RAMDEOBABA UNIVERSITY
[RBU]
NAGPUR – 440013

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE AND APPLICATIONS

RAMDEOBABA UNIVERSITY, NAGPUR
Formerly Shri Ramdobaba College of Engineering & Management (RCOEM) Est. 1984

PROGRAMME SCHEME & SYLLABUS
2026-27

MASTER OF COMPUTER APPLICATIONS (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)
MCA (AI & ML)

Semester-I

Sr. No.	Course Type	Course Code	Course Name	L	P	C	Continuous Assessment	End Semester / Internal Eval	Total	Duration of End Semester
1	PCC	26MC60TP1175	Data Structures and Algorithms-I	3	2	4	50+25	50+25	150	3 Hrs.
2	PCC	26MC60TP1176	Database Management Systems	3	2	4	50+25	50+25	150	3 Hrs.
3	PCC	26MC60TP1177	Computer Networks	3	2	4	50+25	50+25	150	3 Hrs.
4	PCC	26MC60TP1178	Software Engineering	3	2	4	50+25	50+25	150	3 Hrs.
5	PCC	26MC60PR1179	Operating Systems Lab	0	4	2	25	25	50	-
6	AEC	26MC60PR1180	Software Lab -I	0	2	1	25	25	50	-
7	HSMC/ SEC	26HS02PR1175	Communication Skills for Employability	0	2	1	25	25	50	-
			TOTAL	**12**	**16**	**20**	**375**	**375**	**750**	

Semester-II

Sr. No.	Course Type	Course Code	Course Name	L	P	C	Continuous Assessment	End Semester / Internal Eval	Total	Duration of End Semester
1	PCC	26MC60TP1275	Data Structures and Algorithms-II	3	2	4	50+25	50+25	150	3 Hrs.
2	PCC	26MC60TP1276	Cloud Computing	2	2	3	50+25	50+25	150	3 Hrs.
3	PCC	26MC60TP1277	Artificial Intelligence	3	2	4	50+25	50+25	150	3 Hrs.
4	PCC	26MC60TP1278	Data Exploration & Analytics	2	2	3	50+25	50+25	150	3 Hrs.
5	PEC	26MC60TH1279	Program Elective-I	3	0	3	50	50	100	3 Hrs.
6	AEC	26MC60PR1280	Software Lab-II	0	2	1	25	25	50	-
7	OEC	26ID160TH1275	Open Elective	3	0	3	50	50	100	3 Hrs.
			TOTAL	**16**	**10**	**21**	**425**	**425**	**900**	

Course Code	Program Elective-I
26MC60TH1279-1	Cyber Laws & Ethics
26MC60TH1279-2	Organizational Behaviour

Open Elective	
261D160TH1275-1	MOOC Course (Google Cloud Data Analytics Certificate)

Semester-III

Sr. No.	Course Type	Course Code	Course Name	L	P	C	Continuous Assessment	End Semester / Internal Eval	Total	Duration of End Semester
1	PCC	26MC60TP1375	Machine Learning	3	2	4	50+25	50+25	150	3 Hrs.
2	PCC	26MC60TP1376	Business Analytics and Intelligence	3	2	4	50+25	50+25	150	3 Hrs.
3	PCC	26MC60TP1377	Vulnerability Assessment and Penetration Testing	3	2	4	50+25	50+25	150	3 Hrs.
4	PCC	26MC60PR1378	Digital Forensics	0	2	1	50	50	100	2 Hrs
5	PEC	26MC60TP1379	Program Elective-II	3	2	4	50+25	50+25	150	3 Hrs.
6	AEC	26MC60PR1380	Software Lab-III	0	2	1	25	25	50	-
7	VSEC/ Project	26MC60PR1381	Capstone Project Phase-I	0	6	3	25	25	50	-
			TOTAL	**12**	**16**	**21**	**400**	**400**	**800**	

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Course Code	Program Elective-II
26MC60TP1379-1	Enterprise Resource Planning
26MC60TP1379-2	DevOps Fundamentals
26MC60TP1379-3	Generative AI and Its Applications

Semester-IV

Sr. No.	Course Type	Course Code	Course Name	L	P	C	Continuous Assessment	End Semester / Internal Eval	Total	Duration of End Semester
1	PCC	26MC60TP1475	Deep Learning	3	2	4	50+25	50+25	150	3 Hrs.
2	PEC	26MC60TH1476	Product Management	3	0	3	50	50	100	-
3	PEC	26MC60TP1477	Program Elective-III	3	2	4	50+25	50+25	150	3 Hrs.
4	MLC	26MC60TH1478	Research Methodology	2	0	2	50	50	100	2 Hrs.
5	VEC/ Project	26MC60PR1479	Capstone Project Phase-II	0	10	5	75	75	150	-
			TOTAL	**11**	**14**	**18**	**325**	**325**	**650**	

Course Code	Program Elective-III
26MC60TP1477-1	Customer Relationship Management
26MC60TP1477-2	Augmented and Virtual Reality
26MC60TP1477-3	Agentic AI

One year Internship (Semester-III and IV)

Sr. No.	Course Type	Course Code	Course Name	L	T	P	C	Continuous Assessment	End Semester / Internal Eval	Total	Duration of End Semester
1	PEC	26CS01TH0708	NPTEL/ SWAYAM/ MOOC Course	4	0	0	4	50	50	100	03 Hrs
2	PEC	26CS01TH0710	NPTEL/ SWAYAM/ MOOC Course	4	0	0	4	50	50	100	03 Hrs
3	Internship	26CS01PR0709	Internship-I	0	0	26	13	300	300		
			Total	**4**	**0**	**26**	**21**	**400**	**400**	**800**	

Six months Internship (Semester- IV)

Sr. No.	Course Type	Course Code	Course Name	L	T	P	C	Continuous Assessment	End Semester / Internal Eval	Total	Duration of End Semester
1	PEC	26MC60PR1491	Internship-II	0	0	34	18	325	325	650	-

Bridge Program

Sr. No.	Course Type	Course Code	Course Name	L	T	P	C	Continuous Assessment	End Semester / Internal Eval	Total	Duration of End Semester
1		26MC60TH1199	Discrete Structures and Digital Logic	2	1	0	0	-	-	-	-

Credits Distribution Semester-wise:

SEM-I	SEM-II	SEM-III	SEM-IV	Total Credits
20	21	21	18	80

Qualification Type and Credit Requirements under NEP Guidelines		
Levels	**Qualification title**	**Credit requirements**
Level 8	**Post-Graduate Diploma** for those who exit after the successful completion of the first year or two semesters of the two-year Master's degree programme). (Programme duration: One year or two semesters) **[POST-GRADUATE DIPLOMA IN COMPUTER APPLICATIONS]**	41
Level 9	**Master's Degree** (Programme duration: Two years or four semesters after obtaining a Master's degree). **[MASTER OF COMPUTER APPLICATIONS (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)]**	80

SYLLABUS OF SEMESTER - I, MCA (MASTER OF COMPUTER APPLICATIONS) (Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1175 **Course: Data Structures and Algorithm-I**
L: 3 Hrs, P:2 Hr, Per Week **Total Credits: 4**

Course Outcomes :

On successful completion of the course, students will be able to:

1. Apply core OOP concepts to build modular, reusable programs.
2. Design class hierarchies using inheritance, virtual functions, and abstract classes.
3. Develop efficient algorithms using arrays, strings, and recursion with complexity analysis.
4. Implement data structures like linked lists, stacks, and queues for problem-solving.
5. Perform file handling and I/O operations using streams.

Syllabus:

Unit I:
OOP Fundamentals & Class Design : Features of OOP: Encapsulation , Inheritance , Polymorphism , Late Binding , Classes and Objects , Methods and Access Modifiers , Constructors , Garbage Collection.

Unit II:
Inheritance: Deriving a class from another class, Different types of Inheritance, Access control of members under derivation, Different ways of class derivation, Virtual Base Classes and abstract Classes, Virtual Functions.

Unit III:
Algorithmic Foundations & Array Techniques: Basics of Algorithms: characteristics, design principles, Flowcharts and Pseudocode, Time & Space Complexity
Arrays & Strings: 1D and 2D Arrays: operations and applications, String Manipulation techniques , Problem-solving approaches: Sliding Window, Prefix Sum
Searching & Sorting : Linear Search , Binary Search , Sorting Algorithms: Bubble, Selection, Insertion Merge Sort, Quick Sort , Complexity analysis of sorting.

Unit IV:
Data Structures Linked Lists, Stacks and Queues:
Linked Lists: Singly, Doubly, Circular Linked Lists, Operations: insertion, Deletion, Traversal Reversing a Linked List
Stacks: Definition and example, primitive operations on Stacks, Arithmetic expressions (Infix, Postfix and Prefix), Evaluating postfix expression, converting an expression from infix to postfix. Applications of stacks: Tower of Hanoi Problem, **Recursion :** Recursion fundamentals, Factorial and Fibonacci series. **Queues:** Definition and examples of queues, primitive operations, Types of Queues.

Unit V:
Streams and File Handling:
Streams: Stream Classes, Unformatted I/O Operations, Formatted console I/O Operations, Managing output with manipulators.
File Handling: Classes for File stream operations, Opening and closing File, Detecting End of File, File opening modes, File Pointers and their Manipulations, Sequential and Random input -output operations on file.

Text Books:

1. Data Structures and Program Design: Robert Kruse, PHI.
2. Classical Data Structure: Samanta, PHI.
3. ALGORITHMICS: Theory and Practice: Gilles Brassard and Paul Brately, Prentice Hall India Ltd.
4. Introduction to Algorithms: Thomas H. Cormen et.al, Prentice Hall of India.
5. Object Oriented Programming Using C++: E. Balaguruswamy.

Reference Books:

1. Schaum's Outlines Data structure: Seymour Lipschutz, Tata McGraw Hill 2nd Edition.
2. Data Structures and Algorithms: G A V Pai, Tata McGraw Hill.
3. The C++ Programming Language: Stroustrup B., Addison Wesley.
4. The Complete Reference: Herbert Schildt, 4th Edition, Tata McGraw Hill

Lab Syllabus :

Minimum 8 practical's based on theory topics using any object oriented tool (eg. C++, Java, etc.)

SYLLABUS OF SEMESTER - I, MCA (MASTER OF COMPUTER\ APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1176 **Course: Database Management Systems**

L: 3 Hrs, P: 2 Hrs, Per Week **Total Credits: 4**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Identify core DBMS concepts and data models for real-world representation.
2. Apply SQL and PL/SQL for effective data manipulation.
3. Analyze normalization and design efficient schemas with file organization, indexing and hashing.
4. Implement query processing, optimization, concurrency, and recovery.
5. Develop MongoDB-based NoSQL solutions with CRUD and aggregation.

Syllabus:

Unit - I :

Introduction to Database Management Systems:

Introduction, Conventional File Processing System, Components of DBMS, Advantages and Disadvantages, Three-level Architecture proposal for DBMS, Abstraction and Data Integration, Data Independence.

Data Models: Introduction, Types of Data Models, Entity-Relationship Model: E-R diagram, Reduction to relational schemas, Generalization, Specialization & Aggregation. The Relational Model: Keys, Relationship, Integrity rules, Relational Algebra.

Unit - II:

SQL: Overview of SQL, DDL, integrity constraints, DML, set operations, null values, aggregate functions, sub-queries. Intermediate SQL: Joins, Views.

Advanced SQL: Introduction to PL-SQL, Cursors, Triggers

Unit - III :

Relational Database Design: Functional Dependency, Normalization.

File Organization, Indexing and Hashing: Introduction, Ordered indices, B-Tree and B+-Tree file organization, Static & Dynamic hashing.

Unit - IV :
Query Processing and Optimization:

Query Processing: Overview, Selection Operation, Join Operation.

Query Optimization: Overview, Transformation of Relational Expressions, Cost-Based Optimization, Heuristic Optimization.

Concurrency Control and Database Recovery: Concept of Transaction, Serializability, locking protocols. Deadlock Detection and Recovery.

Unit - V :
NoSQL Databases: Introduction to NoSQL, Difference between SQL and NoSQL, Types of NoSQL Databases.

MongoDB: Introduction to MongoDB, JSON Documents & Collections, CRUD Operations in MongoDB, Indexing in MongoDB, Aggregation Framework, Advantages of MongoDB

Text Books:

1. Database Systems Concepts: *Silberschatz, Korth, Sudarshan, McGraw-Hill*.
2. An Introduction to Database Systems: *Bipin C. Desai, Galgotia.*
3. SQL & PL/SQL using Oracle: *Ivan Bayross, BPB Publications.*
4. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence: Pramod J. Sadalage, Martin Fowler, *Addison-Wesley Professional*
5. MongoDB: The Definitive Guide: Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, *O'Reilly Media*

Reference Books:

1. Fundamental of Database Systems: *Elmasri, Navathe, Somayajulu, Gupta Pearson Publications*
2. Database Management System: *Raghu Ramkrishan, Johannes, McGraw Hill*
3. An Introduction to Database Systems: *C.J.Date, Narosa*
4. Seven Databases in Seven Weeks: Eric Redmond, Jim R. Wilson, *Pragmatic Bookshelf*
5. Practical MongoDB: Architecting, Developing, and Administering MongoDB: Navin Sabharwal, Shakuntala Gupta Edward, *Apress*

Lab Syllabus :

Minimum 8 practicals based on theory topics.

SYLLABUS OF SEMESTER - I, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1177 **Course: Computer Networks**

L: 3 Hrs, P: 2 Hrs, Per Week **Total Credits: 4**

Course Outcomes:

On the successful completion of the subject, students will be able to:

1. Analyze different networking models, transmission media, and networking devices.
2. Apply data link and network layer protocols, routing, and error control techniques.
3. Analyze transport and application layer protocols in network communication.
4. Configure and verify VLANs, IPv4/IPv6 addressing, and static routing.
5. Design and evaluate network services such as NAT, DHCP, DNS, NTP, and SNMP

Syllabus:

Unit-I

Computer Network Basics: Introduction to Networks, LAN, MAN, WAN, PAN, Internet, Intranet, Internetwork, Protocol Hierarchy, Design Issues for the Layers, OSI Model, TCP/IP Model. **Network Devices:** Hub, Switch, Router, and Access Point.
Physical Layer: Transmission of Digital Media, Transmission Media, Multiplexing.

Unit-II

Data Link Layer: Design Issues in Data Link Layer, Error Detection & Correction codes: Hamming Code and CRC. Elementary data link protocols, Sliding window protocol, Multiple Access control: Channel Allocation problem. Multiple Access Protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD.
Network Layer: Network Layer Design Issues, Switching Techniques: Circuit and Packet Switching. Routing Algorithms: Distance Vector routing, Link State routing. Congestion Control Algorithms: Congestion prevention policies, Load shading. Network layer Protocols: IP protocol, IPV6.

Unit-III

Transport Layer:
The transport service, Elements of transport protocols: Connection establishment and release, flow control and buffering, Multiplexing. The Internet Transport Protocol: TCP & UDP.
Application Layer: Client Server Model, DNS, FTP, SMTP, HTTP, WWW, Multimedia.

Unit-IV

NETWORK ACCESS: Configure and verify VLANs (normal range) spanning multiple switches, Configure and verify Layer 2 discovery protocols (Cisco Discovery Protocol and LLDP).
IP CONNECTIVITY: Interpret the components of routing table, Determine how a router makes a forwarding decision by default, Configure and verify IPv4 and IPv6 static routing.

Unit-V

IP SERVICES: Configure and verify inside source NAT using static and pools, Configure and verify NTP operating in a client and server mode, DHCP and DNS within the network, SNMP in network operations, Syslog features including facilities and levels, Configure and verify DHCP client and relay.

Text Books

1. "Computer Networks", by Tanenbaum A. S., Pearson Education, 2008, ISBN-978-81-7758-165-2, 4th Edition
2. "Computer Networking- A Top-Down Approach", by James F. Kurose and Keith W Ross, Person Education, ISBN- 978-81-317-9054-0, 7th Edition.

Reference Books

1. "Data Communications and Networking", by Forouzan B. A, Tata McGraw-Hill Publications, 2006, ISBN-0-07-063414-9, 4th edition.
2. "Communication Networks- Fundamental Concepts and Key Architectures", by LeonGarcia-Wadjaja, Tata McGraw-Hill Publications, ISBN-978-0072463521.

Minimum 6 to 8 Practical's based on theory topics.

SYLLABUS OF SEMESTER - I, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1178 **Course: Software Engineering**

L: 3 Hrs, P:2 Hrs, Per Week **Total Credits: 4**

Course Outcomes :

On the successful completion of the subject, students will be able to:

1. Learning the fundamental concepts, principles, and methodologies of software engineering.
2. Analyze and model software requirements effectively.
3. Apply design principles and choose appropriate software development life cycle (SDLC) models.
4. Utilize various testing techniques to ensure software quality.
5. Implement software testing strategies and tools in real-world scenarios.

Syllabus:

Unit - I :

Introduction to Software Engineering

The evolving role of software, changing nature of software, software myths. A Generic view of process: Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI). Process models: The waterfall model, Spiral model and Agile methodology.

Unit - II :

Software Requirements: Functional and non-functional requirements, user requirements, system requirements, interface specification, the software requirements document (SRS)**. Requirements engineering process:** Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management,Use Case Diagrams and User Stories

Unit - III :

Software Design and Development

Design Principles: Cohesion, Coupling, and Modularity, Architectural Design: MVC, Client-Server, and Microservices Architecture, User Interface Design and Prototyping, Coding Standards and Guidelines, Software Configuration Management

Unit - IV :

Software Testing Fundamentals

Introduction to Software Testing: Objectives, Principles, and Importance, Types of Testing: Manual and Automated Testing, Levels of Testing: Unit Testing, Integration Testing, System

Testing, and Acceptance Testing, Black Box and White Box Testing Techniques, Testing Tools Overview: Selenium, JUnit, TestNG

Unit - V :

Risk Management & Quality Assurance

Risk management: Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM. Quality Management: Quality concepts, Software quality assurance (SQA), software reviews, formal technical reviews, statistical software quality assurance, software reliability, the ISO 9000 quality standards

Textbooks:

1. Ian Sommerville, "Software Engineering," 10th Edition, Pearson Education, 2015.
2. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing: Principles and Practices," Pearson Education, 2006.

Reference Books:

1. Roger S. Pressman, "Software Engineering: A Practitioner's Approach," 8th Edition, McGraw Hill, 2014.
2. Naresh Chauhan, "Software Testing: Principles and Practices," Oxford University Press, 2010.
3. Capers Jones, "Software Quality: Analysis and Guidelines for Success," International Thomson Computer Press, 1997.

Lab Syllabus :

Minimum 8 practical’s based on theory comprising UML topics.

SYLLABUS OF SEMESTER - I, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60PR1179 **Course: Operating Systems Lab**

L: 0 Hrs, P:4 Hrs, Per Week **Total Credits: 2**

Course Outcomes :

On the successful completion of the subject, students will be able to:

1. Navigate the Red Hat Enterprise Linux ecosystem and execute essential shell commands to manipulate the user environment and command-line interface.
2. Implement file system hierarchies and security protocols by managing permissions, user accounts, and group policies to ensure data integrity.
3. Analyze and control system operations by monitoring systemd services and configuring secure remote access through SSH and web consoles.
4. Administer system configurations by managing network interfaces and deploying software packages using the DNF package manager.

Syllabus:

1. Introduce Linux and the Red Hat Enterprise Linux ecosystem.
2. Run commands and view shell environments.
3. Manage, organize, and secure files.
4. Manage users, groups, and user security policies.
5. Control and monitor systemd services.
6. Configure remote access by using the web console and SSH.
7. Configure network interfaces and settings.
8. Manage software by using DNF.

SYLLABUS OF SEMESTER - I, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60PR1180 **Course: Software Lab-I**

L: 00 Hrs, P: 02 Hrs, Per Week **Total Credits: 01**

Course Outcomes:

On successful completion of the course, students will be able:
1. To create the basic webpage by using HTML tags.
2. To implement design aesthetics using CSS.
3. To implement interactivity by using Javascript.
4. To implement a dynamic website using PHP.

Syllabus:

Minimum 20 Practical's based on following topics but not limited to:

1. **HTML Basics :** Knowing HTML Basics, Elements, Attributes, Advanced Tags, HTML Forms, Form elements, Frames, XHTML.
2. **HTML5 :** Canvas, Audio and Video elements, Local Storage, Graphics, Geolocation.
3. **CSS Styling** : Advantages of CSS, Types of including styles, Selectors, Multicolumn Layouts, Colors and Opacity, Transformations, Viewport, Responsive websites using Media Queries, using popular libraries.
4. **Javascript :** History of Javascript, Variables, Literals, Operators, Functions, Objects, DOM Events, Validating User Input with Javascript, Using different libraries like JQuery, AngularJS etc.
5. **PHP** : Installing WAMP and creating basic dynamic web pages, accessing form variables, read-write from files, using sessions & cookies, database operations using MySQL with PHP.

Text Books:

1. Beginning HTML, XHTML, CSS, and JavaScript – *Jon Duckett (Wrox)*
2. PHP, MySQL, Javascript & HTML5 All-in-one for Dummies - *Steven Suehring, Janet Valade* (*Wiley*)

Reference Books:

1. HTML5, JavaScript, and jQuery 24-Hour Trainer - *Dane Cameron (Wrox)*
2. Programming PHP – *Kevin Tatroe, Peter MacIntyre (O'Reilly)*

SYLLABUS OF SEMESTER - I, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

School of Humanities and Sciences
Department of Humanities
Syllabus for Semester I (MCA)

Course Code: 26HS02PR1175 **Course: Communication Skills**

L: 0 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 1**

Course Outcomes:

On successful completion of the course, the student will able to do the following:

1. Apply effective listening and speaking skills in professional and everyday conversations.
2. Apply various techniques and tools for effective correspondence.
3. Demonstrate the techniques of effective Presentation Skills.
4. Analyse and apply the effective strategies for Group Discussions.
5. Analyse and apply the effective strategies for Personal Interviews.

Syllabus:

List of Practical (2 hours each for each batch)

1. Speaking Skills
2. Listening Skills
3. Correspondence for Employment
4. Formal Presentations: Orientation
5. Formal Presentations: Practice Session
6. Group Discussion- Orientation
7. Group Discussion- Practice Session
8. Personal Interview: Orientation
9. Personal Interviews: Practice Session

Text Books:

1. Sanjay Kumar, Pushp Lata, “Communication Skills”, Second Edition, Oxford University Press, 2019
2. Barun K. Mitra, “Personality Development and Soft Skills”, Oxford Press, 2016
3. Dr. K. Alex, “Soft Skills: Know Yourself & Know the World”, S Chand. 2009

SYLLABUS OF SEMESTER - II, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1275 **Course: Data Structures and Algorithms-II**

L: 3 Hrs, P: 2 Hrs, Per Week **Total Credits: 4**

Course Outcomes:

On successful completion of the course, the student will able to do the following:

1. Explain the concepts of advanced data structures such as trees, heaps, graphs, and hashing, along with object-oriented programming and multithreading principles.
2. Implement stacks, queues, trees, graphs, and hashing techniques to solve structured computational problems using appropriate programming tools.
3. Analyze the efficiency of algorithms using asymptotic notations and evaluate the performance of divide-and-conquer techniques such as sorting and searching algorithms.
4. Design optimized solutions using greedy algorithms and dynamic programming techniques for solving real-world optimization problems such as shortest paths and scheduling.
5. Evaluate and select suitable data structures and algorithmic strategies to solve complex computational and AI-related problems efficiently.

Syllabus:

Unit I: Basics of Java Programming
Introduction to class and Methods, Access control, instantiating a class, and constructors. Inheritance, run-time polymorphism, Abstract classes and methods, interfaces.

Multithreading: Java Thread models, creating threads using the Runnable interface and extending Thread, thread priorities, Thread Synchronization, Inter-thread communications.

Unit II: Advanced Data Structures -Trees and Binary Trees
Definition and Representation of Trees, Binary Tree Terminology, Representation and Traversal, Threaded Binary Trees and their Traversal, Trees and their Applications; Tree Searching: Insertion and Deletion of a node from a Binary Search Tree

Unit III: Advanced Data Structures (DS)-Graphs and Hashing:
Definition, Representation, Transitive closure, Linked Representation, Graph Traversal and Spanning Forests, Topological sorting of nodes, Undirected Graphs and their Traversals, Applications of Graphs & Heaps.
Hashing: Hash Table structure, Hash Functions, Different Hashing techniques, Collision handling mechanisms.

Unit IV: Algorithm Analysis & Divide and Conquer Technique
The Efficiency of Algorithms, Average and Worst-Case Analysis, Elementary Operations, Asymptotic Notations, Analysis of Algorithms. Binary Searching, Sorting by Merging, Quicksort, Selection and the Median, Arithmetic with Large Integers, Matrix Multiplication.

Unit V: Greedy Technique and Dynamic Programming Technique
Greedy Technique : Minimum Spanning Trees (Prim's, Kruskal's) , Shortest Path (Dijkstra's Algorithm) , Scheduling Problems: Job Scheduling with Deadlines, Knapsack Problem.

Dynamic Programming 0/1 Knapsack Problem, Matrix Chain Multiplication, