Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure and Syllabus

Second Year B. Tech

Computer Science and Engineering(Data Science)

With effect from Year 2023-24

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259802, Website: www.rcpit.ac.in

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

Sr	Course Category	Course Code	Course Title	Teaching Scheme				Evaluation Scheme					Total		
								Continuous Assessment (CA)				ESE			
								TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best of(TT1 & TT2)				
				L	T	P	Credits	[A]			[B]	[C]	[A+B+C]	Credits	
1	BS	22BSCS3010T	Mathematics for Intelligent Systems	3	1		4	20	15	15	15	65	100	4	4
2	PC	22PCCS3020T	Data Structures	3			3	20	15	15	15	65	100	3	4
	PC	22PCCS3020L	Data Structures Laboratory			2	1	25				25	50	1	
3	PC	22PCCS3030T	System Fundamentals	3			3	20	15	15	15	65	100	3	4
	PC	22PCCS3030L	System Fundamentals Laboratory			2	1	25				25	50	1	
4	PC	22PCCS3040T	Database Management Systems	3			3	20	15	15	15	65	100	3	4
	PC	22PCCS3040L	Database Management Systems Laboratory			2	1	25					25	1	
5	PC	22PCCS3050L	Python Laboratory	1		2	2	50				50	100	2	2
6	PC	22PCCS3060L	Web Engineering Laboratory			4	2	50					50	2	2
7	PJ	22PJCS3070L	Semester Project-I			2	1	25				25	50	1	1
8	MC	22MCCS3080T	Constitution of India	1										Audit Course	
			Total	14	1	14	21	280			60	385	725	21	21

Prepared by:
Prof. Dr. P. S. Sanjekar

Checked by:
Prof. S. M. Pardeshi

Prof. Dr. R. B. Wagh
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. 2023-24)

Sr	Course Category	Course Code	Course Title	Teaching Scheme				Evaluation Scheme							
								Continuous Assessment (CA)				ESE	Total		
								TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best of (TT1 & TT2)				
				L	T	P	Credits	[A]			[B]	[C]	[A+B+C]	Credits	
1	PC	22PCCS4010T	Statistics for Data Science	3			3	20	15	15	15	65	100	3	4
	PC	22PCCS4010L	Statistics for Data Science Laboratory			2	1	25					25	1	
2	PC	22PCCS4020T	Machine Learning - I	3			3	20	15	15	15	65	100	3	4
	PC	22PCCS4020L	Machine Learning - I Laboratory			2	1	25				25	50	1	
3	PC	22PCCS4030T	Design and Analysis of Algorithms	3			3	20	15	15	15	65	100	3	4
	PC	22PCCS4030L	Design and Analysis of Algorithms Laboratory			2	1	25				25	50	1	
4	PC	22PCCS4040T	Computer Communication & Networks	3			3	20	15	15	15	65	100	3	4
	PC	22PCCS4040L	Computer Communication & Networks Laboratory			2	1	25				25	50	1	
5	PC	22PCCS4050L	Data Engineering and Visualization Laboratory	1		2	2	50				50	100	2	2
6	HM	22HMCS4060T	Universal Human Values	2	1		3	20	15	15	15	65	100	3	3
7	PJ	22PJCS4070L	Semester Project-II			2	1	25				25	50	1	1
8	HM	22HMCS4080L	Employability Skill Development Program-I			2	1	50					50	1	1
9	MC	22MCCS4090T	Environmental Engineering	1										Audit Course	
			Total	16	1	14	23	325			75	475	875	23	23

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Mathematics for Intelligent Systems (22BSCS3010T)

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

Pre-requisites: Concepts of basic matrices, partial derivatives and basic probability.

Course Objectives:

To build the strong foundation in learners of mathematics needed for building concepts of machine learning.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze probability of random variables and probability distributions.	L4	Analyze
CO2	Demonstrate knowledge of linear algebra.	L2	Understand
CO3	Apply concepts of matrix theory.	L3	Apply
CO4	Demonstrate concepts of calculus.	L2	Understand
CO5	Analyze different optimization techniques.	L4	Analyze

Course Contents

Unit-I Probability, Random Variables and Probability Distributions 10 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.

Probability Distributions: Discrete Probability Distribution: Binomial Distribution, Poisson Distribution, Hypergeometric Distribution.

Continuous Probability Distribution: Uniform Distribution, Exponential Distribution, Normal Distribution, Beta Distribution, Gamma Distribution, Central Limit Theorem.

Unit-II Linear Algebra 08 Hrs.

Vectors in N-Dimensional Vector Space, Properties, Dot Product, Cross Product, Norm and Distance,Vector Spaces over Real Field, Properties of Vector Spaces over Real Field, Subspaces, Linear Independence and Dependence of Vectors, Span of Vectors, Basis of a Vector Space, Dimension of a Vector Space, Cauchy Schwarz Inequality, Linear Transformation, Norms and Spaces, Orthogonal Compliments and Projection Operator, Kernel Hilbert Spaces.

Unit-III Matrix Theory 08 Hrs.

Characteristic Equation, Eigen Values and Eigen Vectors, Properties of Eigen Values and Eigen Vectors, Cayley-Hamilton Theorem, Examples Based on Verification of Cayley Hamilton Theorem, Similarity of Matrices, Diagonalization of Matrices, Functions of Square Matrix, Derogatory and Non-derogatory Matrices, Least Squared and Minimum Normed Solutions.

Unit-IV Calculus 04 Hrs.

Gradient, Directional Derivatives, Jacobian, Hessian, Convex Sets, Convex Functions and its Properties.

Unit-V Optimization 12 Hrs.

Unconstrained and Constrained Optimization, Convergence.

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.

List of tutorials: (any 8)

1. To solve numerical on discrete probability distributions.
2. To solve numerical on continuous probability distributions.
3. To solve numerical on vector spaces (basis and dimension).
4. To solve numerical on cauchy-schwarz inequality and linear transformation.
5. To solve numerical on diagonalizability using eigenvalues and eigenvectors.
6. To solve numerical on minimal polynomial and functions of a matrix.
7. To solve numerical on calculus.
8. To solve numerical on Gradient descent and Lagrange's multiplier method.
9. To solve numerical on KKT method.
10. To solve numerical on all forms of simplex method.

