IV Year - I Semester

S.No	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	PC	UGCS7T0123	Deep Learning	2	1	0	3	30	70	100
2	MC	UGMB7T0123	Human Resources & Project Management	2	0	0	2	30	70	100
3	PE	UGCS7T0223 UGCS7T0323 UGCS7T0423 UGCS7T0523 UGCS7T0623	**Professional Elective-IV** 1. Software Architecture & Design Patterns 2. Blockchain Technology 3. Augmented Reality & Virtual Reality 4. Internet of Things 5. Agentic AI 6. MOOCs (12 week Swayam/NPTEL course recommended by the BoS)	3	0	0	3	30	70	100
4	PE	UGCS7T0723 UGCS7T0823 UGCS7T0923 UGCS7T1023	**Professional Elective-V** 1. Agile Methodologies 2. Generative AI 3. Computer Vision 4. Cyber Physical Systems 5. MOOCs (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	3	0	0	3	30	70	100
7	SEC	UGCS7K1123 UGCS7O1223	Prompt Engineering (or) SWAYAM Plus - Certificate program in Prompt Engineering and ChatGPT	0	1	2	2	30	70	100
8	AC	UGCS7A1323	Constitution of India	2	0	0	0	30	-	30
9	Internship	UGCS7I1423	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 & Project	UGCS8J0123	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

IV Year
I Semester

DEEP LEARNING

Subject Code: UGCS7T0123	**L**	**T**	**P**	**C**
IV Year / I Semester	**2**	**1**	**0**	**3**

Course Objectives:

The main objective of the course is to make students:

- Learn deep learning methods for working with sequential data, deep recurrent & memory networks and deep Turing machines,
- Apply such deep learning mechanisms to various learning problems.
- Identify the open issues in deep learning, and have a grasp of the current research directions.

Course Outcomes:

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

CO1: Understand the fundamental concepts of Artificial Intelligence, Machine Learning, and Deep Learning including learning paradigms, model evaluation, and issues such as overfitting and underfitting (L2)

CO2: Explain the principles of Artificial Neural Networks and deep learning architectures along with training and optimization techniques (L2)

CO3: Apply deep learning frameworks such as Keras, TensorFlow, and PyTorch to design and evaluate classification models (L3)

CO4: Analyze advanced deep learning models such as CNNs, RNNs, GANs, and Autoencoders for solving real-world problems (L4)

Syllabus:

UNIT I: (10 Hours)

Fundamentals of Deep Learning: Artificial Intelligence, History of Machine learning: Probabilistic Modeling, Early Neural Networks, Kernel Methods, Decision Trees, Random forests and Gradient Boosting Machines, Fundamentals of Machine Learning: Four Branches of Machine Learning, Evaluating Machine learning Models, Overfitting and Underfitting. [Text Book 2]

UNIT II: (10 Hours)

Introducing Deep Learning: Biological and Machine Vision, Human and Machine Language, Artificial Neural Networks, Training Deep Networks, Improving Deep Networks. [Text Book3]

UNIT III: (10 Hours)

Neural Networks: Anatomy of Neural Network, Introduction to Keras: Keras, TensorFlow, Theano and CNTK, Setting up Deep Learning Workstation, Classifying

Movie Reviews: Binary Classification, Classifying newswires: Multiclass Classification. [Text Book 2]

UNIT IV: (10 Hours)

Convolutional Neural Networks: Nerual Network and Representation Learing, Convolutional Layers, Multichannel Convolution Operation, Recurrent Neural Networks: Introduction to RNN, RNN Code, PyTorch Tensors: Deep Learning with PyTorch, CNN in PyTorch. [Text Book 3]

UNIT V: (10 Hours)

Interactive Applications of Deep Learning: Machine Vision, Natural Language processing, Generative Adversial Networks, Deep Reinforcement Learning. [Text Book 1] Deep Learning Research: Autoencoders, Deep Generative Models: Boltzmann Machines Restricted Boltzmann Machines, Deep Belief Networks. [Text Book 1]

Mapping of COs to 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	PSO1	PSO2
CO 1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	3	3	3	-	-	-	-	-	-	-	-	-
CO 4	3	3	3	3	3	-	-	-	-	-	3	3	3	3

TEXT BOOKS:

1. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courvile, MIT Press, 2016
2. Deep Learning with Python, Francois Chollet, December 2017, Manning Publications, ISBN: 9781617294433
3. Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence, Jon Krohn, Grant Beyleveld, Aglaé Bassens, September 2019, Addison-Wesley Professional, ISBN: 9780135116821
4. Deep Learning from Scratch, Seth Weidman, September 2019, O'Reilly Media, Inc., ISBN:9781492041412

Reference Books:

1. Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009.
2. Matrix Computations, Golub, G.,H., Van Loan,C.,F, JHU Press,2013.
3. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004.

Web Link:

1. Swayam NPTEL: Deep Learning: https://onlinecourses.nptel.ac.in/noc22_cs22/preview

HUMAN RESOURCES & PROJECT MANAGEMENT

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

Course Objectives: 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.

Course Outcomes:

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

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)

Syllabus:

UNIT I: (10 Hours)

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, SelectionSelection Procedure.

UNIT II: (10 Hours)

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: **(10 Hours)**

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: **(10 Hours)**

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: **(10 Hours)**

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

Mapping of COs to 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	PSO1	PSO2
CO 1	3	3	-	-	-	-	-	-	-	-	-	3	3	3
CO 2	3	3	-	-	-	3	-	3	3	3	3	-	-	-
CO 3	3	3	-	-	-	-	-	3	3	3	3	-	-	-
CO 4	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 Chandra, "Projects, Planning, Analysis, Selection, Financing, Implementation and Review", Tata McGraw Hill Company Pvt. Ltd., New Delhi, 1998.
4. Vasanth Desai, "Project Management", 4th edition, Himalaya Publications, 2018.
5. Lalitha Balakrishnan, Gowri, "Project Management", Himalaya publishing house, New Delhi, 202

SOFTWARE ARCHITECTURE & DESIGN PATTERNS
(PROFESSIONAL ELECTIVE-IV)

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

Course Objectives: 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

Course Outcomes:

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

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)

Syllabus:

UNIT I: (10 Hours)

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 Hours)

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 Hours)**

Design Pattern Catalog: Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, proxy

UNIT IV: **(10 Hours)**

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 Hours)**

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

Mapping of COs to 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	PSO1	PSO2
CO 1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	3	-	-	3	3	3	3	3	3	-	-	-
CO 3	3	3	3	3	3	-	-	-	-	-	-	-	-	-
CO 4	3	3	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: UGCS7T0323	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Course Objectives: The objectives of the course are to make student

1. Learn the fundamentals of Block Chain and various types of block chain and consensus mechanism.
2. Understand public block chain system, Private block chain system and consortium block chain.
3. Identify the security issues of blockchain technology.

Course Outcomes:

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

CO1: Understand the fundamentals of blockchain technology including types, components, consensus mechanisms, and cryptocurrencies (L2)

CO2: Explain public and private blockchain systems, smart contracts, and platforms such as Bitcoin, Ethereum, and Hyperledger (L2)

CO3: Apply blockchain concepts to develop applications using smart contracts, Python, and Hyperledger Fabric (L3)

CO4: Analyze blockchain security, challenges, and real-world applications across domains such as banking, healthcare, and supply chain (L4)

Syllabus:

UNIT I: (10 Hours)

Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future. Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol. Cryptocurrency: Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

UNIT II: (10 Hours)

Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain. Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

UNIT III: (10 Hours)

Private Blockchain System: Introduction, Key Characteristics of Private Blockchain, Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, Ecommerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain. Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda. Initial Coin Offering: Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.

UNIT IV: (10 Hours)

Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

Applications of Blockchain: Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain in Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain

UNIT V: (10 Hours)

Blockchain Case Studies: Case Study 1 – Retail, Case Study 2 – Banking and Financial Services, Case Study 3 – Healthcare, Case Study 4 – Energy and Utilities. Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain. Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

Mapping of COs to POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	3	3	-	-	3	-	3	3	3
CO3	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, Abhilasj K A, Meena Karthikeyan , Universities Press.

Reference Books :

1. Blockchain Blue print for Economy, Melanie Swan, SPD Oreilly.
2. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gauar, Pearson Addition Wesley

AUGMENTED REALITY & VIRTUAL REALITY
(PROFESSIONAL ELECTIVE-IV)

Subject Code: UGCS7T0423	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Course Objectives: The objectives of the course are to

- Provide a foundation to the fast growing field of AR and make the students aware of the various Augmented Reality concepts.
- Give historical and modern overviews and perspectives on virtual reality.

Course Outcomes:

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

CO1: Understand the fundamentals of Augmented Reality and Virtual Reality including history, components, displays, tracking, and perception (L2)

CO2: Explain computer vision techniques, interaction methods, and software architectures used in AR/VR systems (L2)

CO3: Apply geometric modeling, rendering techniques, and visualization methods for developing AR/VR environments (L3)

CO4: Analyze human perception, motion, audio, and interaction principles for designing immersive AR/VR applications (L4)

UNIT I: (10 Hours)

Introduction to Augmented Reality: Augmented Reality, Defining augmented reality, history of augmented reality, Examples, Related fields Displays: Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model, Visual Displays Tracking: Tracking, Calibration, and Registration, Coordinate Systems, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors

UNIT II: (10 Hours)

Computer Vision for Augmented Reality: Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Outdoor Tracking. Interaction: Output Modalities, Input Modalities, Tangible Interfaces, Virtual User Interfaces on Real Surfaces, Augmented Paper, Multi-view Interfaces, Haptic Interaction Software Architectures: AR Application Requirements, Software Engineering Requirements, Distributed Object Systems, Dataflow, Scene Graphs

UNIT III: (10 Hours)

Introduction to Virtual Reality: Defining Virtual Reality, History of VR, Human Physiology and Perception The Geometry of Virtual Worlds: Geometric Models, Axis-Angle Representations of Rotation, Viewing Transformations Light and Optics: Basic Behavior of Light, Lenses, Optical Aberrations, The Human Eye, Cameras, Displays

UNIT IV: **(10 Hours)**

The Physiology of Human Vision: From the Cornea to Photoreceptors, From Photoreceptors to the Visual Cortex, Eye Movements, Implications for VR Visual Perception: Visual Perception - Perception of Depth, Perception of Motion, Perception of Color Visual Rendering: Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates, Immersive Photos and Videos

UNIT V: **(10 Hours)**

Motion in Real and Virtual Worlds: Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Interaction: Motor Programs and Remapping, Locomotion, Social Interaction Audio: The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering

Mapping of COs to 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	PSO1	PSO2
CO 1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	3	-	-	-	-	-	-	3	-	-	-	-
CO 3	3	3	3	3	3	-	3	-	3	-	-	-	3	3
CO 4	3	3	3	3	3	3	-	3	-	-	3	3	3	3

TEXT BOOKS:

1. "Augmented Reality: Principles & Practice" by Schmalstieg, Hollerer, Pearson Education India; First edition (12 October 2016), ISBN-10: 9332578494
2. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016

REFERENCE BOOKS:

1. "AR Game Development", Allan Fowler, 1st Edition, Apress Publications, 2018, ISBN 978-1484236178
2. "Understanding Virtual Reality: Interface, Application and Design", William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. "Developing Virtual Reality Applications: Foundations of Effective Design", Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009
4. "Designing for Mixed Reality", Kharis O'Connell, O'Reilly Media, Inc., 2016, ISBN:9781491962381
5. "Theory and applications of marker-based augmented reality", Sanni Siltanen, Julkaisija, Utgivare Publisher. 2012. ISBN 978-951-38-7449-0 6. "Designing Virtual Systems: The Structured Approach", Gerard Jounghyun Kim, 2005

INTERNET OF THINGS
(PROFESSIONAL ELECTIVE-IV)

