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

Semester-III

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:
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Director

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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

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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: Newton's method, Quasi Newton method.

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

Unit-VI Fourier series — 08 Hrs.

Dirichlet's 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, Parseval's identities (without proof).

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

Reference Books:

1. Stephen Andrilli and David Hecker, "Elementary Linear Algebra", 5th Edition, Academic Press, 2016.
2. Rudolf Lidl, Guter Pilz,"Applied Abstract Algebra", 2nd Edition, Springer 2004.

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3. Howard Anton, Robert C Busby, "Contemporary linear algebra", Wiley 2003.

4. Gilbert Strang, "Introduction to Linear Algebra", 5th Edition, Cengage Learning, 2015.

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

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

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

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

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

End Semester Examination (C):

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

2. Total duration allotted for writing the paper is 3 hrs.

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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

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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 efficiency–best 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 Graph–Graph 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 trees–Terminology- 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, Applications–Dictionary-Telephone

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directory.

Text Books:

1. R. F. Gilberg and B. A. Forouzan, "Data Structures – A Pseudocode Approach with C", 2nd Edition, Cengage Learning, 2005.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, W. H. Freeman, and Company 2008.
3. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", Career Monk Publications, 2nd Edition, 2011
4. Thomas H. Cormen, C.E. Leiserson, R L. Rivest and C. Stein, " Introduction to Algorithms", 3rd Edition, MIT Press, 2009.

Reference Books:

1. Mark A. Weiss,"Data Structures and Algorithm Analysis in C", 4th 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", 2nd 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", 2nd 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", 1st 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):

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

2. Total duration allotted for writing the paper is 3 hrs.

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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

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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.

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- 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.

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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

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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.

Entity–Relationship 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.

Relational–Database 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

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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", 7th Edition, McGraw – Hill, 2019.
2. Elmasri and Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson education, 2016.
3. Peter Rob and Carlos Coronel, "Database Systems Design", Implementation and Management, Thomson Learning, 5th Revised Edition, 2002.
4. G. K. Gupta, "Database Management Systems", 3rd 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", 1st Edition, Wiley Publication, 2007.
3. Sharaman Shah, " Oracle for Professional, Shroff Publishers & Distributers Private Limited", 1st Edition, 2008.
4. Raghu Ramakrishnan and Johannes Gehrke, " Database Management Systems", 3rd 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.

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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.

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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

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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

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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.

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Discrete Structures(PCAI3040T)

Teaching Scheme
Lectures : 03 Hrs./week
Tutorial : 01 Hr/week
Credits : 04

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
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

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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, Warshall's 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.

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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", 6th Edition, Pearson Education, 2015.
2. C. L. Liu, D P Mohpatra, "Elements of Discrete Mathematics", 4th Edition, McGraw-Hill, 2012.
3. Douglas B West.," Introduction to Graph Theory", 2nd Edition, Eastern Economy Edition published by PHI Learning Pvt. Ltd.
4. Ralph Grimaldi, "Discrete and Combinatorial Mathematics", 5th Edition, Pearson Education.
5. S.N. Sivanandam, S. N. Deepa, "Principles of Soft Computing", 2nd Edition, Wiley India Pvt. Ltd., 2011.

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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", Schaum's 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.

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Operating Systems (PCAI3050T)

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: 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

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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, Banker's 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

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Text Books:

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

Reference Books:

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

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.

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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

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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 Banker's 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

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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.

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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

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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 matrix's, numpy zeros() Matplotlib: Matplotlib- Plot different charts, **Pandas:** Data Processing, Pandas-Data structure, Pandas-Series data, Data Frames, Introduction to data processing using pandas.

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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.

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Reference Books:

1. Zed A. Shaw, "Learn Python the Hard Way", 3rd Edition, Addison–Wesley Publication, 2014.
2. Laura Cassell, Alan Gauld, "Python Projects", Wrox Publication, 2015.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 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.

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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

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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

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- 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

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Constitution of India (MCAI3080T)

Teaching Scheme
Lectures : 01 Hr/week

Audit Course

Course Objectives:

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

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

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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, 42nd, 44th, 74th, 76th, 86th & 91st 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, 19th/ 20th 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.

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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.

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