SYLLABUS

(With effect from 2026 -27)

Bachelor Degree

In

Computer Science & Engineering

(Artificial Intelligence & Machine Learning)

V & VI Semester

Out Come Based Education

With

Choice Based Credit System

[National Education Policy Scheme]

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

[An Autonomous Institution affiliated to VTU, Belagavi,
Grant – in – Aid Institution (Government of Karnataka),
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]

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VISION

"To develop skilled professionals in the field of Artificial Intelligence & Machine Learning contributing globally to the benefit of industry and society."

MISSION

- *To impart knowledge in cutting edge Artificial Intelligence technologies that meets industry standards.*
- *Tocollaborate with industry to uplift innovative research and development in Artificial Intelligence & Machine Learning and related domains to meet societal demands.*
- *To produce successful Computer Science and Engineering graduates with a specialization in Artificial Intelligence & Machine Learning with personal and professional responsibilities, and a commitment to lifelong learning.*

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

***P**rofessionalism*
***E**mpathy*
***S**ynergy*
***C**ommitment*
***E**thics*

Department of Computer Science and Engineering (AI & ML)

The Vision of the department is:

"To develop skilled professionals in the field of Artificial Intelligence & Machine Learning contributing globally to the benefit of industry and society".

The mission of the department is:

DM1: To impart knowledge in cutting edge Artificial Intelligence technologies that meets industry standards.

{Required to create professionally competent engineers}

DM2: To collaborate with industry to uplift innovative research and development in Artificial Intelligence & Machine Learning and related domains to meet societal demands.
{Required to create professionally competent engineers and socially responsible engineers}

DM3: To produce successful Computer Science and Engineering graduates with a specialization in Artificial Intelligence & Machine Learning with personal and professional responsibilities and a commitment to lifelong learning.
{Required to create professionally competent engineers}

Program Educational Objectives (PEOs)

PEO1: Graduates will have the ability to adapt, contribute and innovate new technologies and systems in the key domains of Artificial Intelligence and Machine Learning.

PEO2: Graduates will be able to pursue higher education in reputed institutions with AI Specialization.

PEO3: Graduates will have the ability to explore research areas and produce outstanding contribution in various areas of Artificial Intelligence and Machine Learning.

PEO4: Graduates will be ethically and socially responsible solution providers and entrepreneurs in the field of Computer Science and Engineering with AI/ML Specialization.

The National Board of Accreditation (NBA) has defined twelve Program Outcomes for Under Graduate (UG) engineering programs as listed below.

Program Outcomes (POs)

1. Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems..

2. Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4).

3. Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5).

4. Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

5. Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6).

6. Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7)..

7. Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9).

8. Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

9. Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

10. Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

11. Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

The Under Graduate (UG) of B.E Computer Science & Engineering Program has defined **Program Specific Outcomes (PSO**) which are listed below.

PSO1: Apply the knowledge of programming and designing algorithms to develop solutions for engineering problems pertaining to AI&M

PSO2: Analyse and develop models in Machine Learning, Deep Learning using knowledge of AI and modern tools.

Sl. No	Category	Course Code	Course Title	BoS	Teaching & Learning in Hrs per week				Total no. of Hrs per Semester	Total Credits	Examination Marks and Duration				Total Marks CIE +SEE
					CI		LI	TW + SL			Max. Marks CIE	Duration CIE (hours)	Max. Marks SEE	Duration SEE (hours)	
					L	T	P	SL							
1.	ESC	P24CI501	Deep Learning	Resp. dept.	2	2*	-		90	3	50	1.5	50	3	100
2.	PCC	P24CI502	Natural Language Processing	Resp. dept.	2	2*	-		90	3	50	1.5	50	3	100
3.	PCC	P24CI503	Generative AI and LLM	Resp. dept.	3	-	-		90	3	50	1.5	50	3	100
4.	PEC	P24CI504X	Professional Elective - 1	Resp. dept.	2	2*	-		90	3	50	1.5	50	3	100
5.	PEC	P24CI505X	Professional Elective - 2	Resp. dept.	2	2*	-		90	3	50	1.5	50	3	100
6.	PCCL	P24CIL506	Deep Learning Laboratory	Resp. dept.	-	-	2		30	1	50	2	50	3	100
7.	PCCL	P24CIL507	Natural Language Processing Laboratory	Resp. dept.	-	-	2		30	1	50	2	50	3	100
8.	PBL	P24CI508	Mini Project	Resp. dept.	-	-	4		60	2	50	2	50	3	100
9.	HMSC	P24HSMC509A	Employability Enhancement Skills - V	HSMC	1	-	-		30	1	50	1 (MCQ)	50	2 (MCQ)	100
10	HMSC	P24UHV510	Universal Human values	HSMC	2	-	-			PP	50	1 (MCQ)	50	2 (MCQ)	PP/NP
11	MAND		AICTE Activity Points	(students have to earn **100** activity points between 01 to 08 semester)						Compulsory requirement for the award of a degree					
TOTAL										**20**	**500**		**500**		**1000**

	Professional Elective – 1 (P24XX504X)		Professional Elective – 2 (P24XX505X)	
Sl. No.	**Course Code**	**Course Title**	**Course Code**	**Course Title**
1	P24CI5041	Vector Database	P24CI5051	Full Stack Development
2	P24CI5042	Block chain Technology	P24CI5052	Cloud Computing
3	P24CI5043	Managing Big Data	P24CI5053	Business Intelligence and its application
4	P24CI5044	High Performance Computing	P24CI5054	Game Theory and Application

Sl. no	Category	Course Code	Course Title	Bos	Teaching & Learning in Hrs per week				Total no. of Hrs per Semester	Credits	Examination Marks and Duration				Total Marks CIE +SEE
					CI		LI	TW + SL			Max. Marks CIE	Duration CIE (hours)	Max. Marks SEE	Duration SEE (hours)	
					L	T	P	SL							
1.	ESC	P24CI601	Technical Communication and Research Methodology	-	2	2*	-		90	3	50	1.5	50	3	100
2.	PCC	P24CI602	Computer Vision	Resp. dept.	2	2*	-		90	3	50	1.5	50	3	100
3.	PCC	P24CI603	Agentic AI and Automation	Resp. dept.	3	-	-		90	3	50	1.5	50	3	100
4.	PEC	P24CI604X	Professional Elective - 3	Resp. dept.	2	2*	-		90	3	50	1.5	50	3	100
5.	PEC	P24CI605X	Professional Elective - 4	Resp. dept.	2	2*	-		90	3	50	1.5	50	3	100
6.	PCCL	P24CIL606	Computer Vision Laboratory	Resp. dept.	-	-	2		30	1	50	2	50	3	100
7.	PCCL	P24CIL607	Agentic AI and Automation Laboratory	Resp. dept.	-	-	2		30	1	50	2	50	3	100
8.	PROJ	P24CI608	Project Phase - I	-	-	-	4		60	2	50	2	50	3	100
9.	HMSC	P24HSMC609A	Employability enhancement Skills - VI	HSMC	1	-	-		30	1	50	1 (MCQ)	50	2 (MCQ)	100
10.	HMSC	P24IKS610	Indian Knowledge System	HSMC	-	-	-			PP	50	1 (MCQ)	50	2 (MCQ)	PP/NP
11	MAND		AICTE Activity Points	(students have to earn **100** activity points between 01 to 08 semester)						Compulsory requirement for the award of a degree					
TOTAL										**20**	**500**		**500**		**1000**

	Professional Elective – 3 (P24XX604X)		Professional Elective – 4 (P24XX605X)	
Sl. No.	**Course Code**	**Course Title**	**Course Code**	**Course Title**
1	P24CI6041	IoT Communication Protocols	P24CI6051	Cognitive Science and Analytics
2	P24CI6042	Fundamentals of DevOp's	P24CI6052	Social Network Analysis
3	P24CI6043	Robotics Process Automation – Design and Development	P24CI6053	Explainable and Responsible AI
4	P24CI6044	Augmented Reality and Virtual Reality	P24CI6054	Time Series Analysis

Semester: 5th Sem	**Scheme: P24**	
Course Title: Deep Learning		
Course Code: P24CI501	**CIE Marks: 50**	**CIE Weightage: 50%**
Teaching hours/week (L:T:P) 3:0:2	**SEE Marks: 50**	**SEE Weightage: 50%**
Teaching hours of Pedagogy: 40	**Exam Hours: 3 Hours**	
Team work + Self-study Hrs: 2		
Credits: 3		

Prerequisite: Artificial Intelligence, Machine Learning and Data Structures & Algorithms

Course learning Objectives:

CLO1: Understand the fundamentals of Artificial Intelligence, Machine Learning, Deep Learning, and various clustering techniques.

CLO2: Explain the architecture and working principles of Artificial Neural Networks, activation functions, loss functions, and backpropagation.

CLO3: Apply optimization and regularization techniques to improve the performance and generalization capability of deep learning models.

CLO4: Analyze Convolutional Neural Networks (CNNs), transfer learning techniques, and pretrained models for image-related applications.

CLO5: Understand Recurrent Neural Networks (RNNs), LSTM, GRU, and Deep Reinforcement Learning techniques for sequential decision-making and prediction tasks.

Unit 1:	**Hrs: 8**

Introduction to Deep Learning:
Overview of Deep Learning, Introduction to Artificial Intelligence, Machine Learning Explained, Artificial Neural Networks and Deep Learning Explained, Challenges of Deep Learning, History of Deep Learning, Deep Learning Applications.

Clustering Algorithms:
Introduction to Clustering approaches, Proximity measure, Hierarchical Clustering Algorithms, Partial Clustering Algorithm, Density based methods, Grid-based approach, Probability Model – based Methods, Cluster Evaluation Methods.

Text Book Mapping: T1: Chapter – 1; T2: Chapter – 13

Unit 2:	**Hrs: 8**

Introduction to Artificial Neural Networks: What is a Neuron, Perceptron Model, Perceptron as a Binary Classifier, Single and Multilayer Neural Networks.

Introduction to Activation and Loss Functions: Overview of Shallow Networks, The Motivation of Activation Functions, Types of Activation Functions, Loss Functions, Mathematics of Back propagation.

Text Book Mapping: T1: Chapter – 2 & 3

Unit 3:	**Hrs: 8**

Introduction to Optimization: Overview of Optimization, Search Space, Types of Optimization Problems, Hyper parameter Tuning, Gradient Descent Algorithms, Second-Order Optimization Algorithms.

Introduction to Regularization: Introduction to Generalization and Regularization, Overview of Over fitting and Under fitting, Introduction to Regularization, Regularization Techniques, Neural Network Regularization.

Text Book Mapping: T1: Chapter – 4 & 5

Unit4:	Hrs: 8
Convolutional Neural Networks: Introduction to Convolutional Neural Networks(CNN), Machine Learning Approach Vs. Deep Learning Approach, Introduction to Convolutional and Hierarchical Learning, Convolutional Neural Network Vs. Shallow Networks, Generic CNN Architecture, **Parameters and Hyper parameters of CNN:** LeNet-5 Architecture. Transfer Learning, Overview of Transfer Learning, Framework of Transfer Learning, Image Net and Pretrained Models, Advanced CNN Architectures, Transfer Learning Models.	
Text Book Mapping: T1: Chapter – 9 & 10	
Unit 5:	**Hrs: 8**
Recurrent Neural Networks: Overview of Sequence Data, Need for RNN, Topology of RNN, Back propagation in Time Algorithm, Long Short-Term Memory (LSTM), Various Models of LSTM, Gated Recurrent Units (GRU), Case Studies for LSTM. Deep Reinforcement Learning, Overview of Reinforcement Learning, Components of Reinforcement Learning, Markov Decision Model, Dynamic Programming, Model Free Methods, Q-Learning, Deep Q-Network (DQN), Policy Gradient Methods.	
Text Book Mapping: T1: Chapter – 12 & 18	

Course Outcomes

CO1	Explain the concepts of Artificial Intelligence, Machine Learning, Deep Learning, Artificial Neural Networks, and evaluate various clustering algorithms and their applications.
CO2	Describe the architecture of Artificial Neural Networks, activation functions, loss functions, and implement the backpropagation algorithm for neural network training.
CO3	Apply optimization algorithms and regularization techniques to enhance the training efficiency and generalization performance of deep learning models.
CO4	Analyze Convolutional Neural Networks, transfer learning frameworks, and pretrained architectures for solving image classification and computer vision problems.
CO5	Explain the working principles of Recurrent Neural Networks, LSTM, GRU, and Deep Reinforcement Learning algorithms for sequence modeling and decision-making applications.

Suggested Learning Resources:

Textbooks:

Sl. No	Title	Author	Year & Edition (Latest)	Publisher
1.	Deep Learning	S Sridhar and D Narashiman	2025, First Edition	Pearson India Education Services Pvt. Ltd.
2.	Machine Learning	S. Sridhar and M. Vijayalakshmi	2021, First Edition	Oxford University Press (OUP), New Delhi

Reference Books:				
1.	Deep Learning	Ian Goodfellow, Yoshua Bengio, and Aaron Courville	1st Edition, 2016	MIT Press, Cambridge, Massachusetts, USA

Web links and Video Lectures (e-resources)

1. Deep Learning Book (Official Website) https://www.deeplearningbook.org/
2. MIT OpenCourseWare – Deep Learning https://ocw.mit.edu/
3. NPTEL – Deep Learning (Prof. Mitesh M. Khapra, IIT Madras) https://nptel.ac.in/courses/106106224
4. DeepLearning.AI YouTube Channel https://www.youtube.com/@Deeplearningai

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Interactive discussions on AI, Machine Learning, and Deep Learning concepts.
2. Case study analysis of real-world Deep Learning applications (e.g., healthcare, autonomous vehicles, and image recognition).
3. Group presentations on recent advancements in Deep Learning.
4. Think–Pair–Share activities on optimization, regularization, and neural network architectures.
5. Problem-solving sessions on activation functions, loss functions, and backpropagation.
6. Seminar presentations on CNNs, RNNs, Transfer Learning, and Reinforcement Learning.
7. Journal paper review and discussion on emerging Deep Learning techniques.
8. Quiz-based learning and concept mapping for reinforcement of key topics.

AI Tools that Could Be Used

1. **Google Colab** – Cloud-based Python notebooks with GPU/TPU support for deep learning experiments.
2. **Jupyter Notebook / JupyterLab** – Interactive environment for machine learning and deep learning implementation.
3. **TensorFlow** – Open-source deep learning framework for building and training neural networks.
4. **PyTorch** – Deep learning framework for research and production applications.
5. **Keras** – High-level API for developing neural network models.
6. **Hugging Face** – Pre-trained transformer models and NLP applications.
7. **Weights & Biases (W&B)** – Experiment tracking, model visualization, and collaboration.
8. **Kaggle** – Datasets, notebooks, competitions, and cloud-based machine learning environment

Semester: 5th Sem	**Scheme: P24**	
Course Title: Natural Language Processing		
Course Code: P24CI502	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:	**Exam Hours: 3Hours**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

Concepts of Machine Learning , Automata Theory and Formal Languages

Course learning Objectives:

CLO1: Introduce the fundamental concepts of Automata Theory, Formal Languages and compiler design Principles Demonstrate Application of Automata Theory and Formal Languages

CLO2: Apply the principles and Process of Human Languages such as English and other Indian Languages using computers

CLO3: Ability to use existing natural language processing tools to conduct basic natural language processing, such as text normalization, or syntactic parsing.

CLO4: Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology

Unit 1:	**Hrs: 8**

Introduction to Automata Theory: Central Concepts of Automata theory, Deterministic Finite Automata(DFA), Non- Deterministic Finite Automata(NFA) ,Epsilon- NFA, NFA to DFA Conversion.

Text Book Mapping: Textbook 1: Chapter1 – 1.5, Chapter2 – 2.2,2.3,2.5 Chapter4 –4.4

Unit 2:	**Hrs: 8**

Regular Expressions and Context free Grammars: Regular Expressions, Definition and designing CFGs, Derivations Using a Grammar, Parse Trees, Ambiguity and Elimination of Ambiguity, Elimination of Left Recursion.

Text Book Mapping: Textbook 1: Chapter3 – 3.1
Textbook 1: Chapter 5 – 5.1.1 to 5.1.6, 5.2 (5.2.1, 5.2.2), 5.4

Unit 3:	**Hrs: 8**

Overview and language modelling: Overview: Origins and challenges of NLP- Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modelling: Various Grammar- based Language Models.

Text Book Mapping: Textbook 2: 1.1, 1.2, 1.4, 1.5, 1.6, 1.7, 1.9

Unit4:	**Hrs: 8**

Word level and syntactic analysis: Word Level Analysis: Regular Expressions- Finite State Automata-Morphological Parsing-Spelling Error Detection and correction-Words.
Word classes-Part-of Speech Tagging: Part-of- Speech Tagging, Rule-based Part-of-speech Transformation-Based Tagging; Tagging, N-grams

Text Book Mapping: Text Book 2:6.2,6.9,7.1,7.2,8.2,8.3

Unit 5:	Hrs: 8
Discourse: Cohesion, Reference Resolution; **Machine Translation:** Problems in Machine Translation, Characteristics of Indian Languages. **Information Retrieval and Lexical Resources:** Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval Evaluation Lexical Resources: World Net-Frame Net- Stemmers	
Text Book Mapping: Text Book 2: 9.1,9.2,9.3,9.4,9.5,9.6,9.7,12.2,12.3,12.4	

Course Outcomes

CO1	**Understand** the fundamental concepts of automata theory, formal languages, grammar, and language modelling relevant to Natural Language Processing.
CO2	**Analyze and apply** NLP techniques for word-level and syntactic analysis, including morphological processing, spelling correction, N-grams, and Part-of-Speech tagging.
CO3	**Apply and evaluate** NLP techniques for discourse processing, machine translation, information retrieval, and lexical resources, with emphasis on Indian languages.

Suggested Learning Resources:

Textbooks:

Sl. No	Title	Author	Year & Edition (Latest)	Publisher
1.	Introduction to Automata Theory, Languages and Computation	John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman	Third Edition	Pearson
2.	Natural Language Processing and Information Retrieval	Tanveer Siddiqui, U.S. Tiwary	2008	Oxford University Press
Reference Books:				
1.	Natural Language Processing and Text Mining	Anne Kao and Stephen R. Poteet (Eds)	2007	Springer-Verlag London Limited
2.	Natural Language Understanding	James Allen	1995, 2nd edition	Benjamin/Cummings publishing company
3.	Information Storage and Retrieval systems	Gerald J. Kowalski and Mark.T. Maybury	2000	Kluwer academic Publishers

Web links and Video Lectures (e-resources)
1. https://youtu.be/hFeq9wKp8aU?si=xYyER1VS2kdSMIhw

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 5th	**Scheme: P24**	
Course Title: Generative AI and LLM		
Course Code: P24CI503	**CIE Marks:50**	**CIE Weightage:50**
Teaching hours/week (L:T:P) 3:0:0	**SEE Marks:50**	**SEE Weightage:50**
Teaching hours of Pedagogy:40	**Exam Hours: 3hr**	
Team work + Self-study Hrs: 2		
Credits: 3		

Prerequisite: Python Programming

Python Programming

Course learning Objectives:

CLO1: Understand generative AI paradigms and execute basic text-generation workflows using open and proprietary APIs.

CLO2: Trace mathematical operations inside Transformer blocks, including tokenization, self-attention, and positional embeddings.

CLO3: Construct grounded Retrieval-Augmented Generation (RAG) pipelines and multi-modal systems using CLIP and BLIP-2.

CLO4: Develop specialized embedding and representation models using contrastive learning, SBERT, and few-shot SetFit classification.

CLO5: Execute parameter-efficient fine-tuning (PEFT/QLoRA) and preference alignment (DPO) to optimize and evaluate large generative architectures.

Unit 1:	**Hrs:8**

An Introduction to Large Language Models

Understanding Generative AI: Generative AI, Distinguishing generative AI from other AI models, Looking ahead at risks and implications, Introducing use cases of generative AI, The future of generative AI applications.

An Introduction to Large Language Models: What Is Language AI, A Recent History of Language AI, The Moving Definition of a "Large Language Model", The Training Paradigm of Large Language Models, Large Language Model Applications: What Makes Them So Useful, Responsible LLM Development and Usage, Limited Resources Are All You Need,Interfacing with Large Language Models, Proprietary, Private Models, Open Models, Open Source Frameworks, Generating Your First Text

Text Book Mapping: Text-1 Unit-1,Text 2:Unit-1

Unit 2:	**Hrs:8**

Tokens and Embeddings: LLM Tokenization, Text Embeddings (for Sentences and Whole Documents),Word Embeddings Beyond LLMs,Embeddings for Recommendation Systems.

Looking Inside Large Language Models: An Overview of Transformer Models,The Inputs and Outputs of a Trained Transformer LLM, The Components of the Forward Pass,Choosing a Single Token from the Probability Distribution (Sampling/ Decoding), Parallel Token Processing and Context Size,Speeding Up Generation by Caching Keys and Values, Inside the Transformer Block,Recent Improvements to the Transformer Architecture, More Efficient Attention,The Transformer Block, Positional Embeddings (RoPE) ,Other Architectural Experiments and Improvements

Text Book Mapping: Text-1 Unit-2,:Unit-3

Unit 3:	Hrs:8
RAG & Multimodal LLM Overview of Semantic Search and RAG, Semantic Search with Language Models, Dense Retrieval, Reranking, Retrieval Evaluation Metrics, Retrieval-Augmented Generation (RAG), From Search to RAG ,Example: Grounded Generation with an LLM API, Example: RAG with Local Models, Advanced RAG Techniques, RAG Evaluation. **Multimodal Large Language Models:** Transformers for Vision, Multimodal Embedding Models, CLIP: Connecting Text and Images, How Can CLIP Generate Multimodal Embeddings?, OpenCLIP, Making Text Generation Models Multimodal, BLIP-2: Bridging the Modality Gap, Preprocessing Multimodal Inputs.	
Text Book Mapping: Text-1 Unit-8,Unit-9	
Unit4:	**Hrs:8**
Creating Text Embedding Models And Fine-Tuning **Creating Text Embedding Models:** Embedding Models ,What Is Contrastive Learning?, SBERT, Creating an Embedding Model 'Generating Contrastive Examples, Train Model, In-Depth Evaluation, Loss Functions, Fine-Tuning an Embedding Model, Supervised, Augmented SBERT ,Unsupervised Learning, Transformer-Based Sequential Denoising Auto-Encoder, Using TSDAE for Domain Adaptation. **Fine-Tuning Representation Models for Classification:** Supervised Classification, Fine-Tuning a Pretrained BERT Model, Freezing Layers, Few-Shot Classification, SetFit: Efficient Fine-Tuning with Few Training Examples, Fine-Tuning for Few-Shot Classification, Continued Pretraining with Masked Language Modeling ,Named-Entity Recognition, Preparing Data for Named-Entity Recognition, Fine-Tuning for Named-Entity Recognition	
Text Book Mapping: Text-1 :Unit-10,Unit-11	
Unit 5:	**Hrs:8**
Fine-Tuning Generation Models The Three LLM Training Steps: Pretraining, Supervised Fine-Tuning, and Preference Tuning, Supervised Fine-Tuning (SFT), Full Fine-Tuning , Parameter-Efficient Fine-Tuning (PEFT), Instruction Tuning with QLoRA , Templating Instruction Data , Model Quantization , LoRA Configuration Training Configuration ,Training ,Merge Weights ,Evaluating Generative Models ,Word-Level Metrics ,Benchmarks, Leaderboards , Automated Evaluation, Human Evaluation, Preference-Tuning / Alignment / RLHF, Automating Preference Evaluation Using Reward Models, The Inputs and Outputs of a Reward Model, Training a Reward Model , Training No Reward Model , Preference Tuning with DPO, Templating Alignment Data , Model Quantization , Training Configuration , Training ,	
Text Book Mapping: Text-1 :Unit-12	

Course Outcomes

CO1	Understand: Explain the core architectures, capabilities, and risks of Generative AI and Transformer-based Large Language Models.	Under Transf
CO2	Analyze tokenization methodologies, text embeddings, and internal decoding mechanisms within Transformer blocks.	Analyz within
CO3	Design: Design robust Retrieval-Augmented Generation (RAG) frameworks and multimodal AI pipelines using semantic search paradigms.	Design AI pip
CO4	Apply: Apply contrastive learning, supervised classification, and domain adaptation techniques to create custom embedding models.	Apply to crea
CO5	Evaluate: Evaluate and execute parameter-efficient fine-tuning (PEFT), quantization, and human-alignment preferences (RLHF/DPO) on generative architectures.	Evalua human

Suggested Learning Resources:

Textbooks:

Sl. No	Title	Author	Year & Edition (Latest)	Publisher
1.	Hands-On Large Language Models Language Understanding and Generation	Jay Alammar & Maarten Grootendorst	Copyright © 2024, First Edition	Published by O'Reilly Media, Inc.,
2.	Generative AI Foundations in Python	Carlos Rodriguez	Copyright © 2024 Packt Publishing First published: July 2024	Packt Publishing
Reference Books:				
1.	Speech and Language Processing	Daniel Jurafsky, James H. Martin	Third Edition Copyright ©2026	Packt Publishing

Web links and Video Lectures (e-resources)

1. https://www.deeplearning.ai/courses/generative-ai-with-llm
2. https://huggingface.co/learn/llm-course/chapter1/1

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Semester: 5th	**Scheme: P24**	
Course Title: Vector Database		
Course Code: P24CI5041	**CIE Marks:50**	**CIE Weightage:50**
Teaching hours/week (L:T:P) 3:0:0	**SEE Marks:50**	**SEE Weightage:50**
Teaching hours of Pedagogy:40	**Exam Hours: 3hr**	
Team work + Self-study Hrs: 2		
Credits: 3		

Prerequisite:

Database Management System

Course learning Objectives:

CLO1: Students will be able to convert unstructured text into mathematical embeddings and justify why modern AI applications require specialized vector databases.
CLO2: Students will be able to implement an AI-powered semantic search engine using Python.
CLO3: Students will be able to build a complete local document question-answering (RAG) system.
CLO4: Students will be able to develop and deploy a functional chatbot web API using FastAPI .
CLO5: Students will be able to execute advanced vector queries and apply database security practices to protect AI systems from data manipulation attacks.

Unit 1:	**Hrs: 8**

Introduction to Vector Databases & Embedding

Why Do You Need Vector Databases?, SQL Versus Vector Databases ,NoSQL Versus Vector Databases Hybrid Approaches: Combining Structured and Vector Data.

Embeddings: Understanding Vector Embeddings, Why We Need Them, Word2Vec: The Breakthrough That Changed Everything, Doc2Vec: From Words to Documents, From Embeddings to Modern Language Models, Embedding Models: The Specialized Vector Generators, The Embedding Layer: The Gateway to Zero-Shot Learning.

Text Book Mapping: Text1: Unit-1 Unit-2

Unit 2:	**Hrs: 8**

Similarity Semantic Search with SQLite3

Foundations, FAISS Indexes, Quantization, The ANN Problem, Understanding HNSW Indexes, FAISS Architecture and Components.

Semantic Search with SQLite3:Understanding the SQLite Vector Similarity Search Extension, Setting Up the Development Environment, Designing the Database Schema, Connecting to Reddit with the Python Reddit API Wrapper, Content Extraction and Preprocessing, Generating and Storing Embeddings, Building the Vector Index, Implementing Semantic Search, Putting It All Together.

Text Book Mapping: Text1: Unit-3 Unit-4

Unit 3:	Hrs: 8
RAG Systems and Pipelining System Architecture Overview, Database Foundation with Vector Support,Text Processing and Embedding Generation, Hybrid Search Implementation, LLM Integration with Ollama, The RAG Pipeline Demonstration and Testing, Next Steps: Extending the System. **PostgreSQL and pgvector:** System Goals and Capabilities, Architecture Overview, Database Foundation with pg vector, Embedding Generation Strategy, ArXiv Integration and PDF Processing, Advanced Text Chunking, Storage Pipeline with Embeddings, Multilevel Semantic Search, The RAG Pipeline: Deep Dive, Demonstration and Interactive Interface ,Next Steps: Extending the Scientific RAG System.	
Text Book Mapping: Text1: Unit-6 Unit-7	
Unit4:	**Hrs: 8**
Conversation Search and RAG System System Architecture Overview, Database Foundation for Conversation Storage, Conversation Import and Data Processing Pipeline, Efficient Embedding Generation and Batch Processing, Contextual Search with Conversational Understanding, RAG Integration for Conversation History, Complete Web API with FastAPI, Demonstration and Sample Data.	
Text Book Mapping: Text1: Unit-8	
Unit 5:	**Hrs: 8**
Vector Query Language & Security Core Concepts, Data Model, Basic Syntax Structure, Vector Operations, Similarity Search, Hybrid Search, Range Search, Batch Operations, Vector Functions and Aggregations, Vector Functions, Vector Aggregations. Security: Encryption for Vector Databases, Searchable/Queryable Encryption, Homomorphic, Encryption, Secure Multiparty Computation, Common Security Threats to Vector Databases.	
Text Book Mapping: Text 1:Unit-9, Text 2: Unit-1	

Course Outcomes

CO1	(Understand): Vector Database, Differentiate vector databases from traditional SQL/NoSQL systems and explain the mathematical evolution of multi-dimensional text embeddings.
CO2	CO-2 (Analyze): Evaluate indexing algorithms like HNSW (Hierarchical Navigable Small World)and Quantization strategies to optimize the trade-off between search speed and retrieval accuracy.
CO3	CO-3 (Apply): Build production-ready Retrieval-Augmented Generation (RAG) pipelines using local and enterprise database extensions like sqlite-vss and pgvector
CO4	(Create): Design and deploy scalable, conversational web APIs using FastAPI that manage chat history and contextual vector searches
CO5	(Evaluate): Construct secure vector query pipelines while mitigating database-specific vulnerabilities and evaluating advanced privacy-preserving encryption trade-offs.

Suggested Learning Resources:				
Textbooks:				
Sl. No	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
1.	Vector Databases A Practical Introduction	Nitin Borwankar	Copyright © 2026 First Edition	O'Reilly Media, Inc.,
2.	Securing Vector Databases Best Practices for Protecting Your AI Data	Omar Santos, Akram Sheriff, Mustafa Kadioglu,	11-Oct-2024, 12-First Edition	Cisco Security & Trust, Cisco IT Publication.
Reference Books:				
1.	Vector Search for Practitioners with Elastic	Bahaaldine Azarmi & Jeff Vestal	Copyright © 2023 Packt Publishing	Packt Publishing

Web links and Video Lectures (e-resources)
1. https://www.pinecone.io/learn/vector-database 2. https://docs.cohere.com/docs/embeddings

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 5th	**Scheme: P24**	
Course Title: Block Chain Technology		
Course Code: P24CI5042	**CIE Marks: 50**	**CIE Weightage: 50%**
Teaching hours/week (L:T:P) 3:0:0	**SEE Marks: 50**	**SEE Weightage: 50%**
Teaching hours of Pedagogy: 40	**Exam Hours: 3Hours**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

- Knowledge of data structures.
- Students must have knowledge of some programming languages (such as C, C++, and Java)

Course learning Objectives:

CLO1: Understand how blockchain systems (mainly Bitcoin and Ethereum) work.
CLO2: Design, build, and deploy smart contracts and distributed applications.
CLO3: Integrate ideas from blockchain technology into their own projects

Unit 1:	**Hrs: 8**

Introduction: Blockchain, Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain.

Decentralization and Cryptography: Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized Organizations.

Text Book Mapping: Chapter 1 and Chapter 2

Unit 2:	**Hrs: 8**

Cryptographic primitives: Symmetric cryptography, Stream ciphers, Block ciphers, Block encryption mode, Keystream generation modes, Message authentication modes, Electronic code book, Cipher block chaining, Counter mode, Data Encryption Standard (DES) Advanced Encryption Standard (AES), Asymmetric cryptography; Public and private keys, Encryption and decryption using RSA, Cryptographic Hash Function, Merkle tree, Digital signatures :Sign then encrypt, Encrypt then sign,.

Text Book Mapping: Chapter 3 and Chapter 4

Unit 3:	**Hrs: 8**

Bitcoin - Introduction, Transactions, Transactions Structure, Transactions types, Blockchain- The structure of a block, The genesis block, The bitcoin network, Wallets and its types, Bitcoin payments, Bitcoin investment and

buying and selling bitcoins, Bitcoin programming and the command-line interface, Bitcoin improvement proposals (BIPs).

Text Book Mapping: Chapter 5 and Chapter 6

Unit4:	Hrs: 8
Ethereum: Ethereum block chain, Elements of the Ethereum block chain, Precompiled contracts, Accounts and its types, Block header, Ether ,Messages, Mining ,Clients and wallets ,Trading and investment , The Ethereum network ,Applications developed on Ethereum. **Introducing solidity:** Types, value types-Boolean, Integers, Address, Literals, Function types, Reference Types-Arrays, Structs, Mappings, Global variables, Control structures, Events, Inheritance, Libraries, Functions.	
Text Book Mapping: Chapter 10 ,Chapter 11 and Chapter 13	
Unit 5:	**Hrs: 8**
Smart Contract: History of Smart Contract, Ricardian contracts, Deploying smart contracts on a blockchain, The DAO. Hyperledger: projects, Hyperledger as a protocol, Fabric, Hyper ledger Fabric, Sawtooth Lake, Corda Architecture.	
Text Book Mapping: Chapter 9 and Chapter 15	

Course Outcomes

CO1	Explain the basic concepts and technology used for blockchain.
CO2	Describe the primitives of the distributed computing and cryptography related to blockchain.
CO3	Illustrate the concepts of Bitcoin and their usage.
CO4	Analyse the working of Ethereum.
CO5	Describe smart contract, Hyperledger fabric and its framework, design principles and architecture

Suggested Learning Resources:				
Textbooks:				
Sl. No	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
1.	Mastering Block Chain: Distributed Ledgers, Decentralization and Smart Contracts Explained.	Imran Bashir	2017	Packet Publishing
Reference Books:				
1.	Block Chain: Blueprint for a New Economy	Melanic Swan	2015	O'Reilly
2.	Block Chain Basics	Daniel Drescher	2017(1st edition)	Après

Web links and Video Lectures (e-resources)
1. https://www.youtube.com/watch?v=tq-ooflj7R4

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 5th Sem	**Scheme: P24**	
Course Title: Managing Big Data		
Course Code: P24CI5043	**CIE Marks: 50**	**CIE Weightage: 50%**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage: 50%**
Teaching hours of Pedagogy:	**Exam Hours: 3 Hours**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

Concepts of Data base management

Course learning Objectives:

CLO1: Explore and apply the Big Data analytic techniques for business applications.
CLO2: Discuss the overview of Apache Hadoop.
CLO3: Able to implement basic technologies that forms the foundations of Big Data.

Unit 1:	**Hrs: 8**

Introduction to Hadoop: Data!, Data Storage and Analysis, Querying All Your Data, Beyond Batch, Comparison with Other Systems: Relational Database Management Systems, Grid Computing, Volunteer Computing, In memory Data Base.

Hadoop Distributed File system: The Design of HDFS, HDFS Concepts: Blocks, Name nodes and Data nodes, HDFS Federation, HDFS High-Availability, Basic File system Operation, Reading Data from a Hadoop URL.
Data Flow: Anatomy of a File Read, Anatomy of a File Write.

Text Book Mapping: Chapter 1, 3

Unit 2:	**Hrs: 8**

YARN: Anatomy of a YARN Application Run: Resource Requests, Application Lifespan, Building YARN Applications, Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness.

Developing a MapReduce Application: The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, Generic Options Parser, Tool, and Tool Runner, writing a Unit Test with MR-Unit: Mapper, Reducer, Running Locally on Test Data, MapReduce Workflows: Decomposing a Problem into MapReduce Jobs, Job Control, Apache Oozie.

Text Book Mapping: Chapter 4, 6

Unit 3:	Hrs: 8
How MapReduce Works: Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort, Task Execution. **HIVE:** The Hive Shell, An Example, Running Hive, Configuring Hive, Hive Services, The Meta store, Comparison with Traditional Databases, Schema on Read Versus Schema on Write, Updates, Transactions, and Indexes, SQL-on-Hadoop Alternatives, Hive QL, Data Types, Operators and Functions, Tables, Managed Tables and External Tables, Partitions and Buckets, Storage Formats, Importing Data, Altering Tables, Dropping Tables, Querying Data, Sorting and Aggregating, MapReduce Scripts, Joins, Sub queries, Views, User-Defined Functions, Writing a UDF, Writing a UDAF.	
Text Book Mapping: Chapter 7, 17	
Unit4:	**Hrs: 8**
PARAQUET: Data Model, Nested Encoding, Parquet File Format, Parquet Configuration, Writing and Reading Parquet Files Avro, Protocol Buffers, Thrift, Parquet MapReduce. **Spark:** An Example: Spark Applications, Jobs, Stages and Tasks, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution.	
Text Book Mapping: Chapter 13, 18	
Unit 5:	**Hrs: 8**
Sqoop: Getting Sqoop, Sqoop Connectors, A Sample Import, Text and Binary File Formats, Generated Code, Additional Serialization Systems, Imports: A Deeper Look, Controlling the Import, Imports and Consistency, Incremental Imports, Direct-Mode Imports, Working with Imported Data, Imported Data and Hive, Importing Large Objects, Performing an Export, Exports: A Deeper Look, Exports and Transnationality, Exports and Sequence Files. **ZooKeeper :** An Example, Group Membership in Zoo Keeper, Creating the Group, Joining a Group, Listing Members in a Group, Deleting a Group, The ZooKeeper Service, Data Model, Operations, Implementation, Consistency, Sessions, States, Building Applications with ZooKeeper, A Configuration Service, The Resilient ZooKeeper Application, A Lock Service, More Distributed Data Structures and Protocols , ZooKeeper in Production, Resilience and Performance, Configuration.	
Text Book Mapping: Chapter 15, 21	

Course Outcomes

CO1	Understanding big data concepts and Hadoop Distributed File System
CO2	Design big data applications using the comprehensive concepts of YARN and Hadoop I/O operations.
CO3	Develop, debug, and optimize MapReduce applications to understand the mechanisms of MapReduce job execution.
CO4	A comprehensive understanding of Apache Flume, Apache Pig, and Apache Spark to process and analyze large datasets effectively.

Suggested Learning Resources:				
Textbooks:				
Sl. No	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
1.	Hadoop: The Definitive Guide	Tom White	2012 (3rd Edition)	O'Reilly
Reference Books:				
1.	SPARK: The Definitive Guide	Matei Zaharia and Bill Chambers	2018	O'Reilly
2.	Apache Flume: Distributed Log Collection for Hadoop	D'Souza and Steve Hoffman	2014	O'Reilly

Web links and Video Lectures (e-resources)
1. https://www.tutorialspoint.com/big_data_tutorials.html 2. https://www.digimat.in/nptel/courses/video/106104189/L01.html

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 5th Sem	**Scheme: P24**	
Course Title: High Performance Computing		
Course Code: P24CI5044	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:	**Exam Hours: 3**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

Concepts of Operating System

Course learning Objectives:

CLO1: Provides a solid foundation in High Performance Computing (HPC) and its role in science and engineering

CLO2: To study the fundamental techniques for developing HPC applications, the commonly used HPC platforms, the methods for measuring, assessing and analysing the performance of HPC applications.

Unit 1:	**Hrs: 8**

Introduction to High–Performance Computers, CPU Design: Reduced Instruction Set Computers, Multiple–Core Processors, Vector Processors, Parallel Semantics, Distributed Memory Programming

Text Book Mapping: Text 1: Chapter1:1.2,1.3,1.4,1.5

Unit 2:	**Hrs: 8**

Programming Shared Address Space Platforms: Thread Basics, Why Threads? The POSIX Thread API, Thread Creation and Termination, Synchronization Primitives in Threads, Controlling Thread and Synchronization Attributes, Tips for Designing Asynchronous Programs, OpenMP: a Standard for Directive Based Parallel Programming

Text Book Mapping: Text1: Chapter 7:7.1,7.2,7.3,7.4,7.5,7.6,7.8,7.9

Unit 3:	**Hrs: 8**

Programming using the Message-Passing Paradigm: Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation.

Text Book Mapping: Text 1: Chapter 3:3.1,3.2,3.3,3.4,3.5,3.6,3.7

Unit4:	**Hrs: 8**

Introduction: GPUs as Parallel Computers, Architecture of a Model GPU, Why More Speed or Parallelism? Parallel Programming Languages and Models, Overarching Goals. GPU Computing. Introduction to CUDA: Data Parallelism, CUDA Program Structure, A Matrix-Matrix Multiplication Example, Device Memories and Data Transfer

Text Book Mapping: Text 2 Chapter 4:4.1,4.2,4.3,4.4,4.5

Unit 5:	Hrs: 8
CUDA Threads: CUDA Thread Organization, Using blocked and threaded, Synchronization and Transparent Scalability, Thread Assignment, Thread Scheduling and Latency Tolerance. CUDA Memories: Importance of Memory Access Efficiency, CUDA Device Memory Types, A Strategy for Reducing Global Memory Traffic, Performance Considerations: More on Thread Execution, Global Memory Bandwidth, Dynamic Partitioning of SM Resources, Data Perfecting, Instruction Mix, Thread Granularity, Measured Performance and Summary.	
Text Book Mapping: Text 2: Chapter 3:3.1,3.2,3.3,3.4,3.5	

Course Outcomes

CO1	Explain the technologies and architectures used for parallel computing.
CO2	Design and develop parallel programs using OpenMP programming interface.
CO3	Elaborate the principles and architecture of message-passing programming paradigm for solving real world problems.
CO4	Provide an understanding of Graphical Processing Units and their architecture.
CO5	Analyse the features of GPUs, their functionalities.

Suggested Learning Resources:				
Textbooks:				
Sl. No	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
1	Programming Massively Parallel Processors	David B Kirk, Wen-Mei W. Hwu	4th Edition 2022	Rubin H Landau, Oregon State University,
2	Introduction to parallel computing"	by Ananth Grama, Anshul Gupta, Vipin Kumar, George Karypis,	2nd Edition: Published in 2003	Pearson education publishers, 2nd Edition
Reference Books:				
1.	High Performance Computing: Modern Systems and Practices	by Thomas Sterling, Maciej Brodowicz, and Matthew Anderson.	2021	Pearson education publishers,

Web links and Video Lectures (e-resources)
1..youtube.com/@pmpp-book
2.Lecture 01 - Introduction - YouTube

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 5th Sem	**Scheme: P24**	
Course Title: Full Stack Development		
Course Code: P24CI5051	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:	**Exam Hours:**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

HTML, web, Java

Course learning Objectives:

CLO1: Explain the use of learning full stack web development.
CLO2: Make use of rapid application development in the design of responsive web pages.
CLO3: Illustrate Models, Views and Templates with their connectivity in Django for full stack web development.
CLO4: Demonstrate the use of state management and admin interfaces automation in Django.
CLO5: Design and implement Django apps containing dynamic pages with SQL databases.

Unit 1:	**Hrs: 8**

MVC based Web Designing

Web framework, MVC Design Pattern, Django Evolution, Views, Mapping URL to Views, Working of Django URL Confs and Loose Coupling, Errors in Django.

Text Book Mapping: Textbook 1: Chapter 1 and Chapter 3

Unit 2:	**Hrs: 8**

Django Templates and Models

Template System Basics, Using Django Template System, Basic Template Tags and Filters, MVT Development Pattern, Template Loading, Template Inheritance, MVT Development Pattern.

Configuring Databases, Defining and Implementing Models, Basic Data Access, Adding Model String Representations, Inserting/Updating data, Selecting and deleting objects.

Text Book Mapping: Textbook 1: Chapter 4 and Chapter 5

Unit 3:	**Hrs: 8**

Django Admin Interfaces and Model Forms

Activating Admin Interfaces, Using Admin Interfaces, Customizing Admin Interfaces, Reasons to use Admin Interfaces.

Form Processing, Creating Feedback forms, Form submissions, custom validation, creating Model Forms,

Text Book Mapping: Textbook 1: Chapters 6, 7 and 8

Unit4:	Hrs: 8
Generic Views and Django State Persistence Using Generic Views, Generic Views of Objects, Extending Generic Views of objects, Extending Generic Views. MIME Types, Generating Non-HTML contents like CSV and PDF, Syndication Feed Framework, Sitemap framework, Cookies, Sessions.	
Text Book Mapping: Textbook 1: Chapters 9, 11 and 12	
Unit5:	**Hrs: 8**
jQuery and AJAX Integration in Django Ajax Solution, Java Script, XHTML HttpRequest and Response, HTML, CSS, JSON, iFrames, Settings of Java Script in Django, jQuery and Basic AJAX, jQuery AJAX Facilities.	
Text Book Mapping: Textbook 2: Chapters 1, 2 and 7.	

Course Outcomes

CO1	Understand the working of MVT based full stack web development with Django.
CO2	Designing of Models and Forms for rapid development of web pages.
CO3	Analyze the role of Template Inheritance and Generic views for developing full stack web applications.
CO4	Apply the Django framework libraries to render non HTML contents like CSV and PDF.
CO5	Perform jQuery based AJAX integration to Django Apps to build responsive full stack web applications,

Suggested Learning Resources:				
Textbooks:				
Sl. No	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
1.	The Definitive Guide to Django: Web Development Done Right	Adrian Holovaty, Jacob Kaplan Moss	Second Edition, 2009	Springer-Verlag Berlin and Heidelberg GmbH & Co. KG Publishers
2.	Django Java Script Integration: AJAX and jQuery	Jonathan Hayward	First Edition, 2011	Pack Publishing
Reference Books:				
1.	Django 3 Web Development Cookbook	Aidas Bendroraitis, Jake Kronika	Fourth Edition, 2020	Packt Publishing
2.	Django for Beginners: Build websites with Python and Django	William Vincent	First Edition, 2018	Amazon Digital Services

Web links and Video Lectures (e-resources)
1. MVT architecture with Django: https://freevideolectures.com/course/3700/django-tutorials 2. Using Python in Django: https://www.youtube.com/watch?v=2BqoLiMT3Ao 3. Model Forms with Django: https://www.youtube.com/watch?v=gMM1rtTwKxE 4. Real time Interactions in Django: https://www.youtube.com/watch?v=3gHmfoeZ45k 5. AJAX with Django for beginners: https://www.youtube.com/watch?v=3VaKNyjlxAU

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 5th Sem	**Scheme: P24**	
Course Title: Cloud Computing		
Course Code: P24CI5052	**CIE Marks: 50**	**CIE Weightage: 50%**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage: 50%**
Teaching hours of Pedagogy:	**Exam Hours: 3**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

DBMS

Course learning Objectives:

CLO1: Identify the architecture, infrastructure and delivery models of cloud computing
CLO2: Compare and contrast different cloud services.
CLO3: Apply suitable virtualization concept.
CLO4: Apply Cloud automation and management tools to build your own cloud application in Google Cloud Platform.

Unit 1:	**Hrs: 8**

Introduction to Cloud Infrastructure

Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Major Challenges Faced by Cloud Computing, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing.

Text Book Mapping: Text Book 1: Chapter 1

Unit 2:	**Hrs: 8**

Cloud Computing: Application Paradigms and Concepts

Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Grep The Web application. Cloud Resource Virtualization-Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and Para virtualization, Hardware support for virtualization.

Text Book Mapping: Text Book 1: Chapter 2

Unit 3:	**Hrs: 8**

Resource Management and Scheduling

Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling Map Reduce applications subject to deadlines, Resource management and dynamic scaling.

Text Book Mapping: Text Book 1: Chapter 6

Unit4:	Hrs: 8
Google Cloud Platform and Services Types of Cloud Services, Cloud Computing vs. Data Center Computing. Computing Components of Google Cloud Platform, Storage Components of Google Cloud Platform, Networking Components of Google Cloud Platform, Additional Components of Google Cloud Platform. How GCP Organizes Projects and Accounts, Roles and Identities, Billing, Enabling APIs.	
Text Book Mapping: Text Book 2: Chapter 1, Chapter 2, Chapter 3.	
Unit 5:	**Hrs: 8**
Computation in Google Cloud Compute Engine, App Engine, Kubernetes Engine, Cloud Functions, Creating and Configuring Virtual Machines with the console, Creating and Configuring Virtual Machines with Cloud SDK, Basic Virtual Machine Management, Guidelines for planning, Deploying and Managing Virtual Machines, Managing Single Virtual Machine Instances, Introduction to Instance Groups, Guidelines for Managing Virtual Machine.	
Text Book Mapping: Text Book 2: Chapter 4, Chapter 5, Chapter 6.	