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

Text Books:

1. Dr. B. S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publication, 1965.
2. Kanti B. Datta, "Mathematical Methods in Science and Engineering", 1st Edition, Cengage Learning India, 2011.
3. Hamdy A. Taha, "Operations Research - An Introduction", Pearson, 10th Edition, 2010.
4. P. K. Gupta, Mohan Man, "Operations Research", 1st Edition, S. Chand Publication, 2005.

Reference Books:

1. W. Cheney, "Analysis for Applied Mathematics", 1st Edition, New York: Springer Science Business Media, 2001.
2. S. Axler, "Linear Algebra Done Right", 3rd Edition, Springer International Publishing, 2015.
3. J. Nocedal and S. J. Wright, "Numerical Optimization", 2nd Edition, New York: Springer Science+Business Media, 2006.
4. J. S. Rosenthal, "A First Look at Rigorous Probability Theory", 2nd Edition, Singapore: World Scientific Publishing, 2006.

5. Seymour Lipschutz and Marc Lipson, "Linear Algebra Schaum's outline series", 4th Edition, Mc-Graw Hill Publication, 2009.

6. Erwin Kreysizg, John Wiley & Sons, Inc, "Advanced Engineering Mathematics", 10th Edition, 2000.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Data Structures (22PCCS3020T)

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

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

Prerequisite: Computer Programming (C Programming)

Course Objectives:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the concept of time and space complexity for algorithms.	L2	Understand
CO2	Assimilate the concept of various linear and non-linear data structures.	L6	Create
CO3	Solve the problem using appropriate data structure.	L3	Apply
CO4	Implement appropriate searching and sorting technique for a given problem.	L3	Apply

Course Contents

Unit-I

04 Hrs.

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

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

Unit-II

06 Hrs.

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

Unit-III

04 Hrs.

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

Unit-IV

04 Hrs.

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

Unit-V

10 Hrs.

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

Height Balanced Tree: Creation of AVL Tree

Heap: Operations on heap

Applications: Huffman coding

Unit-VI

06 Hrs.

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

Applications of Graphs: Topological sorting.

Unit-VII

08 Hrs.

Searching- Linear Search, Binary Search and Fibonacci search.

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

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

Text Books:

1. R. F. Gilberg and B. A. Forouzan, "Data Structures – A Pseudocode Approach with C", 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.

Reference Books:

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

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Data Structures Laboratory (22PCCS3020L)

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

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

Course Objectives:

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

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

List of Laboratory Experiments(At Least 08)

Suggested Experiments:

- Implementations of Linked List using menu driven approach.
- 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.
- Implementations of stack using menu driven approach.
- Implementations of Infix to Postfix conversion.
- Implementation of prefix and postfix evaluation using menu driven approach.
- Implementation of parenthesis checker using stack.
- Implementations of Linear queue using menu driven approach.
- Implementations of circular queue using menu driven approach.
- Implementations of double ended queue using menu driven approach.
- Implementation of Priority queue program using array and Linked list.
- Implementations of Binary Tree using menu driven approach.
- Implementation of Binary Tree Traversal.
- Implementations of BST.
- Implementation of various operations on tree like – copying tree, mirroring a tree, counting the number of nodes in the tree, counting only leaf nodes in the tree.
- Implementations of Graph traversal using menu driven program (DFS & BSF).
- Implementations of Selection sort, Radix sort using menu driven.
- Implementations of Heap & Heap Sort using menu driven program.
- Implementations of Advanced Bubble Sort and Insertion Sort using menu driven Program.
- Implementations of searching methods (Index Sequential, Fibonacci search, Binary Search) using menu driven program.
- Implementation of hashing functions with different collision resolution techniques.

Minimum eight experiments from the above-suggested list or any other experiment or mini project 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 22PCCS3020T 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.

System Fundamentals(22PCCS3030T)

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

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

Prerequisite: Basic Mathematics

Course Objectives:

To understand the structure, functions and characteristics of computer system and operating systems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the fundamental organization of a computer system.	L1	Remember
CO2	Apply appropriate memory mapping, process scheduling and disk scheduling methods.	L3	Apply
CO3	Identify the need of concurrency and apply appropriate method to solve the concurrency or deadlock problem.	L3	Apply
CO4	Differentiate between various processor architecture.	L4	Analyze

Course Contents

Unit-I

08 Hrs.

Introduction to System Fundamentals: Realization of half adder and full adder using Logic Gates, Von Neumann model, Fixed point representation, Register Transfer and Micro-operations: Floating point representation, Arithmetic Micro- Operations, Arithmetic logical shift unit. Addition and subtraction, Multiplication Algorithms (Booth Multiplication Algorithm), Division Algorithms, Floating Point Arithmetic operations, Instruction Cycle with interrupt and DMA.

Operating System Architecture: Basic functions and services, System calls, Types of Operating Systems: Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real-time OS.

Unit-II

06 Hrs.

Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction format, Addressing Modes, data transfer and manipulation, Program Control, Reduced Instruction Set Computer (RISC).

Process Management: Process Concept, Process states, Process control Block, Threads, Uniprocessor Scheduling: Types of scheduling: Pre-emptive, Non pre-emptive, Scheduling algorithms: FCFS, SJF, RR, Priority. Comparative study of process management in Windows, Linux and Android OS.

Unit-III

08 Hrs.

Memory Organization: Memory Hierarchy, Main Memory, Cache Memory, Memory Mapping, cache coherence, Pentium IV cache organization, ARM cache organization.

Memory Management: Memory partitioning: Fixed and Variable Partitioning, Memory Allocation: Allocation Strategies (First Fit, Best Fit, and Worst Fit), Fragmentation, Swapping, Virtual Memory, Paging. Segmentation, Demand paging and Page replacement policies. Comparative study of memory management in Windows, Linux and Android OS.

Unit-IV

10 Hrs

Concurrency control

Concurrency: Principles of Concurrency, Mutual Exclusion: S/W approaches, H/W Support, Semaphores, Monitors, Classical Problems of Synchronization: Readers-Writers and Producer Consumer problems and solutions.

Deadlock: Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Dining Philosopher problem. Comparative study of concurrency control in Windows, Linux and Android OS.

Unit-V 04 Hrs.

