, Sorted Map, and Navigable Map, HashMap, Linked HashMap, Tree Map, Identity HashMap, Weak HashMap, and Enum Map. Comparator, RandomAccess interfaces as well as Observable class

Unit-VII Generics 04 Hrs.

Basic generics, bounded type parameters, type inference, wildcards, type erasure.

List of Laboratory Experiments

1. Write java programs to understand Expressions, Variables, Basic Math operations.
2. Write java programs to demonstrate different decision-making statements.
3. Write java program to demonstrate input output using command line arguments, buffered reader and data input stream reader.
4. Write a java program to implement Arrays (1D, 2D, irregular).
5. Write a java program to implement Basic String Operations & String Methods.
6. Write a java program to implement Functions, Recursion.
7. Write java programs to demonstrate classes, objects, array of objects.
8. Write java programs to demonstrate call by value and call by reference.
9. Write java programs to demonstrate static non static members, nested and inner classes.
10. Write java programs to demonstrate different Object-oriented features: a) Classes & objects b) Constructors c) Inheritance & Polymorphism.
11. Write java programs to demonstrate the concept of abstract classes and interfaces.
12. Write java programs to import inbuilt packages as well as create and import user defined packages.
13. Write java programs to handle exceptions using Exception Handling Mechanism.
14. Write java programs to implement multithreading.
15. Write java programs to understand GUI designing and database operations (Programs based on GUI designing using swings/ modern APIs).
16. Write java programs to understand java collections.
17. Write java program to implement generics.

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.

Text Books:

1. Herbert Schildt, "Java-The Complete Reference", 11^{th} Edition, Tata McGraw Hill Publication, 2018.

2. E. Balguruswamy, "Programming with Java: A Primer", 5th Edition, Tata McGraw Hill Publication, 2017.

Reference Books:

1. D.T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press, 2015.
2. H. M. Deitel, P. J. Deitel, S. E. Santry, "Advanced Java 2 Platform How to Program", 2nd Edition, Prentice Hall, 2007.
3. Script Demics, "Learn to Master JAVA", from Star EDU solutions, 2017.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PCAI4050L 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.

Universal Human Values (HMAI4060T)

Teaching Scheme
Lectures : 02 Hrs./week
Credits : 02

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	Define the concepts, need, basic guidelines, content and process for value education.	L1	Remember
CO2	Identify the harmony in the human being - harmony in myself.	L3	Apply
CO3	Make use of harmony in the family and society.	L3	Apply
CO4	Relate the nature and existence as co-existence.	L2	Understand
CO5	Explain holistic understanding of harmony on professional ethics.	L2	Understand

Course Contents

Unit-I 05 Hrs.

Introduction: Need, Basic Guidelines, Content and Process for Value Education, Purpose and Motivation for the Course. Self-ExplorationWhat Is 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 Fulfilment of 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 Instrument of I (I Am Being The Doer, Seer and Enjoyer).

Understanding the Characteristics and Activities of Iand Harmony In I.

Understanding the Harmony 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 19. 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.

Implications of the above Holistic Understanding of Harmony on Professional Ethics. Natural Acceptance of Human Values 23. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution fnd Humanistic Universal Order. Competence in Professional Ethics:

1. Ability to utilize the professional competence for augmenting universal human order.
2. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems.
3. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case Studies of Typical Holistic Technologies, Management Models and Production Systems. Strategy for Transition from the Present State to Universal Human Order:

1. At the level of individual: As socially and ecologically responsible engineers, technologists, and managers.
2. At the level of society: As mutually enriching institutions and organizations.

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”.

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 3 hrs.

Universal Human Values Tutorial(HMAI4060TT)

Teaching Scheme	**Examination Scheme**
Tutorial : 01 Hr/week	Teacher Assessment : 25 Marks
Credit : 01	Total Marks : 25 Marks

List of Tutorials (activities):

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 ones 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.

Continuous Assessment (A):

1. Term work shall consist of minimum 4 activities based on activities suggested.

2. Term work shall carry total 25 marks based on the performance in the tutorials.

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

Semester Project-II (PJAI4070L)

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 (HMAI4080)

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.