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:
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Sandip Institute of Technology, Shindur
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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

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Course Contents

Unit-I — 10 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 — 08 Hrs.

Image Enhancement in spatial domain: Point processing techniques, Neighborhood processing. 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)

Unit-V — 04 Hrs.

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

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

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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.

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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 understand Hyper parameter Tuning.
2. To explore Deep Learning Techniques with different learning strategies.
3. To design Deep Learning Models for real time applications.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand and Apply Hyper parameters Tuning.	L1, L3	Understand, Apply
CO2	Interpret working of deep learning models.	L4	Analyze
CO3	Create Deep learning Models for real-world problems.	L6	Create
CO4	Investigate suitable deep learning algorithms for various applications.	L4	Analyze

Course Contents

Unit-I — 08 Hrs.

Neural Networks: Overview of Neural Network, Biological neuron, association of biological with artificial network, ANN: constructing ANN, perceptron, single layer, multilayer feed forward n/w, dimensionality reduction for NN(PCA) Backpropagation Algorithm (EBPTA), Self-Organizing Maps

Unit-II — 03 Hrs.

Introduction to Deep Learning: Deep learning and human brain, why is Deep Learning taking off? Deep Learning applications, Overview of Tools: Torch, TensorFlow, Keras

Unit-III — 05 Hrs.

Hyperparameter Tuning, Batch Normalization: Tuning Process and techniques, Hyperparameters Tuning in Practice: Pandas vs. Caviar, activation functions, Normalizing Activation in a Network, Fitting Batch Norm into a Neural Network, why does Batch Norm work, Batch Norm at Test Time

Unit-IV — 09 Hrs.

Convolutional Neural Network: Introduction to CNNs: convolution, types of kernels, Kernel filter, Principles behind CNNs, Multiple Filters, CNN applications, convolution for images

ConvNet Architectures: Discussions on famous convnet architectures: AlexNet, VGG, GoogLeNet, ResNet

Unit-V — 10 Hrs.

Recurrent Neural Networks: Introduction to Sequence Models and RNNs, Recurrent Neural Network 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-VI — 10 Hrs.

Adversarial Networks: Introduction to adversarial Networks, Auto encoders (standard, denoising, contractive, etc.), Generative Adversarial Networks, Transformers, Applications of Adversarial Networks

Text Books:

1. Simon Haykin, "Neural Networks and Learning Machines", Pearson Prentice Hall, 3rd Edition 2010.

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3rd Edition, 2018.

3. David Foster, "Generative Deep Learning", OReilly 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. Franois Chollet,"Deep Learning with Python", Manning Publication, 2017.

3. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", OReilly 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. Learning Rule: http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/explist.php

2. ANN Virtual Lab: http://cse22-iiith.vlabs.ac.in/List%20of%20experiments.html

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

4. NPTEL Course: Deep Learning Part 1: https://onlinecourses.nptel.ac.in/noc19_cs85/preview

Evaluation Scheme:

Theory :

Continuous Assessment (A):

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

Continuous Assessment (B):

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

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

End Semester Examination (C):

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

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

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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

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List of Laboratory Experiments

Suggested Experiments:

1. Building own Neural Network from scratch
2. To implement EBPTA algorithm.
3. Understanding ANN using Tensor Flow
4. Visualizing Convolutional Neural Network using Tensor Flow with Keras Data.
5. Object detection using RNN using Tensor Flow
6. GAN generator or discriminator.
7. 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 five 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

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2. Journal Submission: 05 Marks

3. Viva-voce: 05 Marks

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

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

End Semester Examination (C):

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

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

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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

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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 DevOps 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

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

End Semester Examination (C):

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

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

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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.

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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.

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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

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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.

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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

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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 Nave 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: Halls Theorem

Unit-V

05 Hrs.

Computational Algorithms:

i. Computational Geometry: Line Segment Properties, Convex Hull Grahams 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, Cooks 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

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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 bruteforce, divide and conquer, greedy, etc.	L6	Create

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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

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

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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.

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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

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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):

Teachers 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

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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-Gmez, "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.

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