File and I/O management: File access methods, I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), RAID, Disk Cache, Arbitration methods, Comparative study of file and I/O management in Windows, Linux and Android OS.

Unit-VI 06 Hrs.

Advance Computer Architecture: Characteristics of Multiprocessors, Flynn's taxonomy, Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors, Introduction to Graphics Processing Units, Introduction to Multiprocessor network topologies.

Text Books:

1. William Stallings, "Computer Organisation and Architecture", 11^{th} Edition, 2018.
2. Greg Gagne, Abraham Silberschatz, Peter B. Galvin ,"Operating System Concepts", 10^{th} Edition, John Wiley & Sons, 2018.

Reference Books:

1. John Hayes, "Computer Architecture and Organization", 3^{rd} Edition, McGrawHill, 2017.
2. M. Morris Mano, "Computer System Architecture", 3^{rd} Edition, Pearson.
3. Andrew S. Tanenbaum and Todd Austin, "Structured Computer Organization", 6^{th} Edition, PHI, 2016.
4. M. Murdocca and V. Heuring, "Computer Architecture and Organization", 1^{st} Edition, WILEY, 2017.
5. Andrew S. Tanenbaum, "Modern Operating Systems", 4^{th} Edition, PHI, 2009.
6. G. Meike, Lawrence Schiefer, "Inside the Android OS: Building, Customizing, Managing and Operating Android System Services (Android Deep Dive)", 2021.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

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

System Fundamentals Laboratory (22PCCS3030L)

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 understand commands of Linux and shell script.
2. To learn thoroughly Booth's, Restoring, and Non-Restoring algorithm.
3. To solve problem of process/thread scheduling and synchronization.
4. To explore memory allocation strategies and disk scheduling algorithms.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate the fundamental Unix commands, system calls and shell scripting.	L2	Understand
CO2	Solve the scheduling algorithms for given problems.	L3	Apply
CO3	Identify the performance of Booth's, Restoring, and Non-Restoring algorithm.	L3	Apply
CO4	Illustrate an algorithm to detect and avoid deadlock.	L2	Understand
CO5	Demonstrate the various page replacement and disk scheduling algorithms.	L2	Understand

List of Laboratory Experiments

Suggested Experiments:

- Implement Booth's multiplication algorithm.
- Implement CPU Non-Preemptive scheduling algorithms like FCFS, SJF, Priority etc.
- Implement CPU Preemptive scheduling algorithms like SRTF, Round Robin, Preemptive priority etc.
- Explore the internal commands of Linux.
- Write shell scripts handling File, Directory, Networking and security aspects.
- Implement Best Fit, First Fit and Worst Fit Memory allocation policy.
- Implement Fully associative and set associative cache memory mapping.
- Implement various cache/page replacement policies.
- Implement order scheduling in supply chain using Banker's Algorithm.
- Implement Disk Scheduling Algorithms.

  Study Experiments:

  - Implement Restoring and Non-Restoring division algorithm.
  - Implement Solution to Producer Consumer Problem of Process Synchronization.
  - Implement Solution to Reader Writer Problem of Process Synchronization.
  - Implement Solution to Dinning Philosopher Problem of Process Synchronization.
  - Implementation of Multithreading using parent process and child process using UNIX calls like fork, exec and wait.

Minimum eight experiments from the above-suggested list or any other experiment or mini project 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 22PCCS3030T 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.

Database Management Systems (22PCCS3040T)

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 Basics

Course Objectives:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Design an optimized database.	L6	Create
CO2	Construct SQL queries to perform operations on the database.	L5, L6	Evaluate, Create
CO3	Demonstrate appropriate transaction management and recovery techniques for a given problem.	L2	Understand
CO4	Apply indexing mechanisms for efficient retrieval of information from database.	L3	Apply

Course Contents

Unit-I

03 Hrs.

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

Unit-II

09 Hrs.

Relational Data Model: Entity-Relationship Model: The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation, Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation.

Relational Model: Introduction to the Relational Model, relational schema and concept of keys, Mapping the ER and EER Model to the Relational Model.

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

Unit-III

09 Hrs.

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

Unit-IV

05 Hrs.

Relational Database Design: Pitfalls in Relational-Database designs, Concept of normalization, Function Dependencies, Normal Forms- 1NF, 2NF, 3NF, BCNF.

Unit-V

09 Hrs.

Transaction Management and Recovery: Transaction Concept, ACID properties, Transaction States, Implementation of atomicity and durability, Concurrent Executions, Serializability, Concurrency Control Protocols: Lock-based, Timestamp based, Validation Based, Deadlock Handling.

Recovery System: Failure classification, Log based recovery, Shadow Paging, ARIES recovery algorithm.

Unit-VI

04 Hrs.

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

Text Books:

1. Korth, Silberchatz, Sudarshan, "Database System Concepts", 7th Edition, McGraw – Hill, 2019.
2. Elmasri and Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2021.
3. G. K. Gupta, "Database Management Systems", 3rd Edition, McGraw – Hill.

Reference Books:

1. Raghu Ramkrishnan and Johannes Gehrke, "Database Management Systems", 3rd Edition, McGraw – Hill.
2. Sharnam Shah, "Oracle for Professional", SPD.
3. Dr. P.S. Deshpande, "SQL and PL/SQL for Oracle 10g", Black Book, Dreamtech Press.
4. Patrick Dalton, "Microsoft SQL Server Black Book", Coriolis Group, U.S.
5. Lynn Beighley, "Head First SQL", O'Reilly Media.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Database Management Systems Laboratory (22PCCS3040L)

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

Examination Scheme
Teacher Assessment : 25 Marks
Total : 25 Marks

Course Objectives:

1. To design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model for a given application.
2. To define schema by converting conceptual model to relational model.
3. To understand the use of Structured Query Language (SQL) syntax for design of given application.
4. To retrieve information from database using different SQL operations

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Build ER/EER diagram for the given application.	L3	Apply
CO2	Utilize ER/EER concepts to convert into relational schema with integrity constraints for given application.	L3	Apply
CO3	Design a database for given application using DDL and DML commands.	L6	Create
CO4	Apply string, SET and Join operations, Aggregate functions and nested queries on given application database.	L3	Apply

List of Laboratory Experiments(At Least 08)

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

Minimum eight experiments from the above-suggested list or any other experiment or mini project 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 22PCCS3040T 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.

