Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure and Syllabus

Third Year B. Tech

Artificial Intelligence & Machine Learning

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 Artificial Intelligence and Machine Learning 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	22PCAI5010T	Digital Signal and Image Processing	3			20	15	15	15	65	100	3	4
	PC	22PCAI5010L	Digital Signal and Image Processing Laboratory			2	25				25	50	1	
2	PC	22PCAI5020T	Machine Learning	3			20	15	15	15	65	100	3	4
	PC	22PCAI5020L	Machine Learning Laboratory			2	25				25	50	1	
3	PC	22PCAI5030T	Natural Language Processing	3			20	15	15	15	65	100	3	4
	PC	22PCAI5030L	Natural Language Processing Laboratory			2	25				25	50	1	
4	PC	22PCAI5040L	Programming Laboratory-III (Full Stack Development Lab)			4	25				25	50	2	2
5@	PE	22PEAI5051T	Computer Network Security	3			20	15	15	15	65	100	3	4
		22PEAI5051L	Computer Network Security Laboratory			2	25				25	50	1	
		22PEAI5052T	Advanced Data Structures and Algorithms	3			20	15	15	15	65	100	3	
		22PEAI5052L	Advanced Data Structures and Algorithms Laboratory			2	25				25	50	1	
		22PEAI5053T	Recommendation Systems	3			20	15	15	15	65	100	3	
		22PEAI5053L	Recommendation Systems Laboratory			2	25				25	50	1	
6	MC	22MCAI5060T	Environmental Engineering	1								Audit Course		
7	PJ	22PJAI5070L	Semester Project-III			2	25				25	50	1	1
8	HM	22HMAI5080L	Employability Skill Development Program-II			2	50					50	1	1
			Total	13		16	280			60	410	750	20	

@Any 1 Professional Elective Course

Prepared by:
Dr. P. S. Sanjekar

Checked by:
Prof. S. M. Pardeshi

Prof. Dr. R. B. Wagh
BOS Chairman

Prof. S. P. Shukla
C.O.E.

Prof. Dr. P. J. Deore
Dean Academics/Dy. Director

Prof. Dr. J. B. Patil
Director

R. C. Patel Institute of Technology, Shirpur
SES
Shirpur Education Society
Autonomous

Digital Signal and Image Processing (22PCAI5010T)

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: Ability to deal with applied and abstract mathematical concepts.

Course Objectives:

1. To introduce students to the basic idea of signals and systems analysis with its characterization in time and frequency domain.
2. To implement algorithms that perform basic image processing- enhancement and filtering.
3. To implement algorithms for basic image segmentation.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Classify signals and systems on the basis of their properties and analyze the implications in the context of practical signals and systems.	L4	Analyze
CO2	Represent signals in the time and frequency domain using multiple representations and analyze LTI systems using convolution in the frequency domain.	L2	Understand
CO3	Implement image enhancement techniques in spatial and frequency domain.	L5	Evaluate
CO4	Interpret and apply image segmentation and representation techniques for object recognition.	L3	Apply

Course Contents

Unit-I — 09 Hrs.

Discrete-Time Signal and Discrete-Time System: Introduction to Digital Signal Processing, Sampling and Reconstruction, Standard DT Signals, Concept of Digital Frequency, Representation of DT signal using Standard DT Signals, Signal Manipulations (shifting, reversal, scaling, addition, multiplication). Classification of Discrete-Time Signals, Classification of Discrete Systems. Linear Convolution formulation for 1-D signal (without mathematical proof), Circular Convolution (without mathematical proof), Linear convolution using Circular Convolution.

LTI system, Concept of Impulse Response and Step Response, Output of DT system using Time Domain Linear Convolution.

Unit-II — 10 Hrs.

Discrete Fourier Transform: Introduction to DTFT, Relation between DFT and DTFT, DFT of DT signal, Inverse DFT.

Properties of the DFT: Scaling and Linearity, Symmetry for real valued signal, Periodicity, Time Shift and Frequency Shift, Time Reversal, Convolution Property.

Fast Fourier Transform: Need of FFT, Radix-2 DIT-FFT algorithm. Flow graph for N=4 and 8 using Radix-2 DIT-FFT, Inverse FFT algorithm, Comparison of complex and real, multiplication and additions of DFT and FFT. Overlap Add Algorithm and Overlap Save Algorithm and implementation using FFT.

Unit-III — 02 Hrs.

Basics of Image Processing: Image acquisition, Sampling, Quantization, Image Types, and Image formats. Colour models RGB and CMYK models.

Unit-IV — 10 Hrs.

Image Enhancement in spatial domain: Point processing techniques, Neighborhood processing. Image Smoothing: Spatial Filters-Linear Filters-Averaging filter, Median filter, Sharpening Spatial Filters- The Laplacian, Unsharp Masking and High boost Filtering, Using First-Order Derivatives —The Gradient-Sobel, Prewitt and Roberts operator, Histogram processing (Stretching & Equalization)

Image Enhancement in Frequency domain: 2D-DFT, Properties of 2D-DFT, Low pass, High pass and Homomorphic filtering.)

Unit-V — 05 Hrs.

Image Restoration: Overview of Degradation models –Unconstrained and constrained re[illegible]

Inverse Filtering, WienerFilter.

Unit-VI

05 Hrs.

Image Segmentation: Basic relationships between pixels -Neighbors, Connectivity, Detection of discontinuities- Point, Line, Edge detection, Region-based segmentation- Region Growing, Region Splitting and merging. Region Identification: chain code, simple geometric border representation, Boundary description using segment sequences. Edge Linking, Hough Transform.

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods,"Digital Image Processing", Pearson, 4th Edition, 2018.
2. Tarun Rawat, "Signals and Systems", Oxford Higher Education, Paperback – 19 July 2010
3. V. Krishnaveni and A.Rajeshwari, "Signals and Systems", Wiley-India, 1st Edition, 2012.

Reference Books:

1. Simon Haykin and Barry Van Veen, "Signals and Sytems", John Wiley and Sons, 1st Edition, 2004.
2. Alan V. Oppenhiem, Alan S. Willsky and S. Hamid Nawab, "Signals and Systems", Prentice-Hall of India, 2nd Edition, 2002.
3. Anil K Jain, "Fundamentals of digital image processing", Paperback, PHI – 1 January 2015.
4. Willliam K Pratt, "Digital Image Processing", John Willey, 2002.
5. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", 1st Edition, PHI Learning Pvt. Ltd., 2011.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

1. Two term tests of 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 Signal and Image Processing Laboratory (22PCAI5010L)

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 convolution, Sampling and Quantization on image quality.
2. To introduce Image Enhancement using different techniques.
3. To introduce homomorphic filter, image zooming and Image Segmentation operations.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement linear and circular convolution with overlap and add method for computing the convolution.	L3	Apply
CO2	Classify effect of sampling and quantization on image quality.	L4	Analyze
CO3	Implement image enhancement using Spatial Domain and frequency domain.	L3	Apply
CO4	Construct image zooming and image Segmentation using different operators.	L3	Apply

List of Laboratory Experiments

Suggested Experiments:

1. Implementation of Linear and Circular Convolution of two discrete time sequences.
2. Implement Overlap and Add method for computing the convolution of two variable length sequences.
3. To understand the effect of Sampling and Quantization on image quality. Study image statistics. (Mean, Variance, Entropy)
4. To perform Spatial Domain Image Enhancement using different Point Processing techniques.
5. To perform Image steganography and retrieve the secret image from the stego image.
6. Implement homomorphic filter.
7. To perform frequency domain Image Enhancement techniques.
8. Perform image zooming.
9. To perform different Image Segmentation operations using different operators and Canny edge detection.

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI5010T with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C):

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

Machine Learning (22PCAI5020T)

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: Knowledge of basic probability and statistics, Data Mining and Analytics concepts

Course Objectives:

1. To understand key machine learning concepts: hypothesis formation, bias-variance trade-off, and model evaluation metrics.
2. To master regression, classification, and clustering techniques.
3. To apply machine learning algorithms to real-world datasets effectively.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyse model performance using evaluation metrics.	L4	Analyze
CO2	Implement and tune regression and classification algorithms.	L3	Apply
CO3	Apply knowledge of Bayesian learning principles.	L3	Apply
CO4	Apply clustering and dimensionality reduction techniques.	L3	Apply
CO5	Understand the fundamentals of Neural Networks.	L2	Understand

Course Contents

Unit-I — 05 Hrs.

Hypothesis and Inductive Bias, Bias-Variance Trade-off, Performance measures, Data Validation.

Evaluation & Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Subsampling, Cross Validation, Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on Cost–Benefit and ROC Curves.

Unit-II — 08 Hrs.

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

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

Unit-III — 08 Hrs.

Bayesian Learning: Bayesian Learning, Naïve Bayes, Bayesian Network: Representation in Bayesian, Belief Network, Inference in Bayesian Network, Applications of Bayesian Network. Classification Model

Unit-IV — 05 Hrs.

Introduction to Support Vector Machine: Support Vectors, Kernels: Linear, Polynomial and Radial Basis Function (RBF) Kernel

Unit-V — 08 Hrs.

Clustering: Cluster Analysis and Requirements of Cluster Analysis Partitioning Methods: k-Means, k-Medoids Hierarchical Methods: Agglomerative, Divisive. Dimensionality Reduction: Dimensionality Reduction Techniques: Principal Component Analysis

Unit-VI — 05 Hrs.

Introduction to Neural Networks and Deep Learning: Deep Learning applications, Association of biological neuron with artificial network, activation functions, weights, bias, threshold, learning rate, momentum factor

McCulloch Pitts Neuron: Theory and architecture; linear separability; Hebb Network: Theory and algorithm, ANN architectures. Hyper parameter tuning and batch normalization, Machine Learning vs Deep Learning.

Text Books:

1. Peter Bruce, Andrew Bruce, Peter Gedeck, "Practical Statistics for Data Scientists" 2nd Edi-

tion, OReilly Publisher, 2020.

2. Howard J. Seltman,"Experimental Design and Analysis", July 11, 2018.

3. Tom Mittchell, "Machine Learning McGraw Hill, 2017.

Reference Books:

1. "Data Mining for Business Analytics, (An Indian Adaptation): Concepts, Techniques and Applications in Python", Cambridge University Press, ISBN NO. 978-1108727747, 2019.

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

3. Stephen Marsland, "Machine Learning an Algorithmic Perspective", CRC Press, 2015

4. Han Kamber, "Data Mining Concepts & Techniques", Morgann Kaufmann Publishers, 2012.

5. Kevin P. Murphy, "Machine Learning — A Probabilistic Perspective", 2012.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview

2. https://www.datacamp.com/tutorial/tableau-tutorial-for-beginners

3. https://www.kaggle.com/code/ekami66/detailed-exploratory-data-analysis-with python

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 Laboratory (22PCAI5020L)

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

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

Course Objectives:

1. Define the basics of Neural Network
2. Understand the key concept of ANN, CNN and RNN for Tensor Flow
3. Explain the concept of GAN generator or discriminator
4. Develop the Mini Project based on the Object Detection, Image or Text Classification etc.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement Neural Network.	L3	Apply
CO2	Analyze ANN, CNN & RNN using Tensor Flow.	L4	Analyze
CO3	Evaluate GAN generator and discriminator.	L5	Evaluate
CO4	Build Mini Project based on Object Detection, Image or Text Classification etc.	L6	Create

List of Laboratory Experiments

Suggested Experiments:

1. Perform Linear Regression.
    - Perform data cleaning
    - EDA
    - Data transformation
    - Model Training
    - Performance evaluation
2. Perform Logistic Regression.
    - Perform data cleaning
    - EDA
    - Data transformation
    - Model Training
    - Performance evaluation
3. Perform Decision Tree using GINI.
    - Data cleaning
    - EDA
    - Data transformation
    - Model Training, Visualize Decision Tree
    - Performance evaluation
4. Perform CART decision tree algorithm.
    - Data cleaning
    - EDA
    - Data transformation
    - Model Training, Visualize Decision Tree
    - Performance evaluation
5. Perform Ensemble methods
    - Data cleaning
    - EDA

- Data transformation
- Model Training
- Performance evaluation

6. Perform Bayesian Classification
   - Data cleaning
   - EDA
   - Data transformation
   - Model Training
   - Performance evaluation
7. Compare performance of classification algorithms.
   - Model Training
   - Performance evaluation
   - Comparision of performance of different classification algorithms
8. Perform Support Vector Machine.
   - Data cleaning
   - EDA
   - Data transformation
   - Dimensionality reduction
9. Perform K-means/ K-Medoids clustering.
   - Data cleaning
   - EDA
   - Data transformation
   - Clustering
10. Study a machine learning patent.
11. Mini project based on any machine learning application.

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI5020T with minimum 08 experiments to be incorporated.

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

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

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

End Semester Examination (C):

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

Natural Language Processing (22PCAI5030T)

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: Python Programming

Course Objectives:

1. To introduce the fundamental concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
2. To examine the NLP models and interpret algorithms for classification of NLP sentences by using both the traditional, symbolic and the more recent statistical approach.
3. To get acquainted with the algorithmic description of the main language levels that includes morphology, syntax, semantics, and pragmatics for information retrieval and machine translation applications.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the Principles and Process of Natural Languages and real-world applications.	L2	Understand
CO2	Demonstrate understanding of state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology.	L3	Apply
CO3	Perform POS tagging for a given natural language and select a suitable language modelling technique based on the structure of the language.	L6	Create
CO4	Check the syntactic and semantic correctness of sentences using grammars and labelling.	L5	Evaluate

Course Contents

Unit-I — 04 Hrs.

Introduction to Natural Language Processing: Origin & History of NLP, Stages in NLP, Ambiguities and its types in English and Indian Regional Languages; Applications of NLP- Machine Translation, Information Retrieval, Question Answering System, Sentiment Analysis, Text Categorization , Text Summarization, Named Entity Recognition.

Unit-II — 06 Hrs.

Computational tools for text analysis: Basic Terms: Tokenization, Stemming, Lemmatization, Natural Language Toolkit (NLTK): Corpora and other data resources, Uses of corpora: Lexicography, Grammar and syntax, Stylistics, Training and evaluation. Basic corpus analysis: Frequency distribution building and analyzing a corpus. Tokenization in the NLTK, Tokenizing text

Unit-III — 09 Hrs.

Word Level Analysis (statistical language model): Inflectional Morphology, Derivational Morphology, Regular expression with types, Morphological Models: finite state morphology, Morphological parsing with FST (Finite State Transducer), Lexicon free FST Porter Stemmer algorithm, Grams and its variation: Bigram, Trigram, Simple (Unsmoothed) N-grams; N-gram Sensitivity to the Training Corpus, Evaluating N-grams: Perplexity, smoothing: Laplace Smoothing, Good-Turing Discounting.

Unit-IV — 07 Hrs.

Syntax analysis: Part-Of-Speech tagging (POS), Tag set for English (Upenn Treebank), Difficulties /Challenges in POS tagging , Rule-based, Stochastic and Transformation-based tagging, Generative Model: Hidden Markov Model (HMM Viterbi) for POS tagging; Issues in HMM POS tagging, Discriminative Model: Maximum Entropy model, Conditional random Field (CRF), CYK.

Unit-V — 08 Hrs.

Semantic Analysis: Lexical Semantics; Corpus study; Study of Various language dictionaries like WorldNet, Babelnet. Attachment for fragment of English, Relations among lexemes & their senses –Homonymy, Polysemy, Synonymy, Hyponymy, Semantic Ambiguity, Word Sense Disambiguation (WSD), Knowledge based approach (Lesk's Algorithm), Supervised (Naïve Bayes, Decision List).

Unit-VI — 05 Hrs.

Pragmatic & Discourse Processing: Discourse: Reference Resolution, Reference Phenomena, Syntactic & Semantic constraint on coherence, Anaphora Resolution using Hobbs and Centering Algorithm, Discourse segmentation, Coreference resolution.

Text Books:

1. Raymond S. T. Lee, "Natural Language Processing: A Textbook with Python Implementation", 1st Edition, 2023.

2. Lewis Tunstall, Leandro von Werra, Thomas Wolf, "Natural Language Processing with Transformers", O'Reilly , 2022.

3. Thushan Ganegedara, Andrei Lopatenko, "Natural Language Processing with TensorFlow: The definitive NLP book to implement the most sought-after machine learning models and tasks", 2nd Edition, 2022.

4. Daniel Jurafsky, James H. and Martin, "Speech and Language Processing An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson, 2014.

Reference Books:

1. Masato Hagiwara, "Real-World Natural Language Processing: Practical applications with deep learning", Mnaning, 2021.

2. Ashish Bansal, "Advanced Natural Language Processing with TensorFlow 2: Build effective real-world NLP applications using NER, RNNs, seq2seq models, Transformers, and more", Packt Publishing, 2021.

Useful Links:

1. Web Resources Blogs and Websites:

2. POS Tagging Hidden Markov Models (HMM) Viterbi algorithm in NLP maths — Data Science in your pocket (medium.com)

3. Text Generation Using N-Gram Model — by Oleg Borisov — Towards Data Science

4. How to Create Beautiful Word Clouds in Python — by Tia Plagata — Towards Data Science

5. Best NLP Algorithms to get Document Similarity — by Jair Neto — Analytics Vidhya — Medium

6. How to Chunk Text Data — A Comparative Analysis — by Solano Todeschini — Towards Data Science

7. Natural Language Processing. Title :- Morphological Analysis — by Raghvendra Zarkar — Medium

Online Courses and Tutorials:

1. NPTEL Course : Natural Language Processing - Course (nptel.ac.in)
2. Cousera: Natural Language Processing Specialization [4 courses] (DeepLearning.AI) — Coursera
3. Udemy: NLP - Natural Language Processing with Python — Udemy

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.

Natural Language Processing Laboratory (22PCAI5030L)

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

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

Course Objectives:

1. To understand Preprocessing steps in NLP like Tokenization, stop word Removal, Lemmatization, stemming.
2. To provide the knowledge of operations involved in Natural Language Processing.
3. Implement complex applications like Information Retrieval System, Spelling Check, Spelling Correction, Auto complete, Text Summarization and Question Answering System.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Use Natural Language Processing to solve language related tasks.	L3	Apply
CO2	Develop various applications based on natural language processing.	L6	Create

List of Laboratory Experiments

Suggested Experiments:

1. Preprocessing steps in NLP: Tokenization, stop word Removal, Lemmatization, stemming using NLTK and SPACY.
2. Implement Named Entity Recognition for any given text.
3. Perform morphological analysis and word generation for any given text.
4. Implement Chunking for the given input text.
5. Build a POS tagger using HMM.
6. Similarity Detection in NLP.
7. Implement N-Gram model for the given text input.
8. Generate word cloud using Python.
9. Any application of NLP: Spell Check, Autocorrect, plagiarism detection, sentiment analysis, sarcasm detection or text analytics in any domain.

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI5030T with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C):

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

Programming Laboratory-III (Full Stack Development Laboratory)(22PCAI5040L)

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

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

Prerequisite: HTML5, CSS3, JavaScript, Database Management System

Course Objectives:

1. To orient students to Basics of REACT along with installation
2. To expose students to Advanced concepts in REACT
3. To orient students to Fundamentals of node.js
4. To expose students to node.js applications using express framework.
5. To gain expertise in a leading document-oriented NoSQL database, designed for speed, scalability, and developer agility using MongoDB

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Design front end application using basic React.	L6	Create
CO2	Design front end applications using functional components of React.	L3	Apply
CO3	Design back-end applications using Node.js.	L3	Apply
CO4	Construct web based Node.js applications using Express.	L3	Apply
CO5	Apply MongoDB for frontend and backend connectivity using REST API.	L3	Apply

Course Contents

Unit-I — 08 Hrs.

React Fundamental

Installation, Installing libraries, Folder and file structure, Components, Component lifecycle, State and Props, React Router and Single page applications, UI design, Forms, Events, Animations, Best practices, React vs Angular vs Vue.

Unit-II — 08 Hrs.

Advance React

Functional components- Refs, Use effects, Hooks, Flow architecture, Model View Controller (MVC) framework, Flux, Bundling the application. Web pack. Self-learning Topics: React Native

Unit-III — 10 Hrs.

Database Connectivity

Database Fundamentals, working with Database Schemas, Create-Read Update-Destroy (CRUD), Database Joins, Querying SQL databases, Serialization, how to model NoSQL data, Document Databases (MongoDB), Create-Read-Update-Destroy (CRUD), NoSQL Best Practices, Mongo Shell and command line use, installing MongoDB, Mapping relationships with MongoDB, using an object-data modelling library (Mongoose)

Unit-IV — 10 Hrs.

Node.js Node.js, Setup Development Environment: Installation of Node.js, Working in REPL, Node JS Console, working with an MVC framework, apply concepts like data types, objects, methods, object-oriented programming, and classes in the context of backend development, Server-Side JavaScript Using Node on the command line NPM JavaScript Build Processes, Event Loop and Emitters, File System Interaction, Modules, Native Node drivers.

Unit-V — 06 Hrs.

Express.js

Introduction, Installation, Express router, REST API, Generator, Authentication, sessions, Integrating with React, Commercial deployment.

Unit-VI — 10 Hrs.

Deployment and Building RESTful API

Understand hosting and deployment. Hosting static websites with GitHub Pages. Deploying server-based applications with Heroku. Deploying Databases with Mongo Atlas. Understanding REST and

guiding principles behind API design. Learn to work with a MongoDB GUI Robo 3T Implementing GET, POST, PUT, PATCH and DELETE by creating a public API from scratch. Understand and use chained route handlers from Express.

List of Laboratory Experiments

1. Installation and Configuration of React.
2. Understanding JSX, Components, Props, State in React.
3. Implementing Forms, Events, Routers, Refs, Keys.
4. Implement CRUD operations in MongoDB.
5. Installation and Configuration of Node.js
6. Implementing Callbacks, Event loops in Node.js
7. Create an application to demonstrate use of React hooks and JS.
8. Create an application to demonstrate use of Conditional rendering in React JS.
9. Create an application to demonstrate various Node.js Events.
10. Create an application to demonstrate Node.js Functions
11. Create an application to demonstrate integration of Node JS and MongoDB.
12. Create an application to demonstrate integration of Node JS and React JS.
13. Create an Online Learning application using REST APIs.
14. Deploy the above developed application on any hosting platform of your choice

Minimum 10 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Text Books:

1. Adam Bretz and Colin J. Ihrig, "Full Stack JavaScript Development with MEAN", SitePoint Pty. Ltd., 2015 Edition.
2. Simon Holmes Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node", Manning Publications, 2015 Edition.
3. Venkat Subramaniam, "Rediscovering JavaScript, Master ES6, ES7, and ES8", The Pragmatic Bookshelf, 2018.
4. Alex Banks and Eve Porcello, "Learning React Functional Web Development with React and Redux", O Reilly, 1st Edition, 2017 Edition
5. Andrew Mead, "Learning Node.js Development", Packt Publishing, 2018 Edition

6. Valentin Bojinov, "RESTful Web API Design with Node.js 10", Packt Publication, 2018 Edition.

Reference Books:

1. Ethan Brown, "Web Development with Node and Express", O'Reilly, 2019 Edition.

2. Shama Hoque, "Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js", 2nd Edition, Packt Publication, 2020.

3. Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications", 2nd Edition, Addison-Wesley Professional, 2017

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PCAI5040L with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C):

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

Computer Network Security (22PEAI5051T)

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: Knowledge of Basic Mathematics and Algorithms.

Course Objectives:

To get familiar with contemporary issues and challenges of various protocol designing in layered architecture and performance analysis of various protocols and security issues.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the concepts of data communication and functionalities of ISO - OSI model & TCP/IP model.	L2	Understand
CO2	Illustrate the functions of Data link layer and Network Layer.	L3	Apply
CO3	Demonstrate the working of transport and application layer protocols.	L3	Apply
CO4	Identify security vulnerabilities and explore various monitoring measures.	L1	Remember
CO5	Explore the fundamentals of security algorithms.	L4	Analyze

Course Contents

Unit-I — 04 Hrs.

Introduction to computer network, Network topology, Networking devices, Reference models: OSI, TCP/IP

Unit-II — 08 Hrs.

Physical and Data link Layer: Introduction, transmission medium, physical addressing, Error control (Hamming code, CRC), Flow control, Data-Link Layer Protocols: HDLC, Media Access Control: ALOHA, CSMA

Unit-III — 09 Hrs.

Network Layer: Unicast Routing Algorithms-(DVR, LSR), IPv4 Addressing (Classfull and Classless), Subnetting, Supernetting design problems, IPv4 Protocol, IPV6 protocol.

Unit-IV — 06 Hrs.

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

Unit-V — 04 Hrs.

Introduction to Security: Security Goals, Security threats and attacks, (Spoofing, Phishing, DOS, Virus, Worm, Trojans, Side-Channel Attack), Intrusion Prevention Systems Intrusion Detection System (IDS), Troubleshooting and monitoring tools, Wireshark, Kali Linux, Honeypot, Nmap, Kismet.

Unit-VI — 08 Hrs.

Fundamentals of security algorithms: Cryptography: Symmetric (Substitution Ciphers, Caesar Cipher, Playfair Cipher, Hill Cipher, Block Ciphers, DES and AES), Asymmetric (PKI, RSA, Digital Signature), Key exchange (Diffie-Hellman), Hashing (MD5, SHA)

Text Books:

1. Andrew S. Tanenbaum, "Computer Networks", 6th Edition, Pearson, 2022.
2. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, TMH, 2017.
3. Atul Kahate, "Cryptography and Network Security" , 3rd Edition, Tata Mc Graw Hill, 2017.
4. William Stallings, "Computer Security Principles and Practice", 7th Edition, Pearson Education, 2017

5. Charles P. Pfleeger, "Security in Computing", 5th Edition, Pearson Education, 2015

6. Bernard Menezes, "Network Security and Cryptography", Cengage Learning, 2014.

7. Bible-Eric Cole, "Network Security", 2nd Edition, Wiley, 2011.

8. Deven Shah, "Mark Stamp's Information Security: Principles and Practice", Wiley, 2009.

Reference Books:

1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", 7th Edition, Pearson Education, 2017.

2. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, 2013.

3. Nader F. Mir, "Computer and Communication Networks", 2nd Edition, Prentice Hall, 2014.

4. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, "Computer Networks: An Open-Source Approach", McGraw Hill Publisher, 2011.

5. Richard Steven, "UNIX Network Programming", Addison Wesley, 2003.

6. B. A. Forouzan, "TCP/IP Protocol Suite", 4th Edition, Tata Mc Graw Hill, 2017.

7. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan Kaufmann Publishers Inc., 2012.

8. Bruce Schneier, "Applied Cryptography, Protocols Algorithms and Source Code in C", 2nd Edition / 20th Anniversary Edition, Wiley, 2015.

Web Links:

1. Nptel Course https://onlinecourses.nptel.ac.in/noc22_cs19/preview

2. Nptel Advanced course https://onlinecourses.nptel.ac.in/noc24_cs11/preview

3. Coursera Course https://www.coursera.org/learn/computer-networking

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

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

End Semester Examination (C):

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

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

Computer Network Security Laboratory(22PEAI5051L)

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 network, protocol, security tools and network simulator like NS2/OPNET /Wireshark.
2. To introduce the concepts of Encryption and Decryption using various cipher techniques and attacks applied on it.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Summarize the different topologies and use in Network Simulator.	L2	Understand
CO2	Implement an error detection code and distance vector routing algorithm.	L6	Create
CO3	Check the applications of TCP socket.	L5	Evaluate
CO4	Utilize the different open source tools for network security and analysis.	L3	Apply
CO5	Identify most common network attacks.	L4	Analyze
CO6	Demonstrate the data integrity using various cryptographic algorithms.	L3	Apply

List of Laboratory Experiments(At Least 08)

Suggested Experiments:

1. Installation & Configuration of Network Simulator (NS2) in Linux environment. -Study of different topologies and create duplex link in NS2.
2. Implementation of an error detection code using CRC.
3. Implementation of Distance Vector/ Link State Routing algorithm.
4. Study of Network simulator (NS) and performance evaluation of Routing protocols using Simulation tool.
5. Applications using TCP sockets like:
   - Echo client and echo server.
   - Chat
   - File Transfer
6. Demonstration of security tools.
7. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer.
8. Design and Implement Caesar cipher cryptographic algorithm by considering letter [A... Z] and digits [0...9]. Apply Brute Force Attack to reveal secret.
9. Design and Implement Encryption and Decryption algorithm using Simple Columnar Transposition cipher technique. Study how dictionary attack can be applied on it.
10. Implement RSA Cryptosystem using RSA Algorithm / Implement Elliptical Curve Digital Signature Algorithm (ECDSA)
11. Demonstrate the data integrity using various cryptographic algorithms viz. MD-5, SHA-1 using VLAB, IIT Bombay.

C/C++/JAVA/Equivalent compiler.

Network Simulator like NS2/OPNET/Wireshark

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PEAI5051T with minimum 08 experiments to be incorporated.

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

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

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

End Semester Examination (C):

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

Advanced Data Structures and Algorithm (22PEAI5052T)

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: Python Programming, Data Structures, Design & Analysis of Algorithms

Course Objectives:

1. To provide conceptual and practical knowledge of Advance Data Structures and Algorithms.
2. To Cultivate algorithmic thinking and problem-solving skills through practice and exposure to diverse problem domains.
3. Develop strategies for breaking down complex problems into manageable sub problems and applying suitable algorithms and data structures.
4. Develop skills to analyze problem complexity and choose appropriate data structures and algorithms for efficient solutions.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the concept of time complexity and its importance in analyzing algorithms and to Explore the complexity analysis of popular machine learning algorithms.	L2	Understand
CO2	Explore balanced search tree data structures and spatial data structures used in geometric and spatial applications.	L2	Understand
CO3	Apply graph algorithms to solve real-world problems related to network flows, matching, and optimization.	L3	Apply
CO4	Understand the complexity classes NP, P, NP-complete, and NP-hard and their significance in algorithm classification and to explore the computational geometry algorithms.	L2	Understand

Course Contents

Unit-I — 08 Hrs.

Analysis of Algorithm Based on Time:

i. **Amortized Analysis:** Aggregate Method, Accounting Method, Potential Method (for Stack data structure)

ii. **Probabilistic and Randomized Algorithm:** Probabilistic approach to algorithm and Randomized Analysis, Indicator Random Variable (IRV), Analysis of Hiring Problem

Complexity Analysis of Machine Learning Algorithms:

iii. Training Time Complexity and Testing Time Complexity

iv. Train/Test Complexity of Linear Regression

v. Train/Test Complexity of Naïve Bayes Classifier

Unit-II — 10 Hrs.

i. **Balanced Search Trees:** Red-Black Tree, Tango Tree, 2-3 Tree, B+ Tree, Splay Tree

Unit-III — 06 Hrs.

Advanced Data Structures:

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

ii. **Probabilistic Data Structure:** Bloom filter, LogLog and HyperLogLog, Count Min sketch, MinHash with Machine Learning context (Vector Representation)

iii. **Functional Data Structures:** Binomial Tree, Binomial Heap

Unit-IV — 06 Hrs.

Graph Based Algorithms:

i. **Flow Network Introduction:** Residual Network, Augmenting Path, Ford-Fulkerson Method, Edmonds-Karp Method, Push-Relable Algorithm

ii. **Bipartite Matching:** Maximum Bipartite Matching

Unit-V — 07 Hrs.

Classification of Algorithms:

i. **Algorithm Classes:** P, NP, NP Hardness and NP Completeness

ii. **Np Completeness Proofs:** Satisfiability (3 sat), Reducibility, Cook's Theorem, Traveling Salesman Problem

iii. **Approximation Algorithms:** Vertex Cover Problem, Travelling Salesman problem

Unit-VI

02 Hrs.

Computational Algorithms – Computational Geometry:

Line Segment Properties, Convex Hull Graham's scan algorithm

Text Books:

1. Thomas H Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, 2009.
2. S. Sridhar, "Design and analysis of algorithms", 1st Edition, Oxford , 2014.
3. Horowitz, Sahani and Rajsekaran, "Fundamentals of Computer Algorithms", 2nd Edition, Galgotia, 1998.
4. Harsh Bhasin, "Algorithms Design and Analysis", 1st Edition, Oxford, 2015.
5. Giuseppe Bonaccorso, "Machine Learning Algorithms", by Packt, 2019.

Reference Books:

1. Rajeev Motwani, Prabhakar Raghavan," Randomized Algorithm", Cambridge University, 2004.
2. Vijay V. Vajirani, "Approximation Algorithms", Springer, 2003.
3. "Computational Complexity", Stanford University, 2010.
4. Jason Brownlee, "Master Machine Learning Algorithms", Machine Learning Mastery, 2020.

Web Resources Blogs and Websites::

1. Train/Test Complexity and Space Complexity of Linear Regression — by Writuparna Banerjee — Level Up Coding (gitconnected.com)
2. Computational Complexity of ML Models — by Paritosh Kumar — Analytics Vidhya — Medium
3. Importance of Understanding the Complexity of a Machine Learning Algorithm — by Baran Köseoğlu — Towards Data Science
4. Probabilistic Data Structures Decoded: Enhancing Performance in Modern Computing — by Naman Agrawal — Towards Data Science
5. ML Security Pro Tips: Understanding MinHash in a Security Context — by Melanie Beck — AI/ML at Symantec — Medium.
6. Bloom Filters and when to use them — by Janko Krstic — The Little Bit Ninja — Medium
7. The Power of Bloom Filters: A Comprehensive Guide — by Chiranjeet Baruah — Medium

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.

Advanced Data Structures and Algorithm Laboratory (22PEAI5052L)

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

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

Course Objectives::

1. To provide conceptual and practical knowledge of Advanced Data Structures and Algorithms.
2. To develop programmming skill through implemetation of various advanced data structures.
3. Develop strategies for breaking down complex problems into manageable sub problems and applying suitable algorithms and data structures.
4. Develop skills to analyze problem complexity and choose appropriate data structures and algorithms for efficient solutions.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the Working Principle of Red Black Tree as an Advanced Data Structure	L2	Understand
CO2	Implement KD Tree Data Structure.	L3	Apply
CO3	Apply graph algorithms to solve real-world problems.	L3	Apply
CO4	Experiment on Computational Geometry Algorithms.	L3	Apply

List of Laboratory Experiments

Suggested Experiments:

1. Experiment on Amortized Analysis.
2. To perform and implement Hiring Problem.
3. Experiment on Randomized Algorithms (Randomized Quick Sort)
4. To implement Red Black Tree creation.
5. To implement Red Black Tree deletion.
6. To implement KD Tree
7. To implement Ford Fulkerson Algorithm
8. To implement Approximation Algorithms (Vertex Cover)
9. Experiment on Computational Geometry Algorithms (Graham Scan)

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PEAI5052T with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C):

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

Recommendation Systems(22PEAI5053T)

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: Knowledge of Machine Learning

Course Objectives:

1. To provide students with the basic concepts of Recommender Systems, design space, trade-offs and its application in various domain.
2. To have a broad understanding of the field of Recommendation Systems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understanding the architecture and working of Collaborative Filtering, Content based recommendation systems.	L2	Understand
CO2	Understanding the architecture and basics of Knowledge based recommendation systems.	L2	Understand
CO3	Analyzing hybrid and ensembles recommendation systems.	L4	Analyze
CO4	Evaluation of recommendation systems by selecting right evaluation parameter.	L5	Evaluate

Course Contents

Unit-I — 06 Hrs.

Introduction to Recommender Systems

Introduction to Recommendation System, Framework of recommendation systems, Eliciting Ratings and other Feedback Contributions, Implicit and Implicit Ratings, Recommender system functions. Applications of recommendation systems, Issues with recommender system.

Unit-II — 08 Hrs.

Collaborative filtering-based Recommender System Architecture of Collaborative Filtering, User-based nearest- neighbour recommendation: Similarity Function, User-Based Algorithms, Item-based nearest neighbour recommendation: Similarity Function, Item-Based Algorithms, Comparing User-Based and Item-Based recommendations, data drift and concept drift.

Unit-III — 07 Hrs.

Content-based Recommender System:

Architecture of content-based systems, Content representation and content similarity, Item profiles, Discovering features of documents, Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, The Role of User Generated Content in the Recommendation Process. Bayes classifier for recommendation, Regression based recommendation system. Advantages and drawbacks of content-based filtering.

Unit-IV — 06 Hrs.

Knowledge based recommendation

Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders, Persistent Personalization in Knowledge-Based Systems, Conversational Recommendation. Search based recommendation, Navigation-based recommendation.

Unit-V — 06 Hrs.

Ensembled- Based and Hybrid Recommendation System

Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta level, Limitations of hybridization strategies. .

Unit-VI — 06 Hrs.

Evaluating Recommendation System:

Evaluation Paradigms, General Goals of Evaluation Design, Design Issues in Offline Recommender

Evaluation, Online Recommender evaluation techniques. Comparison between evaluation design of classification model and recommendation system, Error metrics, Decision-Support metrics, User Centered metrics. Comparative analysis between different types of recommendation systems.

Text Books:

1. C.C. Aggarwal, "Recommender Systems: The Textbook", Springer, 1st Edition, 2016.
2. Jannach D., Zanker M. and FelFering A., "Recommender Systems: An Introduction", Cambridge University Press, 1st Edition, 2011.
3. Ricci, F., Rokach, L., & Shapira, B., Introduction to Recommender Systems Handbook. Springer, Boston, MA 2011.

Reference Books:

1. M.D. Ekstrand, J.T. Riedl, J.A. Konstan, "Collaborative filtering recommender systems", Now publishers, 1st Edition, 2011.
2. J. Leskovec, A. Rajaraman and J. Ullman, "Mining of massive datasets", Cambridge, 2nd Edition, 2012.
3. Rounak Banik, "Hands-On Recommendation Systems with Python: Start building", Ingram short title, 2018.
4. P. Pavan Kumar, S. Vairachilai, Sirisha Potluri, "Recommender Systems: Algorithms and Applications", CRC Press, 1st Edition, 2021.
5. Kim Falk, "Practical Recommender Systems", Manning, 1st Edition, 2019
6. Rounak Banik, "Hands-On Recommendation Systems with Python: Start building powerful and personalized, recommendation engines with Python", 2018.

Web Links:

1. Udemy course on Recommender Systems and Deep Learning in Python: https://realpython.com/build-recommendation-engine-collaborative-filtering.
2. Coursera course on Recommender Systems Specialization: https://www.coursera.org/specializations/recommender-systems
3. http://www.iem.iitkgp.ac.in/eco/Recommender_Systems/
4. https://www.coursera.org/specializations/recommender-systems
5. https://www.udemy.com/course/recommender-systems/

6. https://www.analyticsvidhya.com/blog/2021/08/developing-acourse-recommendersystem- using-python

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.

Recommendation Systems Laboratory (22PEAI5053L)

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

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

Course Objectives:

1. Design a recommender system for various problems.
2. Build different types of recommendation engines.
3. Build Recommenders using various algorithms.
4. Compare the performance of different recommender systems

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Build a Recommendation Engine and Recommender System.	L3	Apply
CO2	Implement Recommendation System.	L6	Create
CO3	Evaluate the Recommendation System.	L5	Evaluate
CO4	Compare the performance of different Recommender Systems.	L2	Understand

List of Laboratory Experiments

Suggested Experiments:

1. Build a Recommendation Engine with Item-Based Collaborative Filtering.
2. Build a Recommendation Engine with User-Based Collaborative Filtering.
3. Build Content-based recommendation engine on different datasets.
4. Build Recommender System using association rule mining.
5. Implement Recommendation System using K-Nearest Neighbors
6. Build Context-Aware Recommender Systems.
7. Build Constraint-based Recommenders.
8. Implement knowledge-based recommender system.
9. Implement a Monolithic hybridization design.
10. Evaluate the recommendation system with evaluation matrix.
11. Compare the performance of different recommender systems.
12. Mini Project.

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on 22PEAI5053T with minimum 08 experiments to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C):

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

Environmental Engineering (22MCAI5060T)

Teaching Scheme
Lecture : 01 Hr./week

Audit Course

Prerequisite: Interest in Environment and its impact on Human.

Course Objectives:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand how human activities affect environment.	L1	Remember
CO2	Understand the various technology options that can make a difference.	L1	Remember

Course Contents

Unit-I Social Issues and Environment 04 Hrs.

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

Unit-II Technological growth for Sustainable Development 04 Hrs.

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

Unit-III Green Technology 05 Hrs.

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

Text Books:

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

Reference Books:

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

Evaluation Scheme:

1. Student should submit a report on the case study declared by teacher.
2. Audit point shall be awarded subject to submission of report of the case study declared by teacher.

Semester Project-III (22PJAI5070L)

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 Third 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 (22HMAI5080L)

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.