Shirpur Education Society's

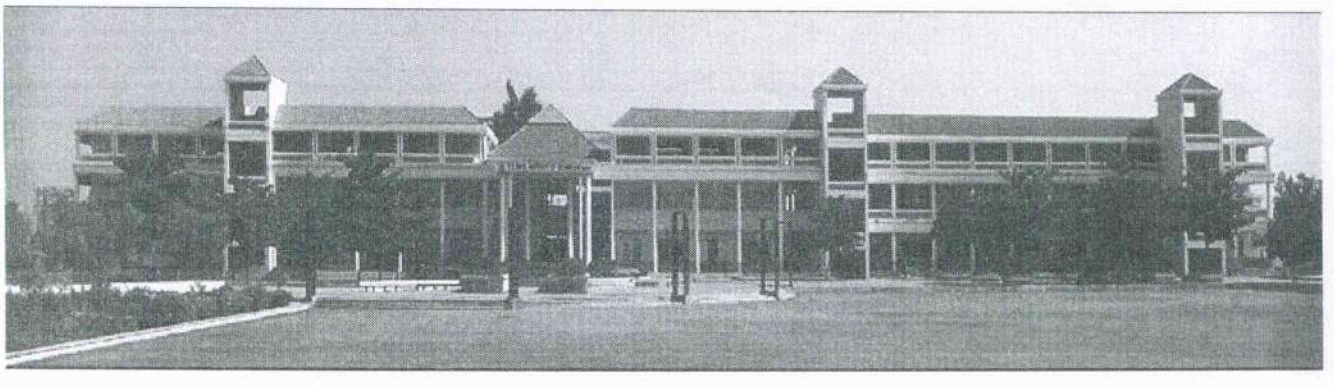
R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure and Syllabus

Third Year B. Tech. (Computer Engineering)

With effect from Year 2024-25



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Third Year B.Tech Computer Engineering Semester-V (w.e.f. 2024-25)

Sr. No.	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credits	
							Continuous Assessment (CA)							
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of(TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1	PC	22PCCO5010T	Data Warehousing and Mining	3			25	10	10	10	65	100	3	4
	PC	22PCCO5010L	Data Warehousing and Mining Laboratory			2	25				25	50	1	
2	PC	22PCCO5020T	Computer Network	3			25	10	10	10	65	100	3	4
	PC	22PCCO5020L	Computer Network Laboratory			2	25				25	50	1	
3	PC	22PCCO5030T	Artificial Intelligence	3			25	10	10	10	65	100	3	4
	PC	22PCCO5030L	Artificial Intelligence Laboratory			2	25				25	50	1	
4	PC	22PCCO5040T	Formal Language and Automata Theory	3			25	10	10	10	65	100	3	3
5#	PE	22PECO5051T	Advanced Algorithms	3			25	10	10	10	65	100	3	4
		22PECO5051L	Advanced Algorithms Laboratory			2	25				25	50	1	
		22PECO5052T	Advanced Operating System	3			25	10	10	10	65	100	3	
		22PECO5052L	Advanced Operating System Laboratory			2	25				25	50	1	
		22PECO5053T	Advanced Database Management System	3			25	10	10	10	65	100	3	
		22PECO5053L	Advanced Database Management System Laboratory			2	25				25	50	1	
		22PECO5054T	Computer Graphics	3			25	10	10	10	65	100	3	
		22PECO5054L	Computer Graphics Laboratory			2	25				25	50	1	
6	HM	22HMCO5060T	Professional and Business Communication Tutorial		2		25					25	2	
7	PJ	22PJCO5070L	Semester Project - III			2	25				25	50	1	
8	HM	22HMCO5080L	Employability Skill Development Program-II			2	50					50	1	
			Total	15	2	12	325			50	450	825	23	

Any 1 Elective Course

Prepared by:
Ms. J. S. Sonawane

Checked by:
Mr. 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
Autonomous

Third Year B.Tech Computer Engineering Semester-VI (w.e.f. 2024-25)

Sr. No.	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credits	
							Continuous Assessment (CA)							
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1	PC	22PCCO6010T	Software Engineering and Project Management	3			25	10	10	10	65	100	3	4
	PC	22PCCO6010L	Software Engineering and Project Management Laboratory			2	25				25	50	1	
2	PC	22PCCO6020T	Machine Learning	3			25	10	10	10	65	100	3	4
	PC	22PCCO6020L	Machine Learning Laboratory			2	25				25	50	1	
3	PC	22PCCO6030T	Information Security	3			25	10	10	10	65	100	3	4
	PC	22PCCO6030L	Information Security Laboratory			2	25				25	50	1	
4#	PE	22PECO6041T	Advanced Network Design	3			25	10	10	10	65	100	3	4
		22PECO6041L	Advanced Network Design Laboratory			2	25				25	50	1	
		22PECO6042T	High Performance Computing	3			25	10	10	10	65	100	3	
		22PECO6042L	High Performance Computing Laboratory			2	25				25	50	1	
		22PECO6043T	Business Analytics	3			25	10	10	10	65	100	3	
		22PECO6043L	Business Analytics Laboratory			2	25				25	50	1	
		22PECO6044T	Compiler Design	3			25	10	10	10	65	100	3	
		22PECO6044L	Compiler Design Laboratory			2	25				25	50	1	
		22PECO6045T	Virtual Reality	3			25	10	10	10	65	100	3	
		22PECO6045L	Virtual Reality Laboratory			2	25				25	50	1	
5	PC	22PCCO6050L	Devops Laboratory			4	50				50	100	2	
6	PJ	22PJCO6060L	Project Stage - I			4	25				25	50	2	
			Total	12	0	16	275			40	435	750	20	

Any 1 Elective Course.

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Semester - V

Data Warehousing and Mining (22PCCO5010T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Basic database concepts, Concepts of algorithm design and analysis

Course Objectives:

1. To identify the need and perform data modelling to provide strategic information for making business decisions.
2. To analyze data and develop relevant mining models to discover knowledge from data in various applications.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Design data warehouse models using dimension-modeling techniques.	L6	Create
CO2	Analyse the data by applying Online Analytical Processing (OLAP) operations for strategic decisions.	L4	Analyze
CO3	Apply preprocessing techniques to the given raw data.	L3	Apply
CO4	Apply appropriate data mining techniques on data sets to retrieve relevant information.	L3	Apply

Course Contents

Unit-I Introduction to Data Warehouse and Dimensional Modelling

08 Hrs.

Introduction to Strategic Information, Need for Strategic Information, Features of Data Warehouse, Data Warehouse versus Data Marts, Data Warehouse versus Data Lake, Top Down versus Bottom Up Approach. Data Warehouse Architecture, E-R Modelling versus Dimensional Modelling, Information Package Diagram, STAR Schema, STAR Schema keys, Snowflake Schema, Fact Constellation Schema, Factless Fact Tables, Update to the Dimension Tables, Aggregate Fact Tables.

Unit-II ETL Process and OLAP

06 Hrs.

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 Analysis, Hypercubes.

OLAP Operations: Drill Down, Roll Up, Slice, Dice and Rotation, OLAP models: MOLAP, ROLAP, HOLAP.

Unit-III Introduction to Data Mining, Data Exploration and Preprocessing

06 Hrs.

Data Mining Task and Techniques, KDD Process, Issues in Data Mining, Applications of Data Mining.

Data Exploration: Types of Attributes, Statistical Description of Data, Data Visualization, Measuring data similarity and dissimilarity.

Data Preprocessing: Major tasks in Preprocessing, Data Cleaning: Missing Values, Noisy data; Data Integration: Entity Identification Problem, Redundancy and Correlation Analysis, Tuple Duplication, Data Value Conflict Detection and Resolution.

Data Reduction: Attribute Subset Selection, Histograms, Clustering and Sampling.

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

Unit-IV Classification and Clustering

08 Hrs.

Classification:

Basic Concepts of Classification, Decision Tree Induction, Attribute Selection Measures using Information Gain, Tree pruning.

Bayes Classification Methods: Bayes' Theorem, Naïve Bayesian Classification.

Model Evaluation: Metrics for Evaluating Classifier Performance, Holdout Method and Random Subsampling, Cross Validation, Bootstrap

Improving Classification Accuracy: Ensemble classification, Bagging, Boosting and AdaBoost, Random Forests.

Clustering:

Cluster Analysis and Requirements of Cluster Analysis.

Partitioning Methods: k-Means, k-Medoids.

Hierarchical Methods: Agglomerative, Divisive.

Evaluation of Clustering: Assessing Clustering Tendency, Determining Number of Clusters and Measuring Cluster Quality: Intrinsic and Extrinsic methods.

Unit-V Mining Frequent Patterns and Association Rules 05 Hrs.

Market Basket Analysis, Frequent Item sets, Closed Item sets, and Association Rule.

Frequent Itemset Mining Methods: Apriori Algorithm, Association Rule Generation,

FP Growth

Unit-VI Spatial and Web Mining 06 Hrs.

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

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

Text Books:

1. Paulraj Ponniah, "Data Warehousing: Fundamentals for IT Professionals", 2nd Edition, Wiley India.
2. Theraja Reema, "Data warehousing", 1st Edition, Oxford University Press, 2009.
3. M. H. Dunham, "Data Mining: Introductory and Advanced Topics", 1st Edition, Pearson Education, 2006.
4. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", 2nd Edition, Pearson Education, 2018.

Reference Books:

1. Han, Jiawei, Jian Pei, and Micheline Kamber, "Data Mining: concepts and techniques", Elsevier, 3rd Edition, 2011.

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 10 marks each will be conducted during the semester.
2. Average 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 Warehousing and Mining Laboratory (22PCCO5010L)

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. Practical exposure on implementation of data mining, preprocessing tasks.
2. Handling and analysis of datasets of any size.
3. Acquire knowledge of multidimensional schemas appropriate for data warehousing.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Recall the fundamental applications and concept of data mining and data warehouses	L1	Remember
CO2	Apply Data Preprocessing Techniques on realistic dataset	L3	Apply
CO3	Extract knowledge from given dataset using data mining techniques	L3	Apply
CO4	Apply Classification Techniques on realistic dataset.	L3	Apply
CO5	Apply Clustering Algorithms on given dataset	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. To visualize the data for a data warehouse using the Business Intelligence tool.
2. Build Data Warehouse/Data Mart for a given problem statement
   (a) Identifying the source tables and populating sample data
   (b) Making information package diagram
   (c) Design dimensional data model i.e. Star schema, Snowflake schema and Fact Constellation schema (if applicable)
3. Perform data Pre-processing task on your dataset
4. To perform various OLAP operations such as slice, dice, drilldown, rollup, pivot
5. Implementation of Classification algorithm
   (a) Using Decision Tree ID3
   (b) Naïve Bayes algorithm
6. Implementation of Clustering algorithm
   (a) K-means
   (b) Hierarchical clustering (single/complete/average)
7. Implementation of Association Rule Mining algorithm
   (a) Apriori algorithm
   (b) FP Tree algorithm
8. Demonstrate performing Classification, Clustering, Association algorithm on data sets using data mining tool (WEKA, R tool, XL Miner, etc.)
9. Implementation of page rank algorithm
10. Implementation of HITS algorithm.
11. Implementation of Spatial Clustering Algorithm- CLARANS Extensions.
12. Case study on recent data mining applications

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PCCO5010T. 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 (ESE):

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

Computer Network (22PCCO5020T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Course Objectives:

1. To get familiar with contemporary issues and challenges of various protocol designs in layered architecture.
2. To assess the strengths and weaknesses of various routing algorithms.
3. To explore the issues and challenges of protocols design while delving into TCP/IP protocol suite

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate the concepts of data communication at physical layer and compare ISO - OSI model & TCP/IP model.	L3	Apply
CO2	Understand the fundamental concepts of the Data Link Layer and analyze different MAC protocols.	L2	Understand
CO3	Design the network using IP addressing and subnetting / super-netting schemes.	L6	Create
CO4	Analyze various transport layer, application layer protocols.	L4	Analyze

Course Contents

Unit-I Introduction to Networking — 05 Hrs.

Introduction to computer network, network applications, network software and hardware components (Interconnection networking devices), Network topology, protocol hierarchies, design issues for the layers, connection-oriented and connectionless services,

Reference models: Layer details of OSI, TCP/IP models.

Introduction to 5G Networks: Overview of 5G technology and its evolution from previous generations (3G, 4G), Core network architecture in 5G.

Unit-II Physical Layer — 04 Hrs.

Introduction to the Digital Communication System, Guided Transmission Media: Twisted pair, Coaxial, Fiber optics, Unguided Media (Wireless Transmission): Radio Waves, Microwave, Bluetooth.

Unit-III Data Link Layer — 08 Hrs.

DLL Design Issues (Services, Framing, Error Control, Flow Control), Error Detection and Correction (Hamming Code, Parity, CRC, Checksum), Elementary Data Link protocols: Stop and Wait, Sliding Window (Go Back N, Selective Repeat), HDLC

Medium Access Control Sublayer: Channel Allocation problem, Multiple Access Protocol (Aloha, Carrier Sense Multiple Access (CSMA/CA, CSMA/CD)

Unit-IV Network layer — 12 Hrs.

Network Layer design issues, Communication Primitives: Unicast, Multicast, Broadcast. IPv4 Addressing (classful and classless), Subnetting, Supernetting design problems, IPv4 Protocol, Network Address Translation (NAT), IPv6,

Routing algorithms: Shortest Path (Dijkstra's), Link state routing, Distance Vector Routing

Routing Protocols: ARP, RARP, ICMP, IGMP, RIP, OSPF

Congestion control algorithms: Open loop congestion control, Closed loop congestion control, QoS parameters, Token & Leaky bucket algorithms.

Unit-V Transport Layer — 06 Hrs.

The Transport Service: Transport service primitives, Berkeley Sockets, Connection management (Handshake), UDP, TCP, TCP state transition, TCP timers, TCP Flow control (sliding Window), TCP Congestion Control: Slow Start

Unit-VI Application Layer — 04 Hrs.

DNS: Name Space, Resource Record and Types of Name Server, HTTP, SMTP, Telnet, FTP, DHCP.

Text Books:

1. A. S. Tanenbaum, "Computer Networks", 6^{th} Edition, Pearson Education, 2020.
2. B. A. Forouzan, "Data Communications and Networking with TCP/IP Protocol Suite", 6^{th} Edition, TMH, 2022.
3. James F. Kurose, Keith W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", 6^{th} Edition, Pearson, 2017.

Reference Books:

1. Behrouz A. Forouzan, Firouz Mosharraf, "Computer Networks: A Top-Down Approach", Mc Graw Hill, 2023.
2. Dhanashree K. Toradmalle, "Computer Networks and Network Design", Wiley, 2020.

Online Resources:

1. https://www.netacad.com/courses/networking/networking-essentials
2. https://www.coursera.org/learn/computer-networking
3. https://nptel.ac.in/courses/106/105/106105081
4. https://www.edx.org/course/introduction-to-networking

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 10 marks each will be conducted during the semester.
2. Average 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 Network Laboratory (22PCCO5020L)

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 get familiar with the different network administration commands.
2. Apply networking techniques to design, implement, and manage small to medium-sized networks.
3. Develop practical skills in network configuration, troubleshooting, and maintenance using various networking tools and devices.
4. To analyse network performance and implement optimization techniques.
5. To provide hands-on experience in implementing basic network security measures and understanding potential vulnerabilities.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To describe the various network administration commands & their use.	L2	Understand
CO2	To design and implement a small network that meets specific requirements.	L6	Create
CO3	To diagnose and resolve common networking issues using diagnostic tools and methodologies.	L4	Analyze
CO4	To implement and analyse different network protocols such as Stop and Wait, Go Back N, Sliding Window etc.	L4	Analyze
CO5	To apply basic network security measures to protect network devices and data from common threats.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. Execute and evaluate network administration commands and demonstrate their use in different network scenarios.
2. Installation & Configuration of Network Simulator (NS2) in Linux/Windows Environment.
3. Building of wired & wireless topology using NS2.
4. Write a program to implement A) Error Detection and Correction B) Framing
5. Implement Stop and Wait protocol in NS2.
6. Write a program to implement Sliding Window Protocols-Selective Repeat, Go Back N.
7. Write a program to find out class of a given IP address, subnet mask, first & last IP address of that block.
8. Write a program to implement any one Routing Protocol.
9. Write a program to implement Congestion Control algorithms.
10. Implement the socket programming for client server architecture.
11. Install and configure Network Management/ Monitoring Tools like Wireshark, Packet Tracer.
12. Analyze the traffic flow of different protocols using Network Management/ Monitoring Tools.
13. Perform File Transfer and Access using FTP.
14. Perform Remote login using Telnet server.
15. Perform network discovery using discovery tools (e.g. Nmap, mrtg)

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PCCO5020T with minimum 10 experiments to be performed. 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 (ESE):

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

Artificial Intelligence (22PCCO5030T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of Programming Language and Algorithms

Course Objectives:

1. Provide the basic ideas and techniques underlying the design of intelligent systems.
2. Impart the knowledge of various search techniques for problem solving.
3. Learn knowledge representation, planning and provide the knowledge to deal with uncertain and incomplete information.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand fundamentals of artificial intelligence systems.	L2	Understand
CO2	Apply various AI approaches to knowledge intensive problem solving, reasoning, planning and uncertainty.	L3	Apply
CO3	Develop the AI applications in real world scenarios.	L6	Create

Course Contents

Unit-I Introduction to Artificial Intelligence — 05 Hrs.

Introduction, History of Artificial Intelligence, Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI

Agents and Environments: Concept of rationality, Nature of environment, Structure of Agents, Types of Agents, PEAS representation for an Agent

Unit-II Problem solving — 12 Hrs.

Problem Solving Agent, Formulating Problems, Example Problems.

Search Methods: Uninformed search, Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID).

Informed Search: Greedy Best First Search, A* Search, Memory bounded heuristic Search. Local Search Algorithms and Optimization Problems: Hill Climbing search, Simulated Annealing, Genetic algorithms, Ant Colony Optimization Adversarial Search: Game Playing, The Minimax algorithm, Alpha-Beta Pruning

Unit-III Knowledge Representation and Reasoning — 07 Hrs.

Knowledge based Agents, The Wumpus World, Propositional Logic, First Order Logic, Inference in FOL, Conjunctive Normal Form, Forward Chaining, Backward Chaining, Unification, Resolution, Logic Programming (PROLOG), Semantic networks

Uncertain Knowledge and Reasoning: Representing knowledge in an uncertain domain, The semantics of Bayesian Belief Network, Inference in Belief Network

Unit-IV Planning — 04 Hrs.

The planning problem, Planning with state space search, Planning graphs, Partial order planning, Hierarchical planning

Unit-V Learning — 07 Hrs.

Types of Learning, Inductive Learning.

Artificial Neural Networks: McCulloh Pitts Model, Perceptron, Feed Forward Network, Backpropagation Algorithm, Self Organizing Map.

Unit-VI Expert System — 04 Hrs.

Introduction, Phases in building Expert Systems, ES Architecture.

Case Study on MYCIN Rule based system Advanced topic: Responsible AI, Introduction to Generative AI

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach", 3rd Edition, Pearson Education, 2010.
2. George F. Luger, "Artificial Intelligence", 6th Edition, Pearson Education, 2021.
3. Deepak Khemani, "A First Course in Artificial Intelligence", 6th Reprint, McGraw Hill Education, 2018f.
4. Saroj Kaushik, "Artificial Intelligence", 1st Edition, Cengage Learning, 2010.

Reference Books:

1. A.P. Engelbrecht, "Computational Intelligence", 3rd Edition, Wiley–Blackwell, 2021.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", 3rd Edition, McGraw Hill Education, 2017.
3. Ivan Bratko, "ROLOG Programming for Artificial Intelligence", 4th Edition, Addison-Wesley 2011.
4. Hagan, Demuth, Beale, "Neural Network Design", 2nd Edition, Martin Hagan 2014.
5. Ronald J. Martin, "The age of Artificial intelligence", Independently published 2023.

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 10 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

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

Artificial Intelligence Laboratory (22PCCO5030L)

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. Provide understanding of various techniques and algorithms of AI used in problem solving, optimization problems and game programming.
2. Familiarize with Perceptron Learning/ Backpropagation algorithm.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the problem and PEAS for a given problems.	L2	Understand
CO2	Identify and apply searching algorithms to solve problems.	L3	Apply
CO3	Write a program for AI gaming problem.	L6	Create
CO4	Write a program to perceptron learning.	L6	Create

List of Laboratory Experiments

Suggested List of Experiments:

1. Select a problem statement relevant to AI.
   (a) Identify the problem
   (b) PEAS Description
   (c) Problem formulation
2. Identify and analyze uninformed search Algorithm to solve the problem. Implement BFS/DFS/DFID search algorithms to reach goal state.
3. Implement DFID search algorithms to reach goal state.
4. Identify and analyze informed search Algorithm to solve the problem. Implement A* search algorithm to reach goal state.
5. Program to implement Local Search algorithm: Hill climbing search
6. Program on Genetic Algorithm to solve a optimization problem in AI.
7. Program to implement learning: Perceptron Learning/ Backpropagation Algorithm.
8. The laboratory will emphasize the use of PROLOG.
   (For example, Program to implement Family Tree in Prolog)
9. Implementation on any AI game: Wumpus world, Tic-tac-toe, 8-Queens Problem
10. Case study of AI Applications.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PCCO5030T.

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 (ESE):

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

Formal Language and Automata Theory (22PCCO5040T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of Discrete Structure, Some knowledge of programming languages, and computer architecture

Course Objective:

To provide a theoretical foundation for the process of computation and to impart an understanding of the notions of automata, formal languages and computability.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Acquire a fundamental understanding of the core concepts in automata theory and formal languages.	L3	Apply
CO2	Design grammar and automata (recognizers) for different language classes.	L6	Create
CO3	Determine the decidability and intractability of computational problems	L3	Apply

Course Contents

Unit-I Fundamentals — 05 Hrs.

Strings, Alphabet, Language, Operations, Chomsky Hierarchy, Finite state machine, definitions, finite automaton model, Acceptance of strings, and languages

Unit-II Regular Languages and Finite Automata — 10 Hrs.

DFA, NFA, NFA with epsilon moves, Equivalence of DFA and NFA- Conversion from NFA to DFA, Equivalence of NFA with epsilon and NFA without epsilon - Conversion from NFA with Epsilon to NFA without Epsilon, DFA minimization: DFA Minimization using Myhill Nerode Theorem, FA with output: Moore and Mealy machines,Regular Expressions: Equivalence of Regular Expressions and Finite automata (Arden's theorem), Closure Properties of Regular Languages, Pumping Lemma for Regular Languages.

Unit-III Context-free Languages — 05 Hrs.

Regular Grammars, Context-free Grammars, Derivations - Leftmost, Rightmost, Parse Trees, Ambiguous Grammars, Simplification of CFG, Normal Forms – Chomsky Normal Form, Greibach Normal Form.

Unit-IV Push Down Automata — 07 Hrs.

Model of a Pushdown Automata, PDA String Acceptance by Empty Stack and Acceptance by Final State, Equivalence of PDAs and Context-free Grammars, Closure Properties of Context-free Languages, Pumping Lemma for Context-free Languages.

Unit-V Recursive and Recursively Enumerable Languages — 08 Hrs.

Definition of Recursive and Recursively Enumerable Languages, Model of a Turing Machines, Computable Functions, Methods for Turing Machine Construction, Modifications of the Basic Turing Machine Model - Multiple Tape TM, Multiple Tracks TM, Non-deterministic TM, Universal Turing Machine.

Unit-VI Decidability and Undecidability — 04 Hrs.

NP complete and NP hard problem, Church's hypothesis, Halting Problem, Post correspondence problem, Rice's theorem

Text Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education, 2016..
2. Michael Sipser, "Theory of Computation", Cengage Learning, 2014.
3. J. C. Martin, "Introduction to Languages and the Theory of Computation", 4th Edition, Tata McGraw-Hill (TMH), 2010.

Reference Books:

1. O. G. Kakde, "Theory of Computation", Laxmi Publications (LP), 2008.
2. Krishnamurthy E. V., "Introductory Theory of Computer Science", East-West Press, 2009.

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 10 marks each will be conducted during the semester.
2. Average 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.

Advanced Algorithms (22PECO5051T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Concepts of Data structures, Discrete Mathematics and Analysis of Algorithms.

Course Objective: To provide conceptual and practical knowledge of Advanced Algorithms.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the chosen algorithm.	L4	Analyze
CO2	Choose appropriate data structure and algorithm for given problem statement.	L3	Apply
CO3	Design the algorithm.	L6	Create

Course Contents

Unit-I Analysis of Algorithm Based on Time — 05 Hrs.

Asymptotic notations: Omega, Theta, Big-O, Small-o, small Omega and Tilde.