Python Laboratory (22PCCS3050L)

Practical Scheme	**Examination Scheme**
Lecture : 01 Hrs./week	Teacher Assessment : 50 Marks
Practical : 02 Hrs./week	End Sem Exam : 50 Marks
Credits : 02	Total : 100 Marks

Prerequisite: Programming Fundamental

Course Objectives:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate basic data types, data structures and the concepts of Object-oriented programming in python.	L2	Understand
CO2	Implement file handling and text processing concepts in python.	L3	Apply
CO3	Develop an application using Tkinter, database connectivity and client-server communication using python.	L3	Apply
CO4	Apply various advance modules of Python for data analysis.	L3, L4	Apply, Analyze

Course Contents

Unit-I — 02 Hrs.

Python Basics: Operators, Input and Output, Control statements, Arrays, String and Character.

Unit-II — 04 Hrs.

Functions and Collections in Python: Functions in python, Calling a Function, Arguments, Arbitrary Arguments, *args, Keyword Arguments, Arbitrary Keyword Arguments, **kwargs, The pass Statement, Recursion, Collections in Python, List, Tuples and Dictionaries

Unit-III — 04 Hrs.

Introduction to OOP: Classes, Objects, and Constructor, Methods and Abstraction, Inheritance, Magic Methods.

Unit-IV — 02 Hrs.

Exception Handling in Python: Exception Handling, Try and Except Statement for Catching Exceptions, Try with Else Clause, Try, Except and Finally Statement for Catching Exception.

Unit-V — 04 Hrs.

Advanced Python Concepts: Modules, Packages, Python Collections Module for Opening and Reading Files and Folders, Python OS Module, Python Date Time Module, Python Math and Random Modules, Text Processing & Regular expression.

Unit-VI — 03 Hrs.

Python Integration Primer: GUI (Graphical User Interface) using Tkinter, Client Server architecture using socket programming.

Unit-VII — 03 Hrs.

Python database Connectivity: Database connectivity using SQLite, CRUD (create, read, update and delete) operations on database (SQLite/ MySQL)

Unit-VIII — 03 Hrs.

Python Numpy Module: Construct Numpy arrays, Printing arrays, Arithmetic Operations on matrix's using Numpy Module, numpy zeros ()

Unit-IX 03 Hrs.

Python Pandas Module: Data Processing using Pandas, Data structure using Pandas, Data Frame using Pandas and perform basic operations

Unit-X 02 Hrs.

Python Matplotlib Module: Install Matplolib module, Perform basic visualization.

Text Books:

1. Zed Shaw, "Learn Python the Hard Way", Addison-Wesley, 3rd Edition, 2013.
2. Laura Cassell, Alan Gauld, "Python Projects", 1st Edition, Wiley, 2015.

Digital Resources:

1. The Python Tutorial: http://docs.python.org/release/3.0.1/tutorial/
2. http://spoken-tutorial.org
3. www.staredusolutions.org

Evaluation Scheme:

Laboratory:

Continuous Assessment (A): 50 Marks:

Laboratory work will be based on 22PCCS3050L with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 10 Marks
2. Journal Submission: 10 Marks
3. Viva-voce: 10 Marks
4. Subject Specific Lab Assignment/Case Study: 20 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): 50 Marks:

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

Web Engineering Laboratory (22PCCS3060L)

Practical Scheme
Practical : 04 Hrs./week
Credits : 02

Examination Scheme
Teacher Assessment : 50 Marks
Total : 50 Marks

Prerequisite: Programming Fundamentals.

Course Objective:

The objective of this lab is to provide the basic framework of web development (MERN Stack) and cloud computing.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Develop a website as per the requirements.	L6	Create
CO2	Apply the concepts of cloud computing to improve the efficiency of web development.	L3	Apply
CO3	Evaluate the requirement of the problem and select appropriate method of web development.	L5	Evaluate

List of Laboratory Experiments

- HTML — 02Hrs
  - Create a static web page using HTML.
  - Create a class timetable using HTML.
  - Create a registration form using HTML.
  - Create a web page using HTML5 tags.
- CSS — 04Hrs
  - Design a web page using External or Embedded Style Sheet.
  - Design a responsive web page using media queries and CSS3.
  - Design a web page using Bootstrap.
  - Design a resume using Bootstrap.
  - Design the admission form using Bootstrap.
- Client-Side Scripting — 04Hrs
  - Programs based on objects in JavaScript.
  - Program to design a calculator using JavaScript.
  - Programs based on form validation.
- React JS — 08Hrs
  - Create an application using React.
  - Introduction to Git and GitHub
  - Introduction to Version Control
  - Using Git Locally and Remotely
  - Collaboration
- Server-Side Scripting — 04Hrs
  - Installation and Configuration of Node.js server
  - Program based on inbuilt functions in Node.js
- Express and MongoDB — 06Hrs
  - Using Mongoose to make schemas in MongoDB.

- Making API end points using Express and testing using postman.
- Develop a website and integrate it with pre-defined API.
- Develop a website to consume user defined API.
- Doing CRUD on database MongoDB using Express.
- Writing tests using mocha and chai.

- XML and XSL 04Hrs
  - Design XML using XML DTD and schema.
  - Implementing XSL elements in XML.
  - Validating XML data through DTD and storing in database.
- Concepts of Cloud Computing 04Hrs
  - Introduction to cloud computing.
  - NIST model
  - Service and Deployment models.
- Networking and Security 04Hrs
  - Identity and Access Management
  - Networking basics
  - VPC networking and security
  - Design a VPC
  - Build your own VPC and Launch a Web Server
- Compute Service 04Hrs
  - Compute Services overview
  - Elastic Computing
  - Serverless Compute service
  - Deploying and scaling web applications
- Storage Service 04Hrs
  - Cloud object storage
  - Cloud block storage
  - Elastic file system
- Database Service 04Hrs

- Cloud Relational database services
- Cloud NoSQL Databases
- Elastic load balancing

Text Books:

