LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution)
DEPARTMENT OF CSE-DATA SCIENCE

SCHEME OF INSTRUCTION & EXAMINATION [LR-23]

(W.E.F Academic Year 2026-27)
B.E. VII-Semester

S. No.	Course Code	Course Category	Course Title	Scheme of Instructions				Scheme of Examination			CREDITS
				L	T	P/ D	Contact Hrs/Week	CIE	SEE	Duration in Hours	
Theory Course											
1	U23CD701	PCC	Cloud Computing	3	-	-	3	40	60	3	3
2	U23CD702	PCC	Data Handling and Data Visualization	3	-	-	3	40	60	3	3
3	U23CD703	PCC	Text Mining	3	1	-	4	40	60	3	4
4	-	PEC	Professional Elective III	3	-	-	3	40	60	3	3
5	-	OEC	Open Elective-III	3	-	-	3	40	60	3	3
Practical / Laboratory Course											
6	U23CD7L1	PCC	Cloud Computing Lab	-	-	3	3	25	50	3	1.5
7	U23CD7L2	PCC	Data Handling and Data Visualization Lab	-	-	3	3	25	50	3	1.5
Project											
8	U23CD7P1	PROJ	Major Project Phase-I	-	-	4	4	50	-	-	2
9	U23CD7P2	PROJ	Technical Seminar	-	-	2	2	50	-	-	2
Total				**15**	**-**	**12**	**27**	**350**	**400**	**-**	**23**

L: Lecture *(Hrs/Wk/Sem)* **T:** Tutorial *(Hrs/Wk/Sem)* ***P*:** Practical **D:** Drawing *(Hrs/Wk/Sem)*
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination **PCC:** Program core course
CD: CSE-Data Science **PEC:** Professional Elective Course **OEC:** Open Elective Course **PROJ:** Project

Note:

1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

PEC 3	U23CD704	Ethical hacking
	U23CD705	Software Project Management
	U23CD706	Pattern Recognition
	U23CD707	Agentic AI

LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution)
DEPARTMENT OF CSE-DATA SCIENCE

SCHEME OF INSTRUCTION & EXAMINATION [LR-23]

(W.E.F Academic Year 2026-27)
B.E. VIII-Semester

S. No.	Course Code	Course Category	Course Title	Scheme of Instructions				Scheme of Examination			CREDITS
				L	T	P/ D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course											
1	-	PCC	Professional Elective IV	3	-	-	3	40	60	3	3
2	-	PEC	Professional Elective V	3	-	-	3	40	60	3	3
3	-	OEC	Open Elective IV	3	-	-	3	40	60	3	3
Practical / Laboratory Course											
4	U23CD8P1	PROJ	Major Project Phase -II	-	-	16	16	50	100	-	8
Total				**9**	**-**	**16**	**25**	**270**	**280**	-	**17**

L: *Lecture (Hrs/Wk/Sem)* ***T:*** *Tutorial (Hrs/Wk/Sem)* ***P:*** *Practical* ***D:*** *Drawing (Hrs/Wk/Sem)*

CIE: Continuous Internal Evaluation **SEE:** Semester End Examination **PCC:** Program core course
CD: CSE-Data Science **PCC:** Program Core Course **PEC:** Professional Elective Course
OEC: Open Elective Course **PROJ:** Project

Note:

1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

PEC 4	U23CD801	Mobile Ad hoc Networks
	U23CD802	Software Testing Methodologies
	U23CD803	Data on Web
	U23CD804	Reinforcement Learning

PEC 5	U23CD805	Cloud Security
	U23CD806	Large language Models
	U23CD807	Semantic Web
	U23CD808	Augmented Reality and Virtual Reality

Course Code	Course Title						Core/ Elective
U23CD701	**CLOUD COMPUTING**						**Core**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
OS, DBMS, CN	3	-	-	-	40	60	3

Course Objectives

1. To understand the concept of cloud computing.
2. To understand the various issues in cloud computing.
3. To familiarize themselves with the lead players in cloud.
4. To appreciate the emergence of cloud as the next generation computing paradigm.
5. To enable students exploring some important cloud computing driven commercial systems and applications.

Course Outcomes

1. Articulate the main concepts, key technologies, strengths and limitations of cloud computing. Identify the architecture, infrastructure and delivery models of cloud computing.
2. Explain the core issues of cloud computing such as security, privacy and interoperability.
3. illustrate the use of various cloud services available online
4. Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
5. Apply the fundamental concepts in datacenters to understand the tradeoffs in power, efficiency and cost.

Unit-1:

Introduction to Cloud Computing: Evolution of Computing, Distributed Computing and Utility Computing, Cloud Computing Fundamentals, Characteristics of Cloud Computing, Cloud Deployment Models- Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Cloud Service Models – IaaS, PaaS, SaaS, Cloud Architecture, Cloud Ecosystem, Benefits and Challenges of Cloud Computing.

Unit-2:

Virtualization and Cloud Infrastructure: Virtualization Concepts, Hypervisors, Virtual Machines, Containerization, Docker Fundamentals, Resource Provisioning, Cloud Infrastructure Management, Data Centres and Cloud Storage, Cloud Networking, Load Balancing, Auto Scaling.

Unit-3:

Cloud Storage and Data Processing: Cloud Storage Models - Object Storage, Block Storage, File Storage, Distributed File Systems, Hadoop Ecosystem, HDFS MapReduce, Apache Spark, Cloud Databases, SQL Databases, NoSQL Databases, Data Warehousing in Cloud, Data Lakes.

Unit-4:

Cloud Security and Governance: Cloud Security Fundamentals, Identity and Access Management (IAM) , Authentication and Authorization, Data Encryption, Secure Data Storage, Network Security, Cloud Compliance, Privacy and Governance, Disaster Recovery, Backup Strategies, Business Continuity Planning.

Unit-5:

Cloud for Data Science and AI Applications: Cloud-based Data Analytics, Machine Learning as a Service (MLaaS), Cloud AI Platforms, Data Pipelines, ETL in Cloud, Serverless Computing, Kubernetes Basics, MLOps Concepts, Deploying ML Models on Cloud, Case Studies using AWS, Azure and Google Cloud.

SUGGESTED READINGS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, **Fourth Edition, 2020**
2. M. Tim Jones, ―Artificial Intelligence: A Systems Approach (Computer Science) ‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008

Course Code	Course Title						Core/Elective
U23CD702	**DATA HANDLING AND DATA VISUALIZATION**						**Core**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
DBMS, P&S	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. It covers essential exploratory techniques for understanding multivariate data by summarizing it through statistical methods and graphical methods
2. To understand various data visualization techniques
3. Supports to summarize the insurers use of predictive analytics, data science and Data Visualization
4. Approaches in the design and analysis of data visualization systems.
5. To familiarize students with the stages of the visualization pipeline, including data modeling, mapping data attributes to graphical attributes.