Amortized Analysis: Aggregate Method, Accounting Method, Potential Method, Beyond worst-case analysis, Dynamic tables and its amortized analysis, RAM model analysis of algorithm.

Unit-II Probabilistic and Randomized Algorithm — 05 Hrs.

Probabilistic approach to algorithm and Randomized Analysis, Indicator Random Variable (IRV), Randomized Quick Sort, Analysis of Hiring Problem, Las Vegas and Monte Carlo algorithm,

Unit-III Advanced Data Structures — 11 Hrs.

Balanced Search Trees: Red-Black Tree, Randomized BST

Heap and Operations: Binomial Tree, Binomial Heap, Treap.

Spatial Data Structure: KD Tree, R Tree, R* Tree.

Probabilistic Data Structure: LogLog and HyperLogLog, Count Min sketch, MinHash with Data mining context.

Unit-IV Graph Based Algorithms — 06 Hrs.

Flow Network Introduction: Residual Network, Augmenting Path, Ford-Fulkerson Method, Edmonds-Karp Method, Push-Relable Algorithm, Relable to Front algorithm.

Bipartite Matching: Maximum Bipartite Matching, Weighted Bipartite Matching.

Unit-V — 06 Hrs.

Computational Geometry: Line Segment Properties, Convex Hull Graham's scan algorithm, Conic Programming.

Geometric Searching: Point Location in polygon using Ray Crossing (Flipped Classroom: 2D Linear Programming with Prune and Search).

Online Algorithms: Competitive Ratio, K-Server.

Unit-VI — 06 Hrs.

Algorithm Classes: P, NP, NP Hardness and NP Completeness

NP Completeness Proofs: Satisfiability (3 sat), Reducibility, TSP.

Approximation Algorithms: Vertex Cover Problem, Travelling Sales Person problem.

Network Approximation: Randomized Rounding, Primal Dual algorithms.

Randomized Classes: RP, BPP, ZPP (Adleman's theorem).

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition.
2. S. Sridhar, "Design and analysis of algorithms", 1st Edition, Oxford.
3. Horowitz, Sahani and Rajsekaran, "Fundamentals of Computer Algorithms", 2nd Edition, Galgotia.
4. Harsh Bhasin, "Algorithms Design and Analysis", 1st Edition, Oxford, 2015.

Reference Books:

1. Rajeev Motwani, Prabhakar Raghavan, "Randomized Algorithm", 1st Edition, Cambridge University.
2. S. K. Basu, "Design Methods and Analysis of Algorithm", 2nd Edition, PHI.
3. Vijay V. Vajirani, "Approximation Algorithms", 1st Edition, Springer.
4. "Computational Complexity", Stanford University.

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 10 marks each will be conducted during the semester.
2. Average 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.

Advanced Algorithms Laboratory (22PECO5051L)

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

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

Course Objective: To provide practical knowledge to design implementable solution.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze performance of algorithm.	L4	Analyze
CO2	Apply appropriate algorithm along with required advance data structures to design solution of algorithm.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. To perform Amortized Analysis.
2. To implement Randomized Algorithms (Randomized Quick Sort).
3. To implement Randomized Algorithms (Hiring Problem).
4. To implement Advanced Data Structure (Red-black Tree Operations).
5. To implement Advanced Data Structure (Binomial Tree Operations).
6. To implement Advanced Data Structure (R Tree Operations).
7. To implement Advanced Data Structure (KD Tree Operations).
8. To implement Advanced Data Structure (MinHash implementation).
9. To implement Graph Based Algorithms (Ford Fulkerson Method).
10. To implement Graph Based Algorithms (Push Relable Method).
11. To implement Graph Based Algorithms (Maximum Bipartite Matching).
12. To implement Computational Geometry (Graham Scan Algorithm).
13. To implement Online Algorithms (K-Server algorithm).
14. To implement Approximation Algorithm (Approximate TSP implementation).

Any other practical covering the syllabus topics and subtopics can be conducted.

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PECO5051T. 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 (ESE):

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

Advanced Operating System (22PECO5052T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Operating System and Computer Organization.

Course Objectives:

1. To understand the difference between distributed, multiprocessor and virtualization concepts.
2. To explore Real Time Operating System concepts.
3. To explore mobile operating systems.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand different types of operating systems concepts to solve real life problems.	L2	Understand
CO2	Analyze system performance by applying virtualization concepts.	L4	Analyze
CO3	Understand mobile operating systems concept.	L2	Understand

Course Contents

Unit-I Introduction — 04 Hrs.

Functions of Operating Systems, Design Approaches: Layered, Kernel Based And Virtual Machine Approach, Need for Advanced Operating Systems, Types of Advanced Operating Systems (NOS, DOS, Multiprocessor OS, Mobile OS, RTOS, Cloud OS).

Unit-II Distributed Operating Systems — 09 Hrs.

Architecture of Distributed Operating Systems, System Architecture Types, Issues in Distributed Operating Systems, Inherent Limitation of Distribute Systems.

Distributed Mutual Exclusion: Classification of Mutual Exclusion Algorithms, Lamport's, Token-Based Algorithm, Suzuki-Kasami's Broadcast Algorithm, Raymond's Tree Based Algorithm, Distributed Deadlock Detection, Distributed File Systems.

Unit-III Real Time Operating Systems — 09 Hrs.

Basic Model of Real Time Systems, Characteristics, Applications of Real Time Systems, Real Time Task Scheduling, Types of Tasks and their Characteristics. Task Scheduling, Clock Driven Scheduling, Hybrid Schedulers, Event Driven Scheduling, EDF Scheduling, Rate Monotonic Algorithm, Handling Resource Sharing.

Resource Handling: Resource Sharing, Priority Inversion, PIP, PCP, HLP, Scheduling Real Time Tasks in Distributed Systems.

Unit-IV Multiprocessor Operating Systems — 06 Hrs.

Introduction, Basic Multiprocessor System Architectures, Design Issues, Threads/ Process Synchronization: The Test and Set Instruction, the Swap Instruction, Implementation of the Process Waits. Processor Scheduling: Issues, Co-Scheduling, Smart Scheduling, Affinity Based Scheduling

Unit-V Virtualisation — 06 Hrs.

Introduction to Virtualisation, Types of Virtualisation, Bare Metal (XEN), Hosted (KVM) Virtualisation, Para Virtualisation, Full Virtualisation, Emulation, Server Virtualisation, Network Virtualisation and Storage Virtualisation.

Unit-VI Mobile Operating System — 05 Hrs.

Mobile OS: Architecture, Android OS, iOS, Virtual OS, Cloud OS and their design issues. Application development using Android.

Text Books:

1. Mukesh Singhal, Niranjan Shivaratri, "Advance Concepts in Operating System", 1st Edition, Mc Graw Hill Edition, 2020.
2. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms", 26 February 2016.

Reference Books:

1. K. C. Wang, "Embedded and Real Time Operating System", 1st Edition, Springer, January 2022.
2. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", 8th Edition, 2017.
3. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education India, 2016.
4. Cris Wolf and Eric M. Halter, "Virtualization from Desktop to Enterprise", 1st Edition, Apress.
5. K. C. Wang, "Embedded and Real-Time Operating Systems Hardcover", 6 April 2017.

Evaluation Scheme:

Theory:

Continuous Assessment (A):

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

Continuous Assessment (B):

1. Two term tests of 10 marks each will be conducted during the semester.
2. Average 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.

Advanced Operating System Laboratory (22PECO5052L)

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 apply advanced virtualization techniques using KVM and XEN.
2. To understand and implement concurrent client-server applications.
3. To understand the basics of mobile application development.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply Client-Server models in networked applications.	L3	Apply
CO2	Understand the mechanisms of Logical clocks and synchronization.	L2	Understand
CO3	Analyze deadlock detection and prevention strategies.	L4	Analyze
CO4	Apply Virtualization techniques to enhance system efficiency.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. Implement concurrent client-server application.
2. Simulate Lamport's logical clock.
3. Implement Ricart-Aggarwala Algorithm.
4. Demonstrate deadlock detection using Edge Chasing algorithm.
5. Demonstrate hosted virtualization using KVM.
6. Load a new operating system virtually on the client machine using the concept of bare metal virtualization by XEN.
7. Hello world, linking activities, passing data.
8. Create a simple list view with image and text.
9. Integrate a website inside an application, use of SQLite.
10. Application development using Android.

Any other practical covering the syllabus topics and subtopics can be conducted.

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PECO5052T. 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 (ESE):

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

Advanced Database Management System (22PECO5053T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Basic knowledge of Database Management Systems.

Course Objectives:

1. To provide an overview of advancement in SQL and Database technology, distributed database systems and document-oriented database.
2. To impart knowledge of query processing and optimization.
3. To understand the usage of advanced data models for real life applications and secure them.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Discuss new developments in database technology, implement advanced data models for real life applications and secure them.	L2	Understand
CO2	Optimize query execution and design distributed database for better resource management.	L5	Evaluate
CO3	Demonstrate the understanding of the concepts related to document-oriented databases.	L3	Apply

Course Contents

Unit-I Advanced Databases — 05 Hrs.

Indexing and Hashing: Types of Single-Level Ordered Indexes, Multilevel Indexes, Dynamic Multilevel Indexes Using B-Trees and B+ Trees.

New Database Applications and Architectures: e.g., Data Warehousing; Multimedia database; NoSQL, Native XML databases (NXD), Graph database.

Unit-II Query Processing and Optimization — 08 Hrs.

Query Processing: Overview, Measures of Query cost, Selection operation, Sorting, Join Operations, and other Operations, Evaluation of Expression.

Query Optimization: Translations of SQL Queries into relational algebra, Heuristic approach and cost-based optimization.

Unit-III Distributed Databases — 08 Hrs.

Introduction: Types of Distributed Database Systems, Distributed Database Architectures.

Distributed Database Design: Data Fragmentation, Replication and Allocation Techniques, Distributed Query Processing (Semi join).

Transaction Management, Concurrency Control (Locking) and Recovery in Distributed Databases.

Unit-IV Document Oriented Database — 06 Hrs.

Object Oriented Database: Need of object-oriented database, Impedance matching problem between OO languages and Relational database, Case study db40.

Document Oriented Database: Need of document Oriented database, Difference between document oriented database and traditional database, Types of encoding XML, JSON, BSON, Representation XML, JSON Objects. Case study on document oriented database such as a MongoDB.

Unit-V Advanced Data Models — 06 Hrs.

Temporal Data Models: Aspects of valid time, Bitemporal time and bi-temporal time with Examples of each.

Spatial model: Types of spatial data models - Raster, Vector and Image. Graph Database: Introduction, Features, Data modeling with graph. MYSQL Postgres, Mobile databases.

Unit-VI Data Security — 06 Hrs.

Introduction to Database Security Issues: Authentication and authorization, Database auditing, Discretionary access control based on granting and revoking privileges, Mandatory access control and Role-based access control for multilevel security, Introduction to statistical database security.

Text Books:

1. Abraham Silberschatz, Henry F. Korth, Sudarshan, "Database System Concepts", 7th Edition, Mc Graw Hill, 2021.
2. Sveta Smirnova and Alkin Tezuysal, "My SQL Cookbook", 4th Edition, O'Reilly Publication, 2022.
3. Shannon Bradshaw, Eoin Brazil, "MongoDB: The Definitive Guide - Powerful and Scalable Data Storage", 3rd Edition, O'Reilly Publication, 2020.
4. Christos Tjortjis, "Graph Databases Applications on Social Media Analytics and Smart Cities", 1st Edition, CRC Press, 2023.

Reference Books:

1. Vinicius M. Grippa and Sergey Kuzmichev, "Learning MySQL", 2nd Edition, O'Reilly Publication, 2021.
2. Tamer OEzsu, Patrick V, "Principles of Distributed Database System", Springer Publication, 2020.

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 10 marks each will be conducted during the semester.
2. Average 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.

Advanced Database Management System Laboratory (22PECO5053L)

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. Discuss professional and commercial databases.
2. Implement query optimization.
3. Design distributed database system to perform fragmentation.
4. Implement advanced data models for real life applications.
5. Handle different database security issues.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Differentiate professional and commercial databases.	L2	Understand
CO2	Simulate and implement query optimization.	L3	Apply
CO3	Implement distributed database design with fragmentation and replication.	L3	Apply
CO4	Process and analyze spatial and temporal data.	L4	Analyze
CO5	Discuss security issues and their measures.	L2	Understand

List of Laboratory Experiments

Suggested List of Experiments:

1. Case study on Professional and Commercial Databases: Summary and Comparison.
2. Simulate Query optimization by applying an SQL Query on any database.
3. Implementation of Query monitor (QEP- Query Execution Plan, Query Statistics).
4. Perform Fragmentation (Range, List, Hash and Key) in DDBS design.
5. Implementation of Replication transparency in DDB.
6. Implementation of two phase / three phases commit protocol.
7. Query execution on XML database.
8. Data handing using JSON. (eg. Display user information from JSON file downloaded from Mobile).
9. Processing of Spatial and temporal data.
10. Case study on Database security issues and measures taken to handle those issues. (Study and document a research paper / patent / product. If possible suggest an improvement.).

