Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure and Syllabus

Third Year B. Tech

Computer Science and Engineering (Data Science)

With effect from Year 2022-23

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

Semester-V														
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	
							Continuous Assessment (CA)							
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best of (TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1	PC	PCCS5010T	Machine Learning-II	3			20	15	15	15	65	100	3	4
	PC	PCCS5010L	Machine Learning-II Laboratory			2	25				25	50	1	
2	PC	PCCS5020T	Artificial Intelligence	3			20	15	15	15	65	100	3	4
	PC	PCCS5020L	Artificial Intelligence Laboratory			2	25					25	1	
3	PC	PCCS5030T	Information Security	3			20	15	15	15	65	100	3	4
	PC	PCCS5030L	Information Security Laboratory			2	25				25	50	1	
4	PC	PCCS5040L	Java and Scala Laboratory			4	50				50	100	2	2
5@	PE	PECS5051T	Distributed Computing	3			20	15	15	15	65	100	3	4
		PECS5051L	Distributed Computing Laboratory			2	25				25	50	1	
		PECS5052T	Time Series Analysis	3			20	15	15	15	65	100	3	
		PECS5052L	Time Series Analysis Laboratory			2	25				25	50	1	
		PECS5053T	Digital System Design	3			20	15	15	15	65	100	3	
		PECS5053L	Digital System Design Laboratory			2	25				25	50	1	
		PECS5054T	Probabilistic Graph Models	3			20	15	15	15	65	100	3	
		PECS5054L	Probabilistic Graph Models Laboratory			2	25				25	50	1	
6	HM	HMCS5060T	Professional and Business Communication	2			50					50	2	2
7	PJ	PJCS5070L	Semester Project-III			2	25				25	50	1	1
8	HM	HMCS5080L	Employability Skill Development Program-II			2	50					50	1	1
			Total	14		16	355			60	410	825	22	

@Any 1 Elective Course

Prepared by:
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Machine Learning -II (PCCS5010T)

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

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

Prerequisite: Linear Algebra, Calculus, Probability, Statistics and Machine Learning Basics.

Course Objectives:

1. To introduce students with the fundamental concepts of artificial neural network and different learning algorithms: supervised and unsupervised neural networks.
2. Develop in-depth understanding of the key techniques in designing Deep Network, Explainable AI and GAN.
3. To expose Deep Network based methods to solve real world complex problems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze different neural network architectures and their learning algorithms.	L4	Analyze
CO2	Implement deep network training and design concepts.	L5	Evaluate
CO3	Build solution using appropriate neural network models.	L3, L6	Apply, Create
CO4	Illustrate performance of deep learning models using Explainable AI.	L2	Understand

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Course Contents

Unit-I Introduction to Artificial Neural Learning 04 Hrs.

History of Deep Learning, Fundamental concepts of biological Neural Networks, Important terminologies of ANN: Activation functions: weights, bias, threshold, learning rate, momentum factor; McCulloch Pitts Neuron: Theory and Architecture; Linear separability; Hebb Network: Theory and Algorithm.

Unit-II Supervised Learning Networks 10 Hrs.

Perceptron: Representational power of Perceptron, The Perceptron Training Rule, Gradient Descent and Delta Rule; Multilayer Networks: A differentiable Threshold Unit, Representational Power of Feedforward Networks; Backpropagation Algorithm: Convergence and local minima, Hypothesis space search and Inductive Bias, Generalization, overfitting and stopping criteria. Regularization for Deep Learning: Parameter Norm Penalties, Dataset Augmentation, Noise Robustness, Early Stooping, Sparse Representation, Dropout. Optimization for Training Deep Models: Challenges in Neural network Optimization, Basic Algorithms, Parameter Initialization Strategies.

Unit-III Convolutional Networks 06 Hrs.

The Convolution Operation, sparse interactions, parameter sharing, Pooling, Convolution and Pooling as an Infinity Strong Prior, Variants of Basic Convolution Function, Efficient Convolution Algorithms.

Unit-IV Sequence Modelling 06 Hrs.

Recurrent Neural Networks (RNN), Bidirectional RNNs, Deep recurrent Networks, Recursive Neural Networks, The challenges of Long-Term Dependencies, Echo State Networks, Leaky Units, The Long Short-Term Memory.

Unit-V Unsupervised Learning Networks 10 Hrs.

Kohonen Self-Organizing Feature Maps – architecture, training algorithm, Kohonen Self-Organizing Motor Map.

Autoencoders: Linear Factor Methods such as Probabilistic PCA and Factor Analysis, Independent Component Analysis, Sparse Coding; Undercomplete Autoencoders, Regularized Autoencoders, Stochastic Encoders and Decoders, Denoising Autoencoders, Contractive Autoencoders, Applications of Autoencoders. **Generative Adversarial Networks:** Generative Vs Discriminative Modeling, Probabilistic Generative Model, Generative Adversarial Networks (GAN), GAN challenges: Oscillation Loss, Mode Collapse, Uninformative Loss, Hyperparameters, Tackling GAN challenges, Wasser-stein GAN, Cycle GAN, Neural Style Transfer.

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Unit-VI Explainable AI 06 Hrs.

Explaining and Interpreting, From black box to white box models, SHAP (Shapley Additive Explanation) and LIME (Local Interpretable Model-agnostic Explanation).

Text Books:

1. Simon Haykin, "Neural Networks and Learning Machines", Pearson Prentice Hall, 3rd Edition, 2010.
2. S. N. Sivanandam and S. N. Deepa, "Introduction to Soft Computing", 3rd Edition, Wiley India Publications, 2018.
3. David Foster, "Generative Deep Learning", O'Reilly Media, 2019.
4. Denis Rothman, "Hands-On Explainable AI (XAI) with Python", Packt, 2020.

Reference Books:

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning", An MIT Press, 2016.
2. François Chollet, "Deep Learning with Python", Manning Publication, 2017.
3. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Publication, 2017.
4. Andrew W. Trask, Grokking, "Deep Learning", Manning Publication, 2019.
5. John D. Kelleher, "Deep Learning", MIT Press Essential Knowledge series, 2019.

Web Links:

1. Learning Rule: http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/explist.php
2. ANN Virtual Lab: http://cse22-iiith.vlabs.ac.in/List%20of%20experiments.html
3. Deep Learning: https://vlab.spit.ac.in/ai/#/experiments
4. NPTEL Course: Deep Learning Part 1: https://onlinecourses.nptel.ac.in/noc19_cs85/preview

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

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End Semester Examination (C):

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

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

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Machine Learning -II Laboratory (PCCS5010L)

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. Monitor and evaluate the deep learning models using different techniques.
2. Building SNN, RNN and explainable AI with real world data.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Build solution using appropriate neural network models.	L4	Analyze
CO2	To expose Deep Network based methods to solve real world complex problems.	L5	Evaluate
CO3	Illustrate performance of deep learning models using Explainable AI.	L2	Understand

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List of Laboratory Experiments

Suggested List of Experiments:

1. Implement Boolean gates using perceptron.
2. Implement backpropagation algorithm from scratch.
3. Monitoring and evaluating deep learning models using Tensorflow and Keras.
4. Evaluate and analyze Prediction performance using appropriate optimizers for deep learning models.
5. Implement Sentiment analysis on text dataset to evaluate customer reviews.
6. Building CNN models for image categorization.
7. Document classification using RNN models.
8. Outlier detection in time series dataset using RNN.
9. Anomaly detection using Self-Organizing Network.
10. Compare the performance of PCA and Autoencoders on a given dataset.
11. Build Generative adversarial model for fake (news/image/audio/video) prediction.
12. Build Explainable AI to improve human decision-making using a two-choice classification experiment with real-world data.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PCCS5010T with at least 10 experiments from the above list to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C):

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

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Artificial Intelligence (PCCS5020T)

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

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

Prerequisite: Basic Mathematics and Data Structures.

Course Objectives:

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

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

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Course Contents

Unit-I 04 Hrs.

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

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

Unit-II 08 Hrs.

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

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

Heuristic Search: Best first Search, Hill Climbing, Solution Space, and Travelling Salesman Problem.

Unit-III 08 Hrs.

Population Based Methods: Simulated annealing, Local beam search, Genetic algorithms, Ant Colony optimization.

Finding Optimal Paths: Branch and Bound, A*, Admissibility and monotonicity properties of A*.

Game Playing: Game Theory, Board games and game tree, The minimax algorithm, Alpha-Beta Pruning and SSS*

Unit-IV 06 Hrs.

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

Unit-V 04 Hrs.

Expert System: Introduction, Phases in building Expert Systems, Architecture, Rule base systems, Inference Engine, Match-Resolve-Execute, Rete Net.

Unit-VI 12 Hrs.

Knowledge and Reasoning in Logic: Logic, Soundness and Completeness, Propositional Logic, First Order Logic, Forward chaining, Backward chaining and Refutation.

Uncertain Knowledge and Reasoning: Fuzzy sets, Fuzzy Logic, Fuzzy Logic Controller.

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Text Books:

1. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education, (India), 2013.
2. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach", 4th Edition, Pearson Education, 2010.
3. John Yen and Reza Langari, "Fuzzy Logic: Intelligence, Control and Information", Pearson, 2002.

Reference Books:

1. Saroj Kaushik, "Artificial Intelligence", 1st Edition, Cengage Learning, 2011.
2. Ivan Bratko, "PROLOG Programming for Artificial Intelligence",4th Edition, Pearson Education, 2011.
3. Elaine Rich and Kevin Knight, "Artificial Intelligence", 3rd Edition, Tata McGraw-Hill, 2008.
4. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y.
5. Patrick Henry Winston, "Artificial Intelligence", 3rd Edition, Addison-Wesley.
6. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2005.

Web Links:

1. Game Theory: https://plato.stanford.edu/entries/game-theory/
2. Fuzzy Logic: https://plato.stanford.edu/entries/logic-fuzzy/
3. AI: https://www.functionize.com/blog/when-is-an-ai-not-an-ai-on-the-intelligent-use-of-ai
4. Logic and Ontology: https://plato.stanford.edu/entries/logic-ontology/

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

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Artificial Intelligence Laboratory (PCCS5020L)

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

Examination Scheme
Teacher Assessment : 25 Marks
Total : 25 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 fuzzy operations for a given problem.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand Intelligent Agents and PEAS for a given problems.	L2	Understand
CO2	Identify and apply searching algorithms to solve problems.	L3	Apply
CO3	Build knowledge base for a problem.	L3	Apply
CO4	Apply fuzzy operations for a given input.	L3	Apply

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List of Laboratory Experiments

Suggested List of Experiments:

1. Study of Intelligent Agents and PEAS for different problems.
2. Identify and analyze uninformed search Algorithm to solve the problem. Implement BFS/DFS/DFID search algorithms to reach goal state.
3. Program to implement Local Search algorithm: Hill climbing search.
4. Program on any natures inspired algorithm to solve a optimization problem in AI
5. Implement A* search algorithm to reach goal state.
6. Implement minimax algorithm for a two-player game.
7. Develop a knowledge base using Prolog.
8. Develop a Rule based System using SWRL on Protégé software.
9. Implement Fuzzy operations for given input values.
10. Design a fuzzy logic controller for a given problem.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PCCS5020T with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

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

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

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Information Security(PCCS5030T)

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

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

Prerequisite: Computer Basics.

Course Objectives: The objective of the course is to introduce indicators of system security, recognize various threats, attacks and vulnerabilities.

CO	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, compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication.	L2, L3, L5	Understand, Compare, Apply
CO3	Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes.	L3, L5	Apply, Evaluate
CO4	Apply different digital signature algorithms to achieve authentication and design secure applications.	L3	Apply
CO5	Understand network security basics, analyze different attacks on networks and systems.	L2, L4	Understand, Analyze
CO6	Understand Software vulnerability and Apply preventive measures.	L2, L3	Understand, Apply

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Course Contents

Unit-I Introduction — 10 Hrs.

Introduction: Cyber Attacks, Need of Security, Security Approaches, Principles of security (confidentiality, authentication, integrity, non-repudiation, access control availability), types of attacks.

Networking Basics: Local Area Network, Protocols - Network Layer, Transport Layer and Application Layer.

Unit-II Number Theory — 06 Hrs.

Modulo Arithmetic, Euclid's Algorithm, Fermat's and Euler's Theorem, Chinese Remainder Theorem, Cipher Properties, Substitution Ciphers – Monoalphabetic Ciphers, Polyalphabetic Ciphers, Transposition Ciphers.

Unit-III Symmetric Cryptography — 08 Hrs.

Block Cipher, Fiestel Structure, Block Cipher Modes of Operation, S-DES, Double DES, Triple DES, AES Algorithm.

Unit-IV Asymmetric Cryptography — 06 Hrs.

Private Key and Public Key Cryptography, The RSA algorithm, Key Management, Diffie-Hellman Key Exchange, Elliptic Curve Operations, Elliptic Curve Diffie-Hellman (ECDH) Key Exchange Algorithm.

Unit-V Integrity and Authentication — 06 Hrs.

Hashing: Properties of cryptographic hash, message digest, MD-5, SHA-1. Public Key Infrastructure (PKI), One way and mutual authentication, Needham-Schroeder Protocol, Authentication methods, Kerberos Authentication Protocol, Biometrics, Digital Certificates: X.509.

Unit-VI Network Security — 06 Hrs.

Network attacks, DoS and DDoS attack, Sniffing, Session hijacking, Spoofing, Phishing, Cross-site Scripting (XSS), IPSec Protocol, SSL Handshake Protocol, Firewalls, IDS Prevention and Detection.

Text Books:

1. William Stallings, "Crpyptography and Network Security Principles and Practices", 7th Edition, Pearson Education, 2017.

2. Behrouz A. Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, McGraw Hill, 2015.

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Reference Books:

1. Atul Kahate, "Cryptography and Network Security", 3rd Edition, McGraw Hill, 2017.
2. Bernard Menezes, "Network Security and Cryptography", 1st Edition, Cengage Learning, 2010.
3. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", 2nd Edition, Pearson, 2005.
4. W. Mao, "Modern Cryptography, "Theory and Practice", 1st Edition, Pearson Education, 2003.
5. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, "Security in computing", Pearson, 5th Edition, 2015.

Web Links:

1. Damn Vulnerable Web Application (DVWA): http://dvwa.co.uk
2. Open Web Application Security Project: https://owasp.org
3. Web penetration testing: https://pentesterlab.com
4. Penetration Testing: https://kali.org

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. 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 3 hrs.

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Information Security Laboratory (PCCS5030L)

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. Apply the cryptographic algorithms for data communication.
2. Demonstrate the data integrity using various cryptographic algorithms.
3. Implement Digital signature for secure data transmission
4. Utilize the different open source tools for network security and analysis.
5. Demonstrate Network Intrusion Detection using network security tool.

CO	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.	L2, L3	Understand, Apply
CO3	Implement Digital signature for secure data transmission.	L6	Create
CO4	Utilize the different open source tools for network security and analysis.	L3	Apply
CO5	Demonstrate Network Intrusion Detection using network security tool.	L2, L3	Understand, Apply

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List of Laboratory Experiments

Suggested List of Experiments:

1. Create a network using CISCO packet tracer.
2. Connect the computers in Local Area Network.
3. Implement Playfair Cipher with key entered by user.
4. Implement polyalphabetic Cipher.
5. Implement Simple and Advanced Columner Transposition technique.
6. Implement Simplified DES.
7. Implement Simple RSA Algorithm with small numbers.
8. Implement Diffie-Hellman Key Exchange.
9. Implement DoS and DDoS attack using Hping.
10. Implement phishing attack using HTTrack Website Cloning.
11. Implement static code analysis using Flawfinder Python Distribution.
12. Implement packet sniffing using Wireshark and TCP Dump.
13. Implement cross site request forgery in a controlled virtual environment using DVWA Web Server.
14. Implement firewalls using IP tables.
15. Implement Network Intrusion Detection System (NIDS).
16. Implement Host based Intrusion Detection System (HIDS).

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PCCS5030T with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

1. Performance in Experiments: 05 Marks

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2. Journal Submission: 05 Marks

3. Viva-voce: 05 Marks

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

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

End Semester Examination (C):

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

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JAVA and Scala Laboratory (PCCS5040L)

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

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

Prerequisite: Programming Fundamentals.

Course Objectives:

1. To learn JAVA and Scala programming concepts.
2. To understand the difference in Object oriented programming and Functional programming.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement Java and Scala program to provide solution for a given Problem.	L2	Understand
CO2	Select suitable programming language depending on the scalability of an application.	L3	Apply

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Course Contents

Unit-I Introduction to Object Oriented Programming 02 Hrs.

1. Features of Java, JVM.
2. Basic Constructs/Notions: Constants, variables and data types, Operators and Expressions, Revision of Branching and looping.
3. Implementation of First Java Program.

Unit-II Classes, Object and Packages 04 Hrs.

1. Implement a Java program to demonstrate Class, Object, Methods.
2. Implement Java program to demonstrate Constructor, Static members and methods.
3. Implement a Java program to solve a given problem using object-oriented concept.
4. Implement a Java program to demonstrate the use of build in packages.

Unit-III Array, String and Vector 06 Hrs.

1. Implement a Java program using 1 D and 2D Array.
2. Implement Java program to demonstrate Strings and String Buffer class.
3. Implement Java program to demonstrate use of Wrapper classes.
4. Implement Java program on Vector.

Unit-IV Inheritance and Interface 04 Hrs.

1. Implement Java program to demonstrate types of inheritance, super keyword.
2. Implement Java program on abstract class and Abstract Method.
3. Implement Java program on interface demonstrating concept of multiple inheritance.
4. Implement Java program on dynamic method dispatch using base class and interface reference.

Unit-V Exception Handling and Multithreading 04 Hrs.

1. Implement Java program to demonstrate try, catch, throw, throws and finally. Also, implement user defined exception.
2. Program to demonstrate concept of Multithreading.
3. Implement Java program to demonstrate the concepts of Thread Synchronization.

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Unit-VI GUI Programming in JAVA 06 Hrs.

1. Implement a JAVA program to create GUI applications with event handling using SWING (Swing components, Containers, JLabel, JButton, JCheckBox, JRadio Buttons, JTextField etc).
2. Implement a JAVA program to create application using SPRING Framework.
3. Implement a JAVA program to demonstrate Database connectivity using JDBC.

Unit-VII Functional Programming Basics Using Sala 02 Hrs.

1. Introduction to Scala: -Characteristics of Functional Programming, Benefits of Scala, Evolution of Scala.
2. Installation of Scala, Run REPL (Read, Evaluate, Print Loop) in Scala.
3. Scala Using Eclipse.

Unit-VIII Scala Programming Basics 04 Hrs.

1. Implement a program to demonstrate Scala programming basic Variable, Data types, Special escape Sequence, String interpolation, Type Conversion, Scope of Variable.
2. Implement a program in SCALA to demonstrate Operators, Precedence Rules, Mathematical Functions.
3. Implement program to demonstrate Conditional Statements and Loops.

Unit-IX Scala Collection 04 Hrs.

1. Implement Program to demonstrate Array, List and Sets in Scala.
2. Implement Program to demonstrate Tuple, Maps, iterator and String in Scala.

Unit-X Scala Functions 04 Hrs.

1. Implement Scala programs to demonstrate Functions Without Any Argument and Return Type, Function to accept another Function as an Argument, Function accepting list and an anonymous Function as argument.
2. Implement programs to demonstrate In-built Functions in Scala.
3. Implement Scala programs to demonstrate Call by value and call by name.

Unit-XI Scala Class object and Inheritance 04 Hrs.

1. Implement Scala programs to demonstrate class and objects.
2. Implement Scala programs to demonstrate inheritance.

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Unit-XII Traits and Packages and Pattern Matching in Scala 04 Hrs.

1. Implement program to demonstrate Traits and packages in Scala.
2. Implement program to demonstrate multiple Inheritance in Scala.
3. Implement program to demonstrate Pattern matching in Scala.

Unit-XIII Exception Handling and File Handling in Scala 04 Hrs.

1. Implement program to demonstrate Exception Handling in Scala.
2. Implement program to demonstrate File Handling in Scala.

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

Text Books:

1. Herbert Schildt, "JAVA: The Complete Reference", 9th Edition, Oracle Press, 2014.
2. Partha Sarathi Bishnu, "Functional Programming using Scala", 2012.

Reference Books:

1. Dean Wampler and Alex Payne, "Programming Scala", O'Reilly, 2014.
2. Ivor Horton, "Beginning JAVA", Wiley India, 2011.
3. Deiteland Deitel, "Java: How to Program", 8th Edition, PHI, 2010.
4. "JAVA Programming", Black Book, Dreamtech Press.
5. "Learn to Master Java programming", Staredusolutions
6. Sachin Malhotra and Saurabh Chaudhary, "Programming in Java", Oxford University Press, 2010.

Web Links:

1. Virtual Lab: https://java-iitd.vlabs.ac.in
2. Virtual Lab: http://vlabs.iitb.ac.in/vlabs-dev/labs/java-iitd/experiments/java-intro-iitd/index.html
3. NPTEL video course link: Programming in Java: https://onlinecou rses.nptel.ac.in/noc22_cs47/preview

Evaluation Scheme:

Laboratory:

Continuous Assessment (A) 50 Marks:

Laboratory work will be based on PCCS5040L with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C) 50 Marks:

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

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Distributed Computing (PECS5051T)

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

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

Prerequisite: Operating Systems.

Course Objectives: The objective of this course is to introduce the fundamentals of distributed computing that includes system architecture, programming model, design, and implementation and performance analysis of these systems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate Interprocess Communication and Synchronization in a Distributed System.	L2, L3	Understand, Apply
CO2	Apply appropriate Resource, Process management, File and Memory technique in a given Distributed Environment for efficient processing.	L3	Apply
CO3	Apply suitable methods to improve data availability in a system.	L3	Apply

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Course Contents

Unit-I Introduction 04 Hrs.

Distributed Computing Models, Issues in Designing Distributed Systems, Network communication: LAN and WAN technologies, Protocols for Network Systems, Asynchronous Transfer Mode.

Unit-II Communication 08 Hrs.

Interprocess Communication: Message Passing, Group Communication, API for Internet Protocols; Remote Communication: Middleware, Remote Procedural Call (RPC) Basics, RPC Implementation, RPC Communication, Exception Handling and Security, RPC in Heterogeneous environment, Failure Handling, RPC Optimization.

Unit-III Synchronization 08 Hrs.

Clock Synchronization, Logical Clocks, Global State, Mutual Exclusion: Centralized, Decentralized, Distributed and Token Ring Algorithms, Election Algorithms: Ring and Bully election algorithms, Deadlocks in Distributed Systems.

Unit-IV Resource and Process Management 06 Hrs.

Desirable features of a global scheduling algorithm, Task Assignment Approach, Load Balancing Approach, Load Sharing Approach, Functions of Distributed Process Management, Desirable features of a process migration mechanism, Process migrations and Threads.

Unit-V Consistency, Replication and Fault Tolerance 08 Hrs.

Introduction to Replication and Consistency, Data-Centric (Continuous Consistency, Consistent Ordering of Operation) and Client-Centric (Eventual Consistency, Monotonic Read, Monotonic Write, Read your Writes, Writes follow Reads); Consistency Models, Replica Management; Fault Tolerance: Introduction, Process resilience, Reliable client-server and group communication, Recovery.

Unit-VI Distributed Shared Memory (DSM) and Distributed File System (DFS) 08 Hrs.

Architecture, Types of DSM, Advantages of DSM, Design Issues in DSM systems, Issues in Implementing DSM systems; Introduction to DFS, DFS Designs, DFS Implementation, File Caching and Replication in DFS.

Text Books:

1. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms", 2nd Edition, Pearson Education, 2017.

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2. Sunita Mahajan and Seema Shah, "Distributed Computing", Oxford University Press, 2013.

Reference Books:

1. S. Tanenbaum and M. V. Steen, "Distributed Systems: Principles and Paradigms", 2nd Edition, Prentice Hall, 2006.

2. M. L. Liu, "Distributed Computing Principles and Applications", Pearson Addison Wesley, 2019.

3. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design", 5th Edition, Pearson Education, 2011.

Web Links:

1. NPTEL Course: Distributed Computing Systems: https://nptel.ac.in/courses/106106107

2. NPTEL Course: Distributed Systems: https://nptel.ac.in/courses/106106168

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

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

End Semester Examination (C):

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

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

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Distributed Computing Laboratory (PECS5051L)

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. Implement multi thred application and client/server using RPC/RMI.
2. Discriminate Inter-process communication and group communication.
3. Implement various algorithms like load balancing algorithm, election algorithm, clock synchronization and mutual exclusion algorithm.
4. Construct distributed file system and deadlock management in distributed systems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement multi thred application and client/server using RPC/RMI.	L3	Apply
CO2	Demonstrate Inter-process communication and group communication.	L4	Analyze
CO3	Implement various algorithms like load balancing algorithm, election algorithm, clock synchronization and mutual exclusion algorithm.	L3	Apply
CO4	Construct distributed file system and deadlock management in distributed systems.	L3	Apply

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List of Laboratory Experiments

Suggested List of Experiments:

1. Implement Client/server using RPC/RMI.
2. Implementation of multithread application.
3. Implement Inter-process communication.
4. Implement Group Communication.
5. Implement Load Balancing Algorithm.
6. Implement Election Algorithm.
7. Implement Clock Synchronization algorithms.
8. Implement Mutual Exclusion Algorithm.
9. Implement Deadlock management in Distributed systems.
10. Implement Distributed File System.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PECS5051T with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C):

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

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Time Series Analysis (PECS5052T)

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

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

Prerequisite: Probability, Statistics and Linear Models.

Course Objectives: Learn basic analysis of time series data; concepts in time series regression; auto-regressive and model averaging models; learn basic concepts of spectral analysis and space-time models.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Interpret a correlogram and a sample spectrum.	L4	Analyze
CO2	Apply appropriate model for a time series dataset.	L3, L5	Apply, Evaluate
CO3	Compute forecasts for a variety of linear and non-linear methods and models.	L2,L3 and L4	Understand, Apply and Analyze

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Course Contents

Unit-I 06 Hrs.

Introduction: Types of forecasting methods, Types of Time Series, simple descriptive techniques, trends in time series (Parametric trends, differencing, non parametric methods, noise), seasonality, Stationary stochastic processes, the correlogram.

Stationary Time Series: Formal definition of a time series, the sample mean and its standard error, Stationary processes: types of stationarity, statistical inference of time series.

Unit-II 06 Hrs.

Linear Time Series: Motivation, Linear time series and moving average models, The AR model, simulating from an autoregressive process, The ARMA model, The ARIMA model, Unit roots, integrated and non-invertible processes, Box – Jenkins Model Selection, Seasonality, The SARIMA model.

Unit-III 08 Hrs.

Prediction: Using prediction in estimating, forecasting for autoregressive processes, forecasting for AR, forecasting for general time series using infinite past, One-step ahead predictors based on the finite past: Levinson -Durbin algorithm; Forecasting for ARMA processes, The Kalman filter.

Unit-IV 10 Hrs.

Models with Trend: Removing trend, Unit Root and Regression Residuals, The Monte Carlo Method, Dickey-Fuller tests.

Multiequation Time Series Models: Intervention Analysis, ADLs and Transfer Functions, Introduction to VAR Analysis.

Unit-V 06 Hrs.

Multivariate Time Series: Background: Sequences and Functions, Convolution, Spectral Representations and mean squared errors; Multivariate time series regression: Conditional independence, Partial correlation and coherency between time series.

Unit-VI 06 Hrs.

Non Linear Time series: The ARCH model: Feature of an ARCH, Existence of a strictly stationary solution, The GARCH model: Existence of stationary solution of a GARCH(1,1) and Bilinear models.

Text Books:

1. Walter Enders, "Applied Econometric Time Series", 4th Edition, Wiley, 2014.
2. B. V. Vishwas and Ashish Patel, "Hands-on Time Series Analysis with Python", 1st Edition,

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Reference Books:

1. Chris Chatfield, "Time- Series Forecasting", 1st Edition, Chapman & Hall/CRC, 2001.
2. Douglas C. Montgomery, Cheryl L. Jennings and Nurat Kulahci, "Introduction to Time Series Analysis and Forecasting", 2nd Edition, Wiley, 2015.
3. Aileen Nielsen, "Practical Time Series Analysis", O'Reilly, 2019.
4. James D Hamilton, "Time Series Analysis", Princeton University Press, 1994.
5. Robert H. Shumway and David S. Stoffer, "Time Series Analysis and Its Applications", Springer, 2000.

Web Links:

1. A course on Time Series Analysis. https://web.stat.tamu.edu/s̃uhasini/teaching673/time_series.pdf
2. A comprehensive guide to Time Series Analysis. https://www.analyticsvidhya.com/blog/2021/10/acomprehensive-guide-to-time-series-analysis/
3. The Complete Guide to Time Series Analysis and Forecasting. https://towardsdatascience.com/the-completeguide- to-time-series-analysis-and-forecasting-70d476bfe775

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

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Time Series Analysis Laboratory (PECS5052L)

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 Introduce students to Time series characteristics and Detecting its Trends.
2. To become familiar with seasonality, Data wrangling and preparation of time series data.
3. To become familiar with AR Model, Moving average model,ARMA model, ARIMA model, SARIMA Model.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand and Detecting trends in Time series Data.	L2	Understand
CO2	Analysing Seasonality in the time series Dataset.	L4	Analyze
CO3	Apply Data Wrangling and prepare for time series Data.	L3	Apply
CO4	Build various model for time Series.	L3, L6	Apply, Create

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List of Laboratory Experiments

Suggested List of Experiments:

1. Time Series Characteristics: Time Series Data, Cross-Section Data, Panel data/ Longitudinal data.
2. Trends:
   (a) Detecting trends using Hodrick -Prescott Filter.
   (b) Detrending a Time Series.
3. Seasonality:
   (a) Multiple Box Plots.
   (b) Autocorrelation Plot.
   (c) Deseasoning of Time-Series Data.
   (d) Seasonal Decomposition.
   (e) Detecting Cyclic Variations.
4. Data Wrangling and Preparation for Time Series Data
5. Smoothing Methods: Simple exponential, Double exponential and Triple exponential.
6. Making Data Stationary: Plots, Summary Statistics, Statistics Unit Root Tests, Augmented Dickey – Fuller Test.
7. Autoregressive Model
8. Moving Average Model
9. ARMA Model
10. ARIMA Model
11. SARIMA Model
12. Anomaly Detection in Time Series Data.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PECS5052T with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C):

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

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Digital System Design (PECS5053T)

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

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

Prerequisite: Basic Electrical & Electronics Engineering.

Course Objectives:

1. To introduce different digital codes and their conversions.
2. To introduce methods for minimizing logical expressions.
3. To outline the formal procedure to design combinational logic circuits.
4. To introduce flip flops and outline the formal procedure to sequential circuits.
5. To illustrate concept of programmable devices.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain different digital codes and their conversions.	L2	Understand
CO2	Minimize logic expressions using various reduction techniques.	L6	Create
CO3	Analyze and design combinational logic circuits.	L4	Analyze
CO4	Design flip-flops using logic gates and use them to realize different sequential circuits.	L6	Create
CO5	Classify different programmable logic devices.	L4	Analyze

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Course Contents

Unit-I

12 Hrs.

Digital codes and binary arithmetic: Signed Binary number representation: Sign Magnitude, 1's complement, 2's complement representation and binary arithmetic's. Codes: Binary, BCD, XS-3, Gray code, ASCII, EBCDIC, Parity, Hamming, conversions.

Unit-II

09 Hrs.

Minimization techniques and Logic gates: Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR, Implementations of Logic Functions using universal gates. Boolean postulates and laws – De-Morgan's Theorem, Boolean expression -Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS), Minimization of Boolean expressions — Karnaugh map Minimization – Quine - Mc Cluskey method of minimization, don't care conditions.

Unit-III

04 Hrs.

Design of Combinational Logic: Introduction to combinational logic, Code converter: BCD, Excess-3, Gray code, Binary Code, Half- Adder, Full Adder, Half Subtractor, Full Subtractor, Binary Adder, BCD adder, Look ahead carry generator, Multiplexers- MUX tree, Encoder, De-multiplexer & Decoders, Implementation of SOP and POS using Multiplexer & De-multiplexer/Decoder

Unit-IV

09 Hrs.

Sequential Logic Design: Introduction to sequential logic, Flip- flop: SR, JK, D, T; Preset & Clear, Truth Tables and Excitation tables, Conversion, Shift Registers: SISO, SIPO, PISO, PIPO, Bi-directional, Counters: Asynchronous counter, Synchronous counter, ring counters, Johnson Counter, Modulus of the counter. State Machines: Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Sequence detector

Unit-V

08 Hrs.

Programmable Logic Devices: Programmable logic devices: Architecture of PROM, PAL, PLA, designing combinational circuits using PLDs. General Architecture of FPGA and CPLD, Introduction to Hardware Description Language.

Text Books:

1. John F. Wakerly, "Digital Design Principles and Practices", 5th Edition, Pearson Education, 2018.

2. R. P. Jain, "Modern Digital Electronics", 4th Edition, Tata McGraw Hill, 2010.

3. M. Morris Mano, "Digital Logic and computer Design", 4th Edition, PHI, 2010.

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Reference Books:

1. Thomas L. Floyd, "Digital Fundamentals", 11th Edition, Pearson Prentice Hall, 2015.
2. Mandal, "Digital Electronics Principles and Applications", 1st Edition, McGraw Hill Education, 2010.
3. Ronald J. Tocci, Neal Widmer, "Digital Systems Principles and Applications", 12th Edition, PHI, 2017.
4. Donald P Leach, Albert Paul Malvino, "Digital Principles and Applications", 8th Edition, Tata McGraw Hill, 2015.
5. Balabanian, Carlson, "Digital Logic Design Principles", 3rd Edition, Wiley Publication, 2000.
6. Holdsworth and R. C. Woods, "Digital Logic Design", 4th Edition, Newnes, 2002.
7. William I. Fletcher, "An Engineering Approach to Digital Design", 10th Edition, PHI, 2015.

Web Links:

1. Digital Electronic Circuits Lab: http://vlabs.iitkgp.ac.in/dec/#
2. Virtual Lab: https://cse15-iiith.vlabs.ac.in/List%20of%20experiments.html
3. NPTEL Course: Digital System Design: https://nptel ac.in/courses/108106177

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

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Digital System Design Laboratory (PECS5053L)

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 the fundamental concepts and methods for design of digital circuits.
2. To provide basic knowledge of simplifying Boolean expressions using logic gates.
3. To learn the concept of constructing logic gates using universal gates.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Simplify Boolean expressions using logic gates.	L4	Analyze
CO2	Construct basic gates using universal gates.	L3	Apply
CO3	Construct binary to gray code and gray to binary code converter.	L3	Apply
CO4	Design and implement adder and subtractor circuit.	L6	Create
CO5	Realization of comparator circuit.	L6	Create
CO6	Realization of counters and flip flop.	L6	Create
CO7	Implementation of basic gates, multiplexer, demultiplexer, counters etc. using VHDL.	L6	Create

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List of Laboratory Experiments

Suggested List of Experiments:

1. Implement 8:3 octal to binary code converter using encoder IC 74148.
2. Verify different logic gates (introduce logic families CMOS and TTL and electrical and switching parameters).
3. Simplification of Boolean functions.
4. Verify Universal gates NAND and NOR and design EXOR and EXNOR gates using Universal gates.
5. Implement Half adder, Full adder, Half subtractor and Full subtractor circuits.
6. To study and implement 4-bit magnitude comparator using IC 7485 and verify its truth table.
7. Implement BCD adder using 4-bit binary adder IC-7483.
8. Flip flops conversion JK to D, JK to T and D to T FF.
9. Implement logic equations using Multiplexer.
10. Design synchronous MOD N counter using IC-7490.
11. Verify encoder and decoder operations.
12. Implement 1:8 De-multiplexer using IC 74138.
13. Implement the functions using 8:1 Multiplexer with the help of IC 74151.
14. Implement digital circuits to perform binary to gray and gray to binary operations.
15. Verify different counter operations.
16. Verify the functions of Universal Shift Register IC 74194: Parallel loading, Right shift, Left shift.
17. Implement any two above experiments using VHDL.

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PECS5053T with at least 10 experiments from the above list to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C):

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

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Probabilistic Graph Models(PECS5054T)

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

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

Prerequisite: Machine learning, Probability.

Course Objectives:

The objective of this course intends to model problems using graphical models; design inference algorithms; and learn the structure of the graphical model from data.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the basic fundamentals of probabilistic graph theory.	L2	Understand
CO2	Illustrate various principles of graph theory and algorithms.	L2	Understand
CO3	Integrate core theoretical knowledge of graph theory to solve problems.	L3	Apply

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Course Contents

Unit-I

06 Hrs.

Fundamentals: Structured Probabilistic Models, Marginal and Joint Distributions, Independence and Conditional Independence.

Bayesian Networks: Independence and Separation, Markov properties and minimalism, Examples (HMM, diagnostic system, etc.).

Unit-II

08 Hrs.

Markov Networks: Boltzmann machine and Ising models, Markov random field, Parameterization, Cliques and potentials, Markov Network Independencies, Factor graphs.

Gaussian Network Models and Exponential Family: Multivariate Gaussians and Gaussian Networks, Exponential families, Entropy and Relative Entropy, Projections.

Unit-III

06 Hrs.

Inference: Analysis of Complexity, Variable elimination, Belief propagation (message passing) on trees, Sum- and Max-product algorithms, Clique tree.

Unit-IV

06 Hrs.

Sampling Methods: MCMC method, Gibbs sampling Algorithm, Importance sampling, Particle filtering. Approximate inference: Loopy belief propagation, Variational inference and optimization view of inference, Mean field approach.

Unit-V

12 Hrs.

Parameter learning: Parameterizing graphical models, Parameter estimation in fully observed Bayesian networks: (Maximum likelihood estimation, Bayesian parameter estimation, Example: HMM), Parameter estimation in fully observed Markov networks: Maximum likelihood estimation (Iterative Proportional Fitting (IPF), Generalized Iterative Scaling (GIS)), Parameter estimation in partially observed graphical models (Expectation-Maximization (EM) - Example: HMM), Learning Conditional Random Fields.

Nonparametric Learning: Gaussian processes, Dirichlet processes, Indian Buffet processes.

Unit-VI

06 Hrs.

Structure learning: Score based approach, Chow-Liu algorithm for Bayesian networks, l1-regularized convex optimization for Markov random fields, Low-rank regularized learning of latent variable models.

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Text Books:

1. Koller, D. and Friedman, N., "Probabilistic Graphical Models: Principles and Techniques", MIT Press, 2009.

Reference Books:

1. Jensen, F. V. and Nielsen, T. D. "Bayesian Networks and Decision Graphs. Information Science and Statistics", 2nd Edition, Springer, 2002.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", 4th Printing. MIT Press, 2013.
3. Barber, D. "Bayesian Reasoning and Machine Learning",1st Edition, Cambridge University Press, 2011.
4. Bishop, C. M. "Pattern Recognition and Machine Learning (Information Science and Statistics)", 2nd printing, Springer, 2011.
5. Wainwright, M. and Jordan, M. "Graphical Models, Exponential Families, and Variational Inference", Foundations and Trends in Machine Learning, 2008.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

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Probabilistic Graph Models Laboratory (PECS5054L)

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 introduce students implementation of graph models.
2. To become familiar with various principles of graph theory and algorithms.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement Discrete and Alarm Bayesian Networks.	L3	Apply
CO2	Build Implementation of Linear Gaussian Bayesian Networks (GBNs).	L3	Apply
CO3	Implementation of Causal Inference.	L3	Apply
CO4	Implementation of Learning using Chow-Liu Algorithm.	L3	Apply

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List of Laboratory Experiments

Suggested List of Experiments:

1. Implement Discrete Bayesian Networks.
2. Implementation of Alarm Bayesian Network.
3. Implementation of Linear Gaussian Bayesian Networks (GBNs).
4. Implementation of Monty Hall Problem using Bayesian Network.
5. Implementation of Exact inference in Bayesian Networks.
6. Implementation of Inference in Discrete Bayesian Network.
7. Implementation of Causal Inference.
8. Implementation of Parameter Learning in Discrete Bayesian Networks
9. Implementation of Learning using Chow-Liu Algorithm.
10. Implementation of learning Tree-augmented Naive Bayes (TAN).

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

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PECS5054T with at least 10 experiments from the above list to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C):

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

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Professional and Business Communication (HMCS5060T)

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

Examination Scheme
Teacher Assessment : 50 Marks
Total Marks : 50 Marks

Prerequisite: Basic course in Effective Communication Skills.

Course Objectives:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Plan, organize and write technical documents like reports, proposals and research papers in the prescribed format using appropriate language and style with an understanding of ethics in written communication.	L3	Apply
CO2	Apply techniques of writing resume, participating in a group discussion and facing interviews.	L3	Apply
CO3	Develop interpersonal skills in professional and personal situations.	L3	Apply
CO4	Understand the documentation process of meetings and conduct meetings in a professional manner.	L2	Understand
CO5	Understand communication across cultures and work ethics.	L2	Understand
CO6	Design and deliver effective presentations using Power Point.	L6	Create

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Course Contents

Unit-I Technical Writing 08 Hrs.

Report Writing : Types of report, parts of formal report, collection of data and survey analysis, pre-writing of report, language and style in reports, formatting of reports, referencing in report.

Proposal Writing : Types of technical proposals, format of proposal, language and style, presentation of proposal.

Technical Paper Writing: parts of a technical paper, language and formatting, referencing in IEEE format.

Plagiarism : Types of plagiarism, consequences of plagiarism.

Unit-II Employment Skills 06 Hrs.

Group Discussion: Purpose of a GD, types of GD, criteria for evaluating a GD, Dos and Don'ts of a GD, Tips to be successful in GD.

Cover Letter & Resume Writing: Format and content of cover letter, types of resume, 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.

Unit-III 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 team work, 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-IV Meetings and Documentation 02 Hrs.

Planning and preparation for meetings, strategies for conducting effective meetings, notice, agenda and minutes of a meeting, business meeting etiquettes.

Unit-V Cross-cultural communication and Ethics 03 Hrs.

Communication across cultures, professional and work ethics, responsible use of social media, introduction to Intellectual Property Rights.

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Unit-VI Presentation Skills

02 Hrs.

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

Reference Books:

1. Fred Luthans, "Organizational Behavior", McGraw Hill, edition.
2. Lesiker and Petit, "Report Writing for Business", McGraw Hill, edition.
3. Huckin and Olsen, "Technical Writing and Professional Communication", McGraw Hill.
4. Wallace and Masters, "Personal Development for Life and Work", 12th Edition, Thomson Learning.
5. Heta Murphy, "Effective Business Communication", Mc Graw Hill, edition.
6. Sharma R.C. and Krishna Mohan, "Business Correspondence and Report Writing", Tata McGraw-Hill Education.
7. Ghosh, B. N., "Managing Soft Skills for Personality Development", Tata McGraw Hill.
8. Bell, Smith, "Management Communication" Wiley India Edition, 3rd edition.
9. Dr. Alex, K., "Soft Skills", S Chand and Company.
10. Subramaniam, R., "Professional Ethics" Oxford University Press.

Evaluation Scheme:

Continuous Assessment (A):

Continuous Assessment shall consist of Presentation, Group Discussion and Assignments. The distribution of marks will be as follows:

1. Presentation: 10 Marks
2. Group Discussion: 10 Marks
3. Assignments: 30 Marks

Total : 50 Marks

List of Assignments(Each assignment carries 06 marks):

1. Business Proposal (PowerPoint presentation)
2. Resume writing
3. Interpersonal Skills (Documentation of activity)

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4. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)

5. Business ethics

The final certification and acceptance of journal/manual/report will be subject to satisfactory perfor- mance of Continuous Assessment and upon fulfilling minimum passing criteria in the CA.

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Semester Project-III (PJCS5070L)

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

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

Course Objectives:

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

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

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Semester Project:

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

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

Student is expected to:

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

Assessment Criteria:

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

Prescribed project report guidelines:

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

- Introduction
- Literature Survey
- Related Theory
- Implementation details

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- Project Outcomes
- Conclusion
- References

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

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

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

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

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

Table 1: Log Book Format

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

Table 2: Continuous Assessment Table

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

Table 3: Evaluation Table

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

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Employability Skill Development Program-II (HMCS5080L)

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

Examination Scheme
Teacher Assessment : 50 Marks
Total : 50 Marks

Prerequisite: 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.

CO	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 and L4	Understand, Analyze
CO3	Understand and illustrate the concept of Exception Handling, Garbage collection.	L2 and L3	Understand, Apply
CO4	Understand and describe the fundamental of DBMS, NoSql, MongoDB.	L2	Understand

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Course Contents

Unit-I 10Hrs

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 10Hrs

Modules: 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 8Hrs

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 8Hrs

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)

1. ML/AI Based Projects
2. Data Analysis Based projects
3. Test Summarization based projects
4. web scrapping and crawling

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Unit-V 10Hrs

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. YashwantKanetkar, "Let Us C", BPB Publication.

Evaluation Scheme:

Teacher Assessment(TA):

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

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.

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.

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