Course Outcomes

CO1	**Explain** the basic cloud computing concepts and distinguish between the various cloud infrastructures.
CO2	**Explain** application paradigm and concept
CO3	**Apply** different types of virtualization and Resource Management techniques that can be used in designing cloud applications.
CO4	**Explain** google platform and services.
CO5	**Apply** Google Cloud Platform using Qwiklabs to build cloud applications.

Suggested Learning Resources:

Textbooks:

Sl. No	Title	Author	Year & Edition (Latest)	Publisher
1.	Cloud Computing Theory and Practice	Dan C Marinescu	2013, (2nd edition)	Elsevier (MK)
2.	Official Google Cloud Certified Associate Cloud Engineer Study Guide,	Dan Sullivan	2019, (1st edition)	SYBEX

Reference Books:

1.	Cloud Computing Implementation, Management and Security	John W Rittinghouse, James F Ransome	2013	CRC Press

Web links and Video Lectures (e-resources)
1. AWS https://www.youtube.com/watch?v=k1RI5locZE4 2. GCP https://www.youtube.com/watch?v=m6ozQnqit50 3. Aneka https://www.youtube.com/watch?v=8FeysgQLwIo

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 5th Sem	**Scheme: P24**	
Course Title: Business Intelligence and its application		
Course Code: P24CI5053	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P) 3:0:0	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy: 40	**Exam Hours: 3Hours**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

Data understanding, Business and System Perception, Measurement System in general

Course learning Objectives:

CLO1: Comprehend the need of BI for a business enterprise.
CLO2: Summarize the types of Digital data & its operation.
CLO3: To outline the Need & Significance of data warehouse in BI applications.
CLO4: Identify the types and step involved in ETL process.
CLO5: To understand the measurement concept to evaluate business performance and build enterprise reports

Unit 1:	**Hrs: 8**

Business View of Information Technology Applications:
Business Enterprise Organization, Its Functions, and Core Business Processes; Baldrige Business Excellence Framework; Key Purpose of Using IT in Business; The Connected World: Characteristics of Internet-ready IT Applications; Enterprise Applications (ERP/CRM, etc.) and Bespoke IT Applications; Information Users and Their Requirements; Case Studies.

Types of Digital Data:
Introduction; Getting into "GoodLife" Database; Getting to Know Structured Data; Getting to Know Unstructured Data; Getting to Know Semi-Structured Data.

Text Book Mapping: Text Book 1-Chapter 1, Chapter 2

Unit 2:	**Hrs: 8**

Introduction to OLTP and OLAP:
OLTP (On-Line Transaction Processing); OLAP (On-Line Analytical Processing); Different OLAP Architectures; OLTP and OLAP; Data Models for OLTP and OLAP; Role of OLAP Tools in the BI Architecture; Should OLAP be Performed Directly on Operational Databases? A Peek into the OLAP Operations on Multidimensional Data.

Getting Started with Business Intelligence:
Using Analytical Information for Decision Support; Information Sources Before Dawn of BI? Business Intelligence (BI) Defined; Evolution of BI and Role of DSS, EIS, MIS, and Digital Dashboards; Need for BI at Virtually all Levels; BI for Past, Present, and Future; The BI Value Chain; Introduction to Business Analytics

Text Book Mapping: Text Book 1-Chapter 3, Chapter 4

Unit 3:	Hrs: 8
BI Definitions and Concepts: BI Component Framework; Who is BI for? BI Users; Business Intelligence Applications; BI Roles and Responsibilities; Best Practices in BI/DW; The Complete BI Professional. **Basics of Data Integration:** Need for Data Warehouse; Definition of Data Warehouse; What is a Data Mart? What is Then an ODS? Ralph Kimball's Approach vs. W.H. Inmon's Approach; Goals of a Data Warehouse; What Constitutes a Data Warehouse? Extract, Transform, Load; What is Data Integration? Data Integration Technologies; Data Quality; Data Profiling	
Text Book Mapping: Text Book 1-Chapter 5, Chapter 6	
Unit4:	**Hrs: 8**
Multidimensional Data Modeling: Introduction; Data Modeling Basics; Types of Data Model; Data Modeling Techniques; Fact Table; Dimension Table; Typical Dimensional Models; Dimensional Modeling Life Cycle. **Measures, Metrics, KPIs, and Performance Management:** Understanding Measures and Performance; Measurement System Terminology; Navigating a Business Enterprise, Role of Metrics, and Metrics Supply Chain; "Fact-based Decision Making" and KPIs; KPI Usage in Companies; Where Do Business Metrics and KPIs Come From?	
Text Book Mapping: Text Book 1-Chapter 7, Chapter 8	
Unit 5:	**Hrs: 8**
Basics of Enterprise Reporting: Reporting Perspectives Common to All Levels of Enterprise; Report Standardization and Presentation Practices; Enterprise Reporting Characteristics in OLAP World; Balanced Scorecard; Dashboards; How Do You Create Dashboards? Scorecards vs. Dashboards **Bi Road Ahead:** Understanding BI and Mobility; BI and Cloud Computing; Business Intelligence for ERP Systems; Social CRM and BI.	
Text Book Mapping: Text Book 1-Chapter 9, Chapter 13	

Course Outcomes

CO1	Interpret the business view of information technology applications
CO2	Summarize the types of Digital data & its operation.
CO3	Outline the Need & Significance of data warehouse in BI applications
CO4	Explain the basics of data integration including data quality and data profiling and implement various data integration approaches
CO5	Identify Key Performance Indicators, Business Metrics, Future of BI, creation of Enterprise Reports.

Suggested Learning Resources:				
Textbooks:				
Sl. No	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
1.	Fundamentals of Business Analytics	Prasad RN, Seema Acharya	Second Edition	Wiley India Pvt. Ltd.
Reference Books:				
1.	Building the Data Warehouse	William H. Inmon	4th Edition	Wiley India Ed.
2.	Business Intelligence	David Loshin	2003,(First Edition)	Elsevier Science

Web links and Video Lectures (e-resources)
1. https://www.mygreatlearning.com/academy 2. https://www.youtube.com/@SimplilearnOfficial 3. https://nptel.ac.in/courses 4.https://www.khanacademy.org/math/statistics-probability

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 5th Sem	**Scheme: P24**	
Course Title: Game Theory and Application		
Course Code: P24CI5054	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P):3:0:0	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:40	**Exam Hours: 3Hours**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

- Basic Engineering Mathematics (Matrices, Probability, and Elementary Linear Algebra)
- Logical and Analytical Thinking
- Fundamentals of Discrete Mathematics (Sets, Relations, Functions, Logic)
- Basic Programming Concepts (preferred but not mandatory)
- Ability to solve quantitative and reasoning problems

Course learning Objectives:

CLO1: Understand the fundamental concepts of game theory, including strategic interactions, rational decision-making, and Nash equilibrium.

CLO2: Analyze strategic games involving pure and mixed strategies and evaluate equilibrium solutions under different game settings.

CLO3: Apply solution concepts such as subgame perfect equilibrium and backward induction to extensive-form games with perfect information.

CLO4: Examine games with incomplete information, Bayesian decision-making, and auction mechanisms to model real-world strategic interactions.

CLO5: Evaluate competitive and repeated games to understand long-term strategic behaviour and optimal decision-making in competitive environments.

Unit 1:	**Hrs: 8**

Introduction to Strategic Games: What is game theory? The theory of rational choice, Strategic games; Examples: The prisoner's dilemma, Bach or Stravinsky, Matching pennies; Nash equilibrium; Examples of Nash equilibrium; Best response functions; Dominated actions

Text Book Mapping: Text book 1 Chapter 1,Chapter 2

Unit 2:	**Hrs: 8**

Introduction; Strategic games in which players may randomize; Mixed strategy Nash equilibrium; Dominated actions; Pure equilibrium when randomization is allowed.Illustration: Expert Diagnosis; Equilibrium in a single population

Text Book Mapping: Text book 1 Chapter 4

Unit 3:	**Hrs: 8**

Extensive games with perfect information; Strategies and outcomes; Nash equilibrium; Subgame perfect equilibrium; Finding sub-game perfect equilibria of finite horizon games: Backward induction; Illustrations: The ultimatum game, Stackelberg's model of duopoly

Text Book Mapping: Text book 1 Chapter 5,Chapter 6

Unit4:	Hrs: 8
Bayesian Games, Motivational examples; General definitions; Two examples concerning information; Illustrations: Cournot's duopoly game with imperfect information, Providing a public good; Auctions: Auctions with an arbitrary distribution of valuations	
Text Book Mapping: Text book 1 Chapter 9	

Unit 5:	Hrs: 8
Competative Games: Strictly competitive games and maximization. Repeated games: The main idea; Preferences; Repeated games; Finitely and infinitely repeated Prisoner's dilemma; Strategies in an infinitely repeated Prisoner's dilemma; Nash equilibrium of an infinitely repeated Prisoner's dilemma, Nash equilibrium payoffs of an infinitely repeated Prisoner's dilemma	
Text Book Mapping: Text book 1 Chapter 11,Chapter 14	

Course Outcomes

CO1	Explain the principles of strategic games, rational choice, dominant strategies, best response functions, and Nash equilibrium for solving strategic decision problems.**Bloom's Level:** L2 (Understand)
CO2	Analyze mixed strategy games and determine equilibrium strategies in situations where players employ probabilistic decision-making. **Bloom's Level:** L4 (Analyze)
CO3	Apply backward induction and subgame perfect equilibrium concepts to solve extensive-form games with perfect information. **Bloom's Level:** L3 (Apply)
CO4	Analyze Bayesian games, auctions, and games with incomplete information to model uncertainty and strategic behaviour.**Bloom's Level:** L4 (Analyze)
CO5	Evaluate competitive and repeated games to determine optimal strategies and equilibrium outcomes in long-term strategic interactions.**Bloom's Level:** L5 (Evaluate)

Suggested Learning Resources:				
Textbooks:				
Sl. No	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
1.	An Introduction to Game Theory	Martin Osborne	First Indian Edition, 2009, 7th impression	Oxford University Press
Reference Books:				
1.	Analysis of Conflict Game Theory	Roger B. Myerson	Re-print Edition, 2008	Harvard University Press
2.	Introduction to Operations Research, Concepts and Cases	Frederick S. Hillier and Gerald J. Lieberman	9th Edition, 2010	Tata McGraw Hill
3.	An Introduction to Game Theory	Joel Watson	Strategy, 2nd Edition, 2007	W.W. Norton & Company

Web links and Video Lectures (e-resources)
1. http://nptel.ac.in/courses.php?disciplineID=111 2. http://www.class-central.com/subject/math(MOOCs) 3. http://academicearth.org/

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 5th Sem	**Scheme: P24**	
Course Title: Deep Learning Laboratory		
Course Code: P24CIL506	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:	**Exam Hours:**	
Team work + Self-study Hrs:		
Credits: 1		

Prerequisite: Python, Data Structures and Algorithms, Artificial Intelligence and Machine Learning, Python development environments such as Jupyter Notebook or Google Colab and Basic knowledge of TensorFlow/Keras or PyTorch

Course learning Objectives:

After successful completion of the **Deep Learning Laboratory**, students will be able to:
CLO1: Develop Python-based programs for data preprocessing, visualization, and clustering using standard machine learning libraries.
CLO2: Design, implement, and evaluate Artificial Neural Network (ANN) models using appropriate activation functions, loss functions, and backpropagation techniques.
CLO3: Apply optimization and regularization techniques to improve the training efficiency and generalization performance of deep learning models.
CLO4: Build and evaluate Convolutional Neural Network (CNN) models and apply transfer learning using pretrained architectures for image classification tasks.
CLO5: Develop Recurrent Neural Network (RNN), LSTM, GRU, and Deep Reinforcement Learning models to solve sequence prediction and decision-making problems using modern deep learning frameworks.

PART – A [Implement any 2 – 3 Experiments from each Unit]

Unit 1: Introduction to Deep Learning & Clustering

Experiment 1
Implement Python programs to perform basic data preprocessing and visualization using NumPy, Pandas, and Matplotlib.

Experiment 2
Implement **K-Means Clustering** on a real-world dataset and evaluate the clusters using the Elbow Method and Silhouette Score.

Experiment 3
Implement **Hierarchical Clustering** and compare its performance with K-Means using suitable proximity measures.

Experiment 4
Implement **DBSCAN (Density-Based Clustering)** and compare the clustering results with partition-based clustering methods.

Unit 2: Artificial Neural Networks

Experiment 5
Implement a **Single Layer Perceptron** for binary classification using Python.

Experiment 6
Develop a **Multilayer Perceptron (MLP)** using TensorFlow/Keras for a classification problem.

Experiment 7

Compare the performance of different **Activation Functions** (Sigmoid, Tanh, ReLU, Leaky ReLU, Softmax).

Experiment 8

Implement the **Backpropagation Algorithm** and analyze the effect of different loss functions on model performance.

Unit 3: Optimization & Regularization

Experiment 9

Compare **Batch Gradient Descent, Stochastic Gradient Descent (SGD), and Mini-Batch Gradient Descent** on a neural network model.

Experiment 10

Implement **Regularization Techniques** (L1, L2, Dropout, Early Stopping) and analyze their effect on overfitting.

Experiment 11

Perform **Hyperparameter Tuning** using Grid Search or Random Search for an ANN model.

Unit 4: Convolutional Neural Networks & Transfer Learning

Experiment 12

Build a **Convolutional Neural Network (CNN)** for handwritten digit classification using the MNIST dataset.

Experiment 13

Implement a CNN for **Image Classification** using the CIFAR-10 dataset.

Experiment 14

Implement **Transfer Learning** using pretrained models (VGG16, ResNet50, MobileNetV2, or EfficientNet) for image classification.

Experiment 15

Compare the performance of different pretrained CNN architectures on a custom image dataset.

Unit 5: Recurrent Neural Networks & Deep Reinforcement Learning

Experiment 16

Implement a **Recurrent Neural Network (RNN)** for sequence prediction or sentiment analysis.

Experiment 17

Implement **LSTM and GRU** models for time-series forecasting or text classification and compare their performance.

Experiment 18

Implement **Q-Learning** on a simple Grid World or FrozenLake environment.

Experiment 19

Implement a **Deep Q-Network (DQN)** using the OpenAI Gym environment (e.g., CartPole) and analyze the learning performance.

PART – B **[Mini – Project]**

Develop an end-to-end **Deep Learning application** using TensorFlow or PyTorch on a real-world dataset (e.g., image classification, sentiment analysis, object detection, or time-series forecasting). Prepare a technical report and present the results.

Course Outcomes (COs) Upon successful completion of the **Deep Learning Laboratory** course, students will be able to:	
CO1:	Implement data preprocessing techniques and clustering algorithms to analyze and interpret patterns in datasets using appropriate evaluation metrics.
CO2:	Design and implement Artificial Neural Network (ANN) models using perceptrons, multilayer neural networks, activation functions, loss functions, and backpropagation for classification tasks.
CO3:	Apply optimization algorithms, hyperparameter tuning, and regularization techniques to improve the performance and generalization of deep learning models.
CO4:	Develop Convolutional Neural Network (CNN) models and apply transfer learning using pretrained architectures for image classification and computer vision applications.
CO5:	Implement Recurrent Neural Networks (RNNs), LSTM, GRU, and Deep Reinforcement Learning algorithms to solve sequence modeling and decision-making problems.

Semester: 5th Sem	**Scheme: P24**	
Course Title: Natural Language Processing Laboratory		
Course Code: P24CIL507	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:	**Exam Hours:**	
Team work + Self-study Hrs:		
Credits: 1		

Prerequisite:

Concepts of Machine Learning , Automata Theory and Formal Languages

Course learning Objectives:

Course Learning Objectives: This course will enable the students to:

CLO1: Understand the basic concepts and basic algorithms of Natural language processing.

CLO2: Apply the principles and Process of Human Languages such as English and other Indian Languages using computers

CLO3: Ability to use existing natural language processing tools to conduct basic natural language processing, such as text normalization, or syntactic parsing.