Any other practical covering the syllabus topics and subtopics can be conducted.

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PECO5053T. 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 (ESE):

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

Computer Graphics (22PECO5054T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Course Objectives:

1. To equip students with the fundamental knowledge of computer graphics and provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
2. To provide an understanding of mapping from a world coordinate to device coordinates, clipping, solid modeling, rendering, and projections.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the applications of computer Graphics. Apply and compare the algorithms for drawing 2D images also explain aliasing, anti-aliasing and half toning techniques.	L3	Apply
CO2	Analyze and apply clipping algorithms and transformation on 2D images.	L4	Analyze
CO3	Explain basic shading, shadows, curves and surfaces and solve curve problems.	L2	Understand

Course Contents

Unit-I Introduction to Computer Graphics 06 Hrs.

Overview of Computer Graphics, Computer Graphics Application and Software, Description of some graphics devices, Input Devices for Operator Interaction, Active and Passive Graphics Devices, Display Technologies, Storage Tube Graphics Displays, Calligraphic Refresh Graphics Displays, Raster Refresh (Raster-Scan) Graphics Displays, Cathode Ray Tube Basics, Colour CRT Raster Scan Basics, Video Basics, The Video Controller, Random Scan Display Processor, LCD displays.

Unit-II Scan Conversion: Lines, Circles and Ellipses and Filling polygons 08 Hrs.

Scan Converting Lines, Mid-point criteria, Problems of Aliasing, Scan Converting Circles, Scan Converting Ellipses, Filling Polygons.

Unit-III 07 Hrs.

Two-Dimensional Transformations: Transformations and Matrices, Transformation Conventions, 2D Transformations, Homogeneous Coordinates and Matrix Representation of 2D Transformations, Translations and Homogeneous Coordinates, Rotation, Reflection, Scaling, Combined Transformation, Transformation of Points, Transformation of the Unit Square, Solid body Transformations, Rotation about an Arbitrary Point, Reflection through an Arbitrary Line, A Geometric Interpretation of Homogeneous Coordinates.

Three-Dimensional Transformations: Scaling, Shearing, Rotation, Reflection, Translation, Multiple Transformation, Rotation about an Arbitrary Axis in Space, Reflection through an Arbitrary Plane, Matrix Representation of 3D Transformations, Composition of 3D Transformations, Affine and Perspective Geometry, Perspective Transformations, Techniques for Generating Perspective Views, Vanishing Points, The Perspective Geometry and camera models, Orthographic Projections, Axonometric Projections, Oblique Projections.

Unit-IV Two-Dimensional Viewing 07 Hrs.

Introduction, Viewing Pipeline View Coordinate reference frame, Window to viewport transformation point clipping, Text Clipping, Line Clipping: Cohen Sutherland Algorithm, Liang Barsky algorithms, Polygon clipping: Sutherland Hodgeman polygon clipping and Weiler Atherton.

Fractal Geometry: Fractal Dimension, Koch Curve, Piano Curve, Hilbert Curve.

Unit-V Visible-Surface Determination 07 Hrs.

Techniques for efficient Visible-Surface Algorithms, Categories of algorithms, Back face removal, The Z-buffer Algorithm, Scan-line method, Painter's algorithms (depth sorting), Area sub-division method,

BSP trees, Visible-Surface Ray Tracing, comparison of the methods.

Illumination and Shading:

Illumination and Shading Models for Polygons, Reflectance properties of surfaces, Ambient, Specular and Diffuse reflections, Atmospheric attenutation, Phong's model, Gouraud shading, some examples.

Unit-VI Graphics Programming using OPENGL 04 Hrs.

Why OpenGL, Features in OpenGL, OpenGL operations, Abstractions in OpenGL – GL, GLU & GLUT, 3D viewing pipeline, viewing matrix specifications, a few examples and demos of OpenGL programs

Text Books:

1. A. P. Godse, Dr. D. A. Godse, "Computer Graphics and Multimedia: Concepts, Algorithms and Implementation using C", Technical publications, 2020.
2. William M. Newman, "Principles of Interactive Computer Graphics", 2001.
3. B. M. Havaldar, "C Graphics and Projects", 2006.

Reference Books:

1. A. P. Godse, Dr. D. A. Godse, "Computer Graphics and Multimedia, Concepts, Algorithms and Implementation using C", KDP Print US, 2020.
2. Donald Hearn and M. Pauline Baker, "Computer Graphics", Pearson Education, 2011.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_cs90/preview
2. https://www.edx.org/learn/computer-graphics/the-university-of-california-san-diego-computer-graphics

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 10 marks each will be conducted during the semester.
2. Average 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 Graphics Laboratory (22PECO5054L)

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

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

Course Objectives:

After completion of the course, the students are able to apply his/her knowledge in,

1. Geometrical transformations in 2D & 3D perspectives.
2. Understand clipping algorithms.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the basic concepts of computer graphics.	L1	Understand
CO2	Apply clipping and filling techniques for modifying an object.	L3	Apply
CO3	Analyze and apply different types of Geometric transformation of ojects in 2D and 3D.	L4	Analyze

List of Laboratory Experiments

Suggested List of Experiments:

1. Implementation of Line Drawing algorithms: DDA, Bresenham's and using them generating line with different styles like dotted, dashed, centered and thick line.
2. Implementation of Circle generation algorithm: Midpoint and using it generating concentric circles.
3. Implementation of Area Filling Algorithm: Boundary Fill, Flood Fill and Scan line, Polygon Fill.
4. Curve Generation: Bezier for n control points, B Spline (Uniform), Fractal Generation (Koch Curve).
5. Program for performing Two Dimensional Transformations: Translation, Scaling, Rotation, Reflection, Shear by using a homogeneous Matrix representation, use of a function for matrix multiplication is desirable, to perform composite transformation.
6. Implementation of Line Clipping Algorithm: Cohen Sutherland, Liang Barsky.
7. Implementation of Polygon Clipping Algorithm: Sutherland Hodgman.
8. Program to represent a 3D object using polygon surfaces and then perform 3D transformation.
9. Program to perform projection of a 3D object on Projection Plane: Parallel and Perspective.
10. Implement Illumination and shading apply on sphere using two light sources in OpenGL.

A minimum of 06 experiments from the above suggested list or any other experiment based on syllabus will be included along with the mini project, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PECO5054T. 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 (ESE):

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

Professional and Business Communication Tutorial (22HMCO5060L)

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

Examination Scheme
Teacher Assessment : 25 Marks
Total : 25 Marks

Prerequisite: Basic course in Effective Communication Skills.

Course Objectives:

1. To inculcate a professional and ethical attitude at the workplace.
2. To enhance communication and interpersonal skills.
3. To develop effective employability skills.
4. To hone written skills for technical documentation.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Prepare technical documents using appropriate style, format, and language.	L6	Create
CO2	Use employability skills to optimize career opportunities.	L3	Apply
CO3	Employ storytelling techniques in corporate situations.	L3	Apply
CO4	Conduct effective meetings and document the process.	L6	Create
CO5	Demonstrate interpersonal skills in professional and personal situations.	L3	Apply
CO6	Describe cultural differences, etiquettes, and the concept of professional ethics.	L3	Apply

Course Contents

Unit-I Technical Writing — 06 Hrs.

Report Writing: Types of reports, Basic structure of a report, collection of data through questionnaires, survey analysis, language and style in reports

Business Proposal Writing: Types of business proposals, format of proposal, language and style, presentation of proposal

Plagiarism: Types of plagiarism, consequences of plagiarism

Unit-II Employment Skills — 08 Hrs.

Group Discussion: Purpose of a GD, types of GD, criteria for evaluating GD, Dos and Don'ts of GD

Resume Writing: Types of resumes, structure, content and formatting of resume

Interview Skills: Types and modes of interview, Preparation for interview, Dos and Don'ts of interview, frequently asked questions during interview

Presentation Skills: Presentation strategies, overcoming stage fear, techniques to prepare effective PowerPoint presentation

Unit-III Corporate Story Telling — 03 Hrs.

Basics of storytelling: Setting, characters, plot, crisis, climax, resolution, Benefits of storytelling

Types of stories: Elevator pitch, product stories, event stories, stories in presentations, storytelling in SOP's and interviews, storytelling to manage conflict or to motivate

Storytelling techniques: Narration using verbal and non-verbal communication, Analysis of storytelling strategies of corporate master storytellers

Unit-IV Meetings and Documentation — 02 Hrs.

Planning and preparation for meetings: Planning layout of meetings, arranging logistics, defining roles and responsibilities

Strategies for conducting effective meetings: Follow the agenda, record discussion, observe meeting decorum

Documentation: Draft notice, agenda and minutes of meeting

Business meeting etiquettes: Verbal and non-verbal aspects of etiquettes.

Unit-V Introduction to Interpersonal Skills — 05 Hrs.

Emotional Intelligence: Definition, difference between IQ and EQ, how to develop EQ

Leadership: Types of leadership, leadership styles, case studies

Team Building: Difference between group and team, importance of teamwork, strategies to be a good team player

Time Management: Importance of time management, cultural views of time, 80/20 rule, time wasters, setting priorities and goals,

Conflict Management: Types of conflicts, strategies to manage conflict, case studies

Unit-VI Cross-cultural communication and Professional ethics

02 Hrs.

Communication across cultures: Understanding cultures and developing sensitivity towards cultural differences.

Corporate etiquettes: Telephone, dining, cubicle etiquette, etc.

Professional ethics: Effective work habits, accountability, integrity and excellence.

Laboratory: Laboratory (conducted batch wise) will comprise of activities and assignments based on the syllabus.

Reference Books:

1. Fred Luthans, "Organizational Behavior", 12^{th} Edition, McGraw Hill, 2010.
2. Lesika and Pettit, "Report Writing for Business", 9^{th} Edition, McGraw Hill, 1994.
3. Huckin and Olsen, "Technical Writing and Professional Communication", 2^{nd} Edition, McGraw Hill, 1991.
4. Wallace and Masters, "Personal Development for Life and Work", 12^{th} Edition, Thomson Learning, 2010.
5. Herta Murphy, "Effective Business Communication", 7^{th} Edition, McGraw Hill, 2017.
6. Sharma R. C. and Krishna Mohan, "Business Correspondence and Report Writing", 5^{th} Edition, Tata McGraw-Hill Education, 2017.
7. Ghosh, B. N., "Managing Soft Skills for Personality Development", Tata McGraw Hill, 2017.
8. Bell, Smith, "Management Communication", 3^{rd} Edition, Wiley India Edition, 2014.
9. Dr. Alex, K., "Soft Skills", 3^{rd} Edition, S. Chand and Company, 2009.
10. Subramanian R., "Professional Ethics", 2^{nd} Edition, Oxford University Press, 2017.
11. Sandeep Das, "How Business Story Telling Works: Increase Your Influence and Impact", Penguin Random House India Pvt. Ltd., 2023.

Evaluation Scheme:

Continuous Assessment (A):

Continuous Assessment shall consist of 6 assignments, Group Discussion and Power Point Presentation based on the business proposal.

The distribution of marks will be as follows:

1. Tutorials: 10 Marks
2. Business Proposal: 10 Marks
3. Group Discussion: 5 Marks

Total : 25 Marks

The final certification and acceptance of termwork will be subject to satisfactory performance of Continuous Assessment and upon fulfilling minimum passing criteria in the CA.

Semester Project - III (22PJCO5070L)

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

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

Course Objective:

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

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

Semester Project:

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

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

Student is expected to:

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

Assessment Criteria:

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

Prescribed project report guidelines:

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

- Introduction
- Literature Survey
- Related Theory
- Implementation details

- Project Outcomes
- Conclusion
- References

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

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

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

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

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

Employability Skill Development Program-II (HMCO5080L)

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

Examination Scheme
Teacher Assessment : 50 Marks
Total : 50 Marks

Prerequisites: Basic Mathematics, Basic knowledge of C programming

Course Objectives:

1. To enhance the problem solving skills with real life examples.
2. To enable the students to express their thoughts and knowledge on various platforms.
3. Able to describe the basic database management system.
4. Able to implement basic programming project using python.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze and solve the logical problem based on words, venn diagram etc.	L4	Analyze
CO2	Understand and solve the English comprehension, Sentence completion, Sentence Correction problems.	L2, L4	Understand, Analyze
CO3	Understand and illustrate the concept of Exception Handling, Garbage collection.	L2, L3	Understand, Apply
CO4	Understand and describe the fundamental of DBMS, NoSql, MongoDB.	L2	Understand

Course Contents

Unit-I — 10 Hrs.

