IV Year - I Semester

S.No	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	PC	UGAI7T0123	Deep Learning	3	0	0	3	30	70	100
2	MC-II	UGMB7T0123	Human Resource & Project Management	2	0	0	2	30	70	100
3	PE	UGCS7T0223 UGAI7T0223 UGAI7T0323 UGAI7T0423	**Professional Elective-IV** 1. Software Architecture & Design Pattern 2. Blockchain Technology 3. DevOps 4. Architecture for Management of Large Datasets 5. MOOCs (Any of the 12-Week SWAYAM /NPTEL Course recommended by the BoS)	3	0	0	3	30	70	100
4	PE	UGAI7T0523 UGAI7T0623 UGAI7T0723 UGAI7T0823	**Professional Elective-V** 1. Agile Methodologies 2. Reinforcement Learning 3. High Performance Computing 4. Quantum Science And Technology 5. MOOCs (Any of the 12-Week SWAYAM /NPTEL Course recommended by the BoS)	3	0	0	3	30	70	100
5	OE		Open Elective – III	3	0	0	3	30	70	100
6	OE		Open Elective – IV	2	0	0	3	30	70	100
7	SEC	UGCS7K1123 UGAI7K0923 UGAI7K1023	Prompt Engineering OR Robotic Process Automation OR SWAYAM Plus-Certificate Program in Prompt Engineering and ChatGPT	0	1	2	2	30	70	100
8	AC	UGAI7A1123	Constitution of India	2	0	0	0	30	-	30
9	Internship	UGAI7I1223	Evaluation of Industry Internship/Mini Project	-	-	-	2	-	50	50
			Total	**18**	**2**	**2**	**21**	**240**	**540**	**780**
Honors/Minor Course (3 or 4.5 Credits)										

IV Year - II Semester

S.No	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	Internship & Major Project	UGAI8J0123	Full Semester Internship & Project Work	0	0	24	12	60	140	200
			Total	**0**	**0**	**24**	**12**	**60**	**140**	**200**

L – Lectures, T – Tutorials, P – Practicals, C – Credits, IM – Internal Marks, EM – External Marks, TM – Total Marks

BS&H - Basic Science & Humanities, ES - Engineering Science, PC - Professional Core, PE - Professional Elective

SEC - Skill Enhancement Course, MC - Management Course, AC - Audit Course, OE - Open Elective

Syllabus
IV B.Tech I SEM

DEEP LEARNING

Subject Code: UGAI7T0123		L	T	P	C
IV Year / I Semester		3	0	0	3

COURSE OBJECTIVE:	
➢ The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short-term memory cells and convolution neural networks.	
SYLLABUS:	
UNIT I:	**(09 hrs)**
Basics- Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability, Convergence theorem for Perceptron Learning Algorithm	
UNIT II:	**(10 hrs)**
Feed forward Networks-Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, auto encoders**.** **Deep Neural Networks:** Difficulty of training deep neural networks, Greedylayer wise training.	
UNIT III: **Changed Unit 3 and unit-4 can inter change**	**(10 hrs)**
Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs. **Convolutional Neural Networks:** LeNet, AlexNet. Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines**.**	
UNIT IV:	**(10 hrs)**
Optimization and Regularization in Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).	
UNIT V:	**(09 hrs)**
Recent trends-Variational Auto encoders, Transformers, GPT Applications: Vision, NLP, Speech.	

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to:

CO1:	Understand the fundamental concepts of artificial neurons, perceptrons, learning algorithms, and neural network architectures. (L2)
CO2:	Apply feedforward neural networks, backpropagation, and deep learning techniques for solving machine learning problems. (L3)

CO3:	Analyze optimization, regularization, recurrent neural networks, and convolutional neural networks for effective deep learning model development. (L4)
CO4:	Evaluate advanced deep learning models such as Autoencoders, Transformers, GPT, and their applications in vision, NLP, and speech processing.(L5)

Mapping CO's to PO's

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	–	–	3	–	–	–	–	–	–	–	3	3
CO2	3	3	3	3	3	–	–	–	–	–	–	–	3	3
CO3	3	3	3	3	3	–	–	–	–	–	–	–	3	3
CO4	3	3	3	3	3	–	–	–	–	–	–	–	3	3

TEXT BOOKS:

1.	Deep Learning, Ian Good fellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.

REFERENCE BOOKS:

1.	Neural Networks: A Systematic Introduction, Raúl Rojas,1996
2.	Pattern Recognition and Machine Learning, Christopher Bishop,2007
3.	Deep Learning with Python, Franço is Chollet, Manning Publications,2017

HUMAN RESOURCE & PROJECT MANAGEMENT

Subject Code: UGMB7T0123		L	T	P	C
IV Year / I Semester		2	0	0	2

COURSE OBJECTIVE:

The main objectives of the course are to

- Provide knowledge about HR planning, recruitment, selection, and job design.
- Develop skills in managing HR functions such as performance appraisal, compensation, and employee relations.
- Emphasize the importance of ethical practices and HR audits in maintaining organizational health.
- Understand the HRD framework and its impact on organizational success.
- Improve group interaction and team dynamics for better collaboration and performance.
- Understand the Fundamentals of Project Management and Project Networks
- Implement appropriate management strategies tailored to specific challenges in different project types.

SYLLABUS:

UNIT I: **(10 hrs)**

HRM: Nature, Scope, Concept of HRM, Functions of HRM, Role of HR manager, emerging trends in HRM, E-HRM, HR audit models, ethical aspects of HRM. HR Planning, Demand and Supply forecasting of HR, Job Design, Recruitment, Sources of recruitment, Selection- Selection Procedure.

UNIT II: **(10 hrs)**

HRD, HR accounting, Models, Concept of Training and Development, Methods of Training. Performance Appraisal: Importance Methods of performance appraisal, Career Development and Counseling, group interaction.

UNIT III: **(12 hrs)**

Basics of Project Management, Concept, resource management, Project environment, Types of Projects, project networks-DPR, Project life cycle, Project proposals, Monitoring project progress, Project appraisal and Project selection, 80-20 rules, production technology, communication matrix

UNIT IV: **(08 hrs)**

Identify various project types and their unique management challenges and apply appropriate management strategies for each. Project Implementation and Review: Forms of project organization, project planning, project control, human aspects of project management, prerequisites for successful project implementation, project review, performance evaluation, abandonment analysis

UNIT V: **(08 hrs)**

Project Implementation and Review: Forms of project organization, project planning, project control, human aspects of project management, prerequisites for successful project implementation, project review, performance evaluation, abandonment analysis

Course Outcomes:

CO1	Understand the concepts of Human Resource Management including HR planning, recruitment, selection, HR audit, and emerging trends (L2)
CO2	Explain Human Resource Development practices such as training, performance appraisal, career development, and HR accounting models (L2)
CO3	Apply project management principles including project planning, resource management, monitoring, and evaluation techniques (L3)
CO4	Analyze project management strategies for different project types including planning, control, review, and performance evaluation (L4)

Mapping CO's to PO's

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	3	-	3	3	3	3	-	-	-
CO3	3	3	-	-	-	-	-	3	3	3	3	-	-	-
CO4	3	3	-	-	-	-	-	3	3	3	3	-	-	-

TEXT BOOKS:

1.	Robert L. Mathis, John H. Jackson, Manas Ranjan Tripathy, Human Resource Management, Cengage Learning 2016.
2.	Sharon Pande and Swapnalekha Basak, Human Resource Management, Text and Cases, Vikas Publishing, 2e, 2016.
3.	Stewart R. Clegg, Torgeir Skyttermoen, Anne Live Vaagaasar, Project Management, Sage Publications, 1e, 2021.
4.	K. Nagarajan, Project Management, New Age International Publishers, 8e, 2017.

REFERENCE BOOKS:

1.	Subba Rao P, "Personnel and Human Resource Management-Text and Cases", Himalaya Publications, Mumbai, 2013.
2.	K Aswathappa, "Human Resource and Personnel Management", Tata McGraw Hill, New Delhi, 2013.
3.	Prasanna
4.	Vasanth Desai, "Project Management", 4th edition, Himalaya Publications, 2018.
5.	Lalitha Balakrishnan, Gowri, "Project Management", Himalaya Publishing house, New Delhi, 2022.

SOFTWARE ARCHITECTURE & DESIGN PATTERNS
(Professional Elective – IV)

Subject Code: UGCS7T0223		**L**	**T**	**P**	**C**
IV Year / I Semester		**3**	**0**	**0**	**3**

COURSE OBJECTIVE:	
The main objectives of the course are to make student ➢ Understand the basic concepts to identify state behavior of real world objects ➢ Apply Object Oriented Analysis and Design concepts to solve complex problems ➢ Construct various UML models using the appropriate notation for specific problem context ➢ Design models to Show the importance of systems analysis and design in solving complex problems using case studies ➢ Study Pattern Oriented approach for real world problems	
SYLLABUS:	
UNIT I:	**(10 hrs)**
Introduction: design pattern, Describing design patterns, the catalog of design pattern, organizing the catalog, how design patterns solve design problems, how to select a design pattern, how to use a design pattern What is object oriented development? key concepts of object oriented design other related concepts, benefits and drawbacks of the paradigm	
UNIT II:	**(10 hrs)**
Analysis a System: Overview of the analysis phase, stage 1 gathering the requirements functional requirements specification, defining conceptual classes and relationships, using the knowledge of the domain Design and Implementation, discussions and further reading	
UNIT III:	**(10 hrs)**
Design Pattern Catalog: Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, proxy.	
UNIT IV:	**(10 hrs)**
Interactive systems and the MVC architecture: Introduction The MVC architectural pattern, analyzing a simple drawing program designing the system, designing of the subsystems, getting into implementation, implementing undo operation drawing incomplete items, adding a new feature pattern based solutions	
UNIT V:	**(10 hrs)**
Designing with Distributed Objects: Client server system, java remote method invocation, implementing an object oriented system on the web, Web services (SOAP, Restful), Enterprise Service Bus	

Course Outcomes:

CO1	Understand the concepts of object-oriented design and design patterns including their classification, benefits, and application in solving design

	problems (L2)
CO2	Analyze system requirements and design conceptual models using object-oriented principles and relationships (L4)
CO3	Apply structural design patterns and MVC architecture to develop modular and maintainable software systems (L3)
CO4	Analyze distributed object-based systems using client-server models, RMI, and web services (SOAP and RESTful) (L4)

Mapping CO's to PO's

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	3	3	3	3	3	3	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	3	-	-	-	-	3	-	3	-	-

TEXT BOOKS:

1.	Object Oriented Analysis, Design and Implementation, Brahma Dathan, Sarnath Rammath , Universities Press, 2013
2.	Design Patterns, Erich Gamma, Richard Helan, Ralph Johman, John Vlissides, PEARSON Publication, 2013

REFERENCE BOOKS:

1.	Frank Bachmann, Regine Meunier, Hans Rohnert "Pattern Oriented Software Architecture", Volume 1, 1996.
2.	William J Brown et al., "Anti Patterns: Refactoring Software, Architectures and Projects in Crisis", John Wiley, 1998.

BLOCKCHAIN TECHNOLOGY
(Professional Elective – IV)

Subject Code: UGAI7T0223		**L**	**T**	**P**	**C**
IV Year / I Semester		**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

- To provide a strong foundation in blockchain technology, including its evolution, architecture, and underlying cryptographic principles.
- To develop understanding of blockchain mechanisms such as Bitcoin technology, consensus algorithms, and smart contracts for decentralized applications.
- To expose students to enterprise blockchain platforms like Hyperledger Fabric and explore real-world applications, challenges, and limitations of blockchain technology.

SYLLABUS:

UNIT I: **(10 hrs)**

INTRODUCTION TO BLOCKCHAIN: Introduction, history of Bitcoin and origins of Blockchain, Fundamentals of Blockchain and key components (Chapter 1-book1), Permission and Permission-less platforms(Chapter 1-book2), Introduction to Cryptography, SHA256 and ECDSA, Hashing and Encryption, Symmetric/ Asymmetric keys, Private and Public Keys(Chapter 3-book2).

UNIT II: **(10 hrs)**

BITCOIN ARCHITECTURE AND BLOCKCHAIN FUNDAMENTALS: hash pointers- - Digital cash etc.- Bitcoin blockchain - Wallet Blocks Merkley Tree - hardness of mining - Transaction verifiability - Anonymity - forks - Double spending - Mathematical analysis of properties of Bitcoin - Bitcoin- the challenges and solutions. (Chapter 3-book2).

UNIT III: **(10 hrs)**

CONSENSUS MECHANISMS: Consensus Algorithms: Proof of Work (PoW) as random oracle - Formal treatment of consistency- Liveness and Fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS), Byzantine Models of fault tolerance. ((Chapter 1-book2))

UNIT IV: **(10 hrs)**

ETHEREUM: Ethereum -Ethereum Virtual Machine (EVM) -Wallets for Ethereum - Solidity - Smart Contracts (Chapter 5-book1), - The Turing Completeness of Smart Contract Languages and verification challenges- Using smart contracts to enforce legal contracts- Comparing Bitcoin scripting vs. Ethereum Smart Contracts-Some attacks on smart contracts (Chapter 6 and Chapter 7-book2)

UNIT V: **(10 hrs)**

HYPERLEDGER FABRIC: Hyperledger fabric- the plug and play platform and mechanisms in permissioned blockchain - Beyond Cryptocurrency applications of blockchain in cyber security- integrity of information- E-Governance and other

contract enforcement mechanisms - Limitations of blockchain as a technologyand myths vs reality of blockchain technology (Chapter 16-book1), (Chapter 9 -book2)

Course Outcomes:

CO1	Understand the fundamentals of blockchain technology, cryptographic principles, and different blockchain architectures.(L2)
CO2	Apply blockchain concepts such as Bitcoin mechanisms, transaction validation, and consensus algorithms in decentralized systems. (L3)
CO3	Analyze smart contracts, Ethereum architecture, and consensus mechanisms for secure and efficient blockchain solutions. (L4)
CO4	Evaluate enterprise blockchain platforms and real-world applications to assess scalability, security, and limitations of blockchain systems. (L5)

Mapping CO's to PO's

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	–	–	2	–	–	–	–	–	–	3	3	3
CO2	3	3	2	–	3	–	–	–	–	–	–	3	3	3
CO3	3	3	3	3	3	–	–	–	–	–	–	3	3	3
CO4	3	3	3	3	3	3	3	–	–	–	–	3	3	3

TEXT BOOKS:

1.	Blockchain Technology Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan, University Press, 2020.
2.	Mastering Blockchain - Distributed ledger technology, decentralization, and smart contracts explained, Imran Bashir,2nd ed. Edition,2018, pakct publication

REFERENCE BOOKS:

1.	S. Shukla, M.Dhawan, S.Sharma.S, Venkatesan "Blockchain Technology: Cryptocurrency and Applications", Oxford University Press 2019.
2.	Cryptography and network security principles and practice, William Stallings, Pearson, 8th edition,

WEB REFERENCES:

1.	https://drive.google.com/file/d/1PtYaDmWYaqPVGjKDnMYGWO5eoI5wMPtJ/view
2.	https://archive.nptel.ac.in/courses/106/104/106104220/
3.	https://www.tutorialspoint.com/blockchain/index.html

DEVOPS

(Professional Elective – IV)

Subject Code: UGAI7T0323		**L**	**T**	**P**	**C**
IV Year / I Semester		**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

- Describe the agile relationship between development and IT operations.
- Understand the skill sets and high-functioning teams involved in DevOps and related methods to reach a continuous delivery capability.
- Implement automated system update and DevOps lifecycle.

SYLLABUS:

UNIT I: **(09 hrs)**

Introduction to DevOps: Introduction to SDLC, Agile Model. Introduction to DevOps. DevOps Features, DevOps Architecture, DevOps Lifecycle, Understanding Workflow and principles, Introduction to DevOps tools, Build Automation, Delivery Automation, Understanding Code Quality, Automation of CI/ CD. Release management, Scrum, Kanban, delivery pipeline, bottlenecks, examples

UNIT II: **(10 hrs)**

Source Code Management(GIT): The need for source code control, The history of source code management, Roles and code, source code management system and migrations. What is Version Control and GIT, GIT Installation, GIT features, GIT workflow, working with remote repository, GIT commands, GIT branching, GIT staging and collaboration.

UNIT TESTING-CODE COVERAGE: Junit, nUnit & Code Coverage with Sonar Qube, SonarQube - Code Quality Analysis.

UNIT III: **(12 hrs)**

Build Automation - Continuous Integration (CI): Build Automation, what is CI Why Cl is Required, CI tools, Introduction to Jenkins (With Architecture), Jenkins workflow, Jenkins master slave architecture, Jenkins Pipelines,

PIPELINE BASICS - Jenkins Master, Node, Agent, and Executor Freestyle Projects& Pipelines, Jenkins for Continuous Integration, Create and Manage Builds, User Management in Jenkins Schedule Builds, Launch Builds on Slave Nodes.

UNIT IV: **(08 hrs)**

Continuous Delivery, Containerization and MLOps Fundamentals:

Continuous Delivery and Continuous Deployment, CD Flow, Introduction to Docker, Docker Installation, Docker Commands, Images and Containers, Dockerfile, Docker Hub.

Introduction to MLOps: MLOps Lifecycle, Differences between DevOps and MLOps, Machine Learning Workflow, Data Versioning, Model Versioning, Experiment Tracking, Reproducibility, Continuous Training (CT), Continuous Monitoring of ML Models, Introduction to MLflow and DVC.

UNIT V: **(09 hrs)**

Configuration Management - ANSIBLE: Introduction to Ansible, Ansible tasks Roles, Jinja2 templating, Vaults, Deployments using Ansible.

CONTAINERIZATION USING KUBERNETES(OPENSHIFT) : Introduction to Kubernetes Namespace& Resources, CI/CD - On OCP, BC, DC& ConfigMaps, Deploying Apps on Open shift Container Pods.

MLOps Deployment and Monitoring: Model Packaging, Model Serving, Deployment using Docker and Kubernetes, Monitoring Model Performance, Introduction to Puppet master and Chef.

List of Experiments	**(09 hrs)**

1. Write code for a simple user registration form for an event.
2. Explore Git and GitHub commands.
3. Practice Source code management on GitHub. Experiment with the source code written in exercise 1.
4. Jenkins installation and setup, explore the environment.
5. Demonstrate continuous integration and development using Jenkins.
6. Explore Docker commands for content management.
7. Develop a simple containerized application using Docker.
8. Integrate Kubernetes and Docker
9. Automate the process of running containerized application developed in exercise 7 using Kubernetes.
10. Install and Explore Selenium for automated testing.
11. Write a simple program in JavaScript and perform testing using Selenium.
12. Develop test cases for the above containerized application using selenium.
13. Install and explore MLflow for experiment tracking.
14. Track machine learning experiments and model versions using MLflow.
15. Containerize and deploy a machine learning model using Docker.
16. Deploy and monitor a machine learning model on Kubernetes/OpenShift.

Course Outcomes:

CO1	Understand DevOps, Agile methodologies, CI/CD pipelines, and MLOps lifecycle concepts for software and machine learning systems. (L2)
CO2	Apply source code management, testing, and build automation tools such as Git, SonarQube, Jenkins, and MLflow in development workflows. (L3)
CO3	Analyze continuous integration, containerization, deployment pipelines, and machine learning deployment architectures using Docker and Kubernetes. (L4)
CO4	Apply configuration management, automation, model deployment, monitoring, and maintenance techniques using Ansible, Selenium, and MLOps tools. (L3)

Mapping CO's to PO's

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	–	–	2	–	–	–	–	–	–	3	3	–
CO2	3	3	2	–	3	–	–	–	3	3	3	3	3	3
CO3	3	3	3	3	3	–	–	–	3	3	3	3	3	3
CO4	3	3	3	3	3	–	–	–	3	3	3	3	3	3

TEXT BOOKS:

1.	Joyner, Joseph., Devops for Beginners: Devops Software Development Method Guide for Software Developers and It Professionals, 1st Edition Mihails Konoplows, 2015.
2.	Alisson Machado de Menezes., Hands-on DevOps with Linux,1st Edition, BPB Publications, India, 2021.

REFERENCE BOOKS:

1.	LenBass, IngoWeber, LimingZhu. DevOps: A Software Architect's Perspective. Addison Wesley; ISBN-10
2.	Gene Kim Je Humble, Patrick Debois, John Willis. The DevOps Handbook, 1st Edition, IT Revolution Press, 2016.
3.	Verona ,Joakim Practical DevOps,1st Edition,PacktPublishing,2016.
4.	Joakim Verona .Practical Devops,2nd Edition.Ingramshorttitle;2nd edition (2018). ISBN10: 1788392574
5.	5Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's View point. Wiley publications. ISBN:9788126579952

ARCHITECTURE FOR MANAGEMENT OF LARGE DATASETS
(Professional Elective – IV)

Subject Code: UGAI7T0423		**L**	**T**	**P**	**C**
IV Year / I Semester		**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

- To understand the architecture, components, and storage mechanisms of Hadoop and HDFS for managing large-scale datasets.
- To familiarize students with distributed computing concepts, Hadoop administration, monitoring, and maintenance in big data environments.
- To develop skills in using big data processing frameworks such as Hive, Giraph, Spark, and Storm for data storage, querying, and analytics.
- To enable students to analyze structured, semi-structured, and unstructured data using scalable big data technologies.
- To introduce Large Language Models (LLMs), transformer architectures, and their role in processing and generating insights from large datasets.

SYLLABUS:

UNIT I: **(09 hrs)**

Hadoop, HDFS and Setting up a Hadoop Cluster : Why Hadoop, Why not RDBMS, RDMBS vs Hadoop, HDFS Daemons, Anatomy of File Read, Anatomy of File Write, Replica Placement Strategy, Working with HDFS commands , Setting up a Hadoop Cluster-Cluster Specification, Cluster Setup and Installation, Hadoop Configuration, Security

UNIT II: **(10 hrs)**

Terminologies and Administering Hadoop: Terminologies used in Big Data Environments-In-memory analytics, In-database processing, Symmetric Multiprocessor System(SMP), Massively Parallel Processing, Difference between Parallel and Distributed Systems, Shared Nothing Architecture, Administering Hadoop-Administering HDFS, Monitoring and Maintenance

UNIT III: **(12 hrs)**

Hive and Architecture of Graph: What is Hive, Hive Architecture, Hive Data Types, Hive File Format, HiveQL, Tables, Querying Data, User Defined Functions (UDF), Architecture of Giraph

UNIT IV: **(08 hrs)**

Spark and Architecture of Storm: Installing Spark, Spark Applications, Jobs, Stages, Tasks, Resilient Distributed Datasets, Shared Variables, Anatomy of a Spark Job Run, Executors and Cluster managers, Architecture of Storm.

UNIT V: **(09 hrs)**

Classification of Digital Data and Large Language Models for Graphs: Classification of Digital Data - Structured Data, Semi-structured Data and Unstructured Data, Understanding large language models-What is an LLM, Applications of LLMs, Stages of building and using LLMs, Introducing the transformer architecture, Utilizing

large datasets, A closer look at the GPT architecture, Building a large language model.

Course Outcomes:

CO1	Understand the fundamentals of big data architectures, Hadoop ecosystem, and distributed storage systems. (L2)
CO2	Analyze distributed computing models, Hadoop administration, and data processing frameworks for large-scale data management.(L4)
CO3	Apply tools such as Hive and Spark for processing, querying, and managing large datasets efficiently.(L3)
CO4	Analyze advanced data processing frameworks and large language models for handling structured and unstructured big data applications.(L4)

Mapping CO's to PO's

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	–	–	2	–	–	–	–	–	–	-	2	-
CO2	3	3	3	3	3	–	–	–	–	–	**–**	3	3	2
CO3	3	3	3	3	3	–	–	–	–	–	**–**	3	3	3
CO4	3	3	3	3	3	–	–	–	–	–	–	3	3	3

TEXT BOOKS:

1.	Seema Acharya and Subhashini Chellappan, "Big Data Analytics", 2nd Ed, Wiley, 2015
2.	Tom White, "Hadoop: The Definitive Guide", 4th Ed, O'reilly, 2015
3.	V. K. Jain, Big Data and Hadoop, Khanna Book Publishing, 2020
4.	Build a Large Language Model (From Scratch), Sebastian Raschka, September 2024 ISBN 9781633437166

REFERENCE BOOKS:

1.	Michael Minelli, Michelle Chambers and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013
2.	P. J. Sadalage, M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012
3.	Storm https://cds.iisc.ac.in/wp-content/uploads/DS256.2017.Storm_.Tutorial.pdf
4.	Giraph https://cds.iisc.ac.in/wp-content/uploads/DS256.2017.L12.Pregel.pdf

AGILE METHODOLOGIES
(Professional Elective – V)

Subject Code: UGAI7T0523		**L**	**T**	**P**	**C**
IV Year / I Semester		**3**	**0**	**0**	**3**

COURSE OBJECTIVE:	
➢ The main objectives of this course are to introduce the important concepts of Agile software development Process, emphasize the role of stand-up meetings in software collaboration, impart the knowledge on values and principles in understanding agility	
SYLLABUS:	
UNIT I:	**(10 hrs)**
Agile Methodology: Theories for Agile Management, Agile Software Development Traditional Model vs. Agile Model, Classification of Agile Methods, Agile Manifesto and Principles, Agile Project Management, Agile Team Interactions, Ethics in Agile Teams, Agility in Design, Testing, Agile Documentations, Agile Drivers, Capabilities and Values.	
UNIT II:	**(10 hrs)**
Agile Process: Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview Lifecycle Work Products, Roles and Practices.	
UNIT III:	**(10 hrs)**
Agile Knowledge Sharing Role of Story-Cards Story-Card Maturity Model (SMM).	
UNIT IV:	**(10 hrs)**
Agility and Requirements Engineering: Impact of Agile Processes in RE, Current Agile Practices, Variance, Overview of RE Using Agile, Managing Unstable Requirements, Requirements Elicitation, Agile Requirements Abstraction Model, Requirements Management in Agile Environment, Agile Requirements Prioritization, Agile Requirements Modelling, Generation Concurrency in Agile Requirements Generation.	
UNIT V:	**(10 hrs)**
Agility and Quality Assurance: Agile Product Development, Agile Metrics, Feature Driven Development (FDD), Financial and Production Metrics in FDD, Agile Approach to Quality Assurance, Test Driven Development, Agile Approach in Global Software Development.	

Course Outcomes:

CO1	Understand Agile concepts, values, principles, and methodologies including Agile Manifesto and project initiation (L2)
CO2	Apply Agile frameworks such as Scrum, Extreme Programming (XP), and Feature Driven Development (FDD) for software project execution. (L3)
CO3	Analyze Agile knowledge-sharing practices, requirements engineering

	techniques, and requirement management in dynamic environments. (L4)
CO4	Analyze Agile quality assurance practices, metrics, test-driven development, and global software development approaches for continuous improvement. (L4)

Mapping CO's to PO's

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	–	–	–	–	–	3	3	3	-	-	-	-
CO2	3	3	3	–	3	–	–	3	3	3	3	3	-	-
CO3	3	3	3	3	3	–	–	–	3	3	3	3	-	-
CO4	3	3	3	3	3	–	–	–	3	3	2	3	-	-

TEXT BOOKS:

1.	Andrew Stellman, Jill Alison Hart, Learning Agile, O'Reilly, 2015.

REFERENCE BOOKS:

1.	Andrew stellman, Jennifer Green, Head first Agile, O'Reilly, 2017.
2.	Rubin K , Essential Scrum : A practical guide to the most popular Agile process, Addison- Wesley, 2013

REINFORCEMENT LEARNING
(Professional Elective – V)

Subject Code: UGAI7T0623		**L**	**T**	**P**	**C**
IV Year / I Semester		**3**	**0**	**0**	**3**

COURSE OBJECTIVE:	
➢ To provide the fundamentals of Reinforcement learning.	
SYLLABUS:	
UNIT I:	**(09 hrs)**
The Reinforcement Learning Problem: Reinforcement Learning, Examples, Elements of Reinforcement Learning, Limitations and Scope, An Extended Example: Tic-Tac-Toe, Summary, History of Reinforcement Learning	
UNIT II:	**(10 hrs)**
Multi-arm Bandits: An n-Armed Bandit Problem, Action-Value Methods, Incremental Implementation, tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence- Bound Action Selection, Gradient Bandits, Associative Search (Contextual Bandits)	
UNIT III:	**(12 hrs)**
Finite Markov Decision Processes: The Agent Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation.	
UNIT IV:	**(08 hrs)**
Monte Carlo Methods: Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off- policy Prediction via Importance Sampling, Incremental Implementation, Off-Policy Monte Carlo Control, Importance Sampling on Truncated Returns	
UNIT V:	**(09 hrs)**
Applications and Case Studies: TD-Gammon, Samuel's Checkers Player, The Acrobot, Elevator Dispatching, Dynamic Channel Allocation, Job-Shop Scheduling.	

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to:

CO1:	Understand the fundamental principles of reinforcement learning, including agent–environment interaction and learning paradigms.(L2)
CO2:	Apply reinforcement learning algorithms to solve decision-making problems under uncertainty.(L3)
CO3:	Analyze reinforcement learning models such as bandits and Markov Decision Processes for optimal policy formulation. (L4)
CO4:	Evaluate the effectiveness of reinforcement learning techniques in real-world applications and complex environments. (L5)

Mapping CO's to PO's

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	–	–	3	–	–	–	–	–	–	-	3	3
CO2	3	3	3	–	3	–	–	–	–	–	–	3	3	3
CO3	3	3	3	3	3	–	–	–	–	–	–	3	3	3
CO4	3	3	3	3	3	3	–	–	–	–	–	3	3	3

TEXT BOOKS:

1.	Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning-An Introduction", 2nd Edition, The MIT Press, 2018
2.	Marco Wiering, Martijn van Otterlo, Reinforcement Learning: State-of-the-Art (Adaptation Learning and Optimization (12)) 2012th Edition

REFERENCE BOOKS:

1.	Vincent François-Lavet, Peter Henderson, Riashat Islam, An Introduction to Deep Reinforcement Learning (Foundations and Trends(r) in Machine Learning), 2019.

HIGH PERFORMANCE COMPUTING
(Professional Elective – V)

Subject Code: UGAI7T0723		**L**	**T**	**P**	**C**
IV Year / I Semester		**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

- The main objectives of the course is to study parallel computing hardware and programming models, performance analysis and modeling of parallel programs

SYLLABUS:

UNIT I: **(09 hrs)**

INTRODUCTION: Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, Multi-core architecture

UNIT II: **(10 hrs)**

PARALLEL PROGRAMMING: Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.

UNIT III: **(12 hrs)**

BASIC COMMUNICATION: Operations- One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations. Programming shared address space platforms: threads- basics, synchronization, OpenMP programming

UNIT IV: **(08 hrs)**

ANALYTICAL MODELS: Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and The effect of Granularity on Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost, optimal execution time. **Dense Matrix Algorithms**: MatrixVector Multiplication, Matrix-Matrix Multiplication.

UNIT V: **(09 hrs)**

PARALLEL ALGORITHMS- SORTING AND GRAPH : Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quick sort, All-Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel BestFirst Search. CUDA Architecture: CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C-Write and launch CUDA C kernels, Manage GPU memory, Manage communication and synchronization, Parallel programming in CUDA- C.

Course Outcomes:

CO1	Understand the fundamentals of parallel computing architectures, performance metrics, and scalability principles. (L2)
CO2	Analyze parallel algorithm design techniques, task decomposition, and load balancing strategies for efficient computation. (L3)
CO3	Apply communication operations, synchronization mechanisms, and OpenMP programming for shared memory parallel systems. (L2)
CO4	Analyze parallel algorithms and GPU-based programming models (CUDA) for solving computationally intensive problems.(L3)

Mapping CO's to PO's

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	–	–	3	–	–	–	–	–	–	-	-	3
CO2	3	3	3	3	3	–	–	–	–	–	–	3	3	3
CO3	3	3	3	3	3	–	–	–	–	–	–	3	3	3
CO4	3	3	3	3	3	–	–	–	–	–	–	3	3	3

TEXT BOOKS:

1.	Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
2.	Jason Sanders, Edward Kandrot, "CUDA by Example", Addison-Wesley, ISBN-13: 978-0-13-138768-3

REFERENCE BOOKS:

1.	Kai Hwang, "Scalable Parallel Computing", McGraw Hill 1998, ISBN: 0070317984
2.	Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013, ISBN: 9780124159884
3.	David Culler, Jaswinder Pal Singh, "Parallel Computer Architecture: A Hardware/Software Approach", Morgan Kaufmann, 1999, ISBN: 978-1-55860-343-1
4.	Rod Stephens, "Essential Algorithms", Wiley, ISBN: ISBN: 978-1-118-61210-1

QUANTUM SCIENCE AND TECHNOLOGY
(Professional Elective – V)

Subject Code: UGAI7T0823		**L**	**T**	**P**	**C**
IV Year / I Semester		**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

- To introduce fundamental concepts of quantum mechanics and its mathematical formalism.
- To explore quantum computing and communication principles and technologies.
- To understand the physical implementation and limitations of quantum systems.
- To enable students to relate quantum theory to practical applications in computing, cryptography, and sensing.
- To familiarize students with the emerging trends in quantum technologies.

SYLLABUS:

UNIT I: **(09 hrs)**

Fundamentals of Quantum Mechanics: Historical background: Blackbody radiation, photoelectric effect, and Compton scattering; Dual nature of light and matter; De Broglie hypothesis; Schrödinger equation; Free particle, infinite potential well, step potential; Operators and observables: position, momentum, Hamiltonian; Commutation relations and uncertainty principle; Quantum postulates and measurement theory; Eigenvalues, eigenfunctions.

UNIT II: **(10 hrs)**

Quantum Information Theory: Classical vs. quantum information; Qubit representation using Bloch sphere; Quantum superposition and quantum entanglement; Dirac notation (bra-ket), tensor products, and composite systems; Bell states and EPR paradox; Quantum gates: Pauli-X, Y, Z; Hadamard; Phase; T; CNOT; Quantum circuit models and notation; Measurement in computational basis; Quantum teleportation and no-cloning theorem;

UNIT III: **(09 hrs)**

Quantum Computing: Classical computing review and limitations; Quantum parallelism and interference; Deutsch and Deutsch-Jozsa algorithms; Grover's search algorithm, Shor's factoring algorithm (overview and significance); Quantum Fourier Transform (QFT),Qiskit, IBM Quantum Experience.

UNIT IV: **(10 hrs)**

Quantum Communication: Introduction to quantum cryptography; Quantum key distribution (QKD): BB84 protocol; Entanglement-based QKD: Ekert protocol (E91); Eavesdropping and security of QKD; Quantum teleportation (circuit and protocol); Quantum dense coding; Quantum networks and entanglement swapping; Role of quantum repeaters; Implementation challenges (loss, decoherence, noise)

UNIT V:	**(12 hrs)**
Quantum Technologies and Emerging Applications: Quantum sensors; Quantum metrology; Quantum imaging; Quantum materials (overview); Hardware platforms: Superconducting qubits, Trapped ions, Photonic quantum processors; Quantum supremacy and NISQ era; Global initiatives and India's National Quantum Mission (NQM); **Introduction to Quantum Machine Learning (Quantum ML):** Quantum-enhanced machine learning, variational quantum circuits, potential applications in classification and optimization (overview only); Ethical concerns and future prospects.	

Course Outcomes:

CO1	Explain the fundamental principles of quantum mechanics, quantum states, and quantum information theory.(L2)
CO2	Analyze quantum phenomena such as superposition, entanglement, quantum gates, and quantum circuits. (L4)
CO3	Apply quantum computing concepts, quantum algorithms, and quantum programming platforms such as Qiskit for solving computational problems.(L3)
CO4	Analyze quantum communication protocols, quantum technologies, and the potential of quantum machine learning for emerging real-world applications. (L4)

Mapping CO's to PO's

POs/ COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	–	–	2	–	–	–	–	–	–	–	–	2
CO2	3	3	3	3	3	–	–	–	–	–	–	3	3	3
CO3	3	3	3	3	3	–	–	–	–	–	–	3	3	3
CO4	3	3	3	3	3	3	3	–	–	–	–	3	3	3

TEXT BOOKS:

1.	Quantum Computation and Quantum Information by Michael A. Nielsen and Isaac L. Chuang
2.	Quantum Mechanics: Concepts and Applications by Nouredine Zettili

ONLINE LEARNING RESOURCES:

1.	https://nptel.ac.in/courses/104104082
2.	https://nptel.ac.in/courses/115104096
3.	https://nptel.ac.in/courses/122106034

PROMPT ENGINEERING
(SKILL ENHANCEMENT COURSE)

Subject Code: UGCS7K1123		**L**	**T**	**P**	**C**
IV Year / I Semester		**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

The main objectives of the course are to

- Apply iterative prompting for clarity and context.
- Create varied prompts to steer model outputs.
- Construct chain-of-thought and structured prompts.
- Develop retrieval-augmented pipelines to ground outputs.
- Evaluate LLM agents and multimodal apps for ethics and robustness.

SYLLABUS:

UNIT I: **(09 hrs)**

Foundations of Prompt Engineering: Definition of prompt engineering, Distinction between prompt engineering and model fine-tuning, Motivation and benefits of prompt engineering, Core principles of effective prompt design**,** Anatomy of a prompt, Setting up the Python environment for LLM interaction, Iterative prompting lifecycle, Common prompt pitfalls and remediation

Lab Experiments:

1. Environment & Connectivity: Install required packages (e.g., transformers, openai); securely configure the API key; run a simple "Hello, world" prompt to verify model access.
2. Baseline vs. Enhanced Prompts: Execute a naïve prompt ("Write a one-paragraph bio of Ada Lovelace.") and an enhanced prompt that adds role framing, specificity, and explicit format instructions; compare both outputs for relevance, completeness, and style.
3. Iterative Refinement on a Simple Task: Summarize the plot of the Shakespearean play Romeo and Juliet in two sentences through three rounds of prompt tweaking:
    a. Minimal instruction.
    b. Addition of length and style constraints
    c. Specification of key content elements (setting and theme) Document how each iteration changes and improves the result.
4. Diagnosing Prompt Failures & Edge Cases: Craft a vague or contradictory prompt; analyze the failure mode (ambiguity, missing context, or format errors); refine the prompt by adding examples or clarifying instructions.

UNIT II: **(10 hrs)**

Advanced Prompt Patterns & Techniques: Enhanced prompt anatomy: contextual detail and explicit output specifications, Few-shot in-context prompting, Prompt structuring and template design, Role-based prompting to establish personas

or system behavior, Negative prompting to filter or suppress undesired content, Constraint specification and instruction enforcement (e.g., length, format), Iterative prompt refinement and optimization

Lab Experiments:

1. Few-Shot vs. Zero-Shot Comparison: Design and execute a zero-shot prompt and a few-shot prompt (with 2–3 exemplar input-output pairs) for a chosen text task (e.g.,sentiment classification or translation); compare outputs for accuracy, consistency, and adherence to examples.
2. Role-Based & Negative Prompting: Craft a role-based prompt to establish a specific persona (e.g., "You are a financial advisor…"); then create a negative prompt to suppress undesired content (e.g., "Do not mention any brand names"); evaluate how each influences the model's response.
3. Constraint Specification & Iterative Refinement: Select an open-ended task (e.g., summarizing a technical article); issue a basic prompt; identify failures in length or format; refine the prompt by adding explicit constraints (word count, bullet format, etc.); document improvements over two refinement cycles.

UNIT III: **(12 hrs)**

Structured Output & Reasoning Techniques: Importance of structured outputs for real-world applications, Prompting for specific formats (lists, tables, Markdown), Generating valid JSON and YAML via explicit instructions, Eliciting chain-of-thought reasoning in zero-shot prompts, Decomposing complex tasks into manageable sub-tasks

Lab Experiments:

1. Structured Format Prompting: Instruct the model to output information as bullet lists and Markdown tables (e.g., "List three benefits of daily exercise in a Markdown table with columns 'Benefit' and 'Description.'"); verify the output matches the requested structure.
2. JSON/YAML Generation: Provide a brief dataset description (e.g., three books with title, author, publication year) and prompt the model to produce valid JSON or YAML; use a parser to validate syntax and refine the prompt if errors occur.
3. Chain-of-Thought & Task Decomposition: Present a multi-step problem (e.g., a logic puzzle) and apply zero-shot CoT prompting (e.g., "Let's think step by step. Explain your reasoning before the final answer."); separately, decompose the problem into sequential sub-questions, collect partial answers, combine them, and compare accuracy against a direct-answer baseline

UNIT IV: **(08 hrs)**

Retrieval-Augmented Generation & LangChain Workflows: Limitations of LLM internal knowledge, Need for external data sources, Introduction to Retrieval-Augmented Generation (RAG), Overview of RAG architecture (indexing vs. retrieval + generation), Getting started with LangChain for LLM applications, Basics of LangChain

Expression Language (LCEL), Simplified indexing pipeline: document loading & text splitting, Fundamentals of embeddings and vector stores, Building a basic retrieval-generation pipeline with an LCEL chain.

Lab Experiments:

1. Building a Simple LCEL Chain: Create a minimal LCEL script that accepts a fixed instruction (e.g., "Summarize this text: …"), passes it to an LLM, and prints the result; verify end-to-end execution.
2. Basic Data Indexing for RAG: Load a small collection of documents; split into uniform chunks (e.g., 200 tokens); generate embeddings for each chunk; store them in an in-memory vector store; inspect for consistency.
3. Constructing & Running a Basic RAG Chain: Build a pipeline that:
    a. Receives a user query
    b. Retrieves the top-k relevant chunks
    c. Constructs a combined prompt with context + query
    d. Send it to the LLM
    e. Returns the answer

Test with sample queries and compare factual accuracy against a prompt without retrieval.

UNIT V:	**(09 hrs)**

Agents, Multimodal AI & Ethical Evaluation: Introduction to LLM agents and their basic architecture, Overview of multimodal AI models (VLMs), Prompting for text-to-image generation and image understanding, Importance of prompt evaluation beyond subjective judgment, Manual evaluation techniques (heuristic checks for accuracy, relevance, format), Introduction to "LLM-as-Judge" for automated evaluation, Security considerations (prompt injection, sensitive-information risks), Prompt-based mitigation strategies for safety and robustness, Ethical concerns (bias, misinformation, data privacy), Brief exploration of UI frameworks (Streamlit/Gradio) for deploying prompt-driven apps, Adapting to the evolving nature of prompt engineering through continuous learning

Lab Experiments:

1. Building a Simple LLM Agent: Register a tool (e.g., a calculator function) and craft prompts that instruct the agent to invoke it when required; implement using LangChain or a function-calling API; test on queries requiring tool execution.
2. Multimodal Prompting Exploration: Generate images from detailed text prompts; feed one generated image into an image-understanding model or API with an appropriate prompt; compare the returned caption to the original prompt to evaluate alignment.
3. Prompt Evaluation & Ethics Workshop:
    a. Select two existing prompts and generate multiple outputs; apply manual heuristic checks for accuracy, relevance, and format compliance.
    b. Use an "LLM-as-Judge" prompt (e.g., "Rate these outputs on a

scale of 1–5 for clarity and correctness.") to automate evaluation. c. Design a prompt- injection test (e.g., "Ignore previous instructions…"), observe the response, then refine system prompts to mitigate the vulnerability.

Course Outcomes:

CO1	Understand the fundamentals of prompt engineering including prompt design principles, lifecycle, and common pitfalls (L2)
CO2	Apply advanced prompt techniques such as few-shot learning, role-based prompting, constraint specification, and structured output generation (L3)
CO3	Apply retrieval-augmented generation (RAG), LangChain workflows, and agent-based systems for building LLM applications (L3)
CO4	Analyze ethical, security, and evaluation aspects of prompt engineering including bias, prompt injection, and model assessment techniques (L4)

Mapping CO's to PO's

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	3	3	3	-	3	3	3	3	-	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO4	3	3	3	3	3	3	-	3	-	-	-	3	3	3

TEXT BOOKS:

1.	Tanmoy Chakraborty, Introduction to Large Language Models, Wiley India, 1st Edition, 2025. ISBN : 9789363864740
2.	Dan Jurafsky and James H. Martin, Speech and Language Processing, 2nd edition, Pearson Press, 2008.
3.	Jacob Eisenstein, Natural Language Processing, First edition,The MIT Press, 2019.

WEB REFERENCES:

1.	https://onlinecourses.nptel.ac.in/noc26_cs88/preview

ROBOTIC PROCESS AUTOMATION
(SEC)

Subject Code: UGAI7K0923		**L**	**T**	**P**	**C**
IV Year / I Semester		**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

- To understand the basics of Robotic Process Automation.
- To demonstrate the use of sequence and control flow for a task.
- To understand different mouse and keyboard activities
- To design an Assistant bot on a keyboard event
- To understand deploying and managing the bot.

SYLLABUS:

UNIT I: **(09 hrs)**

INTRODUCTION TO ROBOTIC PROCESS AUTOMATION: Scope and techniques of automation, Robotic process automation, Benefits of RPA, Components of RPA, RPA platforms, UiPath studio, UiPath Robot, UiPath orchestrator, the future of automation.

UNIT II: **(10 hrs)**

RECORD AND PLAY: UiPath Stack, Types of Robots, the user interface, Quick Access Toolbar, Different panels, Task recorder, Step by step examples using recorder. Sequence, Activities, Control flow, various types of loops, decision making, step by step example using sequence and flow chart, step by step example using sequence and control flow.

UNIT III: **(12 hrs)**

DATA MANIPULATION AND CONTROLS: Variables and Scope, Collections, Arguments, Data table usage, clipboard management, File operations, CSV/Excel to data table and vice versa. Finding and attaching windows, finding the control, techniques for a waiting for a control, act on controls, mouse and keyboard activities, working with UiExplorer, Handling events, Screen scraping, OCR.

UNIT IV: **(08 hrs)**

ASSISTANT BOTS, EXCEPTION HANDLING: Assistant bots, Monitoring system event triggers, Hotkey trigger, Mouse trigger, System trigger Monitoring image and element triggers, Example of monitoring email, Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event. Exception Handling, common exceptions, logging and taking screenshots, Debugging techniques, collecting crash dumps, error reporting.

UNIT V: **(09 hrs)**

DEPLOYING AND MAINTAINING THE BOT: Publishing using publish utility, publish a workflow in Uipath, Overview of Orchestartion server, using orchestration server to control bots, using orchestration server to deploy bots, license management, publishing and managing updates.

Course Outcomes:

CO1	Understand the fundamentals of robotic process automation, its architecture, tools, and real-world applications. (L2)
CO2	Analyze recording mechanisms, control flow structures, and automation workflows to design efficient RPA processes.(L4)
CO3	Apply data manipulation, UI interaction, and event-handling techniques to develop functional automation bots.(L3)
CO4	Analyze deployment, orchestration, and maintenance mechanisms for managing scalable and reliable RPA solutions.(L4)

Mapping CO's to PO's

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	–	–	-	–	–	–	–	–	–	3	3	3
CO2	3	3	3	3	3	–	–	–	–	–	–	3	3	3
CO3	3	3	3	3	3	–	–	–	–	–	–	3	3	3
CO4	3	3	3	3	3	3	–	–	–	–	–	3	3	3

TEXT BOOKS:

1.	Alok Mani Tripathi, "Learning Robotic Process Automation", Packt Publishing, 2018.

REFERENCE BOOKS:

1.	Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation, 1st Edition 2015.
2.	Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant", Independently Published, 1st Edition 2018.
3.	Srikanth Merianda, "Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation", Consulting Opportunity Holdings LLC, 1st Edition 2018.
4.	Lim Mei Ying, "Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes", Packt Publishing, 1st Edition 2018.

WEB REFERENCES:

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

CONSTITUTION OF INDIA

Subject Code: UGAI7A1023		L	T	P	C
IV Year / I Semester		3	0	0	3

COURSE OBJECTIVE:

The objectives of the course are to

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- Address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

SYLLABUS:

UNIT I: **(09 hrs)**

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution- Preamble, Salient, Features

UNIT II: **(10 hrs)**

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III: **(12 hrs)**

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, **Executive-** President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT IV: **(08 hrs)**

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT V: **(09 hrs)**

Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Course Outcomes:

CO1	Understand the historical background, philosophy, and key features of the Indian Constitution (L2)
CO2	Explain fundamental rights, directive principles, and duties of citizens in the constitutional framework (L2)
CO3	Apply knowledge of governance structures including legislature, executive, and judiciary in real-world contexts (L3)
CO4	Analyze local governance, election systems, and institutional roles in strengthening democracy (L4)

Mapping CO's to PO's

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	3	-	-	-	-	_	_
CO2	3	-	-	-	-	-	3	3	3	-	-	-	_	_
CO3	3	-	-	-	-	-	3	3	3	3	3	3	_	_
CO4	3	-	-	-	-	3	3	3	3	3	3	3	_	_

TEXT BOOKS:

1.	The Constitution of India, 1st Edition, (Bare Act), Government Publication, 1950
2.	Framing of Indian Constitution, 1st Edition, Dr. S. N. Busi, Dr. B. R. Ambedkar, 2015

REFERENCE BOOKS:

1.	Indian Constitution Law, 7th Edition, M. P. Jain, Lexis Nexis, 2014