1. Vasan Subramanian,"Pro MERN Stack", 2nd Edition, Apress Publication, 2019.
2. Shama Hoque, "Full-Stack React Projects", 2nd Edition, Packt Publication, 2020.
3. Rajkumar Buyya, James Broberg, Goscinki,"Cloud Computing: Principles and Paradigms", Wiley, 2013.
4. Shalabh Aggarwal, "Flask Framework Cookbook: Over 80 proven recipes and techniques for Python web development with Flask", Packt publication, 2nd Edition, 2019

Reference Books:

1. Benjamin LaGrone, "HTML5 and CSS3 Responsive Web Design Cookbook", 1st Edition, Packt Publishing, 2013.
2. DT Editorial Services, "Web Technologies: Black Book", 1st Edition, Dreamtech Press, 2018.
3. Christopher Schmitt, Kyle Simpson, "HTML5 Cookbook", 1st Edition, O'Reilly Media Inc., 2011.
4. Uttam K. Roy, "Web Technologies", 1st Edition, Oxford University Press, 2010.
5. Greg Sidelnikov, "React. Js Book: Learning React JavaScript Library from Scratch", 1st Edition, Independently Published, 2017.
6. DT Editorial Services, "HTML5 Black Book", 2nd Edition, Dreamtech Press, 2016.
7. Ben Frain, "Responsive Web Design with HTML5 and CSS3", 2nd Edition, Packt Publishing, 2015.
8. Steve Suehring, "JavaScript Step by Step", 3rd Edition, Pearson Education, 2013.
9. Stoyan Stefanov, "React Up Running Building Web Applications", 1st Edition, O'Reilly Media Inc., 2016.
10. Velte, "Cloud Computing a Practical Approach", Tata McGraw-Hill Education.
11. Sandip Bhowmik, "Cloud Computing", Cambridge University Press, 2017.
12. Miguel Grinberg, "Flask Web Development", O'Reilly publication,2018
13. Sack Stouffer Daniel Gaspar, "Mastering Flask Web Development", Packt Publication, 2018

Prepared by

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCCS3060L with minimum 10 experiments to be incorporated.

The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 10 Marks
2. Journal Submission: 10 Marks
3. Viva-voce: 10 Marks
4. Subject Specific Lab Assignment/Case Study: 20 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.

Semester Project-I (22PJCS3070L)

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 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 (22MCCS3080T)

Teaching Scheme
Lecture : 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 thereby to take up competitive examinations.	L1	Remember
CO2	Explain state and central policies, fundamental duties.	L2	Understand
CO3	Identify Electoral Process, special provisions.	L3	Apply
CO4	Relate powers and functions of Municipalities, Panchayat's and Co- operative Societies.	L1	Remember
CO5	Develop Engineering ethics and responsibilities of Engineers.	L3	Apply
CO6	Classify Engineering Integrity & Reliability.	L4	Analyze

Course Contents

Unit-I Introduction to the Constitution of India — 2 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 — 3 Hrs.

Relevance of Directive Principles State Policy Fundamental Duties.

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

Unit-III State Executives — 3 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 — 3 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 — 3 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 Data Science(22PCCS4010T)

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

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

Prerequisite: Calculus

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

Course Contents

Unit-I — 06 Hrs.

Introduction to Statistics: Types of statistics, population vs sample, Measures of Central Tendency, Measures of position. Measures of dispersion, Moments, Pearson's β and γ coefficients, skewness, kurtosis, population parameters and sample statistics, histogram, frequency polygon.

Expected Values: The expected value of a Random Variable, Variance and Standard Deviation, Covariance and Correlation, Conditional Expectation and Prediction, Approximation Methods.

Unit-II — 06 Hrs.

Sampling Distribution: Exponential Family of Distributions, Population and Random Sampling, Sample mean, variance and standard deviation, Sampling from Normal distribution, Chi-Square, Student's t-distribution, F-distributions.

Unit-III — 05 Hrs.

Survey Sampling: The expectation and Variance of the Sample mean, Estimation of population variance, Estimation Ratio, Stratified Random Sampling.

Unit-IV — 04 Hrs

Parameter Estimation: The method of moments, The method of Maximum Likelihood, The Bayesian Approach to Parameter Estimation.

Unit-V — 08 Hrs.

Testing Hypothesis and Goodness of Fit: The Neyman-Pearson Paradigm, The Duality of Confidence Intervals and Hypothesis Tests, Generalized Likelihood Ratio Tests, Likelihood Ratio Test (LRT), Type-I and Type-II errors, Method of Evaluating Tests. Students's t-Test and Chi-Square Test

Unit-VI — 10 Hrs.

Analysis of Variance (ANOVA) for data analysis: The One-way Layout: the F test, Non parametric method- The Kruskal Wallis Test. The Two-way Layout: Additive Parametrization, Randomized Block Design, Non parametric method-Friedman's Test

Analysis of Categorical Data: Fisher's Exact Test, The Chi Square Test of Homogeneity, The Chi Square Test of Independence.

Text Books:

1. S. P. Gupta, "Statistical Methods", Sultan Chand, 46th Edition, 2021.

2. Thomas Hasalwanter, "An Introduction to Statistics with Python", Springer, 1st Edition, 2016.

3. John A. Rice, " Mathematical Statistics and Data Analysis", 3rd Edition, Thomson Learning, 1994.

4. Douglas C. Montgomery, Larry Faris Thomas and George C. Runger, "Engineering Statistics", 3rd Edition, John Wiley & Sons, 2003.

Reference Books:

1. Peter Bruce, Andrew Bruce, Peter Gedeck, "Practical Statistics for data scientists 50+ Essential Concepts Using R and Python", Orelly, 2nd Edition, 2020.

2. Freedman, David, Robert Pisani, Roger Pervis, W. W. Norton, "Statistics", 2007.

3. S. C. Gupta, V. K. Kapoor, Sultan Chand, "Fundamentals of mathematical statistics", 10th Edition, 2002.

4. Allen B. Downey, "Think Stats: Probability and Statistics for Programmers", Green Tea Press, 1st Edition, 2011.

5. "Testing Statistical Hypotheses", E. L. Lehmann, Joseph P. Romano, Springer, 3rd Edition, 2008.

Web Link:

1. Engineering Statistics: https://onlinecourses.nptel.ac.in/noc23_ge25/preview

2. Probability and Statistics: https://onlinecourses.nptel.ac.in/noc21_ma74/preview

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

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

End Semester Examination (C):

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

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

Statistics for Data Science Laboratory (22PCCS4010L)

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	Solve correlation for the data.	L3	Apply
CO3	Solve confidence interval for different parameters.	L3	Apply
CO4	Examine hypothesis test using various statistics.	L5	Analyze
CO5	Discuss non-parametric tests of hypotheses.	L6	Create

List of Laboratory Experiments

Suggested Experiments:

1. To perform descriptive statistics on data.
2. To visualize descriptive statistics on data.
3. To prove central limit theorem.
4. To study sampling distributions and their parameters.
5. To perform Stratified Sampling.
6. To perform statistical estimation tests on data.
7. To calculate confidence interval for different parameters.
8. To perform correlation on given data.
9. To perform hypothesis test using t statistics.
10. To perform hypothesis test using Chi square.
11. To perform Kruskal-Wallis H Test.
12. To perform Friedman Test.

Minimum ten experiments from the above-suggested list or any other experiment or mini project 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 22PCCS4010T 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.

Machine Learning - I(22PCCS4020T)

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:

1. Data Structures
2. Basic Probability
3. Statistics

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, L5	Analyze, Evaluate
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, Bias-Variance Trade-off, Performance measures, Data Validation.

Unit-II — 08 Hrs.

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

Unit-III — 08 Hrs.

Classification: Introduction to decision tree, Learning Decision tree using ID3 and Gini index; CART, Overfitting. Ensemble methods: Bagging (Random Forest) and Boosting (AdaBoost, Gradient Boost and XG Boost).

Unit-IV — 06 Hrs

Bayesian Learning: Introduction to Bayesian Learning, Naïve Bayes, Bayesian Network: Representation in Bayesian Belief Network, Inference in Bayesian Network, Applications of Bayesian Network

Unit-V — 06 Hrs.

Support Vector Machine: Support Vectors, Functional Margin, Geometric Margin, Optimization problem, Lagrange Duality, KKT condition, Maximum margin with noise, Non-linear SVM and Kernel Function.

Unit-VI — 07 Hrs.

Introduction to Clustering: K-means, Adaptive hierarchal Clustering, Gaussian Mixture Models, Expectation Maximization.

Text Books:

1. Ethem Alpaydın, "Introduction to Machine Learning", MIT Press, 4th Edition, 2020.
2. Tom M.Mitchell, "Machine Learning", McGraw Hill, 1st Edition, 2017.
3. Peter Harrington, "Machine Learning In Action", DreamTech Press, 1st Edition, 2012.

Reference Books:

1. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'reilly, 1st Edition, 2016.

2. Stephen Marsland, "Machine Learning An Algorithmic Perspective", CRC Press, 2nd Edition, 2014.

3. Kevin P. Murphy, "Machine Learning — A Probabilistic Perspective", MIT Press, Illustrated Edition, 2012.

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

Web Link:

1. Towards Data Science: https://towardsdatascience.com D

2. Machine Learning — Andrew Ng, Stanford University: https://youtube.com/playlist?list=PLLssT5z_DsKh9vYZkQkYNWcItqhlRJLN

3. Commonly used Machine Learning Algorithms: https://www.analyticsvidhya.com/blog/2017/09/common-machinelearning-algorithms/

4. A Tour to Machine Learning Algorithms: https://machinelearningmastery.com/a-tour-of-machine-learningalgorithms

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

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

End Semester Examination (C):

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

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

Machine Learning - I Laboratory (22PCCS4020L)

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 basic machine learning algorithms for solving practical problems.
2. Make a use of Datasets in implementing the machine learning algorithms.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Make a use of machine learning algorithms for real life dataset.	L3	Apply
CO2	Examine the dataset by choosing appropriate algorithm and evaluate the result.	L4, L5	Analyze, Evaluate
CO3	Build applications using machine learning algorithms.	L6	Create

List of Laboratory Experiments

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. Perform Support Vector Machine.
8. Perform K-means clustering.
9. Perform Expectation –Maximization.
10. Mini project based on any machine learning application.

Minimum ten experiments from the above-suggested list or any other experiment or mini project 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 22PCCS4020T 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.

Design and Analysis of Algorithms(22PCCS4030T)

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

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

Prerequisite: Computer Programming, Data structures.

Course Objectives:

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

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

Course Contents

Unit-I

08 Hrs.

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

Unit-II

07 Hrs.

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

Unit-III

10 Hrs.

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

Unit-IV

07 Hrs

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

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

Unit-V

03 Hrs.

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

Unit-VI

04 Hrs.

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

Text Books:

1. S. Sridhar, "Design and Analysis of Algorithms", 1st Edition, Oxford Education, 2018.
2. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Computer Algorithms", 1st Edition, Galgotia, 2018.

Reference Books:

1. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw- Hill, 1st Edition, 2023.
2. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI, 2nd Edition, 2013.
3. John Kleinberg, Eva Tardos, "Algorithm Design", Pearson, 1st Edition, 2013.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, "Introduction to Algorithms", 3rd Edition, The MIT Press, 2009.
5. Michael T. Goodrich, Roberto Tamassia, "Algorithm Design", Wiley Publication, 1st Edition, 2006.

Web Link:

1. NPTEL Course: https://onlinecourses.nptel.ac.in/noc19_cs47/preview
2. CodeChef: https://www.codechef.com/certification/data-structures-and-algorithms/prepare
3. Hackerrank: https://www.hackerrank.com/domains/algorithms

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Design and Analysis of Algorithms Laboratory (22PCCS4030L)

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

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

Course Objectives:

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

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

List of Laboratory Experiments

Suggested Experiments:

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCCS4030T 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.

Computer Communication & Networks (22PCCS4040T)

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: System Fundamentals

Course Objectives:

This course aims to provide students with a comprehensive understanding of computer networks, from the fundamental concepts of networking to advanced topics such as Internet of Things (IoT) architecture and wireless networks. Students will explore the key components of networking, including the network layer, transport and application layer protocols, and the interconnection of smart objects using IP. By the end of the course, students will be equipped with the knowledge and skills necessary to design, manage, and troubleshoot computer networks, with a focus on emerging technologies and applications in the field

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Develop a strong foundational understanding of computer networks, including the principles and concepts of network communication, protocols, and architectures.	L3	Apply
CO2	Acquire knowledge and practical experience in the design and implementation of IoT architectures.	L6	Create
CO3	Explore the diverse applications of networking in the modern world, with a specific focus on interconnecting smart objects using IP.	L2	Understand

Course Contents

Unit-I — 05 Hrs.

Introduction to Computer Networks: Basics of Computer Networks, Network Topologies and Protocols, OSI and TCP/IP Models, Network Devices and Components.

Unit-II — 08 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-III — 08 Hrs.

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

Unit-IV — 08 Hrs

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-V — 05 Hrs.

IoT Architecture and Technologies: Introduction to the Internet of Things (IoT), IoT Architecture and Components, Communication Protocols for IoT (MQTT, CoAP, etc.)

Unit-VI — 05 Hrs.

Interconnecting Smart Objects with IP: Architecture, IP Protocol Architecture, IPv6 for Smart Object Networks and the Internet of Things, Connectivity Models for Smart Object Networks The applications: Smart Cities and Urban Networks, Home Automation, Structural Health Monitoring.

Text Books:

1. James Kurose, "Computer Networking:A Top-Down Approach", Pearson Education, 8^{tht} Edition, 2022.
2. Behrouz A. Forouzan, "TCP/IP Protocol Suite", McGraw Hill Education, 4th Edition, 2017.

Reference Books:

1. Maciej Kranz , "Building the Internet of Things" by Maciej Kranz, Wiley, 1st Edition, 2016.

2. Rajkumar Buyya, Amir Vahid Dastjerdi, and Sriram Venugopal, "Internet of Things: Principles and Paradigms", Morgan Kaufmann Publishers, 2016.

3. Jean-Philippe Vasseur, "Interconnecting Smart Objects with IP The Next Internet", Morgan Kaufmann Publishers, 2010.

Web Link:

1. Routing Protocol Information: https://www.cisco.com/c/en/us/support/docs/ip/routing-information-protocol-rip/13788-3.html.

2. Transmission of IPv6 Packets over IEEE 802.15.4 Networks: https://datatracker.ietf.org/doc/html/rfc4944

3. IPv6 in IoT: https://pianalytix.com/advantages-of-ipv6-in-iot

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

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

End Semester Examination (C):

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

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

Computer Communication & Networks Laboratory (22PCCS4040L)

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. This course aims to provide students with a comprehensive understanding of computer networks and Students will explore the key components of networking tools and Protocols.
2. Upon completion of this course, students will be able to perform Smart Automation and IoT Implementation by applying the knowledge gained throughout the course to develop innovative solutions for automated environment.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate proficiency in using essential networking commands and tools also Capture and analyze Ping and Trace Route Protocol Data Units (PDUs) using network protocol analyzers.	L1, L2, L3	Remember, Understand, Apply
CO2	Install and configure the Network Simulator (NS2) in a Linux environment, exploring various network topologies and creating duplex links.	L2	Understand
CO3	Design and configure Virtual Local Area Networks (VLANs) to establish communication privacy among different subnetworks. Implement Internet of Everything (IoE) based on IPv6 using Packet Tracer, showcasing the integration of various devices and protocols.	L3	Apply
CO4	Simulate home automation scenarios using Packet Tracer, demonstrating the application of networking principles in real-world scenarios.	L6	Create
CO5	Utilize Wireshark for traffic analysis, gaining insights into network behavior and identifying potential security vulnerabilities.	L3, L4	Apply, Analyze

List of Laboratory Experiments

Suggested Experiments:

1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer.
2. Installation & Configuration of Network Simulator (NS2) in Linux environment. -Study of different topologies and create duplex link in NS2
3. Implementation of Distance Vector/ Link State Routing algorithm
4. Performance evaluation of Routing protocols using Simulation tool
5. Applications using TCP sockets like:
    - Echo client and echo server
    - Chat
    - File Transfer
6. To design and configure Virtual Local Area Network and check the communication privacy among different sub networks.
7. Implement IoE based on IPv6 using packet tracer.
8. Simulate the home automation using Packet Tracer
9. Implementation of the Wireshark for Traffic analysis.
10. Case Study: On Smart Automation.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCCS4040T with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C):

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

Data Engineering and Visualization Laboratory (22PCCS4050L)

Practical Scheme
Lecture : 01 Hrs./week
Practical : 02 Hrs./week
Credits : 02

Examination Scheme
Teacher Assessment : 50 Marks
End Sem Exam : 50 Marks
Total : 100 Marks

Prerequisite: Mathematics for Intelligent Systems, Programming & Database Management System

Course Objectives:

To develop skills of data analysis techniques for data modelling and visualization

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply visualization techniques to understand Data.	L3	Apply
CO2	Apply ETL and perform OLAP operation.	L3	Apply
CO3	Apply appropriate techniques to enhance data quality.	L3	Apply
CO4	Perform feature engineering to get data ready for modelling.	L4	Analyze

Course Contents

Unit-I 04 Hrs.

Data Warehousing, ETL Process and OLAP: Introduction to Data Warehousing, Major steps in ETL process, Data extraction: Techniques, Data transformation: Basic tasks, Major transformation types, Data Loading: Applying Data, OLTP Vs OLAP, OLAP definition, Dimensional Modelling, Star Schema and Snowflake schema, Hypercubus, OLAP operations: Drill down, Roll up, Slice, Dice and Rotation, OLAP models: MOLAP, ROLAP.

Unit-II 04 Hrs.

Data Preprocessing: Data Quality: measurement error, noise, bias, accuracy, outliers, missing values, inconsistent values, duplicate values.

Data Cleaning: handling missing values and noisy data.

Data Transformation: smoothing, attribute construction, aggregation, normalization.

Data Discretization: binning, histogram analysis, cluster.

Outlier Detection: types of outliers, challenges, statistical method, Distance-based method, Density-based method.

Unit-III 05 Hrs.

Feature Engineering: Curse of Dimensionality, Feature selection: Univariate methods (Pearson correlation, Fscore, Chi- square, Signal to noise ratio) and Multivariate methods (Forward selection, backward selection and stepwise selection), Feature extraction: principal component analysis.

Suggested List of Laboratory Experiments:

1. Data Visualization Using Tableau
   (a) Create new measures on a given dataset and visualize them using a bar graph.
   (b) Perform time series aggregation, apply filters on a given dataset, create line and area charts.
   (c) Apply maps, scatter plots on a given dataset and create a dashboard.
   (d) Perform joins, blends and create dual axis chart.
   (e) Perform table calculations, bins, distributions and create Heat maps.
   (f) Create an interactive data story
2. Data Preprocessing
   (a) Perform Exploratory Data Analysis on a given dataset.
   (b) Perform Data cleaning on a given dataset.
   (c) Perform necessary Data Transformation on a given dataset.
3. Feature Engineering
   (a) Perform correlation analysis on a given dataset.
   (b) Perform dimensionality reduction using PCA.

Visualization experiments can be performed using Tableau and Data Preprocessing experiments can be performed using Python/R. A minimum of 10 experiments or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Text Books:

1. Max Kuhn and Keijell Johnson, "Feature Engineering and Selection: A practical Approach for Predictive Models", CRC Press, 1st Edition, 2020.
2. Roy Jafari, "Hands-On Data Preprocessing in Python", 1st Edition, Packt Publishing, 2022.
3. Jason Browniee, "Data Preparation for Machine Learning", Machine Learning Mastry, 1st Edition, 2021.
4. Ethan McCallum, "Bad Data Handbook: Cleaning Up the Data so you can get back to work", 1st Edition, O'Reilly, 2012.

Reference Books:

1. S.C.Gupta and V.K.Kapoor, "Fundamentals of mathematical statistics"', Sultan Chand Publisher, 1st Edition, 2020.
2. Wes McKinney, "Python for Data Analysis"', O'Reilly, 2nd Edition, 2018.
3. Rayan Sleeper, "Practical Tableau"', O'Reilly, 1st Edition, 2018.
4. Jeffrey Shaffer, Steve Wexier, Andy Cotgreave, "The Big Book of Dashboards: Visualizing your Data using Real-World Business Scenarios", Wiley, 1st Edition, 2017.
5. Paulraj Ponniah, "Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals", Wiley, 2nd Edition, 2011.
6. Han, Kamber, Morgan Kaufmann, "Data Mining Concepts and Techniques", 3rd Edition, Elsevier, 2013.

Web Links:

1. NPTEL Course: https://onlinecourses.nptel.ac.in/noc19_ge20/preview
2. Tableau: https://intellipaat.com/blog/what-is-tableau/
3. Data Warehouse: https://onlinecourses.nptel.ac.in/noc19_ge20/preview
4. Feature Engineering: https://towardsdatascience.com/what-is-feature-engineering-importance-tools-and-techniques-for-machine-learning-2080b0269f10

Evaluation Scheme:

Laboratory:

Continuous Assessment (A): 50 Marks:

Laboratory work will be based on 22PCCS4050L with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 10 Marks
2. Journal Submission: 10 Marks
3. Viva-voce: 10 Marks
4. Subject Specific Lab Assignment/Case Study: 20 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): 50 Marks:

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

Universal Human Values (22HMCS4060T)

Teaching Scheme	Examination Scheme
Lectures : 02 Hrs./week	Term Test : 15 Marks
Tutorial : 01 Hr./week	Teacher Assessment : 20 Marks
Credits : 03	End Sem Exam : 65 Marks
	Total Marks : 100 Marks

Course Objectives:

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

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

Course Contents

Unit-I Introduction: Need, Basic Guidelines, Content and Process for Value Education 05 Hrs.

Purpose and Motivation for the Course. Self-Exploration–What 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 Understanding Harmony in the Human Being - Harmony in Myself! 05 Hrs.

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 'I'and 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 Understanding Harmony in the Family and Society: Harmony in Human-Human Relationship. 03 Hrs.

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.

Unit-IV Understanding the harmony in the society (society being an extension of family): 03 Hrs.

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-V Understanding Harmony in the Nature and Existence: 05 Hrs.

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

Unit-VI Implications of the above Holistic Understanding of Harmony on Professional Ethics: 05 Hrs.

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order, b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. 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: a. At the level of individual: as socially and ecologically responsible engineers, technologists, and managers, b. At the level of society: as mutually enriching institutions and organizations.

Universal Human Values Tutorial:

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. Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

3. 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. 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. 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.

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 2 hrs.

Semester Project-II (22PJCS4070L)

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 (22HMCS4080L)

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.

Environmental Engineering (22MCCS4090T)

Teaching Scheme
Lecture : 01 Hr./week

Audit Course

Prerequisite: Interest in Environment and its impact on Human

Course Objectives:

1. Understand environmental issues such as depleting resources, pollution, ecological problems and the renewable energy scenario.
2. Familiarize environment related legislation.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand how human activities affect environment.	L2	Understand
CO2	Understand the various technology options that can make a difference.	L2	Understand
CO3	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.	L3	Apply

Course Contents

Unit-I Social Issues and Environment 04 Hrs.

Ecological footprint and Carrying Capacity, Depleting nature of Environmental resources such as soil, water minerals and forests ,Carbon emissions and Global Warming.

Unit-II Technological growth for Sustainable Development 04 Hrs.

Social, Economic and Environmental aspects of Sustainable Development, Renewable Energy Harvesting ,Concept of Carbon credit, Green Building ,Power and functions of Central Pollution Control Board and State Pollution Control Board.

Unit-III Green Technology 05 Hrs.

History, Agenda, and Challenges Ahead. Sustainable Cloud Computing, and Risk Management, Sustainable Software Design, Data Center Energy Efficiency, Thin-Client and Energy Efficiency.

Text Books:

1. Erach Bharucha, "Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education", Universities Press, 1st Edition, 2019.
2. Mohammad Dastbaz, Colin Pattinson, Babak Akhgar, Morgan and Kaufman, "Green Information Technology A Sustainable Approach", Elsevier, 1st Edition, 2015.
3. R. Rajagopalan, "Environmental Studies From Crisis to Cure", 2012.

Text Books:

1. Paulina Golinska, Marek Fortsch, Jorge Marx-Gómez, "Information Technologies in Environmental Engineering: New Trends and Challenges", Springer, 2011.

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.