Subject Code: UGCS7T0523	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Course Objectives: The main objectives of the course are to make student learn the application areas of IOT , the revolution of Internet in Mobile Devices, Cloud & Sensor Networks and building blocks of Internet of Things and characteristics

Course Outcomes:

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

CO1: Understand the fundamentals of IoT including its evolution, enabling technologies, architectures, and networking components (L2)

CO2: Explain IoT sensing, actuation, and data processing techniques including device design and processing topologies (L2)

CO3: Apply IoT connectivity and communication technologies such as Zigbee, LoRa, Wi-Fi, and related protocols for building IoT systems (L3)

CO4: Analyze IoT interoperability, fog computing, challenges, and real-world applications such as agriculture and vehicular systems (L4)

UNIT I: (10 Hours)

Predecessors of IoT: Introduction, Wireless Sensor Networks, Machine-to-Machine Communications, Cyber Physical Systems Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT

UNIT II: (10 Hours)

IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.

UNIT III: (10 Hours)

IoT Connectivity Technologies: Introduction, IEEE 802.15.4, Zigbee, Thread, ISA100.11A, Wireless HART, RFID, NFC,DASH7, Z-Wave, Weightless, Sigfox, LoRa, NB-IT, Wi-Fi, Bluetooth IoT Communication Technologies: Introduction, Infrastructure Protocols, Discovery Protocols, Data Protocols, Identification Protocols, Device Management, Semantic Protocols.

UNIT IV: (10 Hours)

IoT Interoperability: Introduction, Standards, Frameworks Fog Computing and Its Applications: Introduction, View of Fog Computing Architecture, Fog Computing in IoT, Selected Applications of Fog Computing

UNIT V: (10Hours)

Paradigms, Challenges, and the Future: Introduction, Evolution of New IoT Paradigms, Challenges Associated with IoT, Emerging Pillars of IoT IoT Case Studies: Agricultural IoT, Vehicular IoT

Mapping of COs to 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	PSO1	PSO2
CO 1	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO 2	3	3	3	3	3	-	-	-	3	3	-	-	-	-
CO 3	3	3	3	3	3	-	-	-	3	3	3	-	3	3
CO 4	3	3	3	3	3	3	3	3	-	-	-	-	3	3

TEXT BOOKS:

1. Introduction to IoT, Sudip Misra, Anandarup Mukhaerjee, Arjit Roy, Cambridge University Press, 2021
2. Internet of Things: Architecture, Design Principles and Applications, Rajkamal, McGraw Hill Higher Education

REFERENCE BOOKS:

1. Fog and Edge Computing: Principles and Paradigms, Rajkumar Buyya (Editor), Satish Narayana Srirama (Editor) , ISBN: 978-1-119-52498-4, January 2019
2. Getting Started with the Internet of Things, Cuno Pfister , Oreilly

AGENTIC AI
(PROFESSIONAL ELECTIVE-IV)

Subject Code: UGCS7T0623	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Course Objectives:

Course Outcomes:

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

CO1: Understand the fundamentals of Agentic AI including agent architectures, components, autonomy, and differences from generative and reactive AI (L2)

CO2: Explain decision-making, planning, and learning techniques such as MDPs, reinforcement learning, and ethical decision models in intelligent agents (L2)

CO3: Apply large language models, prompt engineering, and agent frameworks to design and develop agentic systems (L3)

CO4: Analyze responsible AI practices, system design challenges, and real-world applications of agentic AI in domains such as healthcare and cybersecurity (L4)

Syllabus:

UNIT I: (10 Hours)

Foundations of Agentic Intelligence: Understand what Agentic AI is, how it differs from traditional and generative AI, and learn its core theoretical building blocks. Wat is Agentic AI vs. Generative/Reactive AI; Autonomy, Proactivity, and Goal-Directed Behavior; Components of an intelligent agent: Perception, Reasoning, Learning, Action; Agent architectures: Reactive, Deliberative, Hybrid; Rationality and decision models; Real world use cases and motivation for agentic systems

UNIT II: (10 Hours)

Decision Making, Planning & Learning: Teach how agents make decisions, plan under uncertainty, and adapt through learning. Decision processes: utility theory, Markov Decision Processes (MDPs); Planning under uncertainty; Reinforcement learning fundamentals (MDP, policy, reward shaping); Deep RL essentials (PPO, DQN, A3C — as applicable); Meta-cognition and adaptation in agents; Ethical and value-aligned decision making

UNIT III: (10 Hours)

Large Language Models & Prompt-Driven Agent Behavior: Cover how modern agentic systems leverage large language models and advanced prompt techniques. Transformer architecture and attention basics; Role of LLMs in agentic systems; Prompt engineering fundamentals (zero-shot, chain-of-thought, ReAct); Retrieval-

Augmented Generation (RAG) and memory systems; Context management and embedding techniques; Tool-usage and action invocation via prompts

UNIT IV: (10 Hours)

Tools, Frameworks & System Design: Introduce hands-on frameworks used to build agentic AI and how to compose multiple agents into work flows.Overview of agent frameworks: LangChain, LangGraph, AutoGen, CrewAI (documentation & practice); Memory, embedding databases (e.g., FAISS, Pinecone, ChromaDB); Workflow orchestration and multi-agent coordination; Agent-to-agent communication; Deployment patterns and APIs; Monitoring, scalability, and production concerns

UNIT V: (10 Hours)

Responsible & Applied Agentic AI: Address real-world applications, ethical considerations, safety, and career perspectives. Responsible agentic AI design and risk mitigation; Bias, fairness, and interpretability in autonomous systems; Privacy, transparency, and accountability. Safety and alignment challenges; Case studies: Healthcare, cybersecurity, business automation

Mapping of COs to 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	PSO1	PSO2
CO 1	3	3	3	3	3	-	-	-	-	-	-	-	-	-
CO 2	3	3	3	3	-	-	-	-	3	3	-	-	-	-
CO 3	3	3	3	3	3	-	-	-	-	-	3	3	3	3
CO 4	3	3	3	3	-	3	3	3	-	-	-	-	3	3

TEXT BOOKS:

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach (4th Ed.), Pearson.
2. Michael Wooldridge, An Introduction to MultiAgent Systems (2nd ed.)
3. Richard S. Sutton & Andrew G. Barto — Reinforcement Learning: An Introduction

REFERENCE BOOKS:

1. David L. Poole & Alan K. Mackworth — Artificial Intelligence: Foundations of Computational Agents
2. Ken Huang (Ed.) — Agentic AI: Theories and Practices (Springer, 2025)

AGILE METHODOLOGIES
(PROFESSIONAL ELECTIVE-V)

Subject Code: UGCS7T0723	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Course Objectives: 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

Course Outcomes:

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

CO1: Understand Agile concepts, values, principles, and methodologies including Agile Manifesto and project initiation (L2)

CO2: Apply Agile principles in project execution, teamwork, communication, and continuous improvement (L3)

CO3: Implement Scrum practices and XP techniques for effective project planning, development, and adaptability (L3)

CO4: Analyze Lean, Kanban, and coaching practices to improve workflow, eliminate waste, and enhance team performance (L4)

Syllabus:

UNIT I: (10 Hours)

Learning Agile: Agile, Getting Agile into your brain, Understanding Agile values, No Silver Bullet, Agile to the Rescue. A fractured perspective, The Agile Manifesto, Understanding the Elephant, Where to Start with a New Methodology.

UNIT II: (10 Hours)

The Agile Principles: The 12 Principles of Agile Software, The Customer Is Always Right, Delivering the Project, Better Project Delivery for the Ebook Reader Project. Communicating and Working Together, Project Execution—Moving the Project Along, Constantly Improving the Project and the Team. The Agile Project: Bringing All the Principles Together

UNIT III: (10 Hours)

SCRUM and Self-Organizing Teams: The Rules of Scrum, Act I: I Can Haz Scrum, Everyone on a Scrum Team owns the Project, Status Updates Are for Social Networks!, The Whole Team Uses the Daily Scrum, Feedback and the Visibility-Inspection-Adaptation Cycle, The Last Responsible Moment, Sprinting into a Wall, Sprints,

Planning, and Retrospectives.

Scrum Planning And Collective Commitment: Not Quite Expecting the Unexpected, User Stories, Velocity, and Generally Accepted Scrum Practices, Victory Lap, Scrum Values Revisited.

UNIT IV: (10 Hours)

XP And Embracing Change: Going into Overtime, The Primary Practices of XP, The Game Plan Changed, but We're Still Losing, The XP Values Help the Team Change Their Mindset, An Effective Mindset Starts with the XP Values, The Momentum Shifts, Understanding the XP Principles Helps You Embrace Change.

XP, Simplicity, and Incremental Design: Code and Design, Make Code and Design Decisions at the Last Responsible Moment, Final Score.

UNIT V: (10 Hours)

Lean, Eliminating Waste, and Seeing the whole: Lean Thinking, Creating Heroes and Magical Thinking. Eliminate Waste, Gain a Deeper Understanding of the Product, Deliver As Fast As Possible.

Kanban, Flow, and Constantly Improving: The Principles of Kanban, Improving Your Process with Kanban, Measure and Manage Flow, Emergent Behavior with Kanban. The Agile Coach: Coaches Understand Why People Don't Always Want to Change. The Principles of Coaching.

Mapping of COs to 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	PSO1	PSO2
CO 1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO 2	3	3	3	-	-	-	-	3	3	3	-	-	-	-
CO 3	3	3	3	-	-	3	-	-	-	-	-	-	-	-
CO 4	3	3	3	3	3	-	-	-	-	-	3	3	3	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

GENERATIVE AI
(PROFESSIONAL ELECTIVE-V)

Subject Code: UGCS7T0823	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Course Objectives: The objectives of the course are to understand the basics of Generative AI, Text Generation, the process of generating videos, GAN and its variants.

Course Outcomes:

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

CO1: Understand the fundamentals of Generative AI including models such as GANs, VAEs, diffusion models, and ethical considerations (L2)

CO2: Apply language models, transformers, and prompt engineering techniques for text generation using LLMs (L3)

CO3: Analyze image and multimedia generation techniques using GANs, VAEs, diffusion models, and transformer-based architectures (L4)

CO4: Apply generative AI frameworks and tools for training, fine-tuning, and deploying models using platforms like LangChain and Hugging Face (L3)

Syllabus:

UNIT I: (10 Hours)

Introduction To Gen Ai: Historical Overview of Generative modeling, Difference between Gen AI and Discriminative Modeling, Importance of generative models in AI and Machine Learning, Types of Generative models, GANs, VAEs, autoregressive models and Vector quantized Diffusion models, Understanding if probabilistic modeling and generative process, Challenges of Generative Modeling, Future of Gen AI, Ethical Aspects of AI, Responsible AI, Use Cases.

UNIT II: (10 Hours)

Generative Models For Text: Language Models Basics, Building blocks of Language models, Transformer Architecture, Encoder and Decoder, Attention mechanisms, Generation of Text, Models like BERT and GPT models, Generation of Text, Autoencoding, Regression Models, Exploring ChatGPT, Prompt Engineering: Designing Prompts, Revising Prompts using Reinforcement Learning from Human Feedback (RLHF), Retrieval Augmented Generation, Multimodal LLM, Issues of LLM like hallucination.

UNIT III: (10 Hours)

Generation of Images: Introduction to Generative Adversarial Networks, Adversarial Training Process, Nash Equilibrium, Variational Autoencoders, Encoder-Decoder Architectures, Stable Diffusion Models, Introduction to Transformer-based Image Generation, CLIP, Visual Transformers ViT- Dall-E2 and Dall-E3, GPT-4V, Issues of Image Generation models like Mode Collapse and Stability.

UNIT IV: (10 Hours)

Generation of Painting, Music, and Play: Variants of GAN, Types of GAN, Cyclic GAN, Using Cyclic GAN to Generate Paintings, Neural Style Transfer, Style Transfer, Music Generating RNN, MuseGAN, Autonomous agents, Deep Q Algorithm, Actor-critic Network.

UNIT V: (10 Hours)

Open Source Models And Programming Frameworks: Training and Fine tuning of Generative models, GPT 4 All, Transfer learning and Pretrained models, Training vision models, Google Copilot, Programming LLM, LangChain, Open Source Models, Llama, Programming for TimeSformer, Deployment, Hugging Face.

Mapping of COs to 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	PSO1	PSO2
CO 1	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO 2	3	3	3	3	3	-	-	-	-	-	-	-	-	-
CO 3	3	3	3	3	3	3	3	-	-	-	-	-	-	-
CO 4	3	3	3	3	3	-	-	-	-	-	-	-	3	3

TEXT BOOKS:

1. Denis Rothman, "Transformers for Natural Language Processing and Computer Vision", Third Edition , Packt Books, 2024

REFERENCE BOOKS:

1. David Foster, "Generative Deep Learning", O'Reily Books, 2024.
2. Altaf Rehmani, "Generative AI for Everyone", BlueRose One, 2024.

COMPUTER VISION
(PROFESSIONAL ELECTIVE-V)

Subject Code: UGCS7T0923	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Course Objectives: The objectives of the course are to understand the Fundamental Concepts related to sources, shadows and shading, the Geometry of Multiple Views

Course Outcomes:
Upon completion of this course, the students will be able to:
CO1: Understand the fundamentals of image formation, radiometry, color models, and camera systems in computer vision (L2)
CO2: Apply image processing techniques such as filtering, edge detection, and texture analysis for visual feature extraction (L3)
CO3: Analyze multi-view geometry, segmentation, clustering, and tracking methods for interpreting visual scenes (L4)
CO4: Apply geometric camera models, calibration techniques, and model-based vision for real-world applications (L3)

Syllabus:

UNIT I: (10 Hours)
CAMERAS: Pinhole Cameras Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

UNIT II: (10 Hours)
Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Edge Detection: Noise, Estimating Derivatives, Detecting Edges Texture0: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.

UNIT III: (10 Hours)
The Geometry of Multiple Views: Two Views Stereopsis: Reconstruction, Human Stereopsis, Binocular Fusion, Using More Cameras Segmentation by Clustering: What Is Segmentation? Human Vision: Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels,

Segmentation by Graph Theoretic Clustering,

UNIT IV: (10 Hours)

Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples

UNIT V: (10 Hours)

Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, Case study: Mobile Robot Localization Model- Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Case study: Registration in Medical Imaging Systems, Curved Surfaces and Alignment.

Mapping of COs to 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	PSO1	PSO2
CO 1	3	3	-	-	-	-	-	-	-	-	-	-	3	3
CO 2	3	3	-	-	-	-	-	-	3	3	-	-	-	-
CO 3	3	3	3	3	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	3	3	3	-	-	-	-	3	3	3	3	3

TEXT BOOKS:

1. David A. Forsyth, Jean Ponce, "Computer Vision – A Modern Approach", PHI Learning (Indian Edition), 2009.

REFERENCE BOOKS:

1. E. R. Davies, "Computer and Machine Vision – Theory, Algorithms and Practicalities", Elsevier (Academic Press), 4th edition, 2013.
2. R. C. Gonzalez, R. E. Woods, "Digital Image Processing", Addison Wesley, 2008.
3. Richard Szeliski "Computer Vision: Algorithms and Applications" Springer, Verlag London Limited, 2011.

CYBER PHYSICAL SYSTEMS
(PROFESSIONAL ELECTIVE-V)

Subject Code: UGCS7T1023	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Course Objectives: The main objectives of the course are to
- Discuss the core principles behind Cyber Physical Systems
- Identify Security mechanisms of Cyber Physical System
- Describe Synchronization in Distributed Cyber-Physical Systems

Course Outcomes:
Upon completion of this course, the students will be able to:
CO1: Understand the fundamentals of cyber-physical systems including symbolic synthesis, system modeling, and controller design (L2)
CO2: Analyze security requirements, attack models, and countermeasures in cyber-physical systems (L4)
CO3: Apply synchronization and distributed consensus techniques in CPS environments (L3)
CO4: Analyze real-time scheduling and model integration techniques for designing reliable cyber-physical systems (L4)

Syllabus:

UNIT I: (10 Hours)
Symbolic Synthesis for Cyber-Physical Systems: Introduction and Motivation, Basic Techniques - Preliminaries, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques: Construction of Symbolic Models, Continuous Time Controllers, Software Tools

UNIT II: (10 Hours)
Security of Cyber-Physical Systems: Introduction and Motivation, Basic Techniques - Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques: System Theoretic Approaches

UNIT III: (10 Hours)
Synchronization in Distributed Cyber-Physical Systems: Challenges in Cyber-Physical Systems, A Complexity-Reducing Technique for Synchronization, Formal Software Engineering, Distributed Consensus Algorithms, Synchronous Lockstep Executions, Time Triggered Architecture, Related Technology, Advanced Techniques

UNIT IV: **(10 Hours)**

Real-Time Scheduling for Cyber-Physical Systems: Introduction and Motivation, Basic Techniques, Scheduling with Fixed Timing Parameters, Memory Effects, Multiprocessor/ Multicore Scheduling, Accommodating Variability and Uncertainty

UNIT V: **(10 Hours)**

Model Integration in Cyber-Physical Systems: Introduction and Motivation, Causality, Semantic Domains for Time, Interaction Models for Computational Processes, Semantics of CPS DSMLs, Advanced Techniques, ForSpec, The Syntax of CyPhyML, Formalization of Semantics, Formalization of Language Integration.

Mapping of COs to 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	PSO1	PSO2
CO 1	3	3	-	-	-	-	-	-	-	-	-	3	3	3
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	3	3	3	3	3	3	3	3	-	-	-	-
CO 4	3	3	3	3	3	-	-	-	-	-	3	3	-	-

TEXT BOOKS:

1. Raj Kumar, Dionisio De Niz, Mark Klein, Cyber-Physical Systems, Addison-Wesley Professional, 2016
2. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press

REFERENCE BOOKS:

1. E.A.Lee, Sanjit Seshia, Introduction to Embedded Systems: A Cyber-Physical Systems Approach, MIT Press
2. Andre Platzer, Logical Foundations of Cyber-Physical Systems, 2e, Springer Publishing, 2018

PROMPT ENGINEERING
(SKILL ENHANCEMENT COURSE)

Subject Code: UGCS7K1123	**L**	**T**	**P**	**C**
IV Year / I Semester	**0**	**1**	**2**	**2**

Course Objectives: 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.

Course Outcomes:
Upon completion of this course, the students will be able to:
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)

Syllabus:

UNIT I: (10 Hours)
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

UNIT II: (10 Hours)
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

UNIT III: (10 Hours)

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

UNIT IV: (10 Hours)

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

UNIT V: (10 Hours)

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. 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.
5. 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.
6. 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.
7. 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.
8. 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.
9. 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.
10. 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.
11. 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.
12. 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.
13. 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.
14. 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.

15. 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.
16. 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.

Mapping of COs to 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	PSO1	PSO2
CO 1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	3	3	3	-	3	3	3	3	-	-	-	-
CO 3	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO 4	3	3	3	3	3	3	-	3	-	-	-	3	3	3

CONSTITUTION OF INDIA

Subject Code: UGCS7A1323	**L**	**T**	**P**	**C**
IV Year / I Semester	**2**	**0**	**0**	**-**

Course Objectives: 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.

Course Outcomes:

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

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)

Syllabus:

UNIT I: (10 Hours)

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution- Preamble, Salient, Features

UNIT II: (10 Hours)

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: (10 Hours)

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: (10 Hours)

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: (10 Hours)

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.

Mapping of COs to 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	PSO1	PSO2
CO 1	3	-	-	-	-	-	-	3	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	3	3	3	-	-	-	-	-
CO 3	3	-	-	-	-	-	3	3	3	3	3	3	3	3
CO 4	3	-	-	-	-	3	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 Rubrics for Project Work: