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 2023-24

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

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

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	PCAI5010T	Digital Signal and Image Processing	3			20	15	15	15	65	100	3	4
	PC	PCAI5010L	Digital Signal and Image Processing Laboratory			2	25				25	50	1	
2	PC	PCAI5020T	Machine Learning-II(Deep Learning)	3			20	15	15	15	65	100	3	4
	PC	PCAI5020L	Machine Learning-II(Deep Learning)Laboratory			2	25				25	50	1	
3	PC	PCAI5030T	DevOps	3			20	15	15	15	65	100	3	4
	PC	PCAI5030L	DevOps Laboratory			2	25				25	50	1	
4	PC	PCAI5040L	Programming Lab-III(Full stack development using python)			4	25				25	50	2	2
5@	PE	PEAI5051T	Cloud Computing	3			20	15	15	15	65	100	3	4
		PEAI5051L	Cloud Computing Laboratory			2	25				25	50	1	
		PEAI5052T	Advanced Data Structures and Algorithms	3			20	15	15	15	65	100	3	
		PEAI5052L	Advanced Data Structures and Algorithms Laboratory			2	25				25	50	1	
		PEAI5053T	Recommendation Systems	3			20	15	15	15	65	100	3	
		PEAI5053L	Recommendation Systems Laboratory			2	25				25	50	1	
6	PJ	PJAI5060L	Semester Project-III			2	25				25	50	1	1
7	HM	HMAI5070L	Employability Skill Development Program-II			2	50					50	1	1
8	MC	MCAI5080T	Environmental Engineering	1								Audit Course		
			Total	13		16	280			60	410	750	20	

@Any 1 Elective Course

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

Checked by:
Prof. S. M. Pardeshi

Prof. Dr. R. B. Wagh
BOS Chairman

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

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

Prof. Dr. J. B. Patil
Director

R. C. Patel Institute of Technology, Shirpur
Autonomous

Semester-VI (w.e.f. 2023-24)														
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	PCAI6010T	Computer Vision	3			20	15	15	15	65	100	3	4
	PC	PCAI6010L	Computer Vision Laboratory			2	25				25	50	1	
2	PC	PCAI6020T	Natural Language Processing	3			20	15	15	15	65	100	3	4
	PC	PCAI6020L	Natural Language Processing Laboratory			2	25				25	50	1	
3	PC	PCAI6030T	Machine Learning Operations (ML Ops)	3			20	15	15	15	65	100	3	4
	PC	PCAI6030L	Machine Learning Operations (ML Ops) Laboratory			2	25				25	50	1	
4	PC	PCAI6040L	Design Thinking Laboratory			4	25				25	50	2	2
5@	PE	PEAI6051T	IoT Foundations	3			20	15	15	15	65	100	3	4
		PEAI6051L	IoT Foundations Laboratory			2	25				25	50	1	
		PEAI6052T	Time Series Analysis	3			20	15	15	15	65	100	3	
		PEAI6052L	Time Series Analysis Laboratory			2	25				25	50	1	
		PEAI6053T	Human Machine Interaction	3			20	15	15	15	65	100	3	
		PEAI6053L	Human Machine Interaction Laboratory			2	25				25	50	1	
6	HM	HMAI6060T	Professional and Business Communication	2			50					50	2	2
7	PJ	PJAI6070L	Project Stage-I			2	25				25	50	1	1
			Total	14		14	280			60	410	750	21	

@Any 1 Elective Course

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Autonomous

Digital Signal and Image Processing (PCAI5010T)

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

03 Hrs.

Image Restoration: Overview of Degradation models –Unconstrained and constrained restorations-

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 3 hrs.

Digital Signal and Image Processing Laboratory (PCAI5010L)

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 PCAI5010T 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-II(Deep Learning)(PCAI5020T)

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: Artificial Intelligence, Machine Learning

Course Objectives:

1. To explore Deep Learning Techniques with different learning strategies.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the fundamentals of deep learning.	L2	Understand
CO2	Apply supervised deep learning algorithms.	L3	Apply
CO3	Apply unsupervised deep learning algorithms.	L3	Apply
CO4	Understand the fundamentals of adversarial networks.	L2	Understand

Course Contents

Unit-I

05 Hrs.

Introduction to Neural Networks and Deep Learning:

Fundamentals of Neural Network and Deep Learning, Machine Learning vs Deep Learning, Deep Learning applications, Artificial Neural Network (ANN): 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. Hyperparameter tuning and batch normalization.

Unit-II

09 Hrs.

Supervised Learning with Neural Networks:

Perceptron, Multilayer Perceptrons (MLPs), Representational power of Perceptron and MLPs, Training rule, Sigmoid neurons, Gradient Descent and Delta Rule, Multilayer Networks: A differentiable threshold Unit, Feedforward Neural Networks, Representation Power of Feedforward Neural Networks; **Backpropagation Algorithm:** EBPTA, Convergence and local minima, Regularization for Deep Learning: Parameter Norm Penalties, Dataset Augmentation, Noise Robustness, Early Stopping, Sparse Representation, Dropout. Principal Component Analysis and its interpretations, Singular Value Decomposition.

Unit-III

07 Hrs.

Convolutional Neural Network (CNNs):

The Convolution Operation, Types of kernels, Kernel filter, Principles behind CNNs, Multiple Filters, convolution for images, sparse interactions, parameter sharing, Pooling, Convolution and Pooling as an Infinity Strong Prior, Variants of Basic Convolution Function, Efficient Convolution Algorithms. CNN applications.

ConvNet Architectures:

Discussions on famous convnet architectures: AlexNet, ZFNet, VGG, GoogLeNet, ResNet InceptionNets, DenseNets

Unit-IV

07 Hrs.

Recurrent Neural Networks (RNNs):

Introduction to Sequence Models and RNNs, RNN Model, Backpropagation through Time (BPTT), Different Types of RNNs: Unfolded RNNs, Seq2Seq RNNs, Long Short-Term Memory (LSTM), Bidirectional RNN, Vanishing Gradients with RNNs, Gated Recurrent Unit (GRU), RNN applications.

Unit-V

06 Hrs.

Unsupervised Learning with Neural Networks:

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

Autoencoders: Introduction and their relation to PCA, Need, components, properties, architecture and types of encoders.

Linear Factor Methods such as Probabilistic PCA and Factor Analysis, Independent Component Analysis, Sparse Coding; Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders, deep autoencoders, Undercomplete Autoencoders, Stochastic Encoders and Decoders, variational autoencoders(VAEs), Applications of Autoencoders.

Unit-VI

05 Hrs.

Adversarial Networks: Introduction to adversarial Networks, Generative Vs Discriminative Modeling, Generative Adversarial Networks (GAN): Probabilistic Generative Model, Types of GANs, Applications of GANs. Diffusion models vs GANs vs VAEs, Neural Style Transformers and language models.

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", Wiley India Publications, 3rd Edition, 2018.
3. David Foster, "Generative Deep Learning", O'Reilly Media, 2019.
4. Denis Rothman, "Hands-On Explainable AI (XAI) with python", Packt, 2020.

Reference Books:

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

Web Links:

1. d2l-en.pdf
2. Learning Rule: http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/explist.php
3. ANN Virtual Lab: http://cse22-iiith.vlabs.ac.in/List%20of%20experiments.html

4. Deep Learning: https://vlab.spit.ac.in/ai/#/experiments

5. 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 3 hrs.

Machine Learning-II(Deep Learning)Laboratory (PCAI5020L)

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. To study various tools: Torch, TensorFlow, Keras.
2. Building own Neural Network from scratch.
3. To implement hyper parameter tuning.
4. To implement EBPTA algorithm.
5. Understanding ANN using Tensor Flow.
6. Visualizing Convolutional Neural Network using Tensor Flow with Keras Data.
7. OCR using teassaeract
8. Object detection using RNN using Tensor Flow.
9. GAN generator or discriminator.
10. Visualizing autoencoders.
11. Students are supposed to complete any one mini project not limited to following list of projects.
    (a) Sequence Prediction
    (b) Object Detection
    (c) Traffic Sign Classification
    (d) Automatic Music Generation
    (e) Music Genre Classification
    (f) Text Summarizer
    (g) Gender and Age Detection Using Voice
    (h) Chatbot Using Deep Learning
    (i) Neural Style Transfer
    (j) Face Aging
    (k) Driver Drowsiness Detection
    (l) Language Translator
    (m) Image Reconstruction

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 PCAI5020T with minimum 05 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.

DevOps(PCAI5030T)

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 knowledge of Software Engineering

Course Objectives: The objective of this course is to familiarize learners to different development frameworks. The course also introduces students to the principles and process of software engineering and Devops.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply software engineering principles for application development.	L3	Apply
CO2	Students will be to interpret and apply various principles, phases and activities of Agile as well as scrum methodology.	L3	Apply
CO3	Be able to understand and implement Devops principles for CI/CD.	L2	Understand
CO4	Apply testing process for application development.	L3	Apply
CO5	Students will be able to apply Configuration Management Tools using Containerization.	L3	Apply

Course Contents

Unit-I — 07 Hrs.

Introduction: Software Engineering- process framework, Software Development Life Cycle (SDLC) Process Models: Incremental and Evolutionary models.

Devops: Introduction to DevOps, History of DevOps, DevOps definition, DevOps Main Objectives, Continuous Integration & Deployment, Containers and Virtual Development, Configuration Management Tools.

Unit-II — 07 Hrs.

Fundamentals of Agile Process: Need of Agile software development, Agile Manifesto and Principles, Stakeholders and Challenges, Overview of Agile Development Models: Scrum, Extreme Programming, Feature Driven Development, Crystal, Kanban, and Lean Software Development, Methods, Values, Roles, Artifacts, Stakeholders, and challenges. Business benefits of software agility.

Unit-III — 06 Hrs.

Source Code Management: Version Control: GIT Features, 3-Tree Architecture, GIT – Clone /Commit / Push, GIT Hub Projects, GIT Hub Management, GIT Rebase & Merge, GIT Stash, Reset, Checkout, GIT Clone, Fetch, Pull, Membership GITHUB.

Unit-IV — 06 Hrs.

Continuous Integration: Continuous Delivery and Deployment, Benefits of CI/CD, Metrics to track CICD practices, Continuous integration, tools, Build & Test Applications with Continuous Integration, Scheduling build Jobs, Build Scripts, Build Pipeline, Master & Slave Node Configuration, Workspace Management, Security and plugins, Other integration tools

Unit-V — 05 Hrs.

Continuous Testing: Introduction to Selenium, Installing Selenium, Creating Test Cases in Selenium WebDriver, Run Selenium Tests in Jenkins Using Maven, Functionality Testing, UI Testing, Performance Testing, Security Testing.

Unit-VI — 08 Hrs.

Configuration Management in Devops: The Process of Configuration, Configuration Management in DevOps.

Configuration Management Tools Containerization: Container introduction, Docker introduction, Docker Image, Docker Installation, Working with Docker Containers, Docker Engine, Creating Containers with an Image, Working with Images, Docker Hub , Docker Trusted Registry, Docker File

& Commands.

Devops Monitoring Tool: Introduction to Nagios, Installation, Architecture.

Text Books:

1. Roger S. Pressman and Bruce R. Maxim, "Software Engineering: A Practitioner's Approach", 8th Edition, McGraw-Hill Education, 2019.
2. Karl Matthias & Sean P. Kane, "Docker: Up and Running, O'Reilly Publication", 2nd Edition, 2018.
3. Len Bass, Ingo Weber, Liming Zhu,"DevOps A Software Architects Perspective", Addison Wesley Pearson Publication, 1st Edition, 2015.
4. John Ferguson Smart,"Jenkins, The Definitive Guide", 1st Edition, O'Reilly Publication, 2011.
5. Ryan Russell Yates,"Mastering Puppet 5: Optimize enterprise-grade environment performance with Puppet", Packt Publishing (September 29, 2018)

Reference Books:

1. Sricharan Vadapalli,"DevOps: Continuous Delivery, Integration, and Deployment with DevOps: Dive", Packt 2018.
2. Lisa Crispin, Janet Gregory,"Agile Testing: A Practical Guide For Testers And Agile Teams", Pearson, 2010.
3. Janet Gregory, Lisa Crispin, "More Agile Testing: Learning Journeys for the Whole Team", Addison Wesley, 2015.
4. Thomas Uphill, John Arundel, Neependra Khare, Hideto Saito, Hui-Chuan Chloe Lee, Ke-Jou Carol Hsu, "DevOps: Puppet, Docker, and Kubernetes", Packt, 2017.
5. Jim Highsmith,"Agile Project Management: Creating Innovative Products", 2nd Edition, Addison-Wesley Professional, 2009.
6. Andrew Stellman, Jennifer Greene,"Learning Agile: Understanding Scrum, XP, Lean, and Kanban", O Reilly,2015.

Web Links:

1. www.javatpoint.com, https://www.javatpoint.com/devops
2. www.guru99.com, https://www.guru99.com/devops-tutorial.html
3. www.tutorialspoint.com, https://www.tutorialspoint.com/devops_tutorials.htm
4. www.simplilearn.com, https://www.simplilearn.com/tutorials/devops-tutorial

5. www.edureka.co, https://www.edureka.co/blog/devops-tutorial

6. https://www.jenkins.io, https://www.jenkins.io/doc/tutorials/

7. https://github.com, https://github.com/learn/devops

8. www.dotnettricks.com, https://www.dotnettricks.com/learn/devops

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

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

End Semester Examination (C):

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

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

DevOps Laboratory (PCAI5030L)

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. Understand DevOps Principles, and Practices.
2. Perform various GIT operations on local and remote repositories using GIT.
3. Setup and Run Selenium Tests in Jenkins Using Maven.
4. Install and Configure Pull based Software Configuration Management and provisioning tools Using Puppet.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Write a program using DevOp's Practices and Priciples.	L6	Create
CO2	Apply various GIT operations.	L3	Apply
CO3	Understand Docker Architecture and Container Life Cycle.	L2	Undersatnd
CO4	Learn Software Configuration Management and provisioning using Puppet Blocks.	L2	Undersatnd

List of Laboratory Experiments

Suggested Experiments:

1. Write code for a simple user registration form for an event. To understand DevOps: Principles, Practices, and DevOps Engineer Role and Responsibilities.
2. To understand Version Control System / Source Code Management, install git and create a GitHub account.
3. To Perform various GIT operations on local and Remote repositories using GIT Cheat-Sheet.
4. To understand Continuous Integration, install and configure Jenkins with Maven/Ant/Gradle to setup a build Job.
5. To Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to Test and deploy an application over the tomcat server.
6. To Setup and Run Selenium Tests in Jenkins Using Maven.
7. To understand Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.
8. To learn Dockerfile instructions, build an image for a sample web application using Dockerfile.
9. To install and Configure Pull based Software Configuration Management and provisioning tools using Puppet.
10. To learn Software Configuration Management and provisioning using Puppet Blocks (Manifest, Modules, Classes, Function).

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 PCAI5030T 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 using Python)(PCAI5040L)

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

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

Prerequisite: Programming in python

Course Objectives:

1. To create routes and views to handle different HTTP requests.
2. Gain knowledge of working with databases, including connecting to databases, performing CRUD operations
3. Understand the fundamental concepts of backend development and the role of Python in building backend systems.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Gain hands-on experience in building front-end web applications.	L6	Create
CO2	To use the Flask framework to build a simple web server that handles incoming HTTP requests and generates responses.	L3	Apply
CO3	To use the different libraries to connect to databases and perform CRUD (Create, Read, Update, Delete) operations.	L3	Apply
CO4	learn to define API endpoints, handle incoming requests, perform data validation, and generate appropriate responses.	L1, L2	Remember, Understand

Course Contents

Unit-I

04 Hrs.

HTML, CSS, and JavaScript for web development: Introduction to HTML and CSS: Understanding HTML tags, attributes, and elements, Creating HTML documents and basic structure, Working with common HTML elements such as headings, paragraphs, lists, links, images, forms, and tables

Introduction to CSS and its syntax, CSS selectors, properties, and values, Styling HTML elements with CSS, including text formatting, colors, backgrounds, margins, padding, and borders, Creating layouts with CSS using floats, flexbox, and grid, Creating responsive and accessible layouts with CSS.

Introduction to JavaScript: variables, data types, operators, control structures, and functions, Document Object Model (DOM) and how JavaScript interacts with HTML elements, Handling events with JavaScript, such as button clicks, form submissions, and keypresses, Manipulating DOM elements dynamically with JavaScript, Introduction to error handling, debugging in JavaScript coding, Building interactive web pages with JavaScript

Unit-II

04 Hrs.

Introduction to Flask: Flask micro web framework for Python, Flask Application Structure, application file, templates directory, and static files directory, Setting up a basic Flask application with minimal configuration.

Creating Routes and Views in Flask: Understanding Routes, Creating Routes: Defining routes in Flask using decorators, including handling different HTTP methods (GET, POST, etc.) for different routes, Creating Views, view functions in Flask, handle requests from routes and return responses to the client

Unit-III

04 Hrs.

Handling User Input and Forms with Flask: Retrieving data from request objects and processing it, Flask's built-in form handling functionality to validate and process form data, using third-party libraries for form validation, Flask's flash messages to display feedback or error messages.

Using Templates to Render Dynamic Content in Flask: Introduction to Jinja2, creating templates in Flask using Jinja2 syntax, working with template inheritance, template variables, and control structures, Using Flask's template rendering functionality to render dynamic content in HTML pages, passing data from views to templates.

Unit-IV

06 Hrs.

Introduction to Django: Understanding Django the model-view-controller (MVC) architectural pattern, Django project directory, settings file, URL configuration, and application structure, Creat-

ing a Django Project, structure of the data in a Django web application and map them to database tables, Defining models in Django using Python classes, including fields, relationships, and model methods, Django's built-in database migration functionality to create and apply database schema changes.

Building Views and Templates in Django: Understanding Views , handle HTTP requests and generate HTTP responses in Django, Creating view functions in Django that handle requests from URLs, handling different HTTP methods, processing data, and rendering responses, Templates in Django, Creating templates in Django, working with template tags, filters, and template inheritance, Using Django's template rendering functionality to render dynamic content in HTML pages.

Forms and User Authentication in Django: Django's built-in form handling, Creating forms in Django, validating form data, and handling form submissions, rendering form fields in templates, user authentication.

Unit-V 04 Hrs.

Database in python: Using SQL with python, retrieving rows from a table, inserting rows into a table, deleting rows from a table, updating rows in a table, creating database tables through python, Exception handling in databases.

Networking: Protocols, server-client architecture, TCP/IP and UDP communication, Network Fundamentals and Socket Programming, Client-side programming, Internet Data Handling, Web Programming.

Unit-VI 04 Hrs.

Building RESTful APIs with Python: Understanding RESTful architecture, Using Flask or Django to build RESTful APIs, including handling requests, routing, authentication, and authorization, Serializing and deserializing data in Python using formats like JSON or XML for API communication, Writing tests for APIs to ensure their functionality and documenting APIs using tools like Swagger or Postman.

List of Laboratory Experiments

1. Creating an HTML webpage
2. Adding styles to an HTML webpage with CSS and Creating responsive and accessible layouts with CSS.
3. Write a Python Program to work with databases in Python to perform operations such as a. Connecting to database b. Creating and dropping tables c. Inserting and updating into tables.
4. Write a Python program to create server-client and exchange basic information
5. Set up a Flask development environment: Install Flask and set up a virtual environment for development and create a simple Flask application: Build a simple Flask application with a single route that returns a "Hello World" message.
6. Add routes and views to the Flask application: Create additional routes and views in the Flask application to handle different URLs and HTTP methods.
7. Using templates in Flask: Use Jinja2 templates to create dynamic content in the Flask application
8. Handling user input with forms: Create a form in the Flask application to accept user input.
9. Set up a Django development environment: Install Django, create a new Django project, and set up a virtual environment.
10. Creating a Django app: Learn how to create a new app within a Django project, configure the app's settings, and add the app to the project's URL configuration.
11. Building views and templates: Build a set of views and templates for your app, including a homepage, an about page, and a detail page for the blog post model you created
12. Handling user authentication and authorization: Add user authentication to your app, allowing users to create accounts, log in, and log out.
13. Building RESTful APIs with Django

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. Fabrizio Romano , Gaston C. Hillar, Arun Ravindran, "Learn Web Development with Python: Get hands-on with Python Programming and Django web development", 2018.

2. Dr. Gabriele Lanaro, Quan Nguyen, Sakis Kasampalis, "Advanced Python Programming", 2019.

3. Daniel Gaspar, Jack Stouffer, "Mastering Flask Web Development", 2nd Edition, 2018.

Reference Books:

1. Brian K. Jones and David M. Beazley, "Python Coockbook", 2013.

2. Miquel Grinberg,"Flask Web Development 2e: Developing Web Applications with Python", 2018.

3. William Vincent, "Django for beginners: Build websites with Python & Django", 2018.

Web Links:

1. https://www.coursera.org/learn/django-build-web-apps
2. https://www.coursera.org/learn/developing-applications-with-sql-databases-and-django
3. https://www.coursera.org/projects/django-for-beginners-creating-applications-and-views
4. https://www.coursera.org/specializations/django
5. https://www.coursera.org/projects/python-flask
6. https://www.coursera.org/projects/web-development-in-flask-build-your-first-website
7. https://www.w3schools.com/html/html_css.asp

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PCAI5040L 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.

Cloud Computing(PEAI5051T)

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

Course Objectives:

1. Understand the fundamental concepts and principles of cloud computing.
2. Familiarize with popular virtualization technologies and tools.
3. Understand the concept of identity and access management in cloud computing.
4. Learn about big data processing frameworks and tools such as Hadoop, Spark, and Flink.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Familiarize with cloud computing terminologies and industry standards.	L3	Apply
CO2	Hands-on experience in virtualizing resources in a cloud environment.	L5	Evaluate
CO3	Gain knowledge of best practices for securing cloud services and managing user access.	L6	Create
CO4	Familiarize with distributed database design principles and techniques.	L4	Analyze

Course Contents

Unit-I — 04 Hrs.

Introduction to Cloud Computing: Overview of cloud computing, Fundamentals of cloud computing ecosystem, cloud computing characteristics, Components of cloud computing, peer-to-peer, client-server, grid computing, Cloud Architecture, Introduction to distributed computing, need of distributed computing, Introduction to Parallel computing, Parallel computing platforms.

Unit-II — 08 Hrs.

Cloud Services and Deployment Models: Infrastructure as a service (IaaS), Platform as a service (PaaS), Software as a service (SaaS), NIST Model for cloud, Public cloud, Private cloud, Hybrid cloud, Community cloud. Computing services, Storage services, Networking services, Database services.

Virtualization: Full Virtualization, Para- Virtualization, Hardware/ Memory Virtualization, KVM architecture.

Cloud Infrastructure mechanism: Logical network perimeter, virtual server, cloud storage devices, cloud usage monitor, resource replication, readymade environment

Unit-III — 07 Hrs.

Cloud Programming: Programming Support for Amazon EC2: Amazon S3, EBS and Simple DB, Programming Support for Google Apps engine: GFS, Big 4 Tables, Googles NO SQL System, Chubby, Google Distributed Lock Service

Unit-IV — 08 Hrs.

Cloud Security: Securing the Cloud, The security boundary, Security service boundary, Security mapping. Host security for SaaS, 4 PaaS and IaaS

Data Security: Data Security Concerns, Data Confidentiality and Encryption, Data Availability, Data Integrity, Cloud Storage Gateways, Cloud Firewall

Establishing Identity and Presence: Identity and Access Management (IAM)

Unit-V — 06 Hrs.

Serverless Computing: overview of serverless computing, serverless architecture and design patterns, Microservices and event-driven architectures, Functions and triggers

Serverless Platforms and Providers: Overview of serverless platforms and providers (AWS Lambda, Google Cloud Functions, Azure Functions, etc.) Features and capabilities of serverless platforms, Overview of serverless security and governance

Unit-VI

06 Hrs.

Cloud Applications: MapReduce: Paradigm, Programming Model, Applications, Scheduling, Fault-Tolerance, Implementation Overview, Examples Introduction to Spark: Resilient Distributed Datasets (RDDs), RDD Operations, Spark applications: Page Rank Algorithm, GraphX, GraphX API, GraphX working

Introduction to Kafka: What is Kafka, Use cases for Kafka, Data model, Architecture, Types of messaging systems, Importance of brokers

Text Books:

1. Barrie Sosinsky, "Cloud Computing Bible", 2018.
2. Mehul Mahrishi Kamal Kant Hiran, Ruchi Doshi, Dr. Fagbola Temitayo, "Cloud Computing", 2019.

Reference Books:

1. Judith Hurwitz ,"Cloud Computing for Dummies", Wiley Publication, 2020.
2. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risk and Compliance", 2019.

Web Links:

1. https://www.coursera.org/learn/introduction-to-cloud
2. https://www.coursera.org/projects/googlecloud-introduction-to-cloud-dataproc-hadoop-and-spark-on-google-clou-j3jfl
3. https://www.coursera.org/learn/ibm-cloud-essentials
4. https://www.coursera.org/learn/microsoft-azure-cloud-services

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Cloud Computing Laboratory (PEAI5051L)

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

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

Course Objectives:

To give students an overview of the field of Cloud Computing, and an in-depth study into its enabling technologies and main building blocks. Students will gain hands-on experience of different cloud services provided by various cloud providers.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	To Apply fundamental concepts in cloud infrastructures.	L3	Apply
CO2	To Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems	L3	Apply
CO3	To Analyze various cloud programming models and apply them to solve problems on the cloud.	L4	Analyze
CO4	To deploy cloud application.	L6	Create

List of Laboratory Experiments

Suggested Experiments:

1. Virtualization: Hosted Virtualization and Bare Metal Virtualization
2. Creating a virtual machine on a public cloud platform: how to create a virtual machine on a public cloud platform like Amazon Web Services (AWS) or Microsoft Azure and configure it to run a basic application.
3. Host a Static Website on cloud.
4. Configure Identity and Access Management (IAM) for secure access.
5. Create and migrate relational database on cloud.
6. Study different Infrastructure as a service (IaaS), Platform as a service (PaaS), Software as a service (SaaS) application.
7. Install Google App Engine. Create simple web applications using python/java
8. Building a simple web application on the cloud: how to build a simple web page using the cloud infrastructure mechanism, including a virtual server, cloud storage, and networking services.
9. Automate Infrastructure Development using IaaS.
10. Implement serverless architecture and configure notification services.
11. Cloud case studies and future trends.
    Case studies of successful cloud deployments in AI/ML.
    Emerging cloud technologies and trends.
    Ethical and legal considerations in cloud computing.