Course Outcomes

On completion of the course, students will be able to

1. Handle missing data in the real-world data sets try choosing appropriate methods
2. Summarize the data using basic statistics. Visualize the data using basic graphs and plots
3. Identify the outliers if any in the data set
4. Visualize the objects in different dimensions and Design and process the data for Virtualization
5. Apply the virtualization techniques for research projects

UNIT-I

Data Handling Introduction Exploratory Data Analysis: Data Analytics lifecycle, Exploratory Data Analysis (EDA)-Definition, Motivation, Scope in data exploration, and the basic data types Data Type Portability

UNIT-II

Preprocessing-Traditional Methods and Maximum Likelihood Estimation, introduction to Missing data. Traditional methods or dealing with missing data, Maximum Likelihood Estimation-Basics Missing data handling, improving the accuracy analysis Preprocessing Bayesian Estimation Introduction to Bayesian Estimation, Multiple Imputation Phase. Analysis and Pooling Phase, Practical issues in multiple imputation, Models for Missing Notation Random Data

UNIT-III

Introduction and Data Foundation: basics relationship between visualization and other fields The Visualization Process -Pseudo code conventions The Scatter plot. Data Foundation types of data Data Structure-within and between Records Data Preprocessing Data Sets Foundation for Visualization- Visualization stages Semiology of Graphical Symbols-The Eight Visual Variables, historical perspective- taxonomies- Experimental Semiotics based on Perception Gibson's Affordance theory- A Model of Perceptual Processing

UNIT-IV

Visualization Techniques: Spatial Data: One-dimensional data, two-dimensional data, three-dimensional data, dynamic data, combining techniques. Geospatial Data: Visualizing Spatial Data Visualization of Paint Duta -Visualization of Line Data Visualization of Area Data-Other Issues in Geospatial Data Visualization Multivariate Data: Paint Based Techniques Line Based Techniques -Region-Based Techniques - Combinations of Techniques Trees Displaying Hierarchical Structures -Graphics and Networks- Displaying Arbitrary Graphs Networks.

UNIT-V

Interaction Concepts and Techniques: Text and Document Visualization: Introduction-Levels of Text Representations. The Vector Space Model - Single Document Visualization -Document Collection Visualizations-Extended Text Visualizations Interaction Concepts: Interaction Operators -Interaction Operands and Spaces A Unified Framework-Interaction Techniques Screen Space Object-Space Data Space -Attribute Space- Data Structure Space-Visualization Structure Animating Transformations -Interaction Control.

Suggested Readings:

1. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining by Glene J Myatt
2. Matthew Ward George Grinsten and Daniel Keim, "Interactive Data Visualization
3. Foundations. Techniques, Applications, 2010
4. Colin Ware, "information Visualization Perception for Design", 2nd edition Margon Kaufmann Publishers, 2004.

Course Code	Course Title						Core/Elective
U23CD703	**TEXT MINING**						**Core**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
DBMS, P&S	**3**	**1**	**-**	**-**	**40**	**60**	**4**

Course Objectives

The course will introduce the students to

1. Explain the architecture, preprocessing techniques, and core operations of text mining systems.
2. Apply text categorization methods and machine learning algorithms to classify textual data and evaluate classifier performance.
3. Analyze and implement text clustering and information extraction techniques to discover patterns and extract knowledge from text.
4. Utilize probabilistic models and visualization techniques for advanced text mining and analytics tasks.
5. Design and develop text mining solutions for real-world applications in business intelligence, patent analytics, finance, and bioinformatics.

Course Outcomes

On completion of the course, students will be able to

1. Understand the fundamental concepts, architecture, preprocessing techniques, and query languages used in text mining systems.
2. Apply text categorization methods, document representation techniques, and machine learning approaches for text classification.
3. Analyze text clustering and information extraction techniques for discovering patterns and extracting knowledge from textual data.
4. Utilize probabilistic models and visualization techniques in text mining and text analytics applications.
5. Design and implement text mining methodologies and tools to solve real-world problems across various domains.

Unit-1:

Introduction to Text Mining: Defining Text Mining, General Architecture of Text Mining Systems, Core Text Mining Operations, Text Mining Query Languages, Text Mining Preprocessing Techniques, Task-Oriented Approaches.

Unit-2:

Categorization: Applications of Text Categorization, Definition of the Problem, Document Representation, Machine Learning Approach to TC, Using Unlabelled Data to Improve Classification, Evaluation of Text Classifiers.

Unit-3:

Clustering

Clustering Tasks in Text Analysis, The General Clustering Problem, Clustering Algorithms, Clustering of Textual Data.

Information Extraction

Introduction to Information Extraction, IE Examples, Architecture of IE Systems, Inductive Algorithms for IE, Structural IE.

Unit-4:

Probabilistic Models:

Hidden Markov Models, Stochastic Context-Free Grammars, Maximal Entropy Modelling, Conditional Random Fields.

Visualization Approaches:

Introduction, Architectural Considerations, Common Visualization Approaches for Text Mining, Visualization Techniques in Link Analysis, Real-World Example: The Document Explorer System.

Unit-5:

Text Mining Applications:

General Considerations, Corporate Finance-Mining Industry Literature for Business Intelligence A “Horizontal” Text Mining Application: Patent Analysis Solution Leveraging a Commercial Text Analytics Platform, Life Sciences Research: Mining Biological Pathway Information with Gene Ways

TEXTBOOKS:

1. Text Mining Handbook : Advanced Approaches in Analyzing Unstructured Data “Ronen Foldman & James Sanger”.
2. Applied Text Mining — by Usman Qamar and Muhammad Summair Raza.. Published in 2024

Course Code	Course Title						Core/Elective
U23CD704	**ETHICAL HACKING**						**PROFESSIONAL ELECTIVE**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	-	**-**		**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. The methodologies, frameworks, and best practices of ethical hacking for enhancing organizational and information security.
2. The impacts of hacking, various types of hackers, and key information security models.
3. The components of an information security program from a business perspective.
4. The planning and execution of controlled attacks using a structured framework, including reconnaissance, enumeration, vulnerability analysis, exploitation, deliverables, and integration

Course Outcomes:

After successful completion of the course, student will be able to:

1. Demonstrate knowledge of tools, techniques, and resources available to support ethical hacking activities.
2. Analyze and interpret the results of controlled attacks to assess system vulnerabilities effectively
3. Understand the influence of organizational politics, inherent and imposed limitations, and metrics in planning and executing penetration tests.
4. Apply structured frameworks for planning and executing penetration tests, including reconnaissance, enumeration, vulnerability analysis, exploitation, and reporting.
5. Evaluate the role of organizational policies, limitations, and metrics in planning and conducting ethical hacking exercise

UNIT – I: INTRODUCTION TO ETHICAL HACKING

Introduction: Hacking Impacts, The Hacker Framework: Planning the test, Sound Operations, Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Final Analysis, Deliverable, Integration. Information Security Models: Computer Security, Network Security, Service Security, Application Security, Security Architecture Information Security Program: The Process of Information Security, Component Parts of Information Security Program, Risk Analysis and Ethical Hacking

UNIT – II: THE BUSINESS PERSPECTIVE

The Business Perspective: Business Objectives, Security Policy, Previous Test Results, Business Challenges Planning for a Controlled Attack: Inherent Limitations, Imposed Limitations, timing is Everything, Attack Type, Source Point, Required Knowledge, Multi-Phased Attacks, Teaming and Attack Structure, Engagement Planner, The Right Security Consultant, The Tester, Logistics, Intermediates, Law Enforcement

UNIT – III: PREPARING FOR HACK

Preparing for a Hack: Technical Preparation, Managing the Engagement Reconnaissance: Social Engineering, Physical Security, Internet Reconnaissance. Rules of Engagement (scope, objectives, permissions, legal considerations), penetration testing planning and target prioritization, passive and active reconnaissance techniques, OSINT gathering, footprinting and target profiling, DNS and WHOIS analysis, network and service discovery.

UNIT – IV: ENUMERATION AND EXPLOITATION

Enumeration: Enumeration Techniques, Soft Objective, Looking Around or Attack, Elements of Enumeration, Preparing for the Next Phase. Exploitation: Intuitive Testing, Evasion, Threads and Groups, Operating Systems, Password Crackers, RootKits, applications, Wardialing, Network, Services and Areas of Concern

UNIT – V: DELIVERABLE

Deliverable: The Deliverable, The Document, Overall Structure, Aligning Findings, Presentation Integration: Integrating the Results, Integration Summary, Mitigation, Defense Planning, Incident Management, Security Policy, Conclusion

TEXTBOOKS:

1. James S. Tiller, “The Ethical Hack: A Framework for Business Value Penetration Testing”, Auerbach Publications, CRC Press.
2. EC-Council, “Ethical Hacking and Countermeasures Attack Phases”, Cengage Learning.
3. Michael Simpson, Kent Backman, James Corley, “Hands-On Ethical Hacking and Network Defense”, Cengage Learning.

Course Code	Course Title						Core/ Elective
U23CD705	**SOFTWARE PROJECT MANAGEMENT**						**PROFESSIONAL ELECTIVE**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Software Engineering	3	-	-	-	40	60	3

Course Objectives

The course will introduce the students to

1. To understand the fundamental principles of software project management.
2. To have a good knowledge of responsibilities of project manager.
3. To be familiar with the different methods and techniques used for project
4. To be Familiar with the different activities involved in Software Project Management.
5. Explain the quality management & different types of metrics used in software development.

Course Outcomes

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

1. Identify the different project contexts and suggest an appropriate management strategy.
2. Practice the role of professional ethics in successful software development.
3. Identify and describe the key phases of project management.
4. Determine an appropriate project management approach through an evaluation of the business context and scope of the project.
5. Understand the importance of risk. define the questions a decision maker needs to ask.

UNIT – 1

SOFTWARE MANAGEMENT & ECONOMICS: The Waterfall Model, Conventional Software Management Performance; Evolution of Software Economics - Software economics, Pragmatic software cost estimation, reducing software product size, Improving software processes.

UNIT – 2

THE OLD AND THE NEW WAY OF PROJECT MANAGEMENT: Improving team effectiveness, improving automation through software environment, Achieving required quality; Peer inspections – A pragmatic view, The principles of conventional software engineering, Principles of modern software management, Transitioning to an iterative process.

UNIT – 3

SOFTWARE MANAGEMENT PROCESS FRAMEWORK: Life cycle phases, the artifact sets, Management artifacts, Engineering artifacts, Pragmatic artifacts; Model Based Software Architectures - A management perspective and A technical perspective.

UNIT – 4

PROJECT ORGANIZATION AND PLANNING: Work breakdown structures, Planning guidelines, the cost and schedule estimating process, the iteration planning process, Pragmatic planning, Line-of-Business organizations, Project organizations, Evolution of organizations; Process automation - Automation building blocks, The project environment.

UNIT – 5

PROJECT CONTROL AND PROCESS INSTRUMENTATION: The Seven-Core metrics, Management indicators, Quality indicators, Life-Cycle expectations, Pragmatic software metrics, Metrics automation, Modern project profiles, Next generation software economics, Modern process transitions.

Suggested Readings:

1. Walker Royce, “Software Project Management”, 1st Edition, Pearson Education, 2006.
2. Bob Hughes and Mike Cotterell, “Software Project Management”, 3rd Edition, Tata McGraw Hill Edition, 2005.

Course Code	Course Title						Core/Elective
U23CD706	**PATTERN RECOGNITION**						**Professional Elective**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
Programming for problem solving	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. Introducing fundamental concepts, theories, and algorithms for pattern recognition and machine learning.
2. To Understand Pattern Representation, Nearest Neighbor Based Classifier, Bayes ,Classifier.
3. To get knowledge on Hidden Markov Models, Decision Trees.
4. To Acquire Support Vector Machines
5. To Understand Clustering and an application of hand-written digit recognition

Course Outcomes:

On completion of the course, students will be able to

1. Understand the importance of pattern recognition and its representation
2. Analyze the variants of NN algorithm
3. Understand the necessity of Hidden Markov models, decision tree and SVM for classification
4. Understand different types of clustering algorithms
5. Acquire partitional clustering, clustering and an application of hand-written digit recognition

UNIT - I

Introduction: Pattern Recognition, Data Sets for Pattern Recognition, Different Paradigms for Pattern Recognition. Representation: Data Structures for Pattern Representation, Representation of Clusters, Proximity Measures, Size of Patterns, Abstractions of the Data Set, Feature Extraction, Feature Selection, Evaluation of Classifier, Evaluation of Clustering.

UNIT - II

Nearest Neighbor Based Classifier: Nearest Neighbor Algorithm, Variants of the NN Algorithm, use of the Nearest Neighbor Algorithm for Transaction Databases, Efficient Algorithms, Data Reduction, Prototype Selection. Bayes Classifier: Bayes Theorem, Minimum Error Rate Classifier, Estimation of Probabilities, Comparison with the NNC, Naïve Bayes Classifier, Bayesian Belief Network.

UNIT - III

Hidden Markov Models: Markov Models for Classification, Hidden Morkov Models, Classification using HMMs. Decision Trees: Introduction, Decision Tree for Pattern Classification, Construction of Decision Trees, Splitting at the Nodes, Overfitting and Pruning, Examples of Decision Tree Induction.

UNIT - IV

Support Vector Machines: Introduction, Learning the Linear Discriminant Functions, Neural Networks, SVM for Classification. Combination of Classifiers: Introduction, Methods for Constructing Ensembles of Classifiers, Methods for Combining Classifiers.

UNIT - V

Clustering: Importance of clustering, Hierarchical Algorithms, Partitional Clustering, Clustering Large Data Sets. An Application-Hand Written Digit Recognition: Description of the Digit Data, Preprocessing of Data, Classification Algorithms, Selection of Representative Patterns, Results.

Suggested reading:

1. Pattern Recognition: An Algorithmic Approach: Murty, M. Narasimha, Devi, V. Susheela, Spinger Pub, 1st Ed.
2. Fundamentals Of Speech Recognition: Lawrence Rabiner and Biing- Hwang Juang. PrenticeHall Pub.

Course Code	Course Title						Core/Elective
U23CD707	**AGENTIC AI**						**Professional Elective**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
Basics of Data Science and python Programming	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. Understanding, identifying, navigating Agentic AI concepts with Ethical and responsible AI.
2. Data Processing, state management in AI agent, implement and deploying agents
3. Understanding and Implementing / building Agentic RAG,
4. Learn multi agent systems, workflow, build adaptive AI agents
5. Building AI agents with No/Low – Code Tools

Course Outcomes

On completion of the course, students will be able to

1. Analyze the core concepts of Agentic AI and evaluate ethical and responsible AI practices in intelligent agent development.
2. Apply data processing and state management techniques to implement and deploy AI agents effectively.
3. Design and develop Agentic RAG systems for enhanced knowledge retrieval and information synthesis.
4. Analyze and design multi-agent systems and collaborative workflows for adaptive AI solutions.
5. Create intelligent AI agents using low-code and no-code platforms for rapid prototyping and deployment.

UNIT -I:

Introduction Agentic AI, Introduction AI Agents vs. Agentic AI Comparison: Agentic AI, Generative AI, and Traditional AI Agentic AI Building Blocks, Autonomous Agents Human in the Loops Systems, Single and Multi-Agent, AI Systems Agentic AI Frameworks, Overview Ethical and Responsible AI.

UNIT II:

Working with LangChain and LCEL: Components and Modules Data Ingestion and Document Loaders Text Splitting Embeddings Integration with Vector Databases Introduction to Langchain Expression Language (LCEL) Runnables Chains Building and Deploying with LCEL Deployment with Langserve.

UNIT III:

Implementing Agentic RAG: What is Agentic RAG? Agentic RAG vs. Traditional RAG Agentic RAG Architecture and Components Understanding Adaptive RAG. Variants of Agentic RAG Applications of Agentic RAG Agentic RAG with Llamaindex Agentic RAG with Cohere.

UNIT IV:

Multi Agent Systems with LangGraph and CrewAI: Multi Agent Systems Multi Agent Workflows Collaborative Multi Agents Multi Agent Designs Multi Agent Workflow with LangGraph CrewAI Introduction CrewAI Components Setting up CrewAI environment Building Agents with CrewAI.

UNIT V:

Building AI Agents with No/Low- Code Tools: Langfuse Overview Langfuse Dashboard Tracing, Evaluation Managing Prompts Experimentation AI Observability with Langsmith Setting up Langsmith Managing Workflows with Langsmith AgentOps Practical Implementation. Introduction to No-Code/Low-Code AI Benefits and Challenges of No-Code AI Development Key Components of No-Code AI Platforms Building

SUGGESTED READINGS:

1. Agentic Artificial Intelligence: Harnessing AI Agents to Reinvent Business, Work, and Life, by, Pascal Bornet, Jochen Wirtz , Thomas H Davenport.
2. Altaf Rehmani, Generative AI for Everyone: Understanding the Essentials and Applications of This Breakthrough Technology.

Course Code	Course Title						Core/Elective
U23EC711	**INTERNET OF THINGS**						**OPEN ELECTIVE-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
DCN, MPMC	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives:

1. Describe architecture, Design, underlying technologies, platforms and cloud interface.
2. To introduce the concept of implementation of a design of sensor.
3. To introduce different hardware and software components utilizing for IoT
4. To introduce different applications with case studies.

Course Outcomes:

After completing this course, the student will be able to

1. Outline the fundamentals of Internet of Thing and its characteristics.
2. Interpret the Different Sensors used in IoT and its applications.
3. Comprehend the different platforms in IoT.
4. Implement the different Interfacing techniques to IoT
5. Analyze the Domain specific IoTs and its case studies.

UNIT I

INTRODUCTION TO IoT: Sensing, Actuation, Networking basics, Communication Protocols, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT.

UNIT II

Sensors: Working principles, Different types of sensors such as capacitive, Resistive, MEMS, Surface Acoustic wave for Temperature. Equivalent circuit of smart sensors. Importance and advantages of smartsensors.

UNIT-III

IoT Platforms: What is an IoT Device, Exemplary Devices: Raspberry Pi, Raspberry Pi Interfaces, Other IoT Devices: Django, AWS, Beagle Bone Black, RFID-Tags, Cubie Board, ARDUINO.

UNIT-IV

Interfacing: Design procedure, Serial, SPI, I2C Interfaces, Interfacing Microcontroller sensorinterface, interfacing with communication module, Cloud Interface, Thing Speak IoT Platform.

UNIT-V

Domain specific IoTs and Case studies: Home Automation, Smart cities, Environment Applications,Energy, Agriculture, Industry, Health and Lifestyle, Logistics.

Suggested Readings:

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on- Approach)”, 1stEdition, VPT, 2014
2. Internet of Things: A Hands-On Approach Arshdeep Bahga, Vijay Madisetti VPT – Paperback 2015.
3. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things David Hanes, Gonzalo Salgueiro, Patrick Grossetete Cisco Press – Paperback – 16 Aug 2017.

Course Code	**Course Title**						Core
U23CD7L1	**CLOUD COMPUTING LAB**						**Core**
Prerequisite	Hours Per Week				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
	-	**-**	**-**	3	25	50	**1.5**

Course Objectives

1. Understand the basic concepts of cloud computing including virtualization, scalability, and resource pooling, and how they relate to modern computing paradigms.
2. Gain a solid understanding of virtualization principles and technologies, with a focus on Virtual Box as a tool for creating and managing virtualized environments.
3. Creation and Management of Cloud Storage Buckets
4. Implementation of Distributed File Storage using HDFS.
5. Implement Identity and Access Management Policies.

Course Outcomes

After completing this course, the student will be able to

1. Students will learn the fundamental concepts of cloud computing, including virtualization, resource pooling, and scalability, through practical implementation using Virtual Box
2. Students will be proficient in developing C programs within a virtual environment, understanding the nuances of system-level programming and interaction with virtualized hardware resources.
3. Students will implement Distributed File Storage using HDFS.
4. Students will Design a Data Lake Architecture for a Sample Dataset.
5. Students will undertake a project that Access Management Policies.

LIST OF EXPERIMENTS

WEEK 1:

1. Study of Cloud Platforms (AWS, Azure, GCP)
2. Creating and Managing Virtual Machines.

WEEK 2:

1. Installation and Configuration of VirtualBox.
2. Docker Installation and Basic Container Operations

WEEK 3:

1. Create and Run Python Application using Docker Container.
2. Configure Multiple Containers using Docker Compose.

WEEK 4:

1. Creation and Management of Cloud Storage Buckets
2. Upload, Download and Version Control of Files in Cloud Storage

WEEK 5:

1. Implementation of Distributed File Storage using HDFS.
2. Word Count Program using Hadoop MapReduce.

WEEK 6:

1. Data Processing using Apache Spark.
2. Perform CRUD Operations on Cloud SQL Database.

WEEK 7:

1. Create and Manage NoSQL Database.
2. Design a Data Lake Architecture for a Sample Dataset.

WEEK 8:

1. Implement Identity and Access Management Policies.
2. Data Encryption and Secure Storage Implementation.

WEEK 9:

1. Cloud Security Audit using IAM Roles.
2. Backup and Recovery Configuration.

WEEK 10:

1. Disaster Recovery Planning and Testing.
2. Serverless Function Development.

Course Code	Course Title						Core/Elective
U23CD7L2	**Data Handling and Data Visualization Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Basics of Data Science	-	-	**-**	**3**	**25**	**50**	**1.5**

Course Objectives

The course will introduce the students to

1. Understand the various types of data, apply and evaluate the principles of data visualization.
2. Acquire skills to apply visualization techniques to a problem and its associated dataset.
3. Understand the fundamental concepts of data science.
4. Understand different types of data scientists.
5. Summarize the insurers' use of predictive analytics and data science and the roles of data scientists and data science team

Course Outcomes:

After successful completion of the course, student will be able to:

1. . Identify the different data types, visualization types to bring out the insight.
2. Relate the visualization towards the problem based on the dataset to analyze and bring out valuable insight on a large dataset.
3. Demonstrate the analysis of a large dataset using various visualization techniques and tools.
4. Identify the different attributes and showcasing them in plots. Identify and create various visualizations for geospatial and table data.
5. Ability to create and interpret plots using R/Python.

List of Experiments:

1. Collecting and plotting data.
2. Statistical Analysis - such as Multivariate Analysis, PCA, LDA, Correlation regression and analysis of variance.
3. Financial analysis using Clustering, Histogram and HeatMap.
4. Time-series analysis stock market.
5. Visualization of various massive dataset Finance - Healthcare-Census-Geospatial.
6. Visualization on Streaming dataset (Stock market dataset, weather forecasting).
7. Market-Basket Data analysis-visualization.
8. Text visualization using web analytics.

Suggested Reading:

1. Matthew Ward, Georges Grinstein and Daniel Keim, "Interactive Data Visualization
2. Foundations, Techniques, Applications", 2010.
3. Colin Ware, "Information Visualization Perception for Design", 2nd edition, Margon Kaufmann Publishers, 2004.

Course Code	Course Title						Core/ Elective
U23CD7P1	MAJOR PROJECT Phase-I						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	4	50	-	2

Course Objectives:

The objectives of this course are:

1. Enhance practical and professional skills
2. Familiarize tools and techniques of systematic literature survey and documentation
3. Expose the students to industry practices and team work
4. Encourage students to work with innovative and entrepreneurial ideas
5. Obtain knowledge of societal and environmental related areas.

Course Outcomes:

At the end of the course, students would be able to:

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to realworld problems.
2. Evaluate different solutions based on economic and technical feasibility.
3. Analyze various modules pertaining to the sub routines of the projects.
4. Effectively plan a project and confidently perform all aspects of project management.
5. Demonstrate effective written and oral communication skills.

Guidelines:

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.

The department will appoint a project coordinator who will coordinate the following:

Collection of project topics/descriptions from faculty members (Problems can also be invited from the industries)

➢ Grouping of students (max 3 in a group)

➢ Allotment of project guides

➢ The aim of project work is to develop solutions to realistic problems applying the knowledge and skills Obtained in different courses, new technologies and current industry practices.

This requires students to understand current problems in their domain and methodologies to solve these problems.

To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions.

After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide. Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week of the semester which should be strictly adhered to.

Each group will be required to:

1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 30 minutes' presentation followed by 10 minutes' discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

➢ Problem definition and specification

➢ Literature survey

➢ Broad knowledge of available techniques to solve a particular problem.

➢ Planning of the work, preparation of bar (activity)charts

➢ Presentation- oral and written

Course Code	Course Title						Core/Elective
U23CD7P2	TECHNICAL SEMINAR						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	50	-	2

Course Objectives

This course enables students to:

1. Prepare and present a topic on engineering/ technology, for a duration of about 8 to 10 minutes.
2. Gain confidence in facing the placement interviews.
3. Enrich the communication skills of the student and presentations of technical topics of interest, this course are introduced.
4. Use various teaching aids such as overhead projectors, power point presentation and demonstrative models.
5. Encourage and motivate the students to read and collect recent and reliable information about their area of interestconfined to the relevant discipline, from technical publications.

Course Outcomes

At the end of this course, students will be able to**:**

1. Develop the habit of referring the journals for literature review.
2. Understand the gist of the research paper.
3. Identify the potential for further scope.
4. Present the work in an efficient manner.
5. Write the documentation in standard format.

Seminar topics may be chosen by the students with advice from the faculty members and the student shallread further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include followingaspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes inPowerPoint, followed by Question and Answers session for 10 minutes.
2. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by theDepartment.

Guidelines for awarding marks		
S. No.	**Description**	**Max. Marks**
1	Contents and relevance	10
2	Presentation skills	10
3	Preparation of PPT slides	05
4	Questions and answers	05
5	Report in a prescribed format	20

Note:

1. The seminar presentation should be a gist of at least five research papers from **Peer-reviewed** or **UGC recognised** journals.
2. **The seminar report should be in the following order:** Background of work, literature review, techniques used,prospective deliverables, discussion on results, conclusions, critical appraisal and reference.
3. At least two faculty members will be associated with the seminar presentation to evaluate and award marks.
4. Attendance of all the students for weekly seminar presentations is compulsory. If the student fails to secureminimum attendance as per O.U. rules, the marks awarded in the seminar presentation shall remain void.

Course Code	Course Title						Core/Elective
U23CD801	**Mobile Adhoc Networks**						**Professional Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
CN, Distributed Systems	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives:

1. Understanding of the current topics in MANETs and WSNs, both from an industry and research point of views.
2. Understanding of the principles of mobile ad hoc networks (MANETs) and what distinguishes them from infrastructure-based networks. ·
3. Understand how proactive routing protocol's function and their implications on data transmission delay and bandwidth consumption.
4. Know about routing protocol
5. Analyze various routing algorithms

Course Outcomes:

After completing this course, the student will be able to

1. Understand the concepts of sensor networks and applications
2. Understand and compare the MAC and routing protocols for adhoc networks
3. understand basics of Wireless sensors, and Lower Layer Issues and Upper Layer Issues of WSN
4. Understand the transport protocols of sensor networks.
5. understand various broadcast, mutlicast and geocasting protocols in ad hoc and sensor networks

UNIT - I

Introduction to Ad Hoc Networks Characteristics of MANETs, Applications of MANETs and Challenges of MANETs.Routing in MANETs Criteria for classification, Taxonomy of MANET routing algorithms, Topology-based routing algorithms Proactive: DSDV, WRP; Reactive: DSR, AODV, TORA; Hybrid: ZRP; Position- based routing algorithms Location Services-DREAM, Quorum-based, GLS; Forwarding Strategies, Greedy Packet, Restricted Directional Flooding-DREAM, LAR; Other routing algorithms-QoS Routing, CEDAR.

UNIT - II

Data Transmission Broadcast Storm Problem, Rebroadcasting Schemes-Simple-flooding, Probability-based Methods, Area-based Methods, Neighbor Knowledge-based: SBA, Multipoint Relaying, AHBP. Multicasting: Tree-based:AMRIS, MAODV; Mesh-based: ODMRP, CAMP; Hybrid: AM Route, MCEDAR.

UNIT - III

Geocasting Data-transmission Oriented-LBM; Route Creation Oriented-Geo TORA, MGR.TCP over Ad Hoc TCP protocol overview, TCP and MANETs, Solutions for TCP over Ad hoc

UNIT - IV

Basics of Wireless Sensors and Lower Layer Issues-Applications, Classification of sensor networks, Architecture of sensor network, Physical layer, MAC layer, Link layer, Routing Layer.

UNIT - V

Upper Layer Issues of WSN Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs.

SUGGESTED READINGS

1. Ad Hoc and Sensor Networks – Theory and Applications, Carlos Corderio Dharma P.Aggarwal, World Scientific Publications, March 2006, ISBN – 981-256-681-3

2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas,Elsevier Science, ISBN – 978-1-55860-914-3 (Morgan Kauffman)

Course Code	Course Title						Core/Elective
U23CD802	**SOFTWARE TESTING METHODOLOGIES**						**PROFESSIONAL ELECTIVE**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Software Engineering	3	-	-		**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. To study fundamental concepts in software testing
2. To discuss various software testing issues and solutions in software unit test, integration and system testing.
3. To expose the advanced software testing topics, such as object-oriented software testing methods.
4. To provide knowledge of the concepts in software testing such as testing process, criteria, strategies, and methodologies
5. To develop skills in software test automation and management using latest tools.

Course Outcomes:

After successful completion of the course, student will be able to:

1. List a range of different software testing techniques and strategies and be able to apply specific (automated) unit testing ethod to the projects.
2. Distinguish characteristics of structural testing methods
3. Demonstrate the integration testing which aims to uncover interaction and compatibility problems as early as possible.
4. Discuss about the functional and system testing methods.
5. Demonstrate various issues for object-oriented testing.

UNIT – I

Introduction: Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs. Flow graphs and Path testing: Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT - II

Transaction Flow Testing: transaction flows, transaction flow testing techniques. Dataflow testing: Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing. Domain Testing: domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability.

UNIT – III

Paths, Path products and Regular expressions: path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection. Logic Based Testing: overview, decision tables, path expressions, kv charts, specifications.

UNIT – IV

State, State Graphs and Transition testing: state graphs, good & bad state graphs, state testing, Testability tips.

UNIT - V

Graph Matrices and Application: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools.

SUGGESTED READING:

1. Software Testing techniques - Baris Beizer, Dream tech, second edition.
2. Software Testing Tools – Dr. K. V. K. K. Prasad, Dream tech.
3.The craft of software testing - Brian Marick, Pearson Education.

Course Code	Course Title						Core/Elective
U23CD803	**DATA ON WEB**						**PROFESSIONAL ELECTIVE**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
WT, FSWD	3	-	**-**		**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. To introduce the fundamentals of Internet, and the principles of web design.
2. To construct basic websites using HTML and Cascading Style Sheets.
3. To build dynamic web pages with validation using Java Script objects and by applying
4. different event handling mechanisms.
5. To develop modern interactive web applications using PHP, XML and MySQL

Course Outcomes:

After successful completion of the course, student will be able to:

1. Describe the concepts of World Wide Web, and the requirements of effective web design.
2. Develop web pages using the HTML and CSS features with different layouts as per need of applications.
3. Use the JavaScript to develop the dynamic web pages.
4. Construct simple web pages in PHP and to represent data in XML format.
5. Use server-side scripting with PHP to generate the web pages dynamically using the database connectivity

Unit I:

History, various concepts (Object Exchange Model, UnQL, XML Data Model, some language flavors in these data models) Data Queries: Query languages, Query languages for XML, Interpretations and advanced features

Unit II:

Types: Typing semi structured data, Query processing the lore system, Strudel

Unit III:

Trading Between Relations and XML: Data integration, XML publishing and storage systems

Unit IV:

Storing and Querying XML Data Using an RDBMS; XML toolkit, XML Schema and queries, Translating Web

Unit V:

An Information-Theoretic Approach to Normal Forms for Relational and XML Data

Text Books:

1. "Data on the Web: From Relations to Semistructured Data and XML" by Serge Abiteboul, Peter Buneman, and Dan Suciu Web Odyssey - From Codd to XML - by Vianu
2. Foundations of Databases: The Logical Level by Serge Abiteboul
3. Database Management Systems by Korth

Course Code	Course Title						Core/Elective
U23CD804	**REINFORCEMENT LEARNING**						**PROFESSIONAL ELECTIVE**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
AI,	3	-	**-**		**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. This course will provide a solid introduction to the field of reinforcement learning.
2. It will also make the students learn about the core challenges and approaches, including exploration and exploitation.
3. The course will make the students well versed in the key ideas and techniques for reinforcement learning.

Course Outcomes:

After successful completion of the course, student will be able to:

1. Understand basics of RL.
2. Understand RL Framework and Markov Decision Process.
3. Analyzing ning through the use of Dynamic Programming and Monte Carlo.
4. Understand TD(0) algorithm, TD(λ) algorithm.
5. Evaluate different approaches for addressing exploration vs exploitation challenge in terms of performance, scalability, complexity of implementation, and theoretical guarantees

UNIT - I

Basics of probability and linear algebra, Definition of a stochastic multi-armed bandit, Definition of regret, Achieving sublinear regret, UCB algorithm, KL-UCB, Thompson Sampling.

UNIT - II

Markov Decision Problem, policy, and value function, Reward models (infinite discounted, total, finite horizon, and average), Episodic & continuing tasks, Bellman's optimality operator, and Value iteration & policy iteration

UNIT - III

The Reinforcement Learning problem, prediction and control problems, Model-based algorithm, Monte Carlo methods for prediction, and Online implementation of Monte Carlo policy evaluation

UNIT - IV

Bootstrapping; TD(0) algorithm; Convergence of Monte Carlo and batch TD(0) algorithms; Model-free control: Q-learning, Sarsa, Expected Sarsa.

UNIT - V

n-step returns; TD(λ) algorithm; Need for generalization in practice; Linear function approximation and geometric view; Linear TD(λ). Tile coding; Control with function approximation; Policy search; Policy gradient methods; Experience replay; Fitted Q Iteration; Case studies.

SUGGESTED READINGS:

1. "Reinforcement learning: An introduction," First Edition, Sutton, Richard S., and Andrew G. Barto, MIT press 2020.
2. "Statistical reinforcement learning: modern machine learning approaches," First Edition, Sugiyama, Masashi. CRC Press 2015.
3. "Bandit algorithms," First Edition, Lattimore, T. and C. Szepesvári. Cambridge University Press. 2020.
4. "Reinforcement Learning Algorithms: Analysis and Applications," Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, and Jan Peters First Edition, Springer 2021.
5. Alexander Zai and Brandon Brown "Deep Reinforcement Learning in Action," First Edition,Manning Publications 2020.

Course Code	Course Title						Core/Elective
U23CD805	**CLOUD SECURITY**						**Professional Elective**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
Cloud Foundations, Programming and Database, Information Security	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. Impart fundamental concepts in the area of virtualization
2. Impart knowledge in infrastructure as a service
3. Explain monitoring, management and applications
4. Understand the concept of design patterns
5. Learn to design the trusted cloud computing systems

Course Outcomes

On completion of the course, students will be able to

1. Understand the cloud security for infrastructure and applications.
2. Understand the concepts of private and public clouds using modern approaches and tools.
3. Design security models for various business scenarios.
4. Implement and Deploy lightweight Security Services.
5. Create a scenario for threat protection

UNIT 1:

Cloud Security Fundamentals

Introduction to Cloud Security, Basic concepts (CIA) - Confidentiality, Integrity and Availability, Understanding Multi tenancy, Multi tenancy concepts, Design considerations for multi-tenant cloud, Security concerns on multi-tenant cloud environments, Security in context of Cloud Deployment and consumption models, Cloud Governance, Risk and Compliance

UNIT 2:

Virtualization and Container Security

Virtualization Security, Vulnerabilities in management, Vulnerabilities in Hypervisor, Vulnerabilities in Virtualization and virtual machines, Platform Hardening to Prevent Threats, Container Security, Network isolation and Protection, Setting up a secure network, Network isolation and segmentation, Load balancer and Ingress services

UNIT 3:

Identity and Access Management (IAM)

Identity and Access Management (IAM), IAM Operational Areas, Cloud Identity Management, Identity Provisioning in Cloud, Cloud Authentication, SAML, OAuth2.0, OpenID, Multi Factor authentication, Enterprise SSO and federation, Privileged Access Management (PAM), IBM Cloud App ID

UNIT 4:

Data Security

Data Security, protection and IBM key protect in IBM Cloud, Data Integrity in the Cloud, IBM Multi-Cloud Data Encryption, Data in Transit, Protect Data in Transit, Certificate management, Digital certificates Encrypting data in transit, Istio overview to protect microservices

UNIT 5:

DevOps

Application Security, Secure DevOps, Vulnerability and Patch Management, IBM Cloud Pak for Security.

Suggested Readings:

1. Enterprise Cloud Security and Governance: Efficiently Set Data Protection and Privacy Principles by Zeal Vora
2. Cloud Security: A Comprehensive Guide to Secure Cloud Computing 1st Edition, Kindle Edition
3. Cloud Security Automation: Get to grips with automating your cloud security on AWS and OpenStack

Course Code	Course Title						Core/Elective
U23CD806	**LARGE LANGUAGE MODELS**						**PROFESSIONAL ELECTIVE**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
AI	3	-	**-**		**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. The key principles and architectures of Large Language Models, particularly transformer- based models.
2. How to train, fine-tune, and deploy LLMs for a variety of NLP tasks.
3. Explore applications of LLMs in areas such as text generation, machine translation, and conversational AI.
4. Address ethical concerns related to bias, fairness, and transparency in LLMs.
5. Evaluation and optimization of LLMs for real-world deployment, considering computational efficiency and scalability

Course Outcomes:

After successful completion of the course, student will be able to:

1. Understand the fundamental principles of large language models and the transformer architecture.
2. Explain the training process of LLMs, including data pre-processing, model training, and optimization.
3. Implement basic LLM applications, such as text generation, sentiment analysis, and question answering.
4. Critically evaluate the ethical concerns surrounding the use of LLMs, including biases and fairness.
5. Apply fine-tuning techniques to adapt pre-trained models to specific tasks..

UNIT 1: INTRODUCTION TO LANGUAGE MODELS & NLP FUNDAMENTALS

Language models and its Evolution: from n-grams to neural networks, Introduction to NLP tasks: tokenization, POS tagging, Named Entity Recognition (NER). Key challenges in NLP and the role of deep learning.

UNIT II: THE TRANSFORMER ARCHITECTURE & ATTENTION MECHANISM

Introduction to neural networks and deep learning models, The Transformer model: Encoder- decoder architecture, The Attention mechanism and its variations (Self-attention, multi-head attention), Position Encoding and how Transforms handle sequences.

UNIT III: TRAINING LARGE LANGUAGE MODELS

Pre-training vs Fine-tuning large models, Transfer learning in NLP, Techniques for training LLMs (Data collection, tokenization, batching), Optimization methods (Adam, Gradient clipping, learning rate scheduling). Evaluation and Benchmarks, Parameter-efficient fine-tuning, Domain adaptation, Instruction tuning and reinforcement learning with human feedback (RLHF)

UNIT IV: APPLICATIONS OF LARGE LANGUAGE MODE

Text generation (e.g., GPT, Open AI's GPT-3), Text summarization and translation (e.g., T5, BART), Question answering systems and conversational AI (e.g., BERT), Sentiment analysis and classification tasks

UNIT V: ETHICAL CONSIDERATIONS AND DEPLOYMENT OF LLMS

Ethical issues in LLMs: Bias, fairness, and misinformation, Ensuring transparency and interpretability in AI models, Environmental impact: The cost of training large models, Model deployment and optimization strategies (cloud, edge deployment), Future challenges in LLM research (scalability, safety).

SUGGESTED READINGS:

1. Jacob Eisenstein, Natural Language Processing, MIT Press, 1st Ed., 2019.
2. Delip Rao & Brian McMahan, Natural Language Processing with PyTorch, O'Reilly, 1st Ed., 2019.
3. Sebastian Raschka et al., Machine Learning with PyTorch and Scikit-Learn, Packt, 2nd Ed., 2022.

Course Code	Course Title						Core/Elective
U23CD807	**SEMANTIC WEB**						**PROFESSIONAL ELECTIVE**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Web Technologies	3	-	**-**		**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. Introduce Semantic Web Vision and learn Web intelligence
2. Understanding about XML, RDF, RDFS, OWL
3. Querying Ontology and Ontology Reasoning
4. To learn Semantic Web Applications, Services and Technology
5. To learn Knowledge Representation for the Semantic Web

Course Outcomes:

After successful completion of the course, student will be able to:

1.Understand the characteristics of the semantic web technology
2. Understand the concepts of Web Science, semantics of knowledge resource and ontology
3. Describe logic semantics and inference with OWL.
4. Use ontology engineering approaches in semantic applications
5. Learn about web graph processing for various applications such as search engine, community detection

.

UNIT - I

Introduction: Introduction to Semantic Web, the Business Case for the Semantic Web, XML and Its Impact on the Enterprise.

UNIT - II

Web Services: Uses, Basics of Web Services, SOAP, UDDI, Orchestrating Web Services, Securing Web Services, Grid Enabled and Semantic Web of Web Services.

UNIT - III

Resource Description Framework: Features, Capturing Knowledge with RDF.XML Technologies: XPath, The Style Sheet Family: XSL, XSLT, and XSL FO, XQuery, XLink,XPointer, XInclude, XMLBase, XHTML, XForms, SVG.

UNIT - IV

Taxonomies and Ontologies: Overview of Taxonomies, Defining the Ontology Spectrum, Topic Maps,Overview of Ontologies, Syntax, Structure, Semantics, and Pragmatics, Expressing Ontologies Logically, Knowledge Representation.

UNIT - V

Semantic Web Application: Semantic Web Services, e-Learning, Semantic Bioinformatics, Enterprise Application Integration, Knowledge Base.Semantic Search Technology: Search Engines, Semantic Search, Semantic Search Technology, Web Search Agents, Semantic Methods, Latent Semantic Index Search, TAP

SUGGESTED READINGS

1. The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management by Michael C. Daconta, Leo J. Obrst , Kevin T. Smith, Wiley Publishing, Inc.
2.Peter Mika, Social Networks and the Semantic Web, Springer

Course Code	Course Title						Core/Elective
U23CD807	**AUGMENTED REALITY AND VIRTUAL REALITY**						**PROFESSIONAL ELECTIVE**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Human Computer Interaction	3	-	-		**40**	**60**	**3**

Course Objectives

The course will introduce the students to

1. To understand the basics of AR and VR.
2. To learn display, tracking, and vision techniques in AR.
3. To study interaction methods and software architectures.
4. To understand human vision, perception, and rendering in VR.
5. To apply motion and interaction concepts in AR/VR applications. **Course Outcomes:**

After successful completion of the course, student will be able to:

1. Explain fundamentals of AR and display/tracking systems.
2. Analyse computer vision and interaction techniques in AR.
3. Describe fundamentals of VR, geometry, and optics.
4. Examine human vision, perception, and rendering in VR.
5. Apply motion and interaction concepts in AR/VR systems.

UNIT - I

Introduction to Augmented Reality: Augmented Reality - Defining augmented reality, history of augmented reality, Examples, Related fields, Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model, Visual Displays

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

Motion in Real and Virtual Worlds: Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vectron, Interaction: Motor Programs and Remapping, Locomotion, Social Interaction

SUGGESTED READINGS

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

Course Code	**Course Title**						**Core/ Elective**
U23CD8P1	**MAJOR PROJECT PHASE2**						Core
Prerequisite	**Contact Hours Per Week**				**CIE**	**SEE**	**Credits**
	L	T	D	P			
-	-	-	-	16	50	150	8

Course Objectives:

To prepare the students

1. To enhance practical and professional skills.
2. Enable the student extend further the investigative study, either fully theoretical/practical or involving both theoretical and practical work.
3. The work shall be carried out under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry
4. . Preparing an Action Plan for conducting the investigation, including team work
5. Prepare a dissertation in the standard format.

Course Outcomes

1. Demonstrate a sound technical knowledge of their selected topic.
2. Conduct investigations by using research-based knowledge and methods to provide valid conclusions.
3. Provide solutions to societal complex problems utilizing gained engineering knowledge as an individual or by team work.
4. Create/select/use modern tools to overcome the limitation of complex engineering solutions.
5. Communicate with engineering experts and the community at large in written, oral forms and publish a paper (UGC, international conference proceedings and indexed journal)

The aim of Project work –II is to implement and evaluate the proposal made as part of Project Work - I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

The department will appoint a project coordinator who will coordinate the following:

1. Re-grouping of students - deletion of internship candidates from groups made as part of project Work-I 2. Re-Allotment of internship students to project guides

3. Project monitoring at regular intervals all re-grouping/re-allotment has to be completed by the 1st week of VIII semester so that students get sufficient time for completion of the project.

All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor.

The first review of projects for 25 marks can be conducted after completion of five weeks.

The second review for another 25 marks can be conducted after 12 weeks of instruction. Common norms will be established for the final documentation of the project report by the respective departments.

The students are required to submit draft copies of their project report within one week after completion of instruction.

Course Code	Course Title						Core/ Elective
U23MB802	**ENTREPRENEURSHIP**						**Open Elective IV**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives:

1. To teach students the importance of entrepreneurship.
2. To inspire and motivate students to engage in entrepreneurship.
3. To educate students about entrepreneurial environment.
4. To provide training in the creation of a business plan.
5. To foster the development of an entrepreneurial mindset in students.
6. To equip students with the necessary skills to initiate entrepreneurial endeavors

Course Outcomes:

1. To enable students to discern the cues and motives behind entrepreneurship.
2. To provide students with knowledge about different types of enterprises and their growth patterns.
3. To prepare students with an entrepreneurial mindset through entrepreneurship education.
4. To facilitate an understanding of the problems and perspectives associated with entrepreneurship.
5. To equip students to identify opportunities and challenges in entrepreneurship.
6. To foster a comprehensive understanding of the entrepreneurial landscape.

Unit – I: Entrepreneur and Entrepreneurship:

Understanding Concept of Entrepreneurship, Evolution of Entrepreneurship, Characteristics of Entrepreneur, Types of Entrepreneurs, Recent Trends in Entrepreneurship Development, Role of Entrepreneurship in Economic development in India; Rural Entrepreneurship, Need and Importance of Rural Entrepreneurship – Problems and Perspectives of Rural Entrepreneurship.

Unit – II: Factors affecting entrepreneurial growth:

Economic Environment – Economic, Non- Economic and Psychological factors – Growth of Entrepreneurship in India – Role of Government in promotion of Entrepreneurship; Entrepreneurial Motivation, Role of Higher learning Institutes in Entrepreneurial capacity building – Importance of workshops; Entrepreneurship Development Programs (EDPs) – Need, Objectives, course content and instruction – Evaluation of EDPs – Phase wise development of EDP Curriculum.

Unit – III: Idea generation and evaluation:

Idea Generation strategies, Entrepreneurial Opportunity Recognition and Evaluation; Design thinking for finding solutions, prototyping, idea evaluation, entrepreneurial Outlook, value proposition design, customer insight, ideas development. Product/Service Feasibility Analysis, Industry & competition analysis, environment analysis, financial feasibility analysis.

Unit – IV: Social Entrepreneurship:

Meaning, definition; Characteristics of Social Entrepreneurship - Differences between Business and Social entrepreneur, Entrepreneurship and Social Entrepreneurship, Mindset and motivations of Entrepreneur, Qualities and Skills of Social Entrepreneur, The Timmons Model of the Entrepreneurship Process, The PCDO (The People, Context, Deal, and Opportunity) frame work, The Social Entrepreneurship Frame work; Sources of Social Entrepreneurship -Public Sector, Private Sector, Voluntary Sector.

Unit – V: Writing a business plan:

Meaning and significance of a business plan, components of a business plan, Iterating the MVP, Digital Presence for Ventures, Guidelines for writing BP, pre- requisites from the perspective of investor. Business Models, Business Model Canvas.

Suggested Readings:

1. Vasanth Desai, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, Hyd.
2. S. S Khanka, Entrepreneurial Development, S. Chand Publishing House, New Delhi.
3. Vasanth Desai, Small Scale Industry and Entrepreneurship, Himalaya Publishing House, Hyd.
4. A. Sahay and A. Nirjar, Entrepreneurship, Excel Books.
5. Poornima M Charinthmath, Entrepreneurial Development and Small Business Enterprises, Pearson Education Publisher.
6. David H Hott, Entrepreneurship and New Venture Creation, PHI New Delhi.
7. S. R Bowmick & M. Bhowmik, Entrepreneurship, New Age International Books.
8. Morse E.A Mitchel, Cases in Entrepreneurship, Sage Publishers.
9. Raj Aggarwal, Business Environment, Excel Books New Delhi.
10. Donald G Kurato and Richard M Hodgetts, Entrepreneurship, Thompson Publications.
11. Ramachandran , Entrepreneurship Development, McGraw Hill
12. Katz , Entrepreneurship Small Business, McGraw Hill
13. Byrd Megginson, Small Business Management An Entrepreneur‟s Guidebook 7th ed, McGraw Hill
14. Fayolle A, Entrepreneurship and new value creation, Cambridge, Cambridge University Press
15. Hougaard S., The business idea. Berlin, Springer