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 2024-25

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

Third Year B. Tech Computer Science and Engineering (Data Science) Semester-V (w.e.f. 2024-25)														
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	22PCCS5010T	Machine Learning-II(Deep Learning)	3			20	15	15	15	65	100	3	4
	PC	22PCCS5010L	Machine Learning-II(Deep Learning)Laboratory			2	25				25	50	1	
2	PC	22PCCS5020T	Intelligent Systems	3			20	15	15	15	65	100	3	4
	PC	22PCCS5020L	Intelligent Systems Laboratory			2	25					25	1	
3	PC	22PCCS5030T	Image Processing and Computer Vision - I	3			20	15	15	15	65	100	3	4
	PC	22PCCS5030L	Image Processing and Computer Vision - I Laboratory			2	25				25	50	1	
4	PC	22PCCS5040L	Big Data Engineering Laboratory	2		2	50				50	100	3	3
5@	PE	22PECS5051T	Distributed Computing	3			20	15	15	15	65	100	3	4
		22PECS5051L	Distributed Computing Laboratory			2	25					25	1	
		22PECS5052T	Time Series Analysis	3			20	15	15	15	65	100	3	
		22PECS5052L	Time Series Analysis Laboratory			2	25					25	1	
		22PECS5053T	Digital System Design	3			20	15	15	15	65	100	3	
		22PECS5053L	Digital System Design Laboratory			2	25					25	1	
		22PECS5054T	Probabilistic Graph Models	3			20	15	15	15	65	100	3	
		22PECS5054L	Probabilistic Graph Models Laboratory			2	25					25	1	
6	HM	22HMCS5060T	Professional and Business Communication Tutorial		2		50					50	2	2
7	PJ	22PJCS5070L	Semester Project-III			2	25				25	50	1	1
8	HM	22HMCS5080L	Employability Skill Development Program-II			2	50					50	1	1
			Total	14	2	14	355			60	385	800	23	

@Any 1 Elective Course

Prepared by:
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Checked by:
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Director

R. C. Patel Institute of Technology, Shirpur
SES
SHIRPUR EDUCATION SOCIETY
Autonomous

Machine Learning -II (Deep Learning) (22PCCS5010T)

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 and Transfer Learning.
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 different techniques.	L2	Understand

Course Contents

Unit-I — 05 Hrs.

Introduction to Artificial Neural Learning:

Fundamental concepts of biological Neural Networks, NN Architectures, Important terminologies of ANN: Activation functions(sigmoid, ReLu, Leaky ReLu, Tanh, Softmax), weights, bias, threshold, learning rate, McCulloch Pitts Neuron: Theory and Architecture.

Unit-II — 08 Hrs.

Supervised Learning Networks:

Perceptron: Representational power of Perceptron, The Perceptron Training Rule, Delta Rule; Multilayer Networks: Representational Power of Feedforward Networks; Backpropagation Algorithm: Convergence and local minima, Hypothesis space search and Inductive Bias, Generalization, overfitting and stopping criteria.

Optimization for Training Deep Models:

Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies. Optimizers: Gradient Descent (Stochastic, Mini-Batch, Batch), SGD with Momentum, Nesterov Accelerated GD, Adagrad, Adadelta, RMSProp, Adam, Regularization for Deep Learning: Parameter Norm Penalties, Dataset Augmentation, Noise Robustness, Early Stopping, Sparse Representation, Dropout

Unit-III — 06 Hrs.

Convolutional Networks:

The Convolution Operation, sparse interactions, parameter sharing, Pooling, Convolution and Pooling as an Infinity Strong Prior, Variants of Basic Convolution Function, Efficient Convolution Algorithms (AlexNet, LeNet-5, VGG, DenseNet, InceptionNet, ResNet).

Unit-IV — 06 Hrs.

Sequence Modelling:

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 (LSTM).

Unit-V — 08 Hrs.

Unsupervised Learning Networks:

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

Autoencoders:

Sparse Autoencoder, Undercomplete Autoencoders, Regularized Autoencoders, Denoising Autoencoders, Applications of Autoencoders. Linear Factor Methods such as Probabilistic PCA and Factor Analysis, Independent Component Analysis.

Unit-VI 07 Hrs.

Transfer Learning:

Fundamental of Transfer Learning, Pre-trained Model Approach, Freezing, Fine-tuning. Transfer Learning Strategies: Inductive Learning, Inductive Transfer, Transductive Transfer Learning, Unsupervised Transfer Learning; Types of Deep Transfer Learning: Domain Adaptation, Domain Confusion, One-shot Learning, Zero-shot Learning, Multitask Learning; Types of Transferable Components: Instance transfer, Feature- representation transfer, Parameter transfer, Relational-knowledge transfer; Transfer Learning Challenges: Negative Transfer, Transfer Bounds; Applications: Transfer learning for NLP/ Audio/ Speech/ Computer Vision.

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.

Reference Books:

1. François Chollet, "Deep Learning with Python", Manning Publication, 2017.
2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Publication, 2017.
3. Andrew W. Trask, Grokking, "Deep Learning", Manning Publication, 2019.
4. 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.

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 -II(Deep Learning)Laboratory (22PCCS5010L)

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 different techniques.	L2	Understand

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. Transfer Learning with Pre-trained CNN model as a Feature Extractor for Image Classification with a Data Availability Constraint.

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 22PCCS5010L 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.

Intelligent Systems (22PCCS5020T)

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 Intelligent planning.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply appropriate search-based method for a given problem.	L3	Apply
CO2	Analyze various IS approaches to knowledge– intensive problem solving, reasoning and intelligent planning.	L4	Analyze
CO3	Apply the knowledge of reasoning and intelligent planning to solve a problem.	L3	Apply

Course Contents

Unit-I — 08 Hrs.

Fundamentals: Introduction to Intelligence Systems, Evolution, Categorization of Intelligent System, Applications.

Problem solving:

Solving problem by Searching: Problem Solving Agent, Formulating Problems. State Space Search: Uninformed search, Breadth First Search (BFS), Depth First Search (DFS), Depth, Depth First Iterative Deepening (DFID). Heuristic Search: Best first Search, Hill Climbing, Variations of Hill Climbing, Solution Space, and Travelling Salesman Problem

Unit-II — 09 Hrs.

Optimizations:

Population Based Methods: Simulated annealing, Local beam search, Genetic algorithm. 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.

Unit-III — 06 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.

Unit-IV — 05 Hrs.

Logic Foundation for Ontologies:

Knowledge Modelling, Definition, and importance of ontologies in AI, Components of ontologies: classes, properties, individuals, Ontology development methodologies (e.g. Protégé), Ontology languages (e.g. OWL, RDF), Ontology reasoning and inference. Applications of ontologies in AI (e.g. semantic web, knowledge management.

Unit-V — 06 Hrs.

Ontology Modelling:

Advanced ontology modelling constructs (e.g. restrictions, class axioms), Ontology alignment, merging and versioning, Ontology-based data access and integration, Probabilistic and fuzzy ontologies, Rule-based reasoning with ontologies (e.g. SWRL), Scalable ontology reasoning techniques, Real-world ontology case studies and industry applications.

Unit-VI

05 Hrs.

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

Text Books:

1. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education, (India), 2013.
2. Dean Allemang, James Hendler, "Semantic Web for the Working Ontologist", Elsevier 1st Edition, 2008.

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.
7. John Yen and Reza Langari, "Fuzzy Logic: Intelligence, Control, and Information", Pearson, 2002.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Intelligent Systems Laboratory (22PCCS5020L)

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	Identify and apply searching algorithms to solve problems.	L3	Apply
CO2	Build knowledge base for a problem.	L3	Apply
CO3	Apply fuzzy operations for a given input.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. Implement domain specific function 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. Implement Fuzzy operations for given input values.
8. Design a fuzzy logic controller for a given problem.
9. Develop a knowledge base using OWL.
10. Develop a Rule based System using SWRL on Protégé software.

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 22PCCS5020T 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.

Image Processing and Computer Vision - I (22PCCS5030T)

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 co-ordinate geometry, matrix algebra, linear algebra and random process.

Course Objectives:

To teach various feature engineering and preprocessing techniques on image and video data types.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify the need of different image and video pre-processing.	L1	Remember
CO2	Apply different image and video corrections.	L3	Apply
CO3	Compare different image and video processing methods.	L4	Analyze

Course Contents

Unit-I — 04 Hrs.

Digital Image Fundamentals: Steps in Digital Image Processing, Components, Image Sampling and Quantization, Neighborhood of pixels.

Unit-II — 11 Hrs.

Image Enhancement (point processing): Image Negative, Thresholding, Gray-level slicing with and without background, power law and log transform, Contrast Stretching, Histogram equalization

Image Enhancement in Spatial Domain (Neighbourhood processing): Low Pass and High Pass filtering for image enhancement, High boost filtering, Basics of Spatial Filtering, Generating Spatial Filter Masks–Smoothing and Sharpening Spatial Filtering

Image Transforms: 1-D DFT, 2-D Discrete Fourier Transform and Its Inverse, Some Properties of 2D DFT, Walsh -Hadamard, Discrete Cosine Transform, Haar Transform, Slant Transform

Image Enhancement in Frequency Domain: The Basics of Filtering in the Frequency Domain, Smoothing and Sharpening frequency domain filters

Unit-III — 08 Hrs.

Morphology: Erosion and Dilation, Opening and Closing, The Hit or-Miss Transformation. Restoration: Noise models – Mean Filters – Order Statistics – Adaptive filters- Adaptive mean filter, adptive guassian filter. .

Corner and Interest Point detection: The Harris Interest Point Operator: Corner Signals and shifts for various geometric configuration, Performance with crossing point and Junctions, Different forms of Harris Operator, Local Invariant Feature Detectors and Descriptors: Harris scale and Affine-Invariant Detectors and Descriptors.

Unit-IV — 08 Hrs.

Point, Line, and Edge Detection: Detection of Isolated Points, Line detection, edge models, basic and advance edge detection (Kirsch Compass Kernels) , Edge linking and boundary detection, Canny's edge detection algorithm

Thresholding: Foundation, Role of illumination, Basic Global thresholding, Otsu's method Region Based segmentation: Region Growing, Region Splitting and merging, Relationships between pixels, Hough transform

Region Identification: Chain code, simple geometric border representation (Topological and region based descriptor), Fourier Transform of boundaries, Boundary description using segment sequences

Unit-V — 08 Hrs.

Motion: Optical Flow, Interpretation of Optical Fields, Using focus of expansion to avoid collision, Time to adjacency analysis, Basic difficulties with optical flow models, Stero from Motion

Text Books:

1. Rafel C. Gonzalez and Richard E. Woods, "Digital Image Processing", 4^{th} Edition, Pearson Education Asia, 2018.
2. Sanjit Mitra, "Digital Signal Processing: A Computer Based Approach", 4^{th} Edition, Tata McGraw Hill, 2013.

Reference Books:

1. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, "Digital Signal Processing", 4^{th} Edition, Tata McGraw Hill Publication, 2019.
2. E. R. Davies, "Computer and Machine Vision: Theory, Algorithms", 4^{th} Edition, Academic Press, 2012.
3. S. Jayaraman, E. Esakkirajan and T. Veerkumar, "Digital Image Processing", 1^{st} Edition, Tata McGraw Hill Education Private Ltd, 2017.
4. Anil K. Jain, "Fundamentals and Digital Image Processing", 1^{st} Edition, Pearson Education, 2015.
5. John G. Proakis, Dimitris and G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", 4^{th} Edition, Pearson Education, 2014.
6. A. Anand Kumar, "Digital Signal Processing", 2^{nd} Edition, Prentice Hall, 2015.
7. S. Sridhar, "Digital Image Processing", 2^{nd} Edition, Oxford University Press, 2016.

Web Links:

1. NPTEL Digital Image Processing, By Prof. Prabir Kumar Biswas, IIT Kharagpur: https://nptel.ac.in/courses/117/105/117105135/

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

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

Image Processing and Computer Vision - I Laboratory (22PCCS5030L)

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

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

Course Objectives:

1. To become familiar with image processing, geometric, arithmetic and logical operations on images.
2. To introduce Image Enhancement using different techniques.
3. To introduce segmentation, equalization, image restoration background subtraction and motion analysis.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement basic operations applied on image and Image Enhancement using different techniques.	L3	Apply
CO2	Demonstrate histogram equalization and application of Haar transform.	L4	Analyze
CO3	Implement region-based segmentation, morphological operations and edge detection techniques.	L3	Apply
CO4	Construct Image restoration, background subtraction and motion analysis in a video.	L3	Apply

List of Laboratory Experiments

Suggested List of Experiments:

1. To perform basic Image Processing, Geometric, Arithmetic and Logical operations on Images.
2. To perform Spatial Domain Image Enhancement using different Point Processing Techniques like Image Negative Transformation, Thresholding, Gray Level Slicing with without background.
3. To perform Spatial Domain Image Enhancement using different Neighborhood Processing Techniques.
4. To perform Histogram equalization.
5. To perform frequency domain Image Enhancement techniques.
6. To perform region-based segmentation.
7. To perform morphological operations on Image.
8. To perform edge detection using basic and advanced techniques.
9. To perform Image restoration using various filters.
10. To extract the key frames from a video.
11. To perform background subtraction in a video.
12. To perform motion analysis using Lucas-Kanade optical flow estimation Algorithm.

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 22PCCS5030T 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.

Big Data Engineering Laboratory (22PCCS5040L)

Teaching Scheme
Lectures : 02 Hrs./week
Practical : 02 Hrs./week
Credits : 03

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

Prerequisite: Foundations of Data Analysis, Database Management System, Python Laboratory, Java and Scala Laboratory.

Course Objectives:

The objective of this lab is to provide the basic framework of handling and processing big data.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Relate to the need of different types of data preprocessing tools/methods.	L4	Analyze
CO2	Use appropriate tool/method for a specific Data Engineering task.	L3	Apply

Detail of the Experiment

Hadoop Ecosystem — 04 Hrs.

1. Understanding inputs and outputs of Map Reduce Concept of Hadoop.
2. The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of Map Reduce Execution.
3. HDFS file system - Command line.
4. Overview of resource managem ent - YARN.

Infrastructure Implementation — 04 Hrs.

1. Introduction to Kubernetes and Docker.
2. Setting up applications on Kubernetes and Docker.
3. Creating Docker images and deploying them.

Messaging Service — 02 Hrs.

1. Differentiate between different types of connections: Point-to-point, Broadcast/Multicast and Multi point.
2. Real time messaging using AMPS
3. Pub / Sub models
4. Allows subscribers to apply filters on server level

Messaging Service — 02 Hrs.

1. Need of scalability and concurrency in the messaging services.
2. Real time messaging, ensuring scalability and concurrency using Kafka.
3. Pub / Sub models
4. Allows subscribers to apply filters on client side.

Data Processing — 08 Hrs.

1. Need of advance methods for data processing of Big Data.
2. Introduce SPARK
3. Real time and Batch processing of high volume of data.
4. Write scripts using Java/ Python/Scala.

5. Processing high volume records in-memory.

6. Integration with Hive, HDFS, Kafka, event hub and other messaging and storage system.

Data Warehouse — 02 Hrs.

1. Need of advance methods for data warehousing for storing Big data.

2. Introduce HIVE

3. Storage of data on HDFS for high volume data.

4. Perform Analytical queries using Map Reduce.

No SQL Data Store — 02 Hrs.

1. Difference between SQL and NoSQL data stores

2. Types of NoSQL Data stores

3. Introduce HBase

4. Demonstration of Dynamic Scaling

No SQL Data Store — 04 Hrs.

1. NoSQL Databases for different use cases.

2. DynamoDB - Serverless AWS service for storing data in bytes.

3. MongoDB - Data Storage as documents (Binary JSON -BSon).

4. Pipeline, query aggregation, complex querying, transaction.

ETL Task — 04 Hrs.

1. Introduce AWS Glue for ETL.

2. Data Integration service from multiple sources.

3. Keeping track of schema in form of catalogue.

4. Data query via Amazon Athena, Amazon EMR, and Amazon Redshift Spectrum.

Data Retrieval — 04 Hrs.

1. Introduction to Open-Source Indexing Engine Elastic Search for transactional data.

2. Data querying, aggregation, visualization, log extraction and analytics.

Cold Data Retrieval AWS S3, Athena and Redshift — 04 Hrs.

1. Introduction of AWS S3, Athena and RedShift.

2. Storing / Extracting data in S3 in different forms (csv, parquet, text).

3. Querying the data via Athena / Redshift.

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

Text Books:

1. Joe Reis and Matt Housley, "Fundamentals of Data Engineering: Plan and Build Robust Data Systems", 1st Edition, O'Reilley, 2022.

2. Stevan N Brunton and J Nathan Kutz, "Data-Driven Science and Engineering: Machine Learning, Dynamical Systems, and Control", 1st Edition, Cambridge University Press, 2019.

3. Tom White, "Hadoop: The Definitive Guide", O'Reilley, 3rd Edition, 2012.

4. Eric Sammer, "Hadoop Operations", 1st Edition, Reilly, 2012.

5. Pramod J Sadalge and Martin Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", 1st Edition, Addison-Wesley Professional publications 2012.

Reference Books:

1. Paul Zikopoulos, Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, "Understanding Big Data: Analytics for Enterprise Class Hadoop and streaming Data", 1st Edition, The McGraw-Hill Companies, 2017.

2. Gaurav Vaish, "Getting Started with NoSQL", 1st Edition, Packt Publishing, 2013.

3. Manoj Kukreja, "Data Engineering with Apache Spark, Delta Lake, and Lakehouse", 1st Edition, Packt Publishing, 2021.

4. Scott Haines, "Modern Data Engineering with Apache Spark: A Hands-On Guide for Building Mission-Critical Streaming Applications", 1st Edition, Apress Publications, 2022.

Web Links:

1. Real-time Bigdata Messaging Services: Built for realtime: Big data messaging with Apache Kafka, Part 1 | InfoWorld

2. Understanding Big data Processing: Understanding Big Data Processing: 2022's Ultimate Guide - Learn | Hevo (hevodata.com)

3. Serverless Databases: What Is Serverless? An Overview | Knowledge Base | Dashbird

4. Kubernet Vs Docker: Kubernetes vs. Docker: Why Not Both? | IBM

Evaluation Scheme:

Laboratory:

Continuous Assessment (A) 50 Marks:

Laboratory work will be based on 22PCCS5040L with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C) 50 Marks:

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

Distributed Computing (22PECS5051T)

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

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 07 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 06 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.

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 2 hrs.

Distributed Computing Laboratory (22PECS5051L)

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

Examination Scheme
Teacher Assessment : 25 Marks
Total : 25 Marks

Course Objectives:

1. Implement multithread 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 multithread 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

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 22PECS5051T 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.

Time Series Analysis (22PECS5052T)

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

Course Contents

Unit-I — 08 Hrs.

Introduction: Formal definition of a time series, Interpolation vs Extrapolation, Components of time series, Models of Time Series Analysis, Types of forecasting methods, Types of Time Series, Types of time series patterns, different types of data, simple descriptive techniques, Trends in time series (Parametric trends, differencing, non-parametric methods, noise), measurement of trends, seasonality, seasonal indices, stochastic processes, correlogram.

Stationary Time Series: The sample mean and its standard error, Stationary processes (weak and strict), statistical inference of time series.

Unit-II — 08 Hrs.

Linear Time Series: Motivation, Autocorrelation function (ACF) and Partial Autocorrelation function (PACF) plot, Linear time series and MA models, theoretical properties of time series with a MA (1) and MA (2) model, The AR model, simulating from an autoregressive process, The ARMA model, The ARIMA model, Unit roots with $|\Phi|$, backshift and lag operator, integrated and non-invertible processes, SARIMA model, Box – Jenkins Model Selection.

Unit-III — 06 Hrs.

Prediction: Using prediction in estimating, forecasting for autoregressive processes (1), forecasting for AR(p), forecasting for general time series using infinite past, forecasting for ARIMA model, Ψ-weight representation of ARIMA model, One-step ahead predictors based on the finite past: Levinson -Durbin algorithm, Kalman filter.

Unit-IV — 06 Hrs.

Models with Trend: Removing trend, Unit Root (Augmented Dickey Fuller Test) and Regression Residuals, The Monte Carlo Method.

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

Unit-V — 06 Hrs.

Multivariate Time Series: Background: Sequences and Functions, Convolution using Fourier transform, Methods for Estimating the Spectral Density, Smoothing Method (Nonparametric Estimation of the Spectral Density); Multivariate time series regression: Conditional independence, Partial correlation and coherency between time series.

Unit-VI — 05 Hrs.

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

Text Books:

1. Walter Enders, "Applied Econometric Time Series", 4^{th} Edition, Wiley, 2014.
2. B. V. Vishwas and Ashish Patel, "Hands-on Time Series Analysis with Python", 1^{st} Edition, Apress, 2020

Reference Books:

1. Chris Chatfield, "Time- Series Forecasting", 1^{st} Edition, Chapman & Hall/CRC, 2001.
2. Douglas C. Montgomery, Cheryl L. Jennings and Nurat Kulahci, "Introduction to Time Series Analysis and Forecasting", 2^{nd} 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 2 hrs.

Time Series Analysis Laboratory (22PECS5052L)

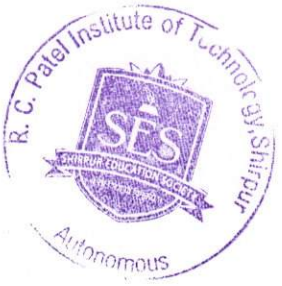
Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
Total : 25 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



List of Laboratory Experiments

Suggested List of Experiments:

1. Trends:
   (a) Detecting trends using Hodrick -Prescott Filter.
   (b) Detrending a Time Series (Pandas, SciPy Signal, HP filter).
2. Seasonality:
   (a) Multiple Box Plots.
   (b) Autocorrelation Plot.
   (c) Deseasoning of Time-Series Data.
   (d) Seasonal Decomposition(Additive and Multiplicative)..
   (e) Detecting Cyclic Variations.
3. Data Wrangling and Preparation for Time Series Data
4. Smoothing Methods: Simple exponential, Double exponential and Triple exponential.
5. Making Data Stationary using Augmented Dicky Fuller Test.
6. Autoregressive Moving Average Model.
7. ARIMA Model
8. VAR Model.
9. ARCH and GARCH Models.
10. Mini Project.

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 22PECS5052T 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.

Digital System Design (22PECS5053T)

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

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 — 08 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 — 06 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.

Reference Books:

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

Digital System Design Laboratory (22PECS5053L)

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

Examination Scheme
Teacher Assessment : 25 Marks
Total : 25 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

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 HDL.

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 22PECS5053T 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.

Probabilistic Graph Models(22PECS5054T)

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 representation methods, learning and inference algorithms.	L2	Understand
CO3	Integrate core theoretical knowledge of graphical models to solve problems.	L3	Apply

Course Contents

Unit-I — 05 Hrs.

Fundamentals: Overview and Motivation of Probabilistic Graphical Models, Structured Probabilistic Models, Marginal and Joint Distributions, Independence and Conditional Independence, Factors.
Bayesian networks (Representation): Semantics and Factorization, Reasoning Patterns, Flow of Probabilistic Influence, Conditional Independence, Independence in Bayesian Networks, Naïve Bayes, Applications .

Unit-II — 07 Hrs.

Temporal Models of Bayesian Network (Representation): Overview of Temporal Models, Dynamic Bayesian Networks (DBN), Hidden Markov Model (HMM), Plate Models.
Structured CPDs (Representation): Overview of Structured CPDs, Tree- Structured CPDs, Independence of Casual Influence, Continuous Variable, Applications.

Unit-III — 06 Hrs.

Markov networks (Representation): Pairwise Markov Networks, General Gibbs Distribution, Conditional Random Fields, Independencies in Markov Networks, I- maps and perfect maps.

Unit-IV — 06 Hrs.

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

Unit-V — 06 Hrs.

Inference and sampling methods (Inference): Simple Sampling, MCMC method, Gibbs sampling Algorithm, Importance sampling, Particle filtering.

Unit-VI — 09 Hrs.

Parameter Estimation (Learning): Learning Overview, Maximum Likelihood Estimation for Bayesian Networks, Bayesian Estimation, Bayesian Prediction, Bayesian Estimation for Bayesian Networks. Maximum Likelihood for Log-Linear Models, Maximum Likelihood for MRFs and CRFs.
Structure Learning: Overview, Likelihood Scores, BIC and Asymptotic Consistency, Bayesian Scores, Learning Tree Structured Networks, Learning General Graphs: Heuristic Search.

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", 2^{nd} Edition, Springer, 2002.
2. Marloes Maathuis, Mathias Drton, Steffen Lauritzen, Martin Wainwright, "Handbook of Graphical Models", Routledge Taylor and Francis group, 2020.
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", 4^{th} Printing. MIT Press, 2013.
4. Barber, D. "Bayesian Reasoning and Machine Learning",1^{st} Edition, Cambridge University Press, 2011.
5. Bishop, C. M. "Pattern Recognition and Machine Learning (Information Science and Statistics)", 2^{nd} printing, Springer, 2011.
6. 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 2 hrs.

Probabilistic Graph Models Laboratory (22PECS5054L)

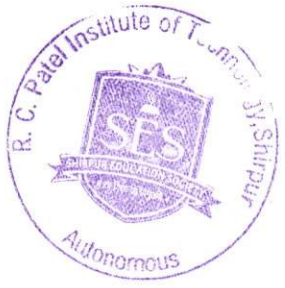
Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
Total : 25 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



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. Implement Approximate Inference using MCMC.
9. Implementation of Parameter Learning in Discrete Bayesian Networks.
10. Mini Project.

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 22PECS5054T 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.

Professional and Business Communication Tutorial (22HMCS5060T)

Teaching Scheme
Tutorials : 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 employability skills.
4. To hone written skills for technical documentation.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Prepare technical documents using appropriate style, format, and language.	L3	Apply
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.	L3	Apply
CO5	Demonstrate interpersonal skills in professional and personal situations.	L3	Apply
CO6	Describe cultural differences, etiquettes, and the concept of professional ethics.	L2	Understand

Course Contents

Unit-I Technical Writing — 06 Hrs.

Report Writing : Types of report, Basic structure of a report, collection of data through questionnaires and 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 a GD, Dos and Don'ts of a GD.

Resume Writing: 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.

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 05 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.

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", 12^{th} 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.
11. Sandeep Das, "How Business Story Telling Works: Increase Your Influence and Impact", Penguin Random House India Pvt. Ltd.

Evaluation Scheme:

Continuous Assessment (A):

The term work will be calculated based on Tutorials (25m), Business Proposal (15m) and Group Discussion (10m).

The distribution of marks will be as follows:

1. Tutorials: 25 Marks

2. Business Proposal : 15 Marks

3. Group Discussion : 10 Marks

Total : 50 Marks

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

Semester Project-III (22PJCS5070L)

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

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

Course Objectives:

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

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

Semester Project:

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

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

Student is expected to:

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

Assessment Criteria:

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

Prescribed project report guidelines:

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

- Introduction
- Literature Survey
- Related Theory
- Implementation details

- Project Outcomes
- Conclusion
- References

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

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

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

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

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

Table 1: Log Book Format

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

Table 2: Continuous Assessment Table

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

Table 3: Evaluation Table

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

Employability Skill Development Program-II (22HMCS5080L)

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

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

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.