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 PEAI5051T 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(PEAI5052T)

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

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

Prerequisite:

1. Knowledge Any Programming Language
2. Data structures and Analysis
3. Discrete mathematics
4. Analysis of Algorithm and Basics of Machine Learning

Course Objectives:

To provide conceptual and practical knowledge of Advance Data Structures and Algorithm.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the chosen algorithm.	L4	Analyze
CO2	Choose appropriate data structure and algorithm for given problem statement.	L1	Remember
CO3	Apply best suitable algorithms for a specific task.	L3	Apply
CO4	Classify the algorithms based on the complexity.	L2	Understand
CO5	Design the algorithm.	L6	Create

Course Contents

Unit-I

06 Hrs.

Analysis of Algorithm Based on Time:

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

ii. Beyond worst-case analysis

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

iv. 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:

v. Training Time Complexity and Testing Time Complexity

vi. Train/Test Complexity of Linear Regression

vii. Train/Test Complexity of Naïve Bayes Classifier

Unit-II

12 Hrs.

Advanced Data Structures:

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

ii. Spatial Data Structure: KD Tree, R Tree (Flipped Classroom: R* Tree)

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

iv. Functional Data Structures: Leftist Heap, Skew Heap, Binomial Heap

Unit-III

06 Hrs.

Algorithms for Machine Learning:

i. Dimension Reduction Algorithms: Rank-k approximation

ii. Continuous Algorithms: Online gradient descent algorithm

iii. Online Learning: Concept of Experts and Bandit (e.g. solving linear program Zero-Sum game)

iv. Smoothed Analysis of Algorithms: The Simplex Algorithm

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, Red-Blue Matching, Weighted Bipartite Matching, Micali Vaziarni Algorithm

iii. Application of Max-flow: Hall's Theorem

Unit-V

05 Hrs.

Computational Algorithms:

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

ii. Geometric Searching: Point Location in polygon using Ray Crossing

iii. Online Algorithms: Competitive Ratio, Ski Rental Problem, K-Server problem, List Accessing, Paging

Unit-VI

04 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

iv. Special Topic: Turing Machine Halting Problem (time and space bounds, nondeterminism)

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. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI, 2005.
3. Vijay V. Vajirani, "Approximation Algorithms", Springer, 2003.
4. "Computational Complexity", Stanford University, 2010.
5. Jason Brownlee, "Master Machine Learning Algorithms", Machine Learning Mastery, 2020.

Web Links:

1. https://levelup.gitconnected.com/train-test-complexity-and-space-complexity-of-linear-regression-26b604dcdfa3

2. https://7-hiddenlayers.com/time-complexities-of-ml-algorithms/

3. https://towardsdatascience.com/importance-of-understanding -the-complexity-of-a-machine-learning-algorithm-9d0532685982

4. https://www.thekerneltrip.com/machine/learning/ computational-complexity-learning-algorithms/

5. https://medium.com/ai-ml-at-symantec/ai-ml-security-pro-tips-understanding -minhash-in-a-security-context3dd0dd2ffe8#: :text=MinHash%20is%20not%20typically %20thought,commonly%20used%20in%20machine%20learning.

6. http://ccf.ee.ntu.edu.tw/ yen/courses/ds17/chapter-6d.pdf

7. https://betterprogramming.pub/compressing-puppy-image-using- rank-k-approximation-a-doodle-explanation-c19de5dfd951

8. https://parameterfree.com/2019/09/11/online-gradient-descent/

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Advanced Data Structures and Algorithm Laboratory (PEAI5052L)

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

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

Course Objectives::

Understand the basic principles and operations of data structures. Apply randomized algorithm, machine learning algorithm and advance data structure algorithm for solving problems effectively.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze algorithms and to determine algorithm correctness and time efficiency class.	L4	Analyze
CO2	Implementations of advanced abstract data type (ADT) and data structures.	L3	Apply
CO3	Design different algorithm techniques brute-force, divide and conquer, greedy, etc.	L6	Create

List of Laboratory Experiments

Suggested Experiments:

1. Experiment on Amortized Analysis.
2. Experiment on Randomized Algorithms (Randomized Quick Sort).
3. Experiment on Advanced Data Structure (Red-black Tree Operations).
4. Experiment on Advanced Data Structure (B+ Tree Operations).
5. Experiment on Advanced Data Structure (MinHash Vector Representation).
6. Experiment on Machine Learning Algorithms (Ford Fulkerson Method).
7. Experiment on Graph Based Algorithms (Ford Fulkerson Method).
8. Experiment on Graph Based Algorithms (Push Relable Algorithm).
9. Experiment on Computational Geometry Algorithms (Graham Scan).
10. Experiment on Online Algorithms (K-Server algorithm)
11. Experiment on Approximation Algorithms (Vertex Cover)
12. Development of new algorithm by students based on any one topic of above mentioned syllabus

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 PEAI5052T 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(PEAI5053T)

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: Statistics for Data Science, and Machine Learning-I.

Course Objectives:

To provide students with the basic concepts of Recommender Systems, design space, trade-offs and its application in various domain.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Compare different types of Recommender Systems.	L2	Understand
CO2	Understand various issues related to Recommender System development.	L2	Understand
CO3	Design a recommender system for a given problem.	L6	Create
CO4	Relate data collected from a Recommender System to understand user preferences and/or behaviour.	L2	Understand

Course Contents

Unit-I — 08 Hrs.

Introduction to Recommender Systems

What is Recommendation engine?, Need for recommender systems, Framework of recommendation systems, Domain, Purpose, Context, Personalization, how will you target your users?, Personalized vs. Non-Personalized, Semi/Segment - Personalized, Privacy, users data and trustworthiness.

Recommender Systems Function, Techniques, Recommender Systems and Human Computer Interaction, Conversational Systems, Visualization, Issues working with RSs data sets: The cold-start problem.

Unit-II — 06 Hrs.

Collaborative filtering-based Recommender System

Understanding ratings and rating data, User-based nearest-neighbor recommendation: Similarity Function, User-Based Algorithms

Item-based nearest neighbor recommendation: Similarity Function, Item-Based Algorithms, Further model-based and preprocessing-based approaches, Comparing User-Based and Item-Based recommendations, data drift and concept drift.

Unit-III — 06 Hrs.

Content-based Recommender System

Architecture of Content-based Systems, Advantages and Drawbacks of Content-based Filtering, Content representation and content similarity, Item profiles, discovering features of data, obtaining item features from tags, representing item profiles, Learning User Profiles and Filtering, Similarity-based retrieval, Classification algorithms, Knowledge base recommendation: Knowledge representation and reasoning, constraint-based recommenders, Case based recommenders.

Unit-IV — 06 Hrs.

Neighbourhood-based Recommendation Methods

Advantages of Neighbourhood Approaches, Neighbourhood-based Recommendation, User-based Rating Prediction, User-based Classification Regression Vs Classification, Item-based Recommendation, User-based Vs Item based Recommendation, Rating Normalization, Similarity Weight Computation, Neighbourhood Selection

Unit-V — 07 Hrs.

Constraint-based

Recommenders Development of Recommender Knowledge Bases, User Guidance in Recommendation

Processes, Calculating Recommendations.

Context-Aware Recommender Systems

Trust Context in Recommender Systems, Modeling Contextual Information in Recommender Systems. Paradigms for Incorporating Context in Recommender Systems: Contextual Pre- Filtering, Contextual Post-Filtering, Contextual Modeling, Combining Multiple Approaches, Additional Issues in Context-Aware Recommender Systems.

Unit-VI

06 Hrs.

Evaluating Recommender system

Evaluation Paradigms, General Goals of Evaluation Design, Design Issues in Offline Recommender Evaluation, Case Study of the Netflix Prize Data Set, Segmenting the Ratings for Training and Testing, Hold-Out, Cross-Validation.

Accuracy Metrics Evaluation: RMSE versus MAE, Impact of the Long Tail, Evaluating Ranking via Correlation, Evaluating Ranking via Utility, Evaluating Ranking via Receiver Operating Characteristic

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. Kim Falk, "Practical Recommender Systems", Manning, 1st Edition, 2019
4. Rounak Banik, "Hands-On Recommendation Systems with Python: Start building powerful and personalized, recommendation engines with Python", 2018.

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.

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

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Recommendation Systems Laboratory (PEAI5053L)

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 Content-based recommendation engine on different datasets.
3. Build Recommender System using association rule mining.
4. Implement Recommendation System using K-Nearest Neighbors
5. Build Context-Aware Recommender Systems.
6. Build Constraint-based Recommenders.
7. Implement knowledge-based recommender system.
8. Evaluate the recommendation system with evaluation matrix.
9. Compare the performance of different recommender systems
10. 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 PEAI5053T 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.

Semester Project-III (PJAI5060L)

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 (HMAI5070L)

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.

Environmental Engineering (MCAI5080T)

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.

Computer Vision (PCAI6010T)

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

Prerequisite: Linear Algebra, Digital Signal Processing, Digital Image Processing

Course Objectives:

1. To develop a comprehensive understanding of computer vision and its real-world applications.
2. To apply image feature detection and noise reduction methods to improve image quality, to extract features and perform model fitting methods to analyze and process images.
3. To implement segmentation and object detection algorithms to identify and locate objects in images.
4. To implement pattern recognition methods to classify and analyze data and motion analysis and action detection methods to track and recognize dynamic objects in videos.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze and explain the core concepts of computer vision, principles of imaging geometry, radiometry, and digitization.	L4	Analyze
CO2	Recognize key image features, implement techniques for modeling noise and feature extraction effectively.	L3	Apply
CO3	Apply clustering, classification, and dimensionality reduction methods in pattern recognition and understand the significance of classifiers and their practical applications in pattern recognition.	L2, L3	Understand, Apply
CO4	Utilize motion analysis techniques to track moving objects in videos. Implement spatio-temporal analysis and dynamic stereo methods in motion analysis and action detection.	L3	Apply

Course Contents

Unit-I — 04 Hrs.

Overview of Computer Vision and its Applications: Image Formation and Representation: Imaging geometry, radiometry, digitization, cameras and Projections, rigid and affine transformation.

Unit-II — 04 Hrs.

Image Features and Noise: Points, corners, edges, Scale and orientation, Modeling image noise, Convolution, image smoothing, pyramid.

Unit-III — 08 Hrs.

Feature Extraction and Model Fitting: Edges - Canny, LOG, DOG, Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Deformation, RANSAC, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Unit-IV — 09 Hrs.

Object Segmentation and Detection: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation, Semantic segmentation, Scene Parsing, Clustering method for segmentation, Distance metrics, Linkage.

Unit-V — 07 Hrs.

Pattern Recognition: Use of Supervised, unsupervised and semi supervised learning in Computer Vision; Deep Learning Models for Computer Vision: CNNs, RNNs, R-CNNs; Transfer Learning; YOLO; Attention Mechanism in Computer Vision.

Unit-VI — 07 Hrs.

3-D Computer Vision:3-D Visualization: Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiple connected surfaces, Image processing in 3D, Measurements on 3D images.

Multiple Image: Stereo, Epipolar Geometry, Stereo Essential and Fundamental Matrices, Multiview stereo, Triangulation, Correspondence, Rectification, 3D Reconstruction.

Shape from X: Reflectance map, Shape from shading, Photometric stereo, Shape from optical flow (moving camera, moving objects), Rotating camera, Silhouettes, Space carving.

Text Books:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", 2nd Edition, Springer Verlag London Limited 2022.
2. Rajeev Ratan, "Hands-On Computer Vision with OpenCV, Keras, and TensorFlow", 1st Edition, Packt Publishing, 2021.
3. E. R. Davies, "Computer Vision: Principles, Algorithms, Applications, Learning", 5th Edition, Academic Press Publisher, 2018.

Reference Books:

1. Hafsa Asad, Vishwesh Shrimali, Nikhil Singh, "The Computer Vision Workshop", 1st Edition, Packt Publishing, 2022.
2. Katsushi Ikeuchi, "Computer Vision: A Reference Guide", 2nd Edition, Springer Publishing, 2021.
3. David Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2nd Edition, 2015.
4. Scott Krig, "Computer Vision Metrics: Survey, Taxonomy, and Analysis", 1st Edition, Apress, Publisher, 2014.

Useful Links:

1. Advances in Computer Vision : 6.869 Course Materials (mit.edu)
2. Machine Vision — Electrical Engineering and Computer Science — MIT OpenCourseWare
3. vision.stanford.edu
4. Computer Vision Notes (Faisal Z. Qureshi at Ontario Tech University) (uoit.ca)
5. Deep Learning for Computer Vision - Course (nptel.ac.in)
6. Computer Vision Basics — Coursera
7. Introduction to Computer Vision and Image Processing — Coursera

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

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

End Semester Examination (C):

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

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

Computer Vision Laboratory (PCAI6010L)

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. Students will be able to choose and apply appropriate image transformation techniques in OpenCV, to solve practical problems. Analyze and select suitable object detection algorithms, demonstrating the ability to evaluate their performance and make informed decisions on the choice of algorithms for specific scenarios.
2. Students will create solutions for video processing tasks, combining basic and advanced techniques in OpenCV. They will design and implement algorithms for analyzing and manipulating video streams.
3. Students will evaluate and apply optical flow computation algorithms to analyze motion in images. They will be able to assess the strengths and limitations of different algorithms in various contexts.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	To apply image transformation techniques accurately and efficiently, demonstrating a practical understanding of their impact on image data.	L3	Apply
CO2	Analyze real-world scenarios, select appropriate object detection algorithms, and implement solutions. They will be able to critically evaluate the results and refine their approaches as needed.	L4	Analyze
CO3	Create innovative video processing applications by combining and extending basic techniques. They will be able to design and implement solutions for complex video analysis tasks.	L6	Create
CO4	Evaluate the accuracy and applicability of optical flow computation algorithms in different scenarios. They will be able to make informed decisions about selecting and applying these algorithms based on their strengths and weaknesses.	L5	Evaluate

List of Laboratory Experiments

Suggested Experiments:

1. Image assessment with NumPy and OpenCV.
2. Image Transformation in OpenCV.
3. Feature Detection using OpenCV- Corner, Edge, Pyramid.
4. Image Denoising and enhancement techniques.
5. Object Detection.
6. Basic Video Processing in OpenCV.
7. Object Tracking.
8. Pattern Recognition.
9. Face Recognition.
10. Optical Flow computation algorithm.
11. 3D Image Reconstruction.
12. Project Based Learning.
13. Research Article Review.

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 PCAI6010T 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 (PCAI6020T)

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs./week	Term Test : 15 Marks
Credits : 03	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 Cantering 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 3 hrs.

Natural Language Processing Laboratory (PCAI6020L)

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 PCAI6020T 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 Operations (ML Ops)(PCAI6030T)

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

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

Prerequisite:

1. Knowledge of Linux Operating system, installation and configuration of services and command line basics.
2. Basics of Machine Learning
3. Knowledge Development Life cycle, development frameworks and DevOps

Course Objectives:

1. The objective of this course is to understand the fundamentals of MLOps and its significance in the ML lifecycle.
2. Students will Learn various tools and technologies used in MLOps to design and build scalable ML pipelines.
3. Students will get exposure to deploy ML models.
4. Students will learn techniques for monitoring, debugging, and optimizing ML systems.
5. Finally, students will explore methods for reproducibility, version control, and model governance.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Automate the deployment of ML models into the core software system or as a service component.	L3, L4	Apply, Analyze
CO2	Deploy machine learning models in a production environment.	L5, L6	Evaluate, Create
CO3	Implement model monitoring and performance evaluation.	L3, L5	Apply, Evaluate
CO4	Manage and scale machine learning infrastructure.	L2, L3	Understand, Apply

Course Contents

Unit-I

06 Hrs.

Introduction to Machine Learning Operations:

Overview of MLOps and its importance, Understanding the challenges in deploying and managing ML models, ML development lifecycle, Role of MLOps in the ML development lifecycle, Introduction to DevOps and its application to ML, MLOps in Practice.

Unit-II

06 Hrs.

Data Management, Model Development and Training for MLOps:

Model Development and Training for MLOps, Data versioning and reproducibility, Data preprocessing and feature engineering pipelines, Data validation and monitoring, Data quality assurance and governance, Model versioning and tracking, Model training pipelines and automation, Hyperparameter tuning and model selection, Model evaluation and validation techniques.

Unit-III

08 Hrs.

Model Deployment and Serving, Continuous Integration and Delivery(CI/CD) for ML:

Model packaging and containerization (e.g., Docker), Infrastructure provisioning and orchestration (e.g., Kubernetes), Deploying models as scalable services, managing model endpoints and versioning, Version control and collaboration (e.g., Git), Building reproducible ML pipelines, Automated testing and code quality checks, Continuous integration and deployment strategies.

Unit-IV

06 Hrs.

Monitoring and Performance Optimization:

Monitoring model performance and behavior, Real-time and batch monitoring techniques, Logging and error tracking in ML systems, Performance optimization and scalability considerations.

Unit-V

08 Hrs.

Cloud Platforms and Infrastructure for MLOps: Introduction to cloud platforms (e.g., AWS, Azure, GCP), Deploying ML models on cloud infrastructure, Managing resources and scaling ML workloads, Cost optimization strategies for ML systems.

Unit-VI

05 Hrs.

Governance and Compliance in MLOps: Data privacy and protection in ML systems, Access control and authentication mechanisms, Security considerations for model deployment, Compliance with industry regulations (e.g., GDPR, HIPAA).

Text Books:

1. Noah Gift ,"Practical MLOps: A Guide to Building Real-World Machine Learning Systems", O'Reilly, 1st Edition, September 2021.
2. Mark Treveil, Nicolas Omont, "Introducing MLOps: How to Scale Machine Learning in the Enterprise", O'Reilly Media, 1st Edition, January 5, 2021.
3. Emmanuel Raj, "Engineering MLOps: Rapidly build, test, and manage production-ready machine learning life cycles at scale", Packt Publishing Limited, 1st Edition, 19 April 2021.

Reference Books:

1. Hannes Hapke and Catherine Nelson, "Building Machine Learning Pipelines: Automating Model Life Cycles with TensorFlow", O'Reilly, 1st Edition, 19 July 2020.
2. Chris Fregly, Antje Barth, "Data Science on AWS: Implementing End-to-End Continuous Machine Learning Pipelines", O'Reilly, 1st Edition, 9 May 2021.
3. Sridhar Alla, Suman Kalyan Adari, "Beginning MLOps with MLFlow: Deploy Models in AWS SageMaker, Google Cloud, and Microsoft Azure", Apress publication, 1st Edition, 8 December 2020.

Web Resources Blogs and Websites:

1. MLflow Blog: MLflow is an open-source platform for managing the ML lifecycle. The blog covers topics related to MLOps, model deployment, and reproducibility.
2. Towards Data Science: A popular online publication with a dedicated section on MLOps, featuring articles and tutorials on topics like model deployment, monitoring, and CI/CD pipelines.

Online Courses and Tutorials:

1. Coursera: "Machine Learning Engineering for Production (MLOps)" by deeplearning.ai. This course provides a comprehensive introduction to MLOps, covering topics like data and model versioning, deployment, monitoring, and more.
2. Udacity: "Machine Learning Deployment" by Google Cloud. This course focuses on deploying and scaling machine learning models using Google Cloud technologies and covers MLOps principles.
3. YouTube: You can find numerous tutorials and talks on MLOps from conferences and industry experts. Look for channels like TensorFlow, PyTorch, and DevOps-related channels.

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Machine Learning Operations Laboratory (PCAI6030L)

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 directions and challenges in MLOps.
2. To Setting up a VCS for ML Projects.
3. Explore and understand Tracking and Management.
4. Implement the Continuous Deployment (CI and CD) for ML Models.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand real word MLOPS case study.	L2	Understand
CO2	Apply VCS tools like Git operation to create a repository for ML projects.	L3	Apply
CO3	Design and conduct A/B tests to compare the performance of different ML models.	L6	Create
CO4	Understand and apply tools like Terraform or AWS Cloud Formation to manage ML infrastructure.	L2, L3	Understand ,Apply

List of Laboratory Experiments

Suggested Experiments:

1. Case Studies and Best Practices
    - Real-world MLOps case studies
    - Best practices and lessons learned
    - Industry trends and emerging technologies in MLOps
    - Future directions and challenges in the field
2. Setting up a Version Control System (VCS) for ML Projects:
    - Experiment with popular VCS tools like Git and create a repository for ML projects.
    - Learn to track code changes, collaborate with team members, and manage different branches.
3. Creating a Continuous Integration (CI) Pipeline:
    - Build a CI pipeline using tools like Jenkins, Travis CI, or GitLab CI.
    - Automate the process of building, testing, and validating ML models with each code commit.
4. Containerization with Docker:
    - Containerize ML models and their dependencies using Docker.
    - Experiment with Docker images, containers, and Dockerfile configurations.
5. Orchestrating ML Workflows with Kubernetes:
    - Deploy ML models as scalable and resilient services using Kubernetes.
    - Experiment with deploying, managing, and scaling ML workloads in Kubernetes clusters.
6. Experiment Tracking and Management:
    - Use tools like MLflow or Neptune.ai to track experiments, log metrics, and manage model versions.
    - Explore features like hyperparameter tuning, model registry, and experiment reproducibility.
7. Continuous Deployment (CD) for ML Models:
    - Implement a CD pipeline to automate the deployment of ML models to production.
    - Experiment with different deployment strategies, such as blue-green deployment or canary releases.

8. Monitoring and Alerting:
    - Set up monitoring and alerting systems to track model performance, data drift, and anomalies.
    - Experiment with tools like Prometheus, Grafana, or DataDog to visualize and monitor ML system metrics
9. Model Performance Optimization:
    - Explore techniques for optimizing model performance, such as model quantization, pruning, or distillation.
    - Experiment with different optimization approaches and measure their impact on model efficiency.
10. A/B Testing and Experimentation:
    - Design and conduct A/B tests to compare the performance of different ML models or algorithms.
    - Experiment with statistical analysis and hypothesis testing to evaluate model improvem Understand the importance of model governance and compliance in regulated industries.
    - Experiment with model explainability, bias detection, and fairness assessment techniques.
11. Infrastructure as Code (IaC) for ML:
    - Use tools like Terraform or AWS CloudFormation to manage ML infrastructure.
    - Experiment with provisioning and automating the setup of ML environments.

Minimum ten 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 PCAI6030T with minimum 10 experiments to be incorporated. The distribution of marks for term work shall be as follows:

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

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

End Semester Examination (C):

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

Design Thinking Laboratory (PCAI6040L)

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

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

Course Objectives:

1. To familiarize students with fundamentals of design thinking and principles.
2. To ensure students can practice the methods, processes and tools of design thinking.
3. To emphasize the role of design thinking in creating innovative and socially impactful solutions using design thinking tools.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Develop an application using fundamentals of Design Thinking.	L3, L6	Apply, Create
CO2	Acquire hands-on proficiency in applying design thinking methodologies, processes.	L3	Apply
CO3	Develop a proactive attitude towards addressing societal challenges using design thinking.	L3,L6	Apply, Create
CO4	Work efficiently as a team member.	L5, L6	Evaluate, Create

Course Contents

Unit-I — 10 Hrs.

Foundation of Design Thinking:

Introduction to Design Thinking, Significance of Design Thinking, Key Tenets of Design Thinking, Design Thinking Process- 4 Critical Questions, Design Thinking Process. Human-Centered Design (HCD) process - Empathize, Define, Ideate, Prototype and Test and Iterate or Empathize, Analyse, Solve and Test.

Unit-II — 09 Hrs.

Stage 1 Empathy: Foundation and Tools of Empathy

Foundation of Empathy, Purpose of empathy, Observation as a tool of empathy, Methods of Observation Empathetic Interview, Stakeholder maps, Jobs to be done, Empathy Maps

Unit-III — 09 Hrs.

Define- Foundation and tool:

Rules of Defining, Importance of Defining, Models of Framing Problem, Customer Journey Map, Customer experience, Persona, big picture thinking through function modelling.

Unit-IV — 09 Hrs.

Ideate:

Introduction to Ideation, Double Diamond, Silent brainstorming, Rules for Brainstorming, Mind Mapping, metaphors for ideation, CREATE and What-If tool for ideation, introduction to TRIZ, Inventive principles and their applications

Unit-V — 10 Hrs.

Prototype & Test -Foundation: Concept of Prototyping, Paper prototype, Story Board prototype, Scenario prototype, Low fidelity and high fidelity, Test Assumptions during the design thinking.

Testing phase: Necessity to test, user feedback, conducting a user test, guidelines for planning a test, how to test, desirable, feasible and viable solutions, iterate phase.

Unit-VI — 05 Hrs.

Design Innovation: Benefits of iteration in the design thinking process, taking the idea to the market, introduction to innovation management in a company.

List of Laboratory Experiments

1. Use online survey tools like Typeform or virtual collaboration tools like Zoom to assess students' understanding of the design thinking process.
2. Design relevant products/services using Smaply, Userforge, or MakeMyPersona to understand user needs
3. Thirty circle Exercise ideation
4. Implement Human-Centered Design (HCD) methodology for developing AI-ML products or services
5. Apply Ideation Techniques with SessionLab/Stormboard/IdeaFlip
6. Exercise: Rewarding Creativity and Risk Taking
7. Construct empathy maps for a given case study-1
8. Perform the steps for practical prototyping in AI-ML projects using digital tools like Boords/Mockingbird/POP
9. Test and validate AI-ML solutions using user testing and feedback with HotJar/PingPong
10. Design thinking using sprint base software

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. Dr. Bala Ramadurai, "Karmic Design Thinking - A Buddhism-Inspired Method to Help Create Human- Centered Products & Services", Self-Published (1 January 2020).
2. Michael G. Luchs, Scott Swan, Abbie Griffin, "Design Thinking: New Product Development Essentials from the PDMA", Wiley-Blackwell; 1st Edition, (25 September 2015).

Reference Books:

1. Pavan Soni, "Design Your Thinking The Mindsets, Toolsets and Skill Sets for Creative Problem-solving", 2020.
2. Michael Lewrick, Patrick Link, Larry Leifer, "Design Thinking Playbk: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems", 2018.
3. Idris Mootee, "Design Thinking For Strategic Innovation: What They Can't Teach You at Business or Design School", 2014.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_mg32/preview
2. https://archive.nptel.ac.in/courses/110/106/110106124/

Evaluation Scheme:

Laboratory:

Continuous Assessment (A):

Laboratory work will be based on PCAI6040L 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.

IoT Foundations (PEAI6051T)

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

Course Objectives:

1. To introduce basic architecture and organization of processor and controller.
2. To introduce optimizing techniques for machine learning.
3. To introduce different architectures used for connected smart devices.
4. To study integration of AI with IoT and various protocols used in the IoT environment.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the basic architecture and organization of processor and controller.	L2	Understand
CO2	Discover embedded systems design principles and concepts.	L2	Understand
CO3	Appraise the role of IoT protocols for efficient network communication.	L5	Evaluate
CO4	Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.	L3	Apply

Course Contents

Unit-I — 08 Hrs.

Introduction to Microprocessor and Microcontroller: Architecture of Microprocessor 8086- Internal registers, CPU, ALU, Types of System Bus, Bus Structure- address and data bus, Instruction Register, Timing and Control, Interrupts and Serial I/O.

Microcontroller: CPU architecture, memory organization, and I/O ports, Embedded peripherals (timers, counters, ADC, DAC), Interrupt handling and real-time programming.

Unit-II — 04 Hrs.

Embedded systems design principles and concepts: Design Principles for Embedded Systems, Techniques for optimizing ML algorithms for low-power devices, Quantization, pruning, and model compression, Model selection and trade-offs in resource-constrained environments.

Unit-III — 08 Hrs.

Introduction to IoT: Definition, Characteristics, Physical and 8 Logical Designs, IoT Protocols, IoT Communications Models and API, IoT Enabling Technologies, IoT Levels and Deployment Templates, IoT Examples, M2M, Industrial IoT (IIoT) and architecture.

RFID Technology: Working of RFID, Components of an RFID system, RFID Transponder (tag) classes, System architecture, Localization and Handover Management, Technology considerations, Performance Evaluation, Applications.

Unit-IV — 06 Hrs.

IoT Data Collection and Preprocessing: Sensor networks and data acquisition techniques - Data Preprocessing for AI and machine learning, Edge Computing for Machine Learning - Deploying machine learning models on edge devices - Edge analytic and decision-making algorithms

Unit-V — 08 Hrs.

IoT and AI Integration: AI –Graphic Processing Unit, Tensor Processing Unit, FPGA-based acceleration for machine learning, case study on Google's TPU and the Edge TPU. TensorFlow Lite, ONNX Runtime, and Edge TPU for deployment of AI models.

Unit-VI — 05 Hrs.

IoT applications: IoT for Entertainment and wearables, IoT for Manufacturing, IoT for Employee safety, IoT for healthcare, IoT for Logistics & Supply chain, Retail Supply chain control, NFC Payment, Intelligent shopping application, Smart product management. Case studies on Smart cities, Smart Home, Smart Environment, Smart Agriculture

Text Books:

1. KCS Murti, "Design Principles for Embedded Systems", Springer Singapore ISBN-978-981-16-3295-2, 22 September 2022.
2. Peter Waher, "Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3", 1st Edition, Packt Publishing, 2018.
3. Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017.
4. Hakima Chaouchi, "Internet of Things: Connecting Objects to the Web", 1st Edition, Wiley, 2013.

Reference Books:

1. Abdulrahman Yarali, "Intelligent Connectivity: AI, IoT, and 5G", (IEEE Press), Wiley-IEEE Press, 2021.
2. Jonathan W. Valvano, "Embedded Microcomputer Systems–Real Time Interfacing", Publisher Cengage Learning, 3rd Edition, 2012.
3. Vijay Madisetti, Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 2015.

Web Links:

1. NPTEL :: Computer Science and Engineering - Microprocessors and Microcontrollers
2. Embedded Systems Academy- https://www.embedded-sys.com/plus/
3. Embedded Systems Basics by Tutorials point-https://www.tutorialspoint.com/embedded_systems/index.htn

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

IoT Foundation Laboratory (PEAI6051L)

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 processor and controller.
2. Understand the key concept of MQTT protocol.
3. Study the concept of different IoT sensors.
4. Understand the Client Server Configuration.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement Neural Network.	L3	Apply
CO2	Analyze basic operations for the MQTT protocol.	L4	Analyze
CO3	Implement the different IoT sensors.	L3	Apply
CO4	Create Client Server Configuration.	L6	Create

List of Laboratory Experiments

Suggested Experiments:

1. Setting up and Programming the Arduino.
2. Implement basic operations for the MQTT protocol: publish and subscribe.
3. Use the NodeMCU to subscribe to messages that published by MQTT client, then display these messages on a 1602 I2C LCD display.
4. To study and implement interfacing of different IoT sensors with Raspberry Pi Pico/Arduino/ModeMCU.
5. To study and implement interfacing of actuators based on the data collected using IoT sensors. (like led switch ON/OFF, stepper motor)
6. To study and implement IoT Data processing using Pandas
7. 3D Pong Game With Arduino and vPython
8. Understanding and Creating a Simple Client Server Configuration

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 PEAI6051T 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.

Time Series Analysis (PEAI6052T)

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

Course Objectives:

1. Learn basic analysis of time series data.
2. Auto regressive and model averaging models.
3. Learn basic concepts of forecasting.
4. To understand the detection of outliers in time series data.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	To understand the basics of Time series Analysis.	L2	Understand
CO2	To apply statistical smoothening methods for the time series data.	L3	Apply
CO3	To forecast the time series data using traditional methods.	L4, L5	Analyze, Evaluate
CO4	To analyze and explore the deep learning techniques for forecasting the time series data.	L4	Analyze

Course Contents

Unit-I — 05 Hrs.

Introduction to Time series: Taxonomy of time series forecasting methods, Time series Decomposition. Real-life examples of time series, types of variation in time series, tests of randomness, tests for trend, seasonality.

Unit-II — 08 Hrs.

Exploratory Data Analysis & Visualizations for Time Series Analysis: Handling time series data: working with Date and Time, Handling Missing values: Understanding missing data, performing data quality checks, handling missing data with univariate imputation using pandas and scikit-learn, Plotting Time series data with interactive Visualizations using hvPlot, Decomposing Time series data.

Unit-III — 08 Hrs.

Smoothening Methods: Naïve method, Seasonal Naïve method, Average method, Moving Average Smoothing, Time series analysis using Linear Regression, Autocorrelation, Auto Regression, stationary data, differentiation, Seasonal differentiation, moving average of error, ARIMA Model, SARIMA, Machine Learning methods- windowing, Neural Network Auto Regressive

Unit-IV — 06 Hrs.

Forecasting: Forecasting in time series models, forecasting for autoregressive processes, One-step ahead predictors based on the finite past: Durbin-Levinson algorithm.

Unit-V — 06 Hrs.

Deep Learning for Time Series Forecasting: Understanding Artificial Neural Networks, forecasting with an RNN using keras, forecasting with LSTM with keras, forecasting with a GRU using keras , forecasting with an RNN using PyTorch, Forecasting with an LSTM using PyTorch, Forecasting with GRU using PyTorch

Unit-VI — 06 Hrs.

Outlier Detection in Time series Data: Detecting Outliers using Statistical methods: Visualizations, Tukey method, z-score and modified z- score. Detecting Outliers using Unsupervised Machine Learning Techniques: KNN, LOF, iForest, One-class Support Vector Machine (OCSVM), Detecting outliers using COPOD and PyCaret

Text Books:

1. Tarek A. Atwan, "Time Series Analysis with Python Cookbook: Practical recipes for exploratory data analysis, data preparation, forecasting, and model evaluation", Packt Publishing Limited, 2022.
2. James D. Hamilton, "Time Series Analysis", Levant Books, 2012.
3. B. V. Vishwas and Ashish Patel, "Hands-on Time Series Analysis with Python", 1st Edition, Apress, 2020.
4. Ted Dunning and Ellen Friedman, "Time Series Databases: New Ways to Store and Access Data", 1st Edition, O'Reilly, 2019.

Reference Books:

1. Vijay Kotu , Bala Deshpande , "Data Science: Concepts and Practice", 2nd Edition, Morgan Kaufmann, 2018.
2. Robert H. Shumway and David S. Stoffer, "Time Series Analysis and Its Applications : With R Examples", Springer, 4th Edition, 2017.

Web Links:

1. Energy consumption time series forecasting with python and LSTM deep learning model — by Eligijus Bujokas — Towards Data Science
2. Autoregression Models for Time Series Forecasting With Python - MachineLearningMastery.com
3. Python — ARIMA Model for Time Series Forecasting - GeeksforGeeks
4. Weekly Rainfall and Temperature Forecasting — Kaggle
5. Air Passenger Forecast : ARIMA - SARIMA — Kaggle
6. Stock Price prediction by simple RNN and LSTM — Kaggle
7. LSTM for Time Series Prediction in PyTorch - MachineLearningMastery.com
8. Gated Recurrent Unit (GRU) With PyTorch (floydhub.com)

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

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

End Semester Examination (C):

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

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

Time Series Analysis Laboratory (PEAI6052L)

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 familiarize students with the characteristics of time series data and the identification of trends within it.
2. To Introduce 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	Utilize Pandas to explore and visualize diverse time series datasets, gaining insights into patterns and trends.	L2, L3	Understand, Apply
CO2	Apply Data Wrangling and prepare for time series Data.	L3	Apply
CO3	Build various model like RIMA and SARIMA for time Series.	L3, L6	Apply, Create
CO4	Detect outliers in time series data using statistical methods.	L3, L4	Apply , Analyze

List of Laboratory Experiments

Suggested Experiments:

1. Data Preprocessing: Clean and preprocess a given time series dataset, handling missing values.
2. Data Exploration: Use Pandas to explore and visualize various time series datasets.
3. Autoregression Models for Time Series Forecasting with Python
4. Apply ARIMA - SARIMA models to predict / forecast the number of passengers travelling using aeroplanes based on time series data.
5. Implementing Basic RNN: Develop an RNN model for stock price prediction using historical data.
6. Time Series Prediction with LSTM Recurrent Neural Networks in Python with Keras
7. Gated Recurrent Unit (GRU) With PyTorch
8. Outlier Detection using statistical methods.
9. Outlier Detection using Unsupervised Machine Learning Techniques
10. Compare and contrast on Statistical methods and Deep Learning methods by forecasting the Weekly Rainfall and Temperature.

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 PEAI6052T 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.

Human Machine Interaction (PEAI6053T)

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

Course Objectives:

1. This course provides an opportunity to learn and apply the design principles of Human Machine Interaction.
2. Learners will learn the basic human psychology of everyday actions and will be able to design an UI prototype of an application.
3. This course covers the discussion on various interaction design concepts.
4. The laboratory experiments are designed to practice the concepts and to adopt the systematic approach for interface design using various UX tools.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify the various design principles used for interacting between human and machine.	L1	Remember
CO2	Apply human psychology of everyday actions and UI design processes for real world applications.	L3	Apply
CO3	Implement mobile, windows, and web-based application.	L3	Apply
CO4	Evaluate and justify UI design and Create an application for a social and technical task.	L5	Evaluate

Course Contents

Unit-I — 07 Hrs.

Introduction:: Introduction to Human Machine Interface, Hardware, software and operating environment to use HMI in various fields. The psychopathology of everyday things – complexity of modern devices; human-centered design; fundamental principles of interaction; Psychology of everyday actions- how people do things; the seven stages of action and three levels of processing; human error.

Unit-II — 06 Hrs.

Graphical User Interface and Web Interface: The Graphical User Interface: Popularity of graphics, the concept of direct manipulation, characteristics of GUI, Web user Interface: Interface popularity, characteristics. Principles of user interface design.

Unit-III — 07 Hrs.

Understanding Goal-Directed Design: Goal-directed design; Implementation models and mental models; Beginners, experts, and intermediates – designing for different experience levels. Understanding users; Modeling users – personas and goals.

Unit-IV — 07 Hrs.

Design Guidelines: Perception, Gestalt principles, visual structure, reading is unnatural, color, vision, memory, six behavioral patterns, recognition and recall, learning, factors affecting learning, and time.

Unit-V — 07 Hrs.

Interaction Styles and Communication:

Interaction Styles: Menus, Windows, Device-based and Screen based Controls.

Communication: Text messages, Feedback, and Guidance, Icons, Multimedia, and colors.

Unit-VI — 05 Hrs.

UX tools: Figma, Just In Mind, and any open-source tool for prototype designing. Mobile Ecosystem: Platforms, Application frameworks: Types of Mobile Applications: Widgets, Applications.

Text Books:

1. Kalbande,Kanade,Iyer, "Galitz's Human Machine Interaction", 1st Edition, Wiley Publications, 2015.
2. Alan Dix, J. E. Finlay, G. D. Abowd, R. Beale, "Human Computer Interaction", Peason,Prentice Hall, 3rd Edition, 2003.
3. Wilbert O. Galitz, "The Essential Guide to User Interface Design", Wiley publication, 3rd Edition, 2007.
4. Donald A. Normann, "Design of everyday things", Basic Books; 2nd Edition, 2013.

Reference Books:

1. Rogers Sharp Preece, "Interaction Design: Beyond Human Computer Interaction", 5th Edition, Wiley publications.
2. Brian Fling, "Mobile Design and Development", 1st Edition, O'Reilly Media Inc.,2009.

Web Links:

1. Nielsen's Heuristics: 10 Usability Principles To Improve UI Design - Aela School
2. 12UX Designer Tools You Should Be Using (From Beginner to Pro) — Columbia Engineering BootCamps

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

End Semester Examination (C):

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

Human Machine Interaction Laboratory (PEAI6053L)

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

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

Course Objectives:

1. To introduce students with different UX tools.
2. To understand principles of good UI design.
3. To design the interface using various UX tools.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the different open source UX tools.	L2	Understand
CO2	Analyze the Graphical user interface and Web interface.	L4	Analyze
CO3	Implement the real world applications.	L3	Apply
CO4	Design UI prototype for given problem statement.	L6	Create

List of Laboratory Experiments

Suggested Experiments:

1. To Study of open-source UX tools (Justinmind Prototype, Pidoco, Marvel ,Figma Prototype) and create a simple design for a given problem definition.
2. Know your client.
   - Design an app that can teach mathematics to children of 4-5 years age in schools in Rural Sector.
   - Design an app that can teach mathematics to children of 4-5 years age in schools in Urban Sector.
   - Design a site that can help people to sell their handmade products in metro cities.
   - Design a site that can connect housewives and keep them engaged.

   Note : Students should be able to do the following for any given problem statement
   - Analysis of user's/client's behavior eg their preferences, interests etc
   - What kind of interfaces will they like and why?
   - Existing apps - analyze and rate them.
   - What will be your choice of screen elements?
   - How will your app/web design be better than the existing one?
3. Goal-oriented design - Design an experience for passengers whose flight /train is delayed.
4. Design Principles - Understand principles of good UI design by heuristic evaluation. Design UI for a given problem statement.
5. Menus & Navigation – Redesign of a user interface (Suggest and implement changes in Existing User Interface) for a given problem statement.
6.
   - Windows & Screen controls – Design UI for a given problem statement.Design a navigator for a student new in your Institute.
   - Design a navigator for a person new in tourist city/ village.
   - Motor paralysis for differently able people.
   - Vaccination App design with localization
7. Icons - Design appropriate icons pertaining to a given domain. (Eg. Greeting cards, Travelling, restaurants, Education, Medical, security at Airport, Malls etc).

8. Colors – Design a personal website for any socio-technical problem. Use color guidelines with statistical graphics for better visualization.

9. Design a Map-based UI(Web User) for the given problem statement. Example: Mumbai Dabbawallas with localization feature. Pet Care New Visitors to Hospital

10. To calculate the screen complexity of the existing Graphical User Interface and redesign the interface to minimize the screen complexity

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 PEAI6053T 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.

Professional and Business Communication (HMAI6060T)

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

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

Prerequisite: Basic course in Effective Communication Skills.

Course Objectives:

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

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	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.	L4	Analyze
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 reports, Basic structure of a report, collection of data through questionnaires, survey analysis, language and style in reports.

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

Plagiarism: Types of plagiarism, consequences of plagiarism

Unit-II Employment Skills — 08 Hrs.

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

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

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

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

Unit-III Corporate Story Telling: — 03 Hrs.

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

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

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

Unit-IV Meetings and Documentation — 02 Hrs.

Planning and preparation for meetings: Planning layout of meetings, arranginglogistics, 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 todevelop EQ

Leadership: Types of leadership, leadership styles, case studies

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

good team player

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

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

Unit-VI Cross-cultural communication and Professional ethics 02 Hrs.

Communication across cultures: Understanding cultures and developingsensitivity towards cultural differences

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

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

Text 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.

Reference Books:

1. Heta Murphy, "Effective Business Communication", Mc Graw Hill, edition.
2. Sharma R.C. and Krishna Mohan, "Business Correspondence and Report Writing", Tata McGraw-Hill Education.
3. Ghosh, B. N., "Managing Soft Skills for Personality Development", Tata McGraw Hill.
4. Bell, Smith, "Management Communication", Wiley India Edition, 3^{rd} Edition.
5. Dr. Alex, K., "Soft Skills", S Chand and Company.
6. Subramaniam, R., "Professional Ethics", Oxford University Press.
7. Sandeep Das, "How Business Story Telling Works: Increase Your Influence and Impact", Penguin Random House India Pvt. Ltd

Evaluation Scheme:

Continuous Assessment (A):

Continuous Assessment shall consist of Presentation, Group Discussion and Assignments.

The distribution of marks will be as follows:

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

Total : 50 Marks

List of Assignments(Each assignment carries 06 marks):

1. Business Proposal (PowerPoint presentation)
2. Resume writing
3. Interpersonal Skills (Documentation of activity)
4. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
5. Business ethics

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

Project Stage-I (PJAI6070L)

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

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

Course Objectives:

- To implement the solution as per the problem statement.
- To develop the team building, writing, logical reasoning and management skills.
- To provide the connections between the designs and concepts across different disciplinary boundaries.
- To encourage students to become independent personnel, critical thinkers and lifelong learners.

Course Outcomes:

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

Syllabus:

Domain knowledge (any beyond) needed from the areas of Artificial Intelligence and Machine Learning for the effective implementation of the project.

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

Guidlines:

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

- Each group will be reviewed twice in a semester and marks will be allotted based on the various points mentioned in the evaluation scheme.
- In the first review of this semester, each group is expected to complete 30 percent of project.
- In the second review of this semester, each group is expected to complete 50 percent of project.
- Interaction with alumni mentor will also be appreciated for the improvement of project.

Student is expected to:

- Maintain Log Book of weekly work done(Log Book Format will be as per Table 4).
- Report weekly to the project guide along with log book.

Table 4: Log Book Format

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

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

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 Stage I Outcomes
- Conclusion
- References

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

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

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

Each group will be reviewed twice in a semester by faculty guide and faculty coordinator based on the following criteria:

- Project progress
- Documentation/Technical paper writing
- Key findings
- Validation of results

Table 5: Continuous Assessment Table

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

Each review consists of 25 marks. Average of the marks scored in both the two reviews will be considered for final grading. The final certification and acceptance of TA ensures the satisfactory performance on the above aspects.

Departmental committee (including project guide) will evaluate project as per Table 6.

Table 6: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Methodology	Fabrication/ Modeling/ Simulation	Result Verification	Presentation	Total
			5	5	5	5	5	25