CLO4: Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology

Practical Component topics

1. To implement and simulate a DFA for binary strings ending with "01" and an NFA for strings containing the substring "ab".
2. To implement and demonstrates an ambiguous grammar by showing multiple valid parse interpretations for the same input expression.
3. Perform Preprocessing (Tokenization, Stop word removal and stemming) of Text
4. Perform Removal of regular expression pattern from textual data
5. Perform Morphological Analysis
6. Implement N-Gram Model
7. Implement Part-of-Speech (POS) Tagging
8. Implement Chunking to extract Noun Phrases Identify semantic relationships between the words from given text
9. Case study 1: Identify the Sentiment of tweets
10. Detect hate speech in tweets

Course Outcomes (COs)

CO1	Implement the way N-gram tool is used for spelling and pronunciation processing, and part-of-speech tagging mechanism using various categories.
CO2	Implement problems that NLP systems face, natural language outputs construction from non-linguistic inputs and machine translation framework approaches.

Semester: 5th Sem	**Scheme: P24**	
Course Title: Employability Enhancement Skills - V		
Course Code: P24HSMC509A	**CIE Marks: 50**	**CIE Weightage: 50%**
Teaching hours/week (L:T:P) 0:2:0	**SEE Marks: 50**	**SEE Weightage:50%**
Teaching hours of Pedagogy: 42 Hours	**Exam Hours: 2Hours**	
Team work + Self-study Hrs: As per the self-study components indicated unit-wise		
Credits: 1		

Prerequisite:

Employability Enhancement Skills – IV (linear data structures and OOP fundamentals)

Course learning Objectives:

CLO1: Perform calculations involving percentages, profit & loss and discounts.
CLO2: Explain concepts behind logical reasoning modules of direction sense and blood relations.
CLO3: Prepare students for the job recruitment process and competitive exams.
CLO4: Develop problem solving skills.
CLO5: Apply programming constructs of C language to solve real-world problems.

Unit 1:	**Hrs: 10**

Quantitative Aptitude: Time and Work, Time, Speed and Distance.
Logical Reasoning: Clocks and Calendars.
Self-study component: Decimal fractions.

Unit 2:	**Hrs: 8**

Quantitative Aptitude: Trains, Boats and Streams, Races.
Verbal Ability: Reading Comprehension, Critical Reasoning.
Self-study component: Game based assessments.

Unit 3:	**Hrs: 8**

ADVANCED DATA STRUCTURES – I

Priority Queues: Introduction to Priority Queues, Ways to implement priority queues, Introduction to heaps, Introduction to Complete Binary Trees and its implementation, Insert and Delete operations in heaps, Implementing priority queues, Heap sort, Inbuilt Priority Queue. **Hashmaps:** Introduction to Hashmaps, Inbuilt Hashmap, Hash functions, Collision handling, Insert and Delete operation implementation in hashmap, Load factor, Rehashing. **Self-study component:** Applications of Queues: Josephus Problem.

Unit 4:	**Hrs: 8**

ADVANCED DATA STRUCTURES – II

Tries: Introduction to Tries, Making a Trie Node class, Insert, Search and Remove operation implementation in Tries, Types of Tries, Huffman coding.
Graphs: Introduction to Graphs, Graph Terminology, Graph implementation, Graph Traversals (DFS and BFS), Weighted and Directed Graphs, Minimum Spanning Trees, Cycle Detection in Graphs, Kruskal's algorithm, Prim's algorithm, Dijkstra's algorithm.
Self-study component: Optimal Binary Search Trees.

Unit 5:	Hrs: 8

ADVANCED DATA STRUCTURES – III

Introduction to Dynamic Programming: Introduction to Memoization, Introduction to Dynamic Programming, Fibonacci numbers using recursion, memoization and dynamic programming.

Applications of Dynamic Programming: Longest Common Subsequence (LCS) using recursion, memoization and dynamic programming, Edit distance using recursion, memoization and dynamic programming, Knapsack problem using recursion, memoization and dynamic programming.

Self-study component: *Lower Bound Arguments, Decision trees.*

Course Outcomes

CO1	Solve the problems based on time and work, speed & distance, trains, boats and streams and races.
CO2	Solve logical reasoning problems based on clocks and calendars and verbal ability skills of reading comprehension and critical reasoning.
CO3	Analyze and represent various data structures and their operations.
CO4	Develop programs with suitable data structures based on the requirements of real-time applications.

Suggested Learning Resources:

Textbooks:

Sl. No	Title	Author	Year & Edition (Latest)	Publisher
1.	Data Structures and Algorithms Made Easy	Narasimha Karumanchi	5th Ed., 2016	CareerMonk
2.	Data Structures Through C in Depth	S. K. Srivastava & Deepali Srivastava	2nd Ed., 2011	BPB Publications
3.	Quantitative Aptitude	Dr. R. S. Aggarwal	Revised Ed., 2022	S. Chand
4.	Verbal Reasoning	Dr. R. S. Aggarwal	Revised Ed., 2018	S. Chand

Reference Books:

1.	Data Structures Using C	Tenenbaum, Langsam & Augenstein	Low Price Ed., 2014	Pearson Education
2.	Data Structures with C (Schaum's Outline Series)	Seymour Lipschutz	2017	McGraw Hill Education
3.	Quantitative Aptitude	Arun Sharma	Latest Ed.	McGraw Hill Education

Web links and Video Lectures (e-resources)

1. Data Structures and Algorithms (NPTEL) – https://nptel.ac.in/courses/106102064
2. Video lectures – https://www.youtube.com/watch?v=CBYHwZcbD-s , https://www.youtube.com/watch?v=2ZLl8GAk1X4 , https://www.youtube.com/watch?v=MdG0Vw9f1A4
3. Data structures tutorials and practice – https://www.geeksforgeeks.org/data-structures/
4. Algorithm visualisations – https://visualgo.net/en
5. Dynamic programming practice – https://leetcode.com/tag/dynamic-programming/

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Hands-on lab – implementing heaps and hashmaps (Learn by Doing) 2. Team demonstration – tracing DFS/BFS and shortest-path algorithms 3. Dynamic programming problem-solving contest 4. Timed aptitude drills simulating placement tests 5. Seminar / poster presentation on real-world applications of graphs and tries

Semester: 6th	**Scheme: P24**	
Course Title: Computer Vision		
Course Code: P24CI602	**CIE Marks: 50**	**CIE Weightage:50**
Teaching hours/week (L:T:P):3:0:0	**SEE Marks:50**	**SEE Weightage:50**
Teaching hours of Pedagogy: 40	**Exam Hours: 3 Hours**	
Team work + Self-study Hrs: 2		
Credits:03		

Prerequisite:

Python Programming & Knowledge of Engineering Mathematics

Course learning Objectives:

CLO-1: Program and manipulate digital images using Python libraries to handle diverse image formats and implement de-noising workflows.

CLO-2: Apply spatial filters, Canny edge detection, and morphological operations to segment and analyze binary image structures.

CLO-3: Compute local image descriptors like SIFT and implement image warping to stitch panoramic scenes.

CLO-4: Analyze multi-view geometry and stereo images to reconstruct 3D structures and build content-based image search indexes.

CLO-5: Design and deploy object tracking systems utilizing optical flow, Kalman filters, or particle filters for video surveillance applications.

Unit 1:	**Hrs: 8**

Image Representation, Handling and Processing

Sensing light, Imaging Device, Problem in digital Images, Picture function and digital mages, Digital Image Formats, Richness and Problems of Real Imagery, Other Types of Sensors.

Basic Image Handling and Processing, PIL—The Python Imaging Library, Matplotlib, NumPy SciPy Advanced Example: Image De-Noising

Textbook Chapter Mapping: Text1: Unit-2 & Text 2: Unit-1

Unit 2:	**Hrs: 8**

Spatial Filtering & Binary Image Analysis

Filtering And Enhancing Images: What needs Fixing, Grey Level Mapping, Removal of Small Image Region, Image Smoothing, Median Filtering,

Edge and Future Detection: Detecting Edges using Differencing Masks, The Canny edge detector, Mask as Matched Filters, Pixels and Neighborhoods, Applying mask to Images, Counting the Object in an Image, Connected Components Labeling, Binary Image Morphology: Structuring Elements, Basic Operations, Some Basic Applications of Binary Morphology, Conditional Dilation.

Textbook Chapter Mapping: Text1: ext1: Unit-3 & Text 2: Unit-2

Unit 3:	**Hrs: 8**

Local Descriptors, Image Mappings and Camera Models

Local Image Descriptors: Harris Corner Detector, SIFT—Scale-Invariant Feature Transform, Matching Geotagged Images.

Image to Image Mappings: Homographies, Warping images ,Creating Panoramas.

The Pin-hole Camera Model, Camera Calibration, Pose Estimation from Planes and Markers.

Textbook Chapter Mapping: Text 2: Unit3, Unit-4	
Unit4:	**Hrs: 8**
Multiple View Geometry Multiple View Geometry: Epipolar Geometry, Computing with Cameras and 3D Structure ,Multiple View Reconstruction, Stereo Images, Searching Images, Content-based Image Retrieval,Visual Words , Indexing Images , Searching the Database for Images , Ranking Results using Geometry ,Building Demos and Web Applications .	
Textbook Chapter Mapping: Text 2: Unit-5, Unit-7	
Unit 5:	**Hrs:8**
Advanced Deep Learning Recognition & Segmentation Motion Estimation and object Tracking: Overview of video surveillance system, Background Subtraction and Modelling, Object Tracking, Kanade-Lucus-Tomasi Tracker, Mean Shift Tracking, Blob Matching, Tracking with Kalaman Filter, Tracking with Particle Filter, Multiple Camera Based object Tracking, Motion Estimation by Opticle flow,MPEG-7 Motion trajectory representation	
Textbook Chapter Mapping: Text 3: Unit-5	

Course Outcomes

CO1	Understand and apply core principles of image acquisition, digital representation, and Python-based program execution to load, manipulate, and process visual media.
CO2	Analyze and implement spatial filtering, neighborhood operations, and mathematical morphology to solve image enhancement and segmentation challenges.
CO3	Develop and evaluate local feature descriptor models and homography matrices to map multi-view geometric configurations and camera parameters.
CO4	Synthesize 3D structures from multiple structural views and deploy content-based image indexing tools for database queries.
CO5	Design and implement temporal motion analysis pipelines and multi-object probabilistic tracking workflows to handle real-world video analytics.

Suggested Learning Resources:				
Textbooks:				
Sl. No	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
1	Computer Vision	Linda Shapiro, Gorge Stockman	23 January 2001	Pearson Prentice Hall
2	Programming Computer Vision with Python	Jan Erik Solem.	Copyright ©2012	O'Reilly Publications
3	Computer Vision and Image Processing	Manas Kamal Bhuyan	© 2020 by Taylor & Francis Group,	CRC Press Taylor & Francis Group
Reference Books:				
1.	Computer Vision: Algorithms and Applications	Richard Szeliski	c 2010 Springer	Szliski Publications. http://szeliski.org/Book/.

Web links and Video Lectures (e-resources)
1. https://scikit-learn.org/stable/modules/clustering.html 2. https://pillow.readthedocs.io/en/stable/handbook/index.html

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 6th	**Scheme: P24**	
Course Title: Agentic AI and Automation		
Course Code: P24CI603	**CIE Marks: 50**	**CIE Weightage:50**
Teaching hours/week (L:T:P)	**SEE Marks:50**	**SEE Weightage:50**
Teaching hours of Pedagogy:	**Exam Hours: 3hrs**	
Team work + Self-study Hrs:		
Credits: 03		

Prerequisite:

Mathematical Foundational Subjects, & Core Knowledge of AIML

Course learning Objectives:

CLO-1: Demonstrate an understanding of generative AI and agentic systems by explaining core concepts, identifying model types and applications, and analyzing the architecture, autonomy, and behavior of intelligent and multi-agent systems.

CLO-2: Explain and apply the essential components and reflective capabilities of intelligent agents to design adaptive, generative AI-based systems.

CLO-3: Design intelligent agents by integrating knowledge representation, reasoning, learning, and generative AI to build adaptive and reflective agentic systems.

CLO-4: Design and develop trustworthy agentic AI systems by applying environment modeling, memory architecture, processing workflows, and ethical principles such as transparency and explainability.

CLO-5: Demonstrate an understanding of safety, ethical considerations, and real-world applications in the design and deployment of agentic AI systems.

Unit 1:	**Hrs: 8**

Fundamentals of Generative AI: Introduction to generative AI, Types of generative AI models, Applications of generative AI, Challenges and Limitations of generative AI.

Principles of Agentic Systems: Technical requirements, Understanding self-governance, agency and autonomy, Exploring the architecture of agentic systems, Reviewing intelligent agents and their characteristics.

Textbook Chapter Mapping: T1: Chapters 1 & 2

Unit 2:	**Hrs: 8**

Essential Components of Intelligent Agents: Technical requirements, Knowledge representation in intelligent agents, Reasoning in intelligent agents, Learning mechanisms for adaptive agents, Decision-making and planning in agentic systems, Enhancing agent capabilities with generative AI.

Designing and Implementing Generative AI-Based Agents: Technical requirements, The importance of reflection in agents, Use cases and examples, Introspection in intelligent agents.

Textbook Chapter Mapping: T1: Chapters 3 & 4

Unit 3:	Hrs: 8
Enabling Tool Use and Planning in Agents: Technical requirements, Understanding the concept of tool use in agents, Planning algorithms for agents, Integrating tool use and planning. **Exploring the Coordinator, Worker, and Delegator Approach: Technical** requirements, Understanding the CWD model, Designing agents with role assignments, Communication and collaboration between agents, Implementing the CWD approach in generative AI systems.	
Textbook Chapter Mapping: T1: Chapters 5 & 6	
Unit4:	**Hrs: 8**
Effective Agentic System Design Techniques: Technical requirements, Focused system prompts and instructions for agents, State spaces and environment modeling, Agent memory architecture and context management, Sequential and parallel processing in agentic workflows. **Trust, Safety, Ethics, and Applications:** Technical requirements, Importance of trust in AI, Techniques for establishing trust, Implementing transparency and explainability.	
Textbook Chapter Mapping: T1: Chapters 7 & 8	
Unit 5:	**Hrs: 8**
Managing Safety and Ethical Considerations: Understanding potential risks and challenges, Ensuring safe and responsible AI, Exploring ethical guidelines and frameworks. **Common Use Cases and Applications:** Creative and artistic applications, Natural language processing and conversational agents, Decision support and optimization.	
Textbook Chapter Mapping: T1: Chapters 9 & 10	

Course Outcomes

CO1	**Explain** the fundamental concepts, model types, and applications of generative AI and agentic systems.
CO2	**Apply** the principles of knowledge representation, reasoning, and learning to design intelligent and adaptive agents.
CO3	**Develop** generative AI-based agentic systems with reflective capabilities for real-world problem-solving.
CO4	**Implement** environment modeling, memory management, and workflow techniques to build safe, transparent, and trustworthy agentic AI systems.
CO5	**Analyze** ethical, safety, and societal implications of agentic AI and apply responsible practices in various application domains.

Suggested Learning Resources:				
Textbooks:				
Sl. No	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
1	Building Agentic AI Systems	Anjanava Biswas & Wrick Talukdar	2025	Packt Publishing
Reference Books:				
1.	AI Agents in Action	Michael Lanham	2025	Manning Publications Co. (Shelter Island, NY)

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 6th Sem	**Scheme: P24**	
Course Title: IoT Communication Protocols		
Course Code: P24CI6041	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:	**Exam Hours:**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

Computer Networks

Course learning Objectives:

CLO1: Understand fundamentals of IoT architecture outline and standards.
CLO2: Understand and analyse different architectural views.
CLO3: Understand the importance of IoT Layer Protocols.
CLO4: Understand the importance of architecture and Industrial Internet of Things.

Unit 1:	**Hrs: 8**

Fundamentals of IoT Introduction

IoT Technology trends and future opportunities, IoT and Business scope Evolution, Business perspectives, Embedded systems Relationships, Challenges of IoT, Characteristics of IoT, Sensors and Actuators in IoT enabling Industrial Automation, Wireless sensor Networks in IoT, connecting all the things in Internet of things, IoT M2M, Software Define Networking.

Textbook Chapter Mapping: Textbook: Ch1, 1.1-1.13

Unit 2:	**Hrs: 8**

IoT protocols

Introduction IOT life cycle , Physical Design, IOT Conceptual architecture, IOT protocols, Levels of IOT, IOT networking Protocols

Textbook Chapter Mapping: Textbook: Ch.3 3.1-3.8

Unit 3:	**Hrs: 8**

IoT protocols

Introduction of 5G networks in IoT, IoT Networking consideration and Challenges, Business case for the IoT, Network optimization for IoT devices, Transport Layer protocols, Network Layer Protocols, IoT communication Challenges.

Textbook Chapter Mapping: Textbook: Ch.3, 3.9-3.17.

Unit4:	**Hrs: 8**

IIOT

Introduction, Evolution of IIOT, Advantages of IIOT, Drivers, Risk associated with IIOT, Businesses and Industries approach IIOT security, Applications of IIOT, Work flow of IIOT, Security considerations and challenges

Textbook Chapter Mapping: Textbook: ch.4, 4.1-4.11

Unit 5:	**Hrs: 8**
Architecture of IIOT Introduction, IIOT layered Architecture, three tier IIOT, Security in IIOT, Service based Frameworks, Solutions against Intrusions in IIOT, Machine learning based solutions.	
Textbook Chapter Mapping: Textbook: Ch.5, 5.1-5.9	

Course Outcomes

CO1	Understand fundamentals of IoT and Architecture.
CO2	Illustrate the different layers of IoT protocols.
CO3	Explore the importance of Industrial IoT.
CO4	Demonstrate Use cases of IIoT applications.

Suggested Learning Resources:				
Textbooks:				
Sl. No	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
1.	IoT Communication Protocols	Dr. Vijendra Pratap Singh, Mr. Neeraj Kumar	2023	Deccan International Academic Publishers
Reference Books:				
1.	Architecting the Internet of Things	Bernd Scholz-Reiter, Florian Micha Helles	2016	Springer

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 6th Sem	**Scheme: P24**	
Course Title: Fundamentals of DevOp's		
Course Code: P24CI6042	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:	**Exam Hours:**	
Team work + Self-study Hrs: 40		
Credits: 3		

Prerequisite:

Cloud Computing

Course learning Objectives:

CLO1: The objective of the course is to acquaint students with the principles and philosophies of DevOps and to explain the foundational material for DevOps.

CLO2: It also introduces students to basic DevOps tools used in the industry for DevOps Engineering.

CLO3: Students will have a hands-on experience of building a CI/CD pipeline for continuous Integration, continuous delivery from start to finish.

CLO4: It also introduces students to Docker and its details.

CLO5: It also introduces students to Kubernetes and its details.

Unit 1:	**Hrs: 8**

DevOps Culture and Practices,Getting started with DevOps, Implementing CI/CD and continuous deployment, Continuous integration(CI), Implementing CI,Continuous delivery(CD),Continuous deployment,Understanding IaC practices,The benefits of IaC, IaC languages and tools,Scripting types, Declarative types,The IaC topology, The deployment and provisioning of the infrastructure, Server configuration, Immutable infrastructure with containers, Configuration and deployment in Kubernetes, IaC best practices

Optimizing Infrastructure Deployment with Packer:

Technical requirements,An overview of Packer, Installing Packer,Installing manually, Installing by script, Installing Packer by script on Linux, Installing Packer by script on Windows, Integrating Packer with Azure Cloud Shell, Checking the Packer installation, Creating Packer templates for Azure VMs with scripts,The structure of the Packer template, The builders section, The provisioners section, The variables section,Building an Azure image with the Packer template,Using Ansible in a Packer template,Writing the Ansible playbook,Integrating an Ansible playbook in a Packer template,Executing Packer,Configuring Packer to authenticate to Azure,Checking the validity of the Packer template,Running Packer to generate our VM image

Textbook Chapter Mapping: Chapter 1 and chapter 4

Unit 2:	**Hrs: 8**

DevOps CI/CD Pipeline I : Managing Your Source Code with Git,Technical requirements, Overviewing Git and its command lines, Git installation, Configuration Git, Git vocabulary, Git command lines, Retrieving a remote repository, Initializing a local repository, Configuring a local repository, Adding a file for the next commit, Creating a commit, Updating the remote repository, Synchronizing the local repository from the remote, Managing branches, Understanding the Git

process and GitFlow pattern,Starting with the Git process,Creating and configuring a Git repository, Committing the code, Archiving on the remote repository, Cloning the repository, The code update, Retrieving updates,Isolating your code with branches, Branching strategy with GitFlow, The GitFlow pattern, GitFlow tools.

Textbook Chapter Mapping: Chapter 6

Unit 3:	**Hrs: 8**

DevOps CI/CD Pipeline II: Continuous Integration and Continuous Delivery, Technical requirements, The CI/CD principles, Continuous integration(CI) ,Continuous delivery(CD),Using a package manager,Private NuGet and npm repository, Nexus Repository OSS,Azure Artifacts,Using Jenkins,Installing and configuring Jenkins, Configuring a GitHub webhook, Configuring a Jenkins CI job,Executing the Jenkins job,Using Azure Pipelines, Versioning of the code with Git in Azure Repos,Creating the CI pipeline,Creating the CD pipeline :the release, Using GitLab CI, Authentication at GitLab, Creating a new project and managing your code source, Creating the CI pipeline,Accessing the CI pipeline execution details.

Textbook Chapter Mapping: Chapter 7

Unit4:	**Hrs: 8**

Containerized Applications with Docker: Containerizing Your Application with Docker, Technical requirements, Installing Docker, Registering on Docker Hub, Docker installation, An overview of Docker's elements, Creating a Dockerfile , Writing a Dockerfile, Dockerfile instructions overview, Building and running a container on a local machine,Building a Docker image,Instantiating a new container of an image, Testing a container locally, Pushing an image to Docker Hub, Deploying a container to ACI with a CI/CD pipeline, The Terraform code for ACI, Creating a CI/CD pipeline for the container.

Textbook Chapter Mapping: Chapter 9

Unit 5:	**Hrs: 8**

Containerized Applications with Kubernetes : Managing Containers Effectively with Kubernetes, Technical requirements, Installing Kubernetes, Kubernetes architecture overview, Installing Kubernetes on a local machine, Installing the Kubernetes dashboard, First example of Kubernetes application deployment, Using HELM as a package manager, Using Azure Kubernetes service, Configuring kubectl for Azure Kubernetes services Advantages of Azure Kubernetes Service, Creating a CI/CD pipeline for Kuberrnetes with Azure Pipelines, The build and push of the image in the Decker Hub , Automatic deployment of the application in Kubermetes

Textbook Chapter Mapping: Chapter 10

Course Outcomes

CO1	**Apply** various **Concepts** and **Principles** used in the topics to understand the theory related to DevOps.
CO2	**Discuss** the fundamental **Definitions** of DevOps & Github relevant to Software development and deployment.
CO3	**Assess** the CI/CD **problems** by applying proper solutions to verify the theoretical concepts.
CO4	**Understand** the various **Properties** and **Applications** pertaining **to Dockers.**
CO5	**Understand** the various **Properties** and **Applications** pertaining to Kubernetes.

Suggested Learning Resources:

Textbooks:

Sl. No	Title	Author	Year & Edition (Latest)	Publisher
1.	Learning DevOps	Mikel Krief	October 2019	Published by Packt Publishing Ltd
2.	DevOps Bootcamp	Mitesh Soni	May 2017	Published by Packt Publishing Ltd
Reference Books:				
1.	DevOps Automation Cookbook	Michael Duffy	Nov, 2015	Published by Packt Publishing Ltd
2.	Effective DevOps	Jennifer Davis	June 2016	Published by O'Reilly Media,in
3.	implementing Modern DevOps	David Gonzalez	Oct 2011	Published by Packt Publishing Ltd

Web links and Video Lectures (e-resources)

1. 1. https://learn.microsoft.com/en-us/azure/devops
2. https://www.guvi.in/devops
3. https://www.youtube.com/watch?v=hQcFE0RD0cQ

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Semester: 6th Sem	**Scheme: P24**	
Course Title: Robotics Process Automation – Design and Development		
Course Code: P24CI6043	**CIE Marks: 50**	**CIE Weightage: 50**
Teaching hours/week (L:T:P): 3:0:0	**SEE Marks: 50**	**SEE Weightage: 50**
Teaching hours of Pedagogy: 40	**Exam Hours: 3Hours**	
Team work + Self-study Hrs: 40		
Credits: 3		

Prerequisite:

Basic knowledge of computer fundamentals, Windows operating system, and programming concepts such as variables, loops, and decision-making. Familiarity with MS Office applications and basic problem-solving skills is desirable.

Course learning Objectives:

CLO1: Understand the basic concepts of RPA platform.
CLO2: Describe the different types of variables, control flow and data manipulation techniques.
CLO3: Understand various control techniques, plugins and extensions in RPA
CLO4: Describe various types and strategies to handle events and exceptions.

Unit 1:	**Hrs: 8**

Robotic Process Automation: Introduction, Scope and techniques of automation Robotic process automation, About UiPath, The future of automation. Record and Play: Record and Play, UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder.

Textbook Chapter Mapping: Textbook 1 – Chapter 1, Chapter 2

Unit 2:	**Hrs: 8**

Sequence, Flowchart, and Control Flow: Sequence, Flowchart, and Control Flow, Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart. Data Manipulation: Data Manipulation, Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example.

Textbook Chapter Mapping: Textbook 1 – Chapter 3, Chapter 4

Unit 3:	**Hrs: 8**

Taking Control of the Controls: Taking Control of the Controls, Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with Ui Explorer, Handling events, Revisit recorder, Screen Scraping, When to use OCR, Types of OCR available, Avoiding typical failure points.

Textbook Chapter Mapping: Textbook 1 – Chapter 5

Unit4:	**Hrs: 8**

Tame that Application with Plugins and Extensions: Tame that Application with Plugins and Extensions, Terminal plugin, SAP automation, Java plugin, Citrix automation, Mail plugin, PDF plugin, Excel and Word plugins. Handling User Events and Assistant Bots: Handling User Events and Assistant Bots, What are assistant bots? Monitoring system event triggers, monitoring image and element triggers, Launching an assistant bot on a keyboard event.

Textbook Chapter Mapping: component: Component: Textbook 1 – Chapter 6, Chapter 7	
Unit 5:	**Hrs: 8**
Exception Handling, Debugging, and Logging: Exception Handling, Debugging, and Logging, Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, debugging techniques, Collecting crash dumps.	
Textbook Chapter Mapping: Textbook 1 – Chapter 8	

Course Outcomes

CO1	Demonstrate Robotic Process Automation & Record and Play feature of UiPath Studio.
CO2	Create different types of variables, control flow and data manipulation techniques.
CO3	Apply various control techniques, plugins and extensions in RPA.
CO4	Illustrate various types and strategies to handle events and exceptions.

Suggested Learning Resources:

Textbooks:

Sl. No	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
1.	Learning Robotic Process Automation	Alok Mani Tripathi	March 2018.	Pack pub
Reference Books:				
1.	Introduction to Robotic Process Automation: A Primer	Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston	2015	Institute for Robotic Process Automation (IRPA)
2.	Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant	Richard Murdoch	2020	Independently Published
3.	Robotic Process Automation Tools, Process Automation and Their Benefits: Understanding RPA and Intelligent Automation	Srikanth Merianda	2018	Consulting Opportunity Holdings LLC

Web links and Video Lectures (e-resources)

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 6th Sem	**Scheme: P24**	
Course Title: Augmented Reality and Virtual Reality		
Course Code: P24CI6044	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:	**Exam Hours:**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

Basic knowledge of Computer Graphics, 3D modelling, programming fundamentals, and multimedia concepts.

Course learning Objectives:

CLO1: Understand the importance of Augmented reality and Virtual reality
CLO2: Describe the history and recent developments of AR
CLO3: Provide the need on emerging technologies AR and VR
CLO4: Discuss the revolution and impact of AR
CLO5: Understand the applications of AR and VR

Unit 1:	**Hrs: 8**

Introduction: Definition of VR, modern experiences, historical perspective. Virtual Reality Applications.
Birds-eye view: Hardware, Software, Human physiology and Perception

Textbook Chapter Mapping:

Unit 2:	**Hrs: 8**

Geometry of Virtual Worlds: Geometric models, Changing Position and orientation, Axis-Angle representation of rotation, Chaining the transformation.
Tracking: Tracking 2D orientation, Tracking 3D orientation, Tracking Position and orientation.

Textbook Chapter Mapping:

Unit 3:	**Hrs: 8**

Getting started with Blender: An introduction to Blender. Features of Blender Layout workspace, Sculpt Workspace, Modelling Workspace, Animation Workspace.
Introduction to Unity, working with objects, Working with Scripts First Person Controller, Third Person Controller.

Textbook Chapter Mapping:

Unit4:	**Hrs: 8**

Introduction to Augmented Reality: Definition and scope, A brief history of augmented reality, Examples, Related fields.
Displays: Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display model, Visual Displays.

Textbook Chapter Mapping:

Unit 5:	Hrs: 8
Evaluating VR Systems and Experiences: Perceptual Training, Recommendations for developers, Comfort and VR sickness, Experiments on Human subjects. **Software Architectures:** AR Application Requirements, Software Engineering Requirements.	
Textbook Chapter Mapping:	

Course Outcomes

CO1	Explain the fundamental concepts of Virtual Reality and Augmented Reality and it‘s Applications.
CO2	Analyse the hardware and software requirements of Augmented Reality and Virtual reality.
CO3	Apply Geometric Modelling Techniques for 2D and 3D model creation in AR/VR.
CO4	**Design** a Virtual Environment to captivate its experiences using Blender and Unity tools.

Suggested Learning Resources:				
Textbooks:				
Sl. No	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
1.	Virtual Reality	Steven M. LaValle	2019	Cambridge university press
2.	Augmented Reality Principles and Practice, Addison-Wesley	Dieter Schmalstieg and Tobias Höllerer	2016	Pearson Education
Reference Books:				
1.	Innovating with Augmented Reality	Kaliraj P, Devi T	2021(1st ed.)	Auerbach Publications

Web links and Video Lectures (e-resources)

1. https://docs.google.com/presentation/d/1ghccIoncBT34OargDKABa_he2Yjy1S-P/edit?usp=sharing&ouid=105825739444009503878&rtpof=true&sd=true
2. https://drive.google.com/file/d/1Qbt7bwPmPXkQq52wOacCZ5BcBMqLUksY/view?usp=sharing
3. https://drive.google.com/file/d/1p-0Oje6zXoefCwbkxUOk49MxyVbLhYd3/view?usp=sharing
4. https://drive.google.com/file/d/1H0MSJdPfOGxDaDX6mzw8WxvM6C5GZ5Wj/view?usp=drive_link
5. https://drive.google.com/file/d/1eG3Yv-XEwEGH7-G8HTE9DOIg_hKuOSbb/view?usp=sharing

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Semester: 6th Sem	**Scheme: P24**	
Course Title: Cognitive Science and Analytics		
Course Code: P24CI6051	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:	**Exam Hours:**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

Basic knowledge of **Artificial Intelligence, Machine Learning, Statistics, Psychology, and Human Cognition**, along with fundamental programming and data analysis concepts.

Course learning Objectives:

CLO1: To understand the interdisciplinary nature and historical evolution of cognitive science.
CLO2: To explore various theoretical models of cognition science.
CLO3: To apply computational models and representations to simulate cognitive processes.

Unit 1:	**Hrs: 8**

Introduction: The Challenge of Cognitive Science: Cognitive Science: An Interdisciplinary Endeavor, Levels of Explanation: The Contrast between Psychology and Neuroscience, The Challenge of Cognitive Science. **The Prehistory of Cognitive Science:** The Reaction against Behaviorism in Psychology, The Theory of Computation and the Idea of an Algorithm, Linguistics and the Formal Analysis of Language.

Textbook Chapter Mapping: Textbook - 1: Chapter-1

Unit 2:	**Hrs: 8**

The Discipline Matures: Three Milestones: Language and Micro-worlds, How Do Mental Images Represent? An Interdisciplinary Model of Vision. The Turn to the Brain-1: Cognitive Systems as Functional Systems? The Anatomy of the Brain and the Primary Visual Pathway.

Textbook Chapter Mapping: Textbook - 1: Chapter-2, Chapter-3

Unit 3:	**Hrs: 8**

The Turn to the Brain-2: Mapping the Stages of Lexical Processing, Studying Memory for Visual Events, The Neural Correlates of the BOLD Signal.

Physical Symbol Systems and the Language of Thought: The Physical Symbol System Hypothesis, From Physical Symbol Systems to the Language of Thought.

Textbook Chapter Mapping: Textbook - 1: PART I: Chapter 3 PART II: Chapter 4

Unit4:	Hrs: 8
Neural Networks and Distributed Information Processing: Neurally Inspired Models of Information Processing, Single-Layer Networks and Boolean Functions, Multilayer Networks, Information Processing in Neural Networks: Key Features. **Applying Dynamical Systems Theory to Model the Mind:** Cognitive Science and Dynamical Systems, Applying Dynamical Systems: Two Examples from Child Development,	
Textbook Chapter Mapping: Textbook – 2 Chapter 5, Chapter 6	
Unit 5:	**Hrs: 8**
Bayesianism in Cognitive Science: Bayesianism: A Primer, Perception as a Bayesian Problem, Neuroeconomics: Bayes in the Brain. **Modules and Architectures:** Architectures for Artificial Agents, Fodor on the Modularity of Mind, The Massive Modularity Hypothesis, Hybrid Architectures: The Example of ACT-R. **Strategies for Brain Mapping:** Structure and Function in the Brain, Studying Cognitive Functioning: Techniques from Neuroscience.	
Textbook Chapter Mapping: Textbook – 2 Chapter 7, Chapter 8	

Course Outcomes

CO1	**Understand** the foundational concepts, interdisciplinary nature, and theoretical frameworks of cognitive science.
CO2	**Apply** cognitive models, neural network concepts, and computational theories to represent and simulate cognitive processes
CO3	**Analyze** brain-based approaches and cognitive architectures to evaluate mental representations and cognitive functionality.

Suggested Learning Resources:				
Textbooks:				
Sl. No	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
1.	An Introduction to the Science of the Mind	Jose Luis Bermudez	2020 & 3rd Edition	Cambridge University Press, New York
Reference Books:				
1.	Emerging Trends and Applications in Cognitive Computing	Pradeep Kumar Mallick, Samarjeet Borah	2019 & 1st Edition	IGI Global Publishers
2.	Cognitive computing and Big Data Analytics	Judith H Hurwitz, Marcia Kaufman, Adrian Bowles	2015 & 1st Edition	Wiley
3.	Theory and Applications	Vijay Raghvan, Venu Govindaraju, C.R. Rao.	2016 Edition & 1st	Elsevier publications, North Holland

Web links and Video Lectures (e-resources)
1. https://youtu.be/LlSdZLsiAzo. 2. https://youtu.be/Pwm6DqdC4pU. 3. https://youtu.be/NsID1iM8gRw. 4. https://www.coursera.org/learn/philosophy-cognitive-sciences 5. https://www.coursera.org/learn/neurobiology.

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 6th Sem	**Scheme: P24**	
Course Title: Social Network Analysis		
Course Code: P24CI6052	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:	**Exam Hours:**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

Basic knowledge of **Graph Theory, Data Structures, Statistics, Database Management Systems, and basic programming concepts**.

Course learning Objectives:

CLO1: To understand the concept of Social Network Analysis.
CLO2: To define Network centrality components like density, reachability, connectivity, and reciprocity
CLO3: To understand similarity and structural equivalence in SNA
CLO4: To understand two modes of networks in SNA
CLO5: To learn the visualization of social networks

Unit 1:	**Hrs: 8**

Introduction to the Semantic Web and Social Networks: The Semantic Web, Limitations of the current Web, The semantic solution, Development of the Semantic Web and the emergence of the social web.

Textbook Chapter Mapping:

Unit 2:	**Hrs: 8**

Social Network Analysis: What is network analysis, Development of Social Network Analysis Key concepts and measures in network analysis, The global structure of networks, The macro-structure of social networks, Personal networks.

Textbook Chapter Mapping:

Unit 3:	**Hrs: 8**

Centrality and power : Centrality and centralization in SNA
Introduction: The several faces of power , Degree centrality, Degree: Freeman's approach, Closeness centrality, Closeness: Path distances, Closeness: Reach Closeness: Eigenvector of geodesic distances , Betweenness Centrality , Betweenness: Freeman's approach to binary relations.

Textbook Chapter Mapping:

Unit4:	**Hrs: 8**

Two-mode networks for SNA
Understanding mode networks- Bi-partite data structures, visualizing two-mode data, quantitative analysis using two-mode Singular value decomposition (SVD) analysis two-mode factor analysis, two-mode correspondence analysis.

Textbook Chapter Mapping:

Unit 5:	Hrs: 8
VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS Visualization, Visualizing Online Social Networks, Node-Link Diagrams, Adjacency Matrix Representations and applications of Social Network Analysis.	
Textbook Chapter Mapping:	

Course Outcomes

CO1	**Design** and develop semantic web related applications
CO2	**Understand** the fundamental concepts of social network analysis
CO3	**Analyze** the centrality and centralization in SNA
CO4	**Ability** to represent two-mode networks in SNA
CO5	**Learn** the Visualization of social networks

Suggested Learning Resources:

Textbooks:

Sl. No	Title	Author	Year & Edition (Latest)	Publisher
1.	Introduction to Social Network Methods	Robert A. Hanne man, Mark Riddle, Mark Riddle	2005	University of California
Reference Books:				
1.	Statistical Analysis of Network Data with R	Eric D, Kolaczyk, Gábor Csárdi	2014	Springer

Web links and Video Lectures (e-resources)

1. http://faculty.ucr.edu/~hanneman/nettext/index.html
2. https://onlinecourses.nptel.ac.in/noc22_cs117/preview
3. https://nptel.ac.in/courses/106106239
4. https://www.coursera.org/learn/social-network-analysis
5. https://visiblenetworklabs.com/guides/social-network-analysis-101/

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Semester: 6th Sem	**Scheme: P24**	
Course Title: Explainable and Responsible AI		
Course Code: P24CI6053	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:	**Exam Hours:**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

- Basic understanding of machine learning algorithms and deep learning algorithms
- Analytical thinking and basic programming concept
- Ability to thing in terms of qualitative and quantitative thinking

Course learning Objectives:

CLO1: Explain the basics of Explainable AI, Ethical issues and Usage of Explainability

CLO2: Describe the consumers of explainable AI

CLO3: Develop the Explainability for tabular data image data and Text data.

CLO4: Understand the Bias and Fairness in data and model

Unit 1:	**Hrs: 8**

Basics of Explainable and Responsible

AI Introduction

Why Explainable AI ,What Is Explainable AI , Who Needs Explain ability, Challenges in Explain ability, Evaluating Explain ability, How Has Explain ability Been Used, How LinkedIn Uses Explainable AI , PwC Uses Explainable AI for Auto Insurance Claims, Accenture Labs Explains Loan Decisions, DARPA Uses Explainable AI to Build "Third-Wave AI".

Brief Overview of AI and Its Potential ,Foundations of AI: From Concept to Reality AI in Action: A Multifaceted Landscape ,The Promise of AI: Unlocking Boundless Potential Frontier, Importance of Responsible AI ,Ethics in the Age of AI: The Call for Responsibility, Mitigating Bias and Discrimination: Pioneering Fairness and Equity, Privacy in the Age of Surveillance: Balancing Innovation and Security, Human-Centric Design: Fostering Collaboration Between Man and Machine Ethics in AI Governance: Navigating a Complex Landscape Conclusion: The Ongoing Dialogue of Responsibility , Core Ethical Principles -Bias and Fairness: Cornerstones of Responsible AI Transparency and Explain ability, Privacy and Security, Robustness and Reliability .

Textbook Chapter Mapping: Textbook 1,2: Ch. 1

Unit 2:	**Hrs: 8**

Explain ability explained

An Overview of Explain ability

What Are Explanations ,Interpretability and Explain ability, Explain ability Consumers, Practitioners—Data Scientists and ML Engineers, Observers—Business Stakeholders and Regulators, End Users—Domain Experts and Affected Users, Types of Explanations, Premodeling Explainability, Intrinsic Versus Post Hoc Explainability, Local, Cohort, and Global Explanations, Attributions, Counterfactual, and Example-Based Explanations, Themes Throughout Explainability, Feature Attributions, Surrogate Models Activation.

Explainability for Tabular Data: Permutation Feature Importance, Permutation Feature Importance

from Scratch, Permutation Feature Importance in scikit-learn, Shapley Values SHAP (SHapley Additive exPlanations), Visualizing Local Feature Attributions, Visualizing Global Feature Attributions, Interpreting Feature Attributions from Shapley Values, Managed Shapley Values, Explaining Tree-Based Models ,From Decision Trees to Tree Ensembles ,SHAP's TreeExplainer, Partial Dependence Plots and Related Plots ,Partial Dependence Plots (PDPs) Individual Conditional Expectation Plots (ICEs) ,Accumulated Local Effects (ALE)

Textbook Chapter Mapping: Textbook 1: Ch. 2,3

Unit 3:	**Hrs: 8**

Explainability in Text and Image

Explainability for Image Data Integrated Gradients (IG), Choosing a Baseline, Accumulating Gradients

Improvements on Integrated Gradients, XRAI How XRAI Works, Implementing XRAI, Grad-CAM How Grad-CAM Works Implementing Grad-CAM , Improving Grad-CAM LIME, How LIME Works Implementing LIME.

Explainability for Text Data: Overview of Building Models with Text, Tokenization, Word Embeddings and Pretrained Embeddings LIME How LIME Works with Text, Gradient x Input, Intuition from Linear Models From Linear to Nonlinear and Text Models ,Grad L2-norm, Layer Integrated Gradients, A Variation on Integrated Gradients, Layer-Wise Relevance Propagation (LRP), How LRP Works, Deriving Explanations from Attention

Which Method to Use?, Language Interpretability Tool

Textbook Chapter Mapping: Textbook 1: Ch. 4, 5

Unit4:	**Hrs: 8**

Transparency and Explainability

Bias and Fairness

Understanding Bias in Data and Models, Importance of Understanding Bias, How Bias Can Impact Decision-Making Processes, Types of Bias, Examples of Real-world Cases Where Models Exhibited Biased Behavior, Techniques to Detect and Mitigate Bias, Techniques to Detect Bias, Techniques to Mitigate Bias

Implementing Bias Detection and Fairness,

Stage 1: Data Bias Dataset Details

Stage 2: Model BiasConclusion

Transparency and Explainability : Transparency, Explainability, Importance of Transparency and Explainability in AI Models, Real-world Examples of the Impact of Transparent AI, Methods for Achieving Explainable AI Explanation Methods for Interpretable Models: Decision Trees and Rule-Based Systems

Generating Feature Importance Scores and Local Explanations Tools, Frameworks, and

Implementation of Transparency and ExplainabilityOverview of Tools and Libraries for AI Model Transparency

Implementation of Explainable AI Stage 1: Model Building, Stage 2: SHAPStage 3: LIME, Stage 4: ELI5Challenges and Solutions in Achieving Transparency and Explainability,Addressing the "Black Box" , Nature of AI Models Balancing Model Performance and Explain ability Trade-offs between Model Complexity, Performance, and Explain ability .

Textbook Chapter Mapping: Textbook 2: Ch. 2,3

Unit 5:	Hrs: 8
Privacy and Security **Privacy and Security:** Privacy Concerns in AI Privacy, Privacy Attacks in AI Models, Mitigating Privacy Risks in AI Security Concerns in AI, Potential Threats to Security Mitigating Security Risks in AI. **Robustness and Reliability:** Concepts of Robustness and Reliability, Importance in AI Systems Metrics for Measuring Robustness and Reliability ,Challenges in Achieving Robustness Sensitivity to Input Variations ,Model Overfitting, Outliers and Noise	
Textbook Chapter Mapping: Textbook 2: Ch. 4,5	

Course Outcomes

CO1	**Understand** the fundamentals of Explainable AI, Ethical issues and Usage of Explainability
CO2	**Describe** the consumers of explainable AI and Explain ability for tabular data
CO3	**Develop** Explain ability for image data and text data
CO4	**Explain** Bias and Fairness and Transparency
CO5	**Explain** Security and Privacy

Suggested Learning Resources:

Textbooks:

Sl. No	Title	Author	Year & Edition (Latest)	Publisher
1.	Explainable AI for practitioners	Michael Munn & David Pitman Foreword by Ankur Taly	2022	OREILLY
2.	Introduction to Responsible AI: Implement Ethical AI Using Python	Avinash Manure, Saravanan S , Shaleen Bengani	2023	Apress
Reference Books:				
1.	Responsible AI ,Artificial intelligence, foundation theory and algorithm	Virginia Dignum	2019	Springer

Web links and Video Lectures (e-resources)

1. **KAIST XAI Tutorial Series** (Excellent recent lectures on local/global methods, evaluation, LLMs)
   https://www.youtube.com/playlist?list=PLjNpu357Za8iODt2dcp7T7PB3CN9_FFh9
2. **Vizuara – Explainable AI (XAI) Project-based Course**
   (SHAP, LIME, Grad-CAM, Counterfactuals with Colab)
   https://www.youtube.com/playlist?list=PLPTV0NXA_ZShaln9GfiHO_c0HzOSqLOGv
3. **A Data Odyssey – Explainable AI Playlist**
   https://www.youtube.com/playlist?list=PLqDyyww9y-1SwNZ-6CmvfXDAOdLS7yUQ4

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 6th Sem	**Scheme: P24**	
Course Title: Time Series Analysis		
Course Code: P24CI6054	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:	**Exam Hours:**	
Team work + Self-study Hrs:		
Credits: 3		

Prerequisite:

Basic knowledge of Probability and Statistics, Linear Algebra, Calculus, and basic programming/data analysis concepts.

Course learning Objectives:

CLO1: Learn the importance of time series analysis on the data.
CLO2: Identify approaches to handle linear stationary and non stationary models.
CLO3: Analyse ways of model building and parameter estimation.
CLO4: Recognize methods to handle multivariate time series data.

Unit 1:	**Hrs: 8**

Introduction, Five Important Practical Problems, **Autocorrelation Function and Spectrum of Stationary Processes:** Autocorrelation Properties of Stationary Models, Spectral Properties of Stationary Models, **Linear Stationary Models:** General Linear Process, Autoregressive Processes, Moving Average Processes.

Textbook Chapter Mapping: Ch. 1.1, Ch. 2.1,2.2 Ch. 3.1,3.2,3.3,3.4

Unit 2:	**Hrs: 8**

Linear Nonstationary Models: Autoregressive Integrated Moving Average Processes, Three Explicit Forms for the ARIMA Model, Integrated Moving Average Processes.

Forecasting : Minimum Mean Square Error Forecasts and Their Properties, Calculating Forecasts and Probability Limits, Examples of Forecast Functions and Their Updating.

Textbook Chapter Mapping: Ch. 4.1,4.2,4.3, Ch. 5.1,5.2,5.3,5.4,5.5.

Unit 3:	**Hrs: 8**

Model Identification: Objectives of Identification, Identification Techniques, Initial Estimates for the Parameters, Model Multiplicity.

Parameter Estimation: Study of the Likelihood and Sum-of-Squares Functions, Nonlinear Estimation, Some Estimation Results for Specific Models, Likelihood Function Based on the State- Space Model.

Textbook Chapter Mapping: Ch. 6.1,6.2,6.3,6.4 Ch. 7.1,7.2,7.3,7.4,7.5.

Unit4:	Hrs: 8
Model Diagnostic Checking: Checking the Stochastic Model, Overfitting, Diagnostic Checks Applied to Residuals, Use of Residuals to Modify the Model, **Analysis of Seasonal Time Series:** Parsimonious Models for Seasonal Time Series, Some Aspects of More General Seasonal ARIMA Models, Structural Component Models and Deterministic Seasonal Components.	
Textbook Chapter Mapping: Ch. 8.1,8.2,8.3 Ch. 9.1,9.2,9.3,9.4,9.5	
Unit 5:	**Hrs: 8**
Multivariate Time Series Analysis: Stationary Multivariate Time Series, Vector Autoregressive Models, Vector Moving Average Models, Vector Autoregressive--Moving Average Models, Forecasting for Vector Autoregressive--Moving Average Processes, State Space Form of the VARMA Model.	
Textbook Chapter Mapping: Ch. 14.1,14.2,14.3,14.4,14.5,14.6,14.8	

Course Outcomes

CO1	**Apply** the fundamental concept of Time series analysis for Autocorrelation Function and spectrum on linear stationary models.
CO2	**Develop** non-linear stationary models and perform forecasting.
CO3	**Identify** models and estimate the various parameters .
CO4	**Recognize** ways to perform model diagnostic checking and analyze the seasonal time series.
CO5	**Analyze** multivariate time series data.

Suggested Learning Resources:

Textbooks:

Sl. No	Title	Author	Year & Edition (Latest)	Publisher
1.	Time Series Analysis – Forecasting and Control	George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung	2016	Wiley Publications

Web links and Video Lectures (e-resources)

1. https://nptel.ac.in/courses/103106123
2. https://www.youtube.com/watch?v=GE3JOFwTWVM
3. https://www.youtube.com/watch?v=tepxdcepTbY
4. https://www.youtube.com/watch?v=rDwczdWBlTA

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Semester: 6th	**Scheme: P24**	
Course Title: Computer Vision Laboratory		
Course Code: P24CIL606	**CIE Marks: 50**	**CIE Weightage:50**
Teaching hours/week (L:T:P)	**SEE Marks:50**	**SEE Weightage:50**
Teaching hours of Pedagogy:	**Exam Hours: 3hrs**	
Team work + Self-study Hrs:		
Credits: 01		

Prerequisite:

Mathematical Foundational Subjects, & Core Knowledge of AIML

Course learning Objectives:

CLO-1: To introduce the fundamental physics of digital image formation, colour spaces, and spatial domain processing techniques.

CLO-2: To impart knowledge on the mathematical principles behind low-level structural feature extraction, including edges, corners, and key point descriptors.

CLO-3: To expose students to classical machine learning pipelines, unsupervised data clustering, and dimensionality reduction techniques tailored for visual data.

CLO-4: To provide a comprehensive understanding of deep learning building blocks, specifically the engineering and optimization of Convolutional Neural Networks

Laboratory Practical List

		Aligned Unit	CO Mapped
Lab-1	Write a script to convert RGB source images into distinct color spaces (HSV, YCrCb) and implement customized global histogram equalization from scratch.	Unit-1	CO1
Lab-2	Construct an interactive program applying spatial Gaussian blurring and custom high-pass sharpening operations over noisy input frames.	Unit-1	CO1
Lab-3	Develop a standalone edge extraction tool executing standard Canny tracking configurations with dynamically adjustable threshold parameters.	Unit-2	CO2
Lab-4	Implement a local keypoint matching script utilizing Harris Corner mapping and SIFT descriptors to connect identical regions across translated frames.	Unit-2	CO2
Lab-5	Write a program using K-Means clustering to partition a digital color photograph automatically into a user-specified quantity (K) of uniform segments.	Unit-3	CO3
Lab-6	Train an SVM model using scikit-learn on extracted structural image features (e.g., HOG or PCA patches) to perform binary image classification.	Unit-3	CO3
Lab-7	Build, compile, and validate a basic 3-layer Convolutional Neural Network from scratch in PyTorch/TensorFlow to categorize data samples (e.g., MNIST/CIFAR-10).	Unit-4	CO4
Lab-8	Implement transfer learning using a pre-trained ResNet-50 network model to classify a custom dataset of domain-specific target images.	Unit-4	CO4

Lab-9	Deploy a pre-trained YOLO or Single Shot Detector (SSD) model to identify and isolate objects within real-time streaming desktop video.	Unit-5	CO5
Lab-10	Create an active tracker using the classical Lucas-Kanade optical flow equation or a deep tracking layer to follow pixel displacement coordinates across frame sequences.	Unit-5	CO5

Course Outcomes (COs)

Based on the practical list provided, here are the formally stated **Course Outcomes (COs)** mapped to their respective laboratory exercises and units. These outcomes define what a student will be able to achieve upon successful completion of the course.

CO1: Apply fundamental image transformation and enhancement techniques.

CO2: Execute feature detection, edge extraction, and keypoint matching algorithms.

CO3: Implement classical machine learning and unsupervised clustering for image segmentation and classification.

CO4: Design, train, and optimize deep convolutional architectures for image categorization.

CO5: Deploy real-time computer vision models for object detection and motion tracking.

Semester: 6th Sem	**Scheme: P24**	
Course Title: Agentic AI and Automation Laboratory		
Course Code: P24CIL607	**CIE Marks: 50**	**CIE Weightage:**
Teaching hours/week (L:T:P)	**SEE Marks: 50**	**SEE Weightage:**
Teaching hours of Pedagogy:	**Exam Hours:**	
Team work + Self-study Hrs:		
Credits: 1		

Prerequisite: Python, Data Structures and Algorithms, Artificial Intelligence and Machine Learning, Python development environments such as Jupyter Notebook or Google Colab and Basic knowledge of TensorFlow/Keras or PyTorch

Course learning Objectives:

After successful completion of the **Agentic AI and Automation Laboratory**, students will be able to:

CLO1: Demonstrate proficiency in using Generative AI tools, Large Language Models (LLMs), and prompt engineering techniques to develop intelligent AI applications.

CLO2: Design and implement intelligent and reflective AI agents by integrating knowledge representation, reasoning, planning, and memory mechanisms.

CLO3: Develop autonomous and multi-agent systems using modern Agentic AI frameworks and workflow automation tools to solve real-world problems.

CLO4: Apply Retrieval-Augmented Generation (RAG), tool integration, and deployment techniques to build scalable, context-aware, and interactive Agentic AI applications.

CLO5: Evaluate and develop trustworthy Agentic AI systems by incorporating explainability, safety, ethical AI principles, and responsible deployment practices.

PART – A [Implement any 2 – 3 Experiments from each Unit]

Unit 1: Fundamentals of Generative AI and Agentic Systems

Experiment 1

Install and configure the Python environment, Google Colab/Jupyter Notebook, and Generative AI libraries (OpenAI SDK, LangChain, Hugging Face Transformers).

Experiment 2

Explore and compare different Generative AI models (LLMs, Diffusion Models, GANs) through simple application demonstrations.

Experiment 3

Develop prompt engineering techniques to generate high-quality text responses using Large Language Models.

Experiment 4

Build a simple conversational AI assistant using an LLM API to understand the behavior of intelligent agents.

Unit 2: Intelligent Agents and Reflection

Experiment 5

Implement a knowledge-based intelligent agent capable of answering domain-specific queries using Retrieval-Augmented Generation (RAG).

Experiment 6

Develop an autonomous task-planning agent using LangChain or LlamaIndex with multiple reasoning steps.

Experiment 7
Design and implement a reflective agent capable of evaluating and refining its own responses.
Experiment 8
Develop a multi-step workflow agent integrating planning, reasoning, and decision-making capabilities.

Unit 3: Agent Memory and Multi-Agent Systems
Experiment 9
Implement short-term and long-term memory mechanisms for conversational agents.
Experiment 10
Develop a context-aware AI assistant capable of maintaining conversation history and personalized interactions.
Experiment 11
Design a multi-agent system where multiple intelligent agents collaborate to solve a complex task.
Experiment 12
Implement inter-agent communication and task delegation using an agent orchestration framework.

Unit 4: Agent Development Frameworks and Automation
Experiment 13
Develop an AI agent using LangChain, CrewAI, AutoGen, or similar frameworks integrated with external tools.
Experiment 14
Implement Retrieval-Augmented Generation (RAG) using vector databases such as FAISS or ChromaDB.
Experiment 15
Develop an AI automation workflow integrating APIs, document processing, and external tools.
Experiment 16
Deploy an Agentic AI application using Streamlit or Gradio with a user-friendly interface.

Unit 5: Trustworthy Agentic AI and Applications
Experiment 17
Evaluate Agentic AI systems using performance metrics such as accuracy, latency, hallucination rate, and response quality.
Experiment 18
Implement explainability and transparency techniques for AI-generated responses.
Experiment 19
Develop a secure and ethical AI assistant by incorporating safety guardrails, content filtering, and responsible AI principles.

PART – B [Mini – Project]

Develop a complete Agentic AI application by integrating Generative AI, autonomous reasoning, memory, tool usage, and workflow automation to solve a real-world problem.

Course Outcomes (COs)

Upon successful completion of the **Agentic AI and Automation Laboratory**, students will be able to:

CO1: Develop basic Generative AI applications using Large Language Models (LLMs), prompt engineering techniques, and AI development environments to understand the principles of agentic systems.

CO2: Design and implement intelligent and reflective AI agents by integrating knowledge representation, reasoning, planning, and decision-making techniques for adaptive problem-solving.

CO3: Develop context-aware and multi-agent systems by incorporating memory mechanisms, agent communication, and collaborative task execution using modern agentic AI frameworks.

CO4: Build and deploy Agentic AI applications by integrating Retrieval-Augmented Generation (RAG), external tools, workflow automation, and user interfaces using contemporary development frameworks.

CO5 : Evaluate and implement trustworthy Agentic AI systems by applying explainability, ethical AI principles, safety mechanisms, and performance evaluation techniques in real-world applications.

Semester: 6th Sem	**Scheme: P24**	
Course Title: Employability Enhancement Skills - VI		
Course Code: P24HSMC609A	**CIE Marks: 50**	**CIE Weightage: 50%**
Teaching hours/week (L:T:P) 0:2:0	**SEE Marks: 50**	**SEE Weightage:50%**
Teaching hours of Pedagogy: 42 Hours	**Exam Hours: 2Hours**	
Team work + Self-study Hrs: As per the self-study components indicated unit-wise		
Credits: 1		

Prerequisite:

Employability Enhancement Skills – V (advanced data structures)

Course learning Objectives:

CLO1: Perform calculations involving permutations and combinations, probability, ages and data interpretation.
CLO2: Explain concepts behind logical reasoning modules of syllogisms and data sufficiency.
CLO3: Prepare students for the job recruitment process and competitive exams.
CLO4: Develop problem solving skills through various programming languages.

Unit 1:	**Hrs: 8**

Quantitative Aptitude: Permutation and Combination, Probability, Ages.
Self-study component: Inferred meaning.

Unit 2:	**Hrs: 8**

Quantitative Aptitude: Data Interpretation.
Logical Reasoning: Syllogisms, Data Sufficiency.
Self-study component: Chain rule.

Unit 3:	**Hrs: 10**

Soft Skills: Group Discussions, Resume Writing, LinkedIn Profiling, Interview Skills.
Interview Preparation: Mock GDs, Resume Validation and Personal Interviews.
Self-study component: Interpersonal communication.

Unit 4:	**Hrs: 10**

COMPETITIVE CODING – I

Arrays: Find a peak element which is not smaller than its neighbors, Kth Smallest/Largest element, Kadane's Algorithm, Missing number in array, Rearrange Array Alternately, Sort 0s, 1s and 2s, Trapping Rain Water, Chocolate Distribution Problem, Array Leaders, Minimum Number of Platforms Required for a Railway/Bus Station, Rotate a matrix by 90 degrees without using any extra space, Find maximum element of each row in a matrix, Print matrix in snake pattern.

Strings: Reverse words in a given string, Converting Roman Numerals to Integer, Find the minimum distance between the given two words, Check whether two Strings are anagram of each other, Remove duplicates from a given string, Multiply Strings, Find largest word in dictionary, Longest Common Prefix, Reduce the string by removing K consecutive identical characters, Check if given String is Pangram or not, Compare Version Numbers.

Self-study component: Logarithmic Complexity with Binary Search.

Unit 5:	Hrs: 12

COMPETITIVE CODING – II

Linked List: Print the Middle of a given linked list, Reverse a Linked List, Reverse a Doubly Linked List, Rotate a Linked List, Delete middle of linked list, Pairwise Swap Nodes of a given Linked List, Remove duplicates from a sorted linked list, Convert singly linked list into circular linked list, Merge two sorted linked lists, Check if a singly linked list is palindrome, Insert a node in the 5th position in a singly linked list.

Stacks and Queues: Parenthesis Checker, Reverse a String using Stack, Reverse an array using Stack, Delete Middle element from stack, Find Next Greater Element using Stack, The Stock Span Problem, Reverse First k Elements of Queue, Insert one element at front using queue, Implement a Queue using an Array, Maximum number of diamonds that can be gained in K minutes, Sorting a Queue without extra space.

Database: Introduction to database, Types of SQL statements, MySQL commands.

Self-study component: Schema change statements in SQL.

Course Outcomes

CO1	Solve the problems based on permutation and combination, probability, ages and data interpretation.
CO2	Solve logical reasoning problems based on syllogisms and data sufficiency.
CO3	Apply suitable programming language and / or suitable data structures to solve the given problem.

Suggested Learning Resources:

Textbooks:

Sl. No	Title	Author	Year & Edition (Latest)	Publisher
1.	Guide to Competitive Programming: Learning and Improving Algorithms Through Contests	Antti Laaksonen	2nd Ed., 2020	Springer
2.	Cracking the Coding Interview	Gayle Laakmann Mc Dowell	6th Ed., 2015	CareerCup
3.	Fundamentals of Database Systems	Elmasri & Navathe	7th Ed., 2015	Pearson
4.	Quantitative Aptitude	Dr. R. S. Aggarwal	Revised Ed., 2022	S. Chand
5.	How to Sharpen Your Interview Skills	Prem Vas	Latest Ed.	–

Reference Books:

1.	Programming in ANSI C	E. Balagurusamy	8th Ed., 2019	Tata McGraw Hill
2.	The C Programming Language	Brian W. Kernighan & Dennis M. Ritchie	2nd Ed., 1988	Prentice Hall
3.	Database System Concepts	Silberschatz, Korth &	7th Ed., 2019	

		Sudarshan		
4.	An Introduction to Database Systems	C. J. Date, A. Kannan & S. Swamynatham	8th Ed., 2006	Pearson Education
5.	Quantitative Aptitude	Arun Sharma	Latest Ed.	McGraw Hill Education

Web links and Video Lectures (e-resources)

1. Problem Solving through Programming in C (NPTEL) – https://archive.nptel.ac.in/courses/106/105/106105171/
2. NPTEL courses – https://onlinecourses.nptel.ac.in/noc22_cs91/ , https://onlinecourses.nptel.ac.in/noc18_cs15/preview, http://nptel.ac.in/courses/106106093/, http://nptel.ac.in/courses/106106095/
3. Video lecture – https://youtu.be/c5HAwKX-suM
4. Company-wise interview preparation – https://www.geeksforgeeks.org/company-interview corner/
5. Coding practice and contests – https://leetcode.com/ and https://www.hackerrank.com/

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Mock group discussions and personal interviews (Individual Role Play)
2. Weekly timed coding contests on arrays, strings and linked lists (Learn by Doing)
3. Hands-on MySQL lab – writing and executing SQL statements
4. Resume validation and LinkedIn profiling workshop
5. Case-based group tasks simulating company selection rounds

Semester: 6th Sem	**Scheme: P24**	
Course Title: Indian Knowledge Systems		
Course Code: P24IKS610	**CIE Marks: 100**	**CIE Weightage:**
Teaching hours/week (L:T:P) 1:0:0	**SEE Marks:**	**SEE Weightage:**
Teaching hours of Pedagogy: 15 Hours	**Exam Hours:**	
Team work + Self-study Hrs: As per the self-study components indicated unit-wise		
Credits: 1		
Prerequisite:		
Course learning Objectives:		
CLO1: To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system. **CLO2:** To make the students understand the traditional knowledge and analyse it and apply it to their day-to-day life.		
Unit 1:		**Hrs: 5**
Introduction to Indian Knowledge Systems (IKS): Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge.		
Unit 2:		**Hrs: 5**
Traditional Knowledge in Humanities and Sciences: Linguistics, Number and measurements Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.		
Unit 3:		**Hrs: 5**
Traditional Knowledge in Professional domain: Town planning and architecture- Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.		

Course Outcomes

CO1	
CO2	
CO3	

Suggested Learning Resources:

Textbooks:

Sl. No	Title	Author	Year & Edition (Latest)	Publisher
1.	Introduction to Indian Knowledge System- concepts and applications	B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N	2022	PHI Learning Private Ltd, ISBN-978-93.
2.	Knowledge Traditions and Practices of India	Kapil Kapoor, Avadesh Kumar Singh	2005	DK Print World (P) Ltd., ISBN 81-246-0334

Web links and Video Lectures (e-resources)

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/
3. http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63
4. https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5. https://unctad.org/system/files/official-document/ditcted10_en.pdf
6. http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf
7. https://unfoundation.org/what-we-do/issues/sustainable-development- goals/?gclid=EAIaIQobChMInpJtb_p8gIVTeN3Ch27LAmPEAAYASAAEgIm1vD_BwE