Reasoning : Data sufficiency, Logical Deductions, Logical Sequence of Words, Logical Venn Diagrams, Statement and Arguments, Statement and Assumptions, Statement and Conclusions Syllogism.

English: Reading Comprehension, Para Jumbles, Cloze Test, Tenses/ Voice/ Speech, Prepositions/ SVA/ Articles, Vocab /Verbal Analogy, Sentence completion, Sentence Correction.

Unit-II — 10 Hrs.

Modules: Introduction, Importance of Modularity programming, Import keyword, User defined modules creation, Function based modules, Classes based modules, Connecting modules, 'from' keyword.

Files Handling: Reading file char by character, Reading file line by line, Modes of files, Writing into file, Append data to a file, Reading CSV file, Pickling and Un pickling

Garbage collection: Introduction, Importance of manual GC, Self-referenced objects, 'gc' module, Collect() method, Threshold function.

Unit III — 08 Hrs.

Collections Framework: Introduction to collection of data types, Importance of Data processing, DS algorithms introduction.

List: Create a list, Adding elements, Deleting elements, Pre-defined functionality of List, Nested List, Immutability and Mutability of List.

Set: The functionality of Set object, Frozen set, Dictionaries, Create a dictionary, Adding elements

Dict: Pre-defined functions of Dict class, Programs using Collection types

Unit IV — 08 Hrs.

Tkinter: – GUI Types of Layouts , Create Labels and Display images, Create Buttons, Create Events, StringVar class, Calculator program using GUI.

Basic ML AI including Projects: Iterators, Nested functions, Generators, Closures, Decorators, Basic ML and AI, PIP, Visualization etc...

Project Domain (Per domain 1 or 2 project)

- ML/AI Based Projects
- Data Analysis Based projects
- Test Summarization based projects
- Web scrapping and crawling

Unit V 10 Hrs.

DBMS Using Python: Introduction to Mysql, Mysql – Python connectivity, DDL, DRL, DML, Transaction management examples (rollback and commit), GUI –Database connectivity.

NoSql Using Python: Installation and Configuration, MongoDB Tools, Collection and Documents, CRUD and the MongoDB Shell, Introduction to CRUD, Introduction to the MongoDB API, Creating a Database, Collection and Documents.

Data Modelling and Schema Design: MongoDB Database References Model Tree Structures, MongoDB Analysing Queries, Atomic Operations, Map Reduce, Text Search, Regular Expression, Capped Collections Administration MongoDB Deployment and Cluster setup, MongoDB GridFS, Trident Spout, Working with Replica Sets, MongoDB Sharding.

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:

Teacher Assessment(TA):

Teacher's Assessment (TA) will carry weightage of 50 marks. The components of TA and 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

Any other component recommended by BOS and approved by Dean Academics.

Semester - VI

Software Engineering and Project Management (22PCCO6010T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites:

1. Concepts of Object Oriented Programming & Methodology.
2. Knowledge of developing applications with front end & back end connectivity.

Course Objective:

1. To provide an idea of using various process models in the software industry according to given scenario.
2. To gain the knowledge of how Analysis, Design, Implementation, Testing and Management processes are conducted in a software project.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand basic concepts of Software Engineering process and models.	L2	Understand
CO2	Identify requirements, analyse, design and develop the software projects.	L3	Apply
CO3	Create project plan and schedule and track the progress of the project using various software project management tools.	L6	Create
CO4	Apply testing principles on software projects.	L3	Apply

Course Contents

Unit I — 08 Hrs.

Introduction to Software Engineering and Process Models: Nature of Software, Software Engineering, Software Process, CMM, Generic Process Model.

Prescriptive Process Models: The Waterfall Model, V Model.

Incremental Process Model: Incremental Model.

Evolutionary Process Models: Prototyping Paradigm, The Spiral Model.

Concurrent Process Models: Concurrent Process Model.

Agile Methodology: Agility Principals, Agile Process Models: Extreme Programming (XP), Adaptive Software Development (ASD), Dynamic Systems Development Method (DSDM), Scrum, Crystal, Feature Driven Development (FDD), Agile Modeling (AM), Kanban Model.

Unit II — 07 Hrs.

Requirement Analysis: Requirement Elicitation, Software Requirement Specification (SRS).

Requirement Models: Scenario Based Models, Class Based Models, Behavioural Models and Flow Models.

Unit III — 06 Hrs.

Design Engineering and Analysis: Design Principles, Design Concepts, Effective Modular Design-Cohesion and Coupling.

Translating the requirement models into the design model.

Designs: Architectural Design, Component Level Design, User Interface Design.

Unit IV Software Project Management — 08 Hrs.

Project Management Concepts: Management Spectrum, 3Ps.

Process and Project Metrics: Metrics in the Process and Project Domains, software measurement, metrics for software quality.

Software Project Estimation: LOC, FP, Empirical Estimation Models COCOMO I, COCOMO II, Specialized Estimation Techniques.

Software Project Scheduling: Work Breakdown Structure, Network Diagram, Gantt Chart, PERT, CPM, Stakeholders and Communication plan, Introduction to Project Management Information System (PMIS).

Unit V — 05 Hrs.

Software Risk Management: Risk Identification, Risk Assessment, Risk Projection, Risk Refinement, RMMM Plan.

Software Configuration Management: SCM, SCM Repositories, SCM Process, Change Control and Version Control.

Unit VI

05 Hrs.

Software Testing Fundamentals: Strategic Approach to Software Testing, Unit Testing, Integration Testing, Verification, Validation Testing, System Testing, Test Strategies for WebApps.

Software Testing Techniques: White Box Testing, Basis Path Testing, Control Structure Testing and Black Box Testing, TDD.

Text Books:

1. Roger Pressman, "Software Engineering: A Practitioner's Approach", 7^{th} Edition, McGraw-Hill Publications.
2. Ian Sommerville, "Software Engineering", 9^{th} Edition, Pearson Education.
3. Ugrasen Suman, "Software Engineering-Concepts and Practices", 2^{nd} Edition, Cengage Learning.

Reference Books:

1. Ali Behfrooz and Fredeick J. Hudson, "Software Engineering Fundamentals", Oxford University Press.
2. Pankaj Jalote, "An Integrated Approach to Software Engineering", 3^{rd} Edition, Springer/Narosa, 2005.
3. Jibitesh Mishra and Ashok Mohanty, "Software Engineering", 1^{st} Edition, Pearson, 2011.
4. Rajib Mall, "Fundamentals of Software Engineering", 4^{th} Edition, Prentice Hall India, 2018.

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 10 marks each will be conducted during the semester.
2. Average 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.

Software Engineering and Project Management Laboratory (22PCCO6010L)

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 impart state-of-the-art knowledge on Software Engineering in an interactive manner through the Web.
2. Present case studies to demonstrate practical applications of different concepts.
3. Provide a scope to students where they can solve small, real life problems.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Can produce the requirements and use cases the client wants for the software being produced.	L3	Apply
CO2	Participate in drawing up the project plan. The plan will include at least extent and work assessments of the project, the schedule, available resources, and risk management can model and specify the requirements of mid-range software and their architecture.	L1	Remember
CO3	Create and specify such a software design based on the requirement specification that the software can be implemented based on the design.	L6	Create
CO4	Can assess the extent and costs of a project with the help of several different assessment methods.	L5	Evaluate

List of Laboratory Experiments

Suggested List of Experiments:

1. Prepare detailed statement of problem for the selected / allotted mini project and identify suitable process model for the same with justification.
2. Develop Software Requirement Specification (SRS) document in IEEE format for the project.
3. Identify scenarios develop UML Use case and Class Diagram for the project.
4. Draw DFD (upto 2 levels) and prepare Data Dictionary for the project.
5. Develop Activity / State Transition diagram for the project.
6. Develop Sequence and Collaboration diagram for the project.
7. Use project management tool to prepare schedule and estimation for the project.
8. Prepare RMMM plan for the project.
9. Change specification and make different versions using any SCM Tool.
10. Develop test cases for the project using testing techniques.

Any other practical covering the syllabus topics and subtopics can be conducted.

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PCCO6010T. 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 (ESE):

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

Machine Learning (22PCCO6020T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Data Structures, Basic Probability and Statistics, Algorithms, Data Mining.

Course Objectives:

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To become familiar with regression, classification and clustering tasks.
3. To become familiar with Dimensionality reduction Techniques.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Gain knowledge about basic concepts of Machine Learning.	L2	Understand
CO2	Identify machine learning techniques suitable for a given problem.	L3	Apply
CO3	Apply various machine learning techniques.	L3	Apply
CO4	Design application using machine learning techniques.	L6	Create

Course Contents

Unit-I Introduction to Machine Learning — 06 Hrs.

Types of Machine Learning, Steps involved in developing a Machine Learning Application, Evaluating a Learning Algorithm: Deciding what to try next, Evaluating Hypothesis, Model Selection and Train/ Validation/ Test Sets, Bias Vs variance: Regularization and Bias/ Variance, Learning Curve, Error Analysis, Handling Skewed Data: Error Matrices for Skewed Classes, Tradeoff between Precision and recall, Issues in Machine Learning, Application of Machine Learning

Unit-II Learning with Regression and trees — 06 Hrs.

Learning with Regression: Simple Linear Regression, Multiple Linear Regression, Logistic Regression. Learning with Trees: Decision Trees, Constructing Decision Trees using Gini Index, Classification and Regression Trees (CART).

Unit-III Dimensionality Reduction — 07 Hrs.

Dimensionality Reduction Techniques: Principal components analysis (Eigen values, Eigen vectors, Orthogonality), Independent Component Analysis, Single value decomposition,

Unit-IV Classification — 08 Hrs.

Classification using Bayesian Belief networks,

Hidden Markov Models

Support Vector Machine: Maximum Margin Linear Separators, Quadratic Programming solution to finding maximum margin separators, Kernels for learning non-linear functions.

Classification using k Nearest Neighbour Algorithm

Unit-V Clustering — 07 Hrs.

Basics of clustering, Hard vs Soft Clustering, Density Based Clustering: DBSCAN, Expectation maximization (EM) for soft clustering, Semi-supervised learning with EM using labelled and unlabeled data, Radial Basis functions.

Unit-VI Applications of Machine Learning — 05 Hrs.

Recommender Systems, Machine Learning for Image Recognition, Sentiment Analysis, Machine Learning for video surveillance.

Text Books:

1. Ethem Alpaydın, "Introduction to Machine Learning", 4th Edition, MIT Press, 2020.

2. Peter Harrington, "Machine Learning In Action", 1st Edition, DreamTech Press, 2012.

3. Tom M. Mitchell, "Machine Learning", 1st Edition, McGraw Hill, 2017.

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

5. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.

Reference Books:

1. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 2nd Edition, 2019.

2. Witten Ian H., Eibe Frank, Mark A. Hall, and Christopher J. Pal. "Data Mining: Practical machine learning tools and techniques", 1st Edition, Morgan Kaufmann, 2016.

3. Han Kamber, "Data Mining Concepts and Techniques", 3rd Edition, Morgann Kaufmann Publishers, 2012.

4. Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, "Foundations of Machine Learning", The MIT Press, 2012.

5. H. Dunham, "Data Mining: Introductory and Advanced Topics", 1st Edition, Pearson Education, 2006.

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 10 marks each will be conducted during the semester.

2. Average 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 Laboratory (22PCCO6020L)

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

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

Course Objectives:

1. To implement linear and logistic regression model.
2. To implement supervised learning algorithm.
3. To Apply Exploratory Data Analysis.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To Build and Analyze regression model.	L4	Analyze
CO2	To Build and Analyze supervised machine learning algorithm.	L4	Analyze
CO3	Make use of Exploratory Data Analysis.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. To implement Linear Regression.
2. To implement Logistic Regression.
3. To implement CART decision tree algorithm.
4. To implement Support Vector Machine.
5. To implement Bayesian Classification.
6. To implement PCA.
7. To implement K-Nearest Neighbour.
8. To implement Radial basis functions.
9. Mini project based on any machine learning application.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PCCO6020T with minimum 06 experiments along with a mini project 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 (ESE):

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

Information Security (22PCCO6030T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Knowledge of Programming Basics and Computer Network.

Course Objectives:

1. To acquire fundamental knowledge of modular arithmetic and number theory to establish a foundational understanding of cybersecurity principles.
2. Grasp the concepts of symmetric and asymmetric cryptography, applying various techniques to address confidentiality and authentication requirements in information systems.
3. Apply digital signature and hashing algorithms effectively to achieve authentication and integrity in the design of secure applications, demonstrating practical competence in securing digital information.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand system security goals and concepts, classical encryption techniques and acquire fundamental knowledge on the concepts of modular arithmetic and number theory.	L2	Understand
CO2	Understand the concept of symmetric and asymmetric cryptography and apply the different techniques to solve confidentiality and authentication.	L3	Apply
CO3	Apply different digital signature and hashing algorithms to achieve authentication and integrity to design secure applications. .	L3	Apply
CO4	Understand network security basics, analyze different attacks on networks and systems, understand vulnerability and apply preventive measures.	L4	Analyze

Course Contents

Unit-I Introduction and Number Theory 08 Hrs.

Services, Mechanisms and attacks, the OSI security architecture-Network security model, classical Encryption techniques (Symmetric cipher models, substitution techniques, transposition Techniques), Number theory Groups, Rings, Fields, Modular arithmetic, Euclid's algorithm, Finite fields, Polynomial Arithmetic, Prime numbers, Fermat's and Euler's theorem, Chinese Remainder theorem.

Unit-II Symmetric Cryptography 06 Hrs.

Block cipher principles, block cipher modes of operation, Simplified Data Encryption Standard (DES), DES, Double DES, Triple DES, Simplified Advanced Encryption Standard (S-AES).

Unit-III Asymmetric Cryptography 06 Hrs.

Symmetric vs. Asymmetric Cryptography, Principles of public key cryptosystems, and Essential Number Theory for Public-Key Algorithm: Euler's Phi Function. The RSA algorithm, Key management, Diffie Hellman Key exchange,

Case Study:Elliptic curve arithmetic, Elliptic curve cryptography.

Unit-IV Integrity, Authentication and Digital Certificates 08 Hrs.

Cryptographic hash functions, Properties of secure hash function, MD5, SHA-1, MAC, HMAC, CMAC. User Authentication and Entity Authentication, One-way and mutual authentication schemes, Needham Schroeder Authentication protocol, Kerberos Authentication protocol. RSA Signature Schemes, Elgamal Digital Signatures, Digital Signature Algorithm. Digital Certificate: X.509, PKI.

Unit-V Network Security 07 Hrs.

Network security basics: Packet Sniffing, ARP spoofing, port scanning, IP spoofing, TCP syn flood, DNS Spoofing. Denial of Service: Classic DOS attacks, Source Address spoofing, ICMP flood, SYN flood, UDP flood, Distributed Denial of Service, Defenses against Denial-of-Service Attacks.

Internet Security Protocols: SSL, IPSEC, Secure Email: PGP, Firewalls, IDS and types, Honey pots.

Unit-VI Software Security Software Vulnerabilities 04 Hrs.

Buffer Overflow, Salami Attack, Format string, cross-site scripting, SQL injection, Malware: Viruses, Worms, Trojans, Logic Bomb, Bots, Rootkits.

Case Study: Introduction to Secured Software Development Life Cycle.

Text Books:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", 8th Edition, Pearson Education, Sept 2020.
2. Behrouz A. Forouzan, "Cryptography & Network Security", 3rd Edition, Tata Mc-Graw Hill, 2015.

Reference Books:

1. Bruce Schneier, "Applied Cryptography: Protocols, Algorithms and Source Code in C", 2nd Edition, Wiley, 2007.
2. Charles Pfleeger, Shari Lawrence Pfleeger & Jonathan Margulies, "Security in Computing", 6th Edition, Addison Wesley Professional, 2023.
3. Michael Howard, Steve Lipner, "The Security Development Life Cycle", 1st Edition, Microsoft Press, 2006.

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 10 marks each will be conducted during the semester.
2. Average 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.

Information Security Laboratory (22PCCO6030L)

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

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

Course Objectives:

1. To implement various cryptographic algorithms.
2. To demonstrate the Data Integgrity.
3. To understand and explore different Network Security and analysis tools.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the cryptographic algorithms for data communication.	L3	Apply
CO2	Demonstrate the data integrity using various cryptographic algorithms.	L3	Apply
CO3	Utilize the different open source tools for network security and analysis	L3	Apply
CO4	Demonstrate Network Intrusion Detection using network security tool.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. Design and Implement Caesar cipher cryptographic algorithm by considering letter [A..Z] and digits [0..9]. Apply Brute Force Attack to reveal secret.
2. Design and Implement Encryption and Decryption algorithm using Simple Columnar Transposition cipher technique. Study how dictionary attack can be applied on it.
3. Design and Implement your "own" cipher combining "Substitution" and "Transposition" techniques.
4. Implement RSA Cryptosystem using RSA Algorithm / Implement Elliptical Curve Digital Signature Algorithm (ECDSA).
5. Demonstrate the data integrity using various cryptographic algorithms viz. MD-5, SHA-1 using VLAB, IIT Bombay
6. Implement registration webpage asking for information along with the password (Strong enough). Store the password in database in encrypted form after adding few salt characters in the password. Verify the strength of password and perform analyses using various attack.
7. Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.
8. Study of packet sniffer tools wireshark, : Download and install wireshark and capture icmp, tcp, and http packets in promiscuous mode. Explore how the packets can be traced based on different filters.
9. Implementation of Network Intrusion Detection System using SNORT and IPTABLE.
10. Implement DOS Attack using HPing, Hping3 and other tools.
11. Implement Buffer Overflow Attack using Ollydbg, Splint, Cppcheck.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PCCO6030T. 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 (ESE):

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

Advanced Network Design (22PECO6041T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Data Structures, Computer Networks, Operating Systems

Course Objectives:

1. To develop a comprehensive understanding of advanced network design principles and their strategic implications.
2. To acquire proficiency in the practical implementation of network designs, including physical infrastructure, configurations, and lifecycle management.
3. To apply analytical skills to assess network data traffic, security threats, and performance metrics for informed decision-making.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the need for advanced networks and standards in various scenarios, evaluating specific design requirements for topology, cabling, and physical component placement.	L3	Apply
CO2	Develop frameworks and standards for the implementation of network designs, incorporating best practices in configuration management. Also apply human factor concepts to enhance usability and troubleshoot network issues.	L3	Apply
CO3	Integrate IPv6 in network design, design and implement security systems, and analyze real-world examples of advanced network design. Also compare performance metrics in Internet routing and VoIP	L4	Analyze

Course Contents

Unit-I Introduction to Advanced Network Design 05 Hrs.

Overview of Advanced Network Design Principles: Definition of advanced network design, Importance of strategic network planning

Review of Basic Networking Concepts: OSI Model revisited, TCP/IP fundamentals, Network addressing and subnetting

Emerging Trends in Networking: Software-Defined Networking (SDN), Network Function Virtualization (NFV), Internet of Things (IoT) in networking.

Unit-II Physical Network Design and Infrastructure 09 Hrs.

Physical Network Design: Topology design considerations, Cabling and physical component placement, Redundancy and fault tolerance in physical design

Advanced Router Configuration: In-depth configuration of routers, Routing protocols (EIGRP, OSPF, BGP), Router optimization and scalability

Unit-III Configuring and Managing the Network Infrastructure 06 Hrs.

Network Configuration Best Practices: Implementation of network designs, Configuration management and version control

Network Lifecycle Management: Maintenance and troubleshooting strategies, Network monitoring and performance optimization

Unit-IV Analyzing Network Data Traffic 06 Hrs.

Traffic Analysis Fundamentals: Packet capture and analysis tools, Understanding network protocols

Quality of Service (QoS) Implementation, QoS requirements and strategies, Traffic classification and shaping

Unit-V Network Security and IPv6 06 Hrs.

Threats and Vulnerabilities in Networks: Common network security threats, Vulnerability assessment and risk analysis

Firewall and Intrusion Detection/Prevention Systems, Designing and placing firewalls strategically, Intrusion detection and prevention strategies

Virtual Private Networks (VPNs) and IPv6: Implementing VPNs for security, Integration of IPv6 in network design

Unit-VI Internet Routing and VOIP 07 Hrs.

Internet Routing with BGP: BGP essentials and best practices, Internet routing considerations

Voice over IP (VoIP) Basics: Introduction to VoIP technologies, Design considerations for VoIP in networks

Case Studies and Best Practices: Examining real-world examples of advanced network design, best practices for implementing advanced network solutions

Text Books:

1. Olivier Bonaventure, "Computer Networking: Principles, Protocols and Practice," No Starch Press, 2013.
2. Kevin Dooley, "Designing Large Scale LANs," O'Reilly Media, 2011.
3. Mani Subramanian, "Network Management: Principles and Practice," Addison-Wesley, 2000.
4. Ilya Grigorik, "High-Performance Browser Networking," O'Reilly Media, 2013.
5. William Stallings, "Network Security Essentials," Pearson, 2016.
6. William A. Flanagan, "VoIP and Unified Communications: Internet Telephony and the Future Voice Network," Wiley, 2012.

Reference Books:

1. Laura Chappell, "Wireshark Network Analysis," Protocol Analysis Institute, 2012.
2. Silvia Hagen, "IPv6 Essentials," O'Reilly Media,2006.
3. Iljitsch Van Beijnum, "BGP: Building Reliable Networks with the Border Gateway Protocol," O'Reilly Media, 2002.
4. Tim Szigeti, "End-to-End QoS Network Design," Cisco Press, 2004.
5. Jeffrey S. Beasley and Piyasat Nilkaew, "A Practical Guide to Advanced Networking," Pearson, 2017.
6. Gary A. Donahue, "Network Warrior," O'Reilly Media, 2011.

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 10 marks each will be conducted during the semester.
2. Average 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.

Advanced Network Design Laboratory (22PECO6041L)

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 get familiar with network design principles.
2. Apply networking techniques to design physical network layout.
3. To configure different routing protocols.
4. Develop practical skills in network configuration, troubleshooting, and maintenance.
5. To provide hands-on experience in implementing basic network security measures and understanding potential vulnerabilities.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Evaluate and interpret case studies to implement advanced network design principles.	L5	Evaluate
CO2	Create and simulate physical network layouts using advanced simulation tools, demonstrating comprehensive design skills.	L6	Create
CO3	Apply knowledge to configure and optimize various routing protocols, ensuring efficient network routing.	L3	Apply
CO4	To diagnose and resolve common networking issues using diagnostic tools and methodologies.	L4	Analyze
CO5	Analyse and simulate network security threats using advanced tools to understand vulnerabilities and mitigation techniques.	L4	Analyze

List of Laboratory Experiments

Suggested List of Experiments:

1. Implement advanced network design principles through case study analysis.
2. Design a physical network layout using simulation tools like Cisco Packet Tracer or GNS3.
3. Configure routers for EIGRP, OSPF, and BGP, optimizing routing tables.
4. Set up a network infrastructure adhering to industry best practices.
5. Develop troubleshooting skills and perform routine maintenance tasks.
6. Analyze network traffic using tools like Wireshark.
7. Implement Quality of Service (QoS) strategies for network traffic.
8. Simulate and analyze common network security threats using tools like Metasploit.
9. Design and implement effective firewall and intrusion detection/prevention systems.
10. Configure and deploy Virtual Private Networks (VPNs) for secure communication.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PECO6041T. 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 (ESE):

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

High Performance Computing (22PECO6042T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Computer Organization and Architecture or equivalent

Course Objectives:

1. To design, develop and analyze parallel programs on high performance computing resources using parallel programming.
2. Learn to design parallel programs on high performance computing.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe parallel processing approaches and different parallel processing platforms involved in achieving High Performance Computing.	L2	Understand
CO2	Discuss different design issues in parallel programming.	L2	Understand
CO3	Develop efficient and high-performance parallel programming.	L3	Apply
CO4	Understand parallel programming using message passing paradigm using open-source APIs.	L5	Evaluate

Course Contents

Unit-I Introduction to Parallel Computing — 06 Hrs.

Motivating Parallelism, Scope of Parallel Computing, Levels of parallelism (instruction, transaction, task, thread, memory, function)

Classification Models: Architectural Schemes (Flynn's, Shore's, Feng's, Handler's) and Memory access (Shared Memory, Distributed Memory, Hybrid Distributed Shared Memory)

Parallel Architectures: Pipeline Architecture, Array Processor, Multiprocessor Architecture.

Unit-II Pipeline Processing — 06 Hrs.

Introduction, Pipeline Performance, Arithmetic Pipelines, Pipeline instruction processing, Pipeline stage design, Hazards, Dynamic instruction scheduling.

Unit-III Parallel Programming Platforms — 08 Hrs.

Parallel Programming Platform Implicit Parallelism: Trends in Microprocessor & Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines.

Unit-IV Parallel Algorithm Design — 07 Hrs.

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads. Parallel Algorithm Models, Basic Communication operations: Broadcast and Reduction Communication types.

Unit-V Performance Measures — 06 Hrs.

Speedup, Efficiency and Scalability, abstract performance metrics (work, critical paths), Amdahl's Law, Gustafson's Law, Weak vs. Strong Scaling, Performance Bottlenecks, Data Races and Determinism, Data Race Avoidance. Cluster Setup & its Advantages, Performance Models & Simulations; Networking Protocols & I/O, Messaging Systems, Process Scheduling, Load Sharing and Balancing; Distributed Shared Memory, Parallel I/O.

Unit-VI HPC Programming — 06 Hrs.

Programming Using the Message-Passing Paradigm: Principles of Message Passing Programming,The Building Blocks: Send and Receive Operations MPI: the Message Passing Interface, Topology and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Introduction to OpenMP

Text Books:

1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar, "Introduction to Parallel Computing", Pearson Education, 2nd Edition, 2007.
2. M. R. Bhujade, "Parallel Computing", 2nd Edition, New Age International Publishers, 2009.
3. Kai Hwang, Naresh Jotwani, "Advanced Computer Architecture: Parallelism, Scalability, Programmability", McGraw Hill, 3rd Edition, 2017.
4. Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall / CRC Computational Science series, 2011.

Reference Books:

1. Michael J. Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw-Hill International Editions, Computer Science Series, 2008.
2. Kai Hwang, Zhiwei Xu, "Scalable Parallel Computing: Technology, Architecture, Programming", McGraw Hill, 1998.
3. Laurence T. Yang, MinyiGuo, "High- Performance Computing: Paradigm and Infrastructure", Wiley, 2006.

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 10 marks each will be conducted during the semester.
2. Average 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.

High Performance Computing Laboratory (22PECO6042L)

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 provide hands-on experience with parallel programming concepts and tools.
2. To develop practical skills in designing and implementing parallel programs using MPI and OpenMP.
3. To understand and apply different parallel processing techniques to solve computational problems.
4. To evaluate the performance and efficiency of parallel programs on high performance computing platforms.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Execute basic parallel programs using MPI and OpenMP.	L3	Apply
CO2	Develop and implement parallel algorithms for various computational problems.	L6	Create
CO3	Analyze the performance of parallel programs and understand the factors affecting it.	L4	Analyze
CO4	Gain practical experience in using parallel programming directives and libraries.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. Execution of Simple Hello world program on MPI platform.
2. (a) Program to send data and receive data to/from processors using MPI
   (b) Program illustrating Broadcast of data using MPI.
3. Implement a parallel program to demonstrate the cube of N number within a set range.
4. Implement various Sorting Algorithm.
5. Implement a program to demonstrate balancing of workload on MPI platform.
6. Using directives of MPI/OpenMP implement parallel programming for calculator application (add, sub, multiplication, and division).
7. Evaluate performance enhancement of HPC for any of the following: One-Dimensional Matrix-Vector Multiplication/ Single-Source Shortest-Path/ Sample Sort/Two-Dimensional MatrixVector Multiplication.
8. Case Study: OpenMP
9. Mini Project

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PECO6042T.

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 (ESE):

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

Business Analytics (22PECO6043T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Basic statistics and Database.

Course Objectives:

1. To acquire skills, practices and techniques used in converting data into information and knowledge that aids in business decision making.
2. To apply statistical learning including quantitative, qualitative analysis techniques.
3. To apply analysis and visualization to aid decision making in varied business scenarios.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Comprehend analytics, its types and techniques.	L1	Remember
CO2	Apply Base SAS programming to diverse dataset for analysis.	L2	Understand
CO3	Apply visual analytics for data analysis and report design.	L3	Apply
CO4	Formulate business objectives, data selection/collection, preparation and design for various business applications.	L5	Evaluate

Course Contents

Unit-I Introduction to Analytics 07 Hrs.

Analytics, Types of Analytics, Techniques for Analytics, Use Cases in Descriptive Analytics, Predictive Analytics, Presciptive Analytics, Role of Statistics, Datamining, Machine Learning in Analytics, Formulation of Business Problem.

Unit-II Introduction to Base SAS, Visual Analytics 07 Hrs.

SAS Program : Introduction to SAS program, Submitting a SAS program – SAS Studio, SAS Enterprise Guide, SAS Windowing environment, SAS program syntax, Getting Stated with SAS Visual Analytics: Exploring SAS VA concepts, Using Home page, Administrating the Environment and Managing Data: Exploring Data Builder, Exploring Administrator.

Unit-III Reading SAS Dataset, Generating Statistical Reports 07 Hrs.

Accessing Data: Examining SAS Data sets, Accessing SAS Libraries

Producing Detail Reports: Subsetting Report data, Sorting and Grouping Report data, Enhancing Reports

Formatting Data Values: Using SAS Formats, User defined Formats

Reading SAS Dataset. Importing data into SAS from various sources. Generating Statistical Reports for the imported data into SAS. Interpretation of the Statistical Reports.

Unit-IV Using the Explorer in Visual Analytics 06 Hrs.

Selecting Data and defining Data Item properties. Creating Visualisations, Enhancing Visualisations with Analytics Interacting with Visualizations and Explorations.

Unit-V Designing Reports 06 Hrs.

Creating a Simple Report, Creating Data Items and Working with Graphs, Working with Filters and Report sections, Working with other objects, Applying Graph level display rules in Reports.

Unit-VI Viewing SAS VA Reports and Case Study 06 Hrs.

Creating Analysis and Reports, Text Analytics, Case Study – Applying to different Business Scenarios.

Text Books:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, "Business Intelligence and Analytics", Pearson, 2019.

2. SAS programming 1 – Essentials.

3. SAS Visual Analytics – Fast Track.

4. SAS Support.

Reference Books:

1. R.N Prasad, Seema Acharya, "Fundamentals of Business Analytics", Wiley 2nd Edition,2019.

2. U. Dinesh Kumar, "Business Analytics: The Science of Data-Driven Decision Making", Wiley, 2nd Edition, 2021.

3. Regi Mathew, "Business Analytics for Decision Making", Pearson 1st Edition, 2020.

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 10 marks each will be conducted during the semester.

2. Average 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.

Business Analytics Laboratory (22PECO6043L)

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 learn how to use and apply SAS Studio and Excel to solve business problems.
2. To become familiar with the processes needed to develop, report, and analyze business data.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand and use the fundamentals of the SAS programming language.	L2	Understand
CO2	Make use of SAS, Excel and CSV in business analytics.	L3	Apply
CO3	Understand new SAS data set by manipulating data from existing data sets using SAS expressions	L2	Understand
CO4	Analyze and report on data and export results to common formats (PDF, Excel).	L4	Analyze
CO5	Apply different types of data (SAS, Excel, or text), then explore and prepare the data.	L3	Apply
CO6	Apply SAS programming principles in practical examples.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. Importing data in SAS from Excel and CSV file.
2. Creating summary statistical data.
3. Exporting results to Excel and PDF.
4. Manipulating data with functions.
5. Using data with formats like charts and graphs.
6. Creating data by applying filters and performing data analysis on it.
7. Working with graph level display rules.
8. Analyzing a Text data source.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PECO6043T.

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 (ESE):

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

Compiler Design (22PECO6044T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisites: Knowledge of Data Structures and Algorithms, Theory of Computation.

Course Objectives:

1. To initiate an understanding of compilers in general and in brief about phases of compiler.
2. To provide a theoretical framework for optimizing the code.
3. To familiarize and encourage the students to use various compiler construction tools.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the basics of compilation steps.	L2	Understand
CO2	Apply different parsing algorithms.	L3	Apply
CO3	Ability to apply the knowledge of lex tool & yacc tool to develop a scanner & parser.	L3	Apply
CO4	Implement code generation and apply code optimization techniques.	L3	Apply

Course Contents

Unit-I Introduction to Compilers — 07 Hrs.

Compilers – Analysis of the source program – Phases of a compiler – Cousins of the Compiler – Grouping of Phases – Compiler construction tools – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens.

Unit-II Syntax Analysis — 08 Hrs.

Role of the parser

Top Down parsing – Recursive Descent Parsing – Predictive Parsing – Bottom-up parsing – Shift Reduce Parsing – Operator Precedent Parsing – LR Parsers – SLR Parser – Canonical LR Parser – LALR Parser.

Unit-III Syntax-Directed Translation — 08 Hrs.

Syntax-Directed Translation

Syntax-Directed Definitions, Evaluation Orders for SDD's, Applications of Syntax-Directed Translation, Syntax-Directed Translation Schemes, Implementing L-Attributed SDD's.

Intermediate-Code Generation

Variants of Syntax Trees, Three-Address Code, Types and Declarations, Type Checking, Control Flow, Switch-Statements, Intermediate Code for Procedures.

Unit-IV Code Optimization — 06 Hrs.

Introduction– Principal Sources of Optimization – Optimization of basic Blocks – DAG representation of Basic Blocks - Introduction to Global Data Flow Analysis

Unit-V Runtime Environments — 05 Hrs.

Source Language issues – Storage Organization –Storage Allocation strategies – Access to non-local names – Parameter Passing, Error detection and recovery.

Unit-VI Code Generation — 05 Hrs.

Issues in the design of Code Generator, Basic Blocks and Flow graphs, Code generation algorithm, DAG representation of Basic Block.

Text Books:

1. A. V. Aho, R. Shethi, Monica Lam, J. D. Ulman, "Compilers Principles, Techniques and Tools", 2nd Edition, Pearson Education.

Reference Books:

1. John R. Levine, Tony Mason & Doug Brown, "Lex & yacc", 2nd Edition, O'Reilly.
2. Kenneth C. Louden, "Compiler Construction: Principles and Practices", 1st Edition, Cengage Learning.

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 10 marks each will be conducted during the semester.
2. Average 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.

Compiler Design Laboratory (22PECO6044L)

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 design & implement a front end of the compiler.
2. To develop program for solving parser problems.
3. To create program for intermediate code generation.
4. To learn the new code optimization techniques and apply it to improve the performance of a program in terms of speed & space.
5. To learn & use the new tools and technologies used for designing a compiler.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the practical approaches of how a compiler works.	L2	Understand
CO2	Understand and analyze the role of syntax and semantics of Programming languages in compiler construction.	L2	Understand
CO3	Apply the techniques and algorithms used in Compiler Construction in compiler component design.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. Develop a lexical analyzer to recognize a few patterns in C. (ex. Identifiers, constants, comments, operators etc.)
2. Implementation of lexical analyzer using lex tool.
3. Derive First and Follow of a variable.
4. Design LL (1) Parser.
5. Implementation of Intermediate code generation.
   (a) Assignment statement
   (b) Boolean statement
   (c) Loop
6. Implementation of code generator algorithm.
7. Implementation of code optimization techniques (constant folding etc.)
8. Case study: LLVM

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PECO6044T.

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 (ESE):

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

Virtual Reality (22PECO6045T)

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

Examination Scheme
Term Test : 10 Marks
Teacher Assessment : 25 Marks
End Sem Exam : 65 Marks
Total Marks : 100 Marks

Prerequisite: Computer Graphics

Course Objectives:

1. To equip students with the fundamental knowledge of Virtual Reality.
2. Acquire practical knowledge of 3D user interface input hardware, including tracking devices, 3D mice, and specialized input devices, and learn how to choose the most suitable input devices for various 3D interface applications.
3. Gain proficiency in VR programming using VRML and Java 3D, enabling the creation of interactive and engaging virtual environments..

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To make students know the basic concept and understand the framework of virtual reality.	L2	Understand
CO2	To understand principles and multidisciplinary features of virtual reality and apply it in developing applications.	L3	Apply
CO3	To know the technology for multimodal user interaction and perception VR, particularly the visual, audial and haptic interface and behaviour.	L2	Understand
CO4	To understand an introduction to the AR system framework and apply AR tools in software development.	L3	Apply

Course Contents

Unit-I Introduction to VR — 08 Hrs.

Important factors in VR system, Types of VR System, advantages of VR, modelling techniques in VR.

3D USER INTERFACE INPUT HARDWARE: Input device characteristics, Desktop input devices, Tracking Devices, 3D Mice, Special Purpose Input Devices, Direct Human Input, Home - Brewed Input Devices, Choosing Input Devices for 3D Interfaces.

Unit-II Computing Architecture for Virtual Reality — 04 Hrs.

Graphical rendering pipeline: OPENGL pipeline, Haptic, PC graphics architecture and accelerator SGI reality architecture, The Sun Blade 1000 architecture.

Unit-III Software Technologies — 07 Hrs.

Database - World Space, World Coordinate, World Environment, Objects - Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and other attributes, VR Environment - VR Database, Tessellated Data, LODs, Cullers and Occluders, Lights and Cameras, Scripts, Interaction - Simple, Feedback, Graphical User Interface, Control Panel, 2D Controls, Hardware Controls, Room / Stage / Area Descriptions, World Authoring and Playback, VR toolkits, Available software in the market.

Unit-IV 3D Interaction Techniques — 08 Hrs.

3D Manipulation tasks, Manipulation Techniques and Input Devices, Interaction Techniques for 3D Manipulation, Design Guidelines - 3D Travel Tasks, Travel Techniques, Design Guidelines - Theoretical Foundations of Wayfinding, User Centred Wayfinding Support, Environment Centred Wayfinding Support, Evaluating Wayfinding Aids, Design Guidelines - System Control, Classification, Graphical Menus, Voice Commands, Gestural Commands, Tools, Multimodal System Control Techniques, Design Guidelines, Case Study: Mixing System Control Methods, Symbolic Input Tasks, symbolic Input Techniques, Design Guidelines, Beyond Text and Number entry

Unit-V Designing And Developing 3D User Interfaces — 08 Hrs.

Strategies for Designing and Developing Guidelines and Evaluation.

Virtual reality programming using VRML and Java 3D

VIRTUAL REALITY APPLICATIONS: Engineering, Architecture, Education, Medicine, Entertainment, Science, Training.

Unit-VI Augmented and Mixed Reality — 04 Hrs.

Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges

with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

Text Books:

1. R. K. Maurya, "Computer Graphics with Virtual Reality", Wiley India, 2011.
2. Doug A. Bowman, Ernest Kuijff, Joseph J. LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", 2nd Edition, Addison Wesley, USA, 2017.
3. Christopher D. Watkins, Stephen R. Marenka ,"Virtual Reality Excursions with Programs in C", Elsevier Science, 2014.

Reference Books:

1. Alan B. Craig, William R. Sherman and Jeffrey D. Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
2. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Merging Real and Virtual Worlds", 2005.
4. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002.
5. Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann Publishers, 2013.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/106/106106138
2. https://www.coursera.org/specializations/virtual-reality
3. https://www.edx.org/certificates/professional-certificate/ucsandiegox-virtual-reality-app-development

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 10 marks each will be conducted during the semester.
2. Average 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.

Virtual Reality Laboratory (22PECO6045L)

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 fundamental skills in Virtual Reality (VR) by gaining hands-on experience with VR hardware and software tools.
2. To identify, configure, and test different types of 3D input devices for compatibility and effectiveness in virtual environments.
3. To develop competence in VR programming using VRML and Java 3D by creating interactive virtual environments.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate fundamental knowledge of Virtual Reality.	L3	Apply
CO2	Evaluate and select appropriate 3D User Interface input hardware.	L5	Evaluate
CO3	Develop an interactive virtual environment using VRML or Java 3D.	L6	Create
CO4	Apply practical skills in VR project development.	L3	Apply

List of Laboratory Experiments

Students are supposed to complete any one mini project related to Virtual Reality (max group of 3 students).

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA):

Laboratory work will be based on 22PECO6045T. 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 (ESE):

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

DevOps Laboratory (22PCCO6050L)

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

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

Prerequisites:

1. Knowledge of Linux Operating system, installation and configuration of services and command line basics.
2. Software Development Life cycle.

Course Objectives:

1. To understand the fundamentals of DevOps engineering.
2. To be proficient with DevOps terminologies, concepts, benefits, and deployment options to meet real world software development requirements.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Interpret and apply various principles, phases and activities of Agile methodology and DevOps principles to meet software development requirements.	L3	Apply
CO2	Understand and implement DevOps principles for CI/CD.	L3	Apply
CO3	Apply testing process for application development and configuration management tools.	L3	Apply

Course Contents

Unit-I Introduction to DevOps — 06 Hrs.

Phases of Software Lifecycle, Minimum Viable Product (MVP) Crossfunctional Teams, Lean, ITIL, Agile development methodologies, DevOps as a prominent culture to achieve agility in the software development process, DevOps Stakeholders, Goals, DevOps and Agile, DevOps Tools.

Unit-II Version Control — 06 Hrs.

Introduction, Overview of Version Control Systems, Role of Version Control System, Types of Control Systems and their Supporting Tools, Importance of version control in CICD pipeline

Unit-III Continuous Integration — 08 Hrs.

Introduction to Jenkins (With Master –Slave Architecture), Choosing a launch method, Administering Jenkins slaves, Labels, groups and load balancing. Creating Views and Jobs in Jenkins: The Jenkins user interface, Jobs in Jenkins, Creating Views, Managing Views and Jobs in Jenkins: Managing Views in Jenkins, Navigating a job's project page, Job Execution, The Job Execution Configuration Panel, The Status Panel, Console Panel.

Unit-IV Continuous Deployment — 05 Hrs.

Overview of Docker, Benefits of Docker Workflow, Process Simplification, Architecture, Docker Containers, Docker Workflow, Anatomy of Dockerfile, Building an Image, Running an Image, Custom base Images, Storing Images.

Unit-V Continuous Testing — 08 Hrs.

Introducing WebDriver and WebElements, Selenium Testing Tools, Differences between Selenium 2 and Selenium 3, Setting up a project in Eclipse with Maven and TestNG using Java, WebElements, Locating WebElements using WebDriver, Interacting with WebElements, Different Available WebDrivers, Using Java 8 Features with Selenium.

Introducing Java 8 Stream API, Using Stream API with Selenium WebDriver.

Unit-VI Continuous Management — 06 Hrs.

The Parts of an Infrastructure System, Infrastructure Platforms, Infrastructure Resources, Compute Resources, Storage Resources, Network Resources.

Puppet: Puppet Architecture, The Puppet Server, setting up the Puppet Agent, Performance Optimizations,

Ansible: Ansible Architecture, Ansible and Infrastructure Management, Local Infrastructure Development: Ansible and Vagrant.

Introduction to open-source tools for data gathering and management, AWS

Text Books:

1. Karl Matthias & Sean P. Kane, "Docker: Up and Running", 3rd Edition, O'Reilly Publication, 2022.
2. Craig Berg, "DevOps For Beginners: A Complete Guide To DevOps Best Practices", 2020.
3. Mikael Krief, "Learning DevOps: A comprehensive guide to accelerating DevOps culture adoption with Terraform, Azure DevOps, Kubernetes, and Jenkins", Packt Publication, 2nd Edition, 2022.
4. Gene Kim, Jez Humble, et.el, "The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations", IT Revolution Press, 2nd Edition, 2021.
5. Mark Reed, "DevOps: The Ultimate Beginners Guide to Learn DevOps Step-By-Step", LLC Publication, 2020.
6. Deepak Gaikwad, Viral Thakkar, "DevOps Tools from Practitioner's Viewpoint", Wiley, 2019.

Reference Books:

1. Mark S. Merkow, "Practical Security for Agile and DevOps", CRC Press Taylor & Francis, 2022.
2. Emily Freeman, "DevOps for Dummies", 3rd Edition, Wiley Publication, 2019.
3. Martin Alfke , Felix Frank, "Puppet 5 Essentials", 3rd Edition, O'Reilly Publication,2017.

Suggested List of Experiments:

1. To understand Version Control System / Source Code Management, install git and create a GitHub account.
2. To Perform various GIT operations on local and Remote repositories using GIT Cheat-Sheet.
3. To understand Continuous Integration, install and configure Jenkins with Maven/Ant/Gradle to setup a build Job.
4. To Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to Test and deploy an application over the tomcat server.
5. To understand Jenkins Master-Slave Architecture and scale your Jenkins standalone implementation by implementing slave nodes.

6. To Setup and Run Selenium Tests in Jenkins Using Maven.
7. To understand Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.
8. To learn Dockerfile instructions, build an image for a sample web application using Dockerfile.
9. To install and Configure Pull based Software Configuration Management and provisioning tools using Puppet/Ansible.
10. To learn Software Configuration Management and provisioning using Puppet Blocks (Manifest, Modules, Classes, Function).
11. To provision a LAMP/MEAN Stack using Puppet Manifest.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (TA) 50 Marks:

Laboratory work will be based on 22PCCO6050L. 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 (ESE) 50 Marks:

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

Project Stage-I (22PJCO6060L)

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

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

Course Objectives:

1. To understand the basic concepts and principles of project development.
2. To formulate/identify the problem statement.
3. To implement the solution as per the problem statement.
4. To develop the team building, writing, logical reasoning and management skills.
5. To provide the connections between the designs and concepts across different disciplinary boundaries.
6. To encourage students to become independent personnel, critical thinkers and lifelong learners.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	To identify the problem statement and produce solution of the problem considering cultural, social, environmental and economic factors using appropriate tool and method.	L4	Analyze
CO2	Demonstrate project based learning that allows students to transfer existing ideas into new applications.	L2	Understand
CO3	Develop an ability to work in teams and manage to conduct the project development activity.	L3	Apply
CO4	Integrate different perspectives from relevant disciplines which help them to get internships, jobs and admission for higher studies.	L3	Apply
CO5	Present the project development in the form of technical writing, understand what constitutes to plagiarism and how to use proper referencing styles.	L2	Understand

Syllabus:

Domain knowledge (any beyond) needed from the following areas for the effective implementation of the project:

Database Management System, Networking and Internet of Things, Embedded Systems, Data science and Big data, Web and Application Development, Robotics, AI and Machine Learning, etc.

The above areas can be updated based on the technological innovations and development needed for specific project.

Guidelines: The main purpose of this activity is to improve the students' technical skills, communication skills by integrating writing, presentation and teamwork opportunities.

- Each student shall work on project stage-I as approved by the departmental committee, a group of 03 to 04 students (max allowed: 5 students in extraordinary cases, subject to the approval of the departmental committee) shall be allotted for each Project stage-I. The departmental committee shall include Head of Department, project coordinator and guide(s).
- Each group shall submit at least 3 topics for the Project stage-I. The departmental committee shall finalize one topic for every group.
- Each group is required to maintain separate log book for documenting various activities of the project stage-I (Refer Table 4).
- Each group will be reviewed twice in a semester and marks will be allotted based on the various points mentioned in the evaluation scheme.
- In the first review of this semester, each group is expected to complete 30% of project stage-I.
- In the second review of this semester, each group is expected to complete 50% of project stage-I.
- Interaction with alumni mentor will also be appreciated for the improvement of project stage-I.

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.
- Assessment of the project (at the end of the semester) will be done by the departmental committee.
- Oral examination shall be conducted by Internal and External examiners. Students have to give presentation and demonstration based on their project stage-I.

Prescribed project report guidelines:

Size of report shall be of minimum 30 pages (excluding cover and front pages). Project stage-I report should include appropriate content for:

- **Abstract**
- **Introduction**
  - Background
  - Motivation
  - Problem Statement
  - Objectives
  - Scope
- **Literature Survey**
  - Review of Existing System(s)
  - Limitations of Existing System(s)
- **Proposed System**
  - Analysis/Framework/ Algorithm
  - Details of H/W and S/W required
  - Design details
  - Methodology (your approach to solve problem)
- **Implementation Plan for Project Stage-II**
- **Conclusion**
- **References**

Assessment criteria for the departmental committee for Continuous Assessment:

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

Assessment criteria for the departmental committee for End Semester Exam:

Departmental committee will evaluate project as per Table 6.

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 Sheet

Sr	P.R.N.	Name of Student	Student Attendance (5)	Log Book Maintenance (5)	Literature Review (5)	Depth of Understanding (5)	Report (5)	Total (25)
			5	5	5	5	5	25

Table 6: Evaluation Sheet

Sr	P.R.N.	Name of Student	Project Stage - I Selection (5)	Design/ Simulation/ Logic (5)	PCB/ Hardware/ Programming (5)	Result Verification (5)	Presentation (5)	Total (25)
			5	5	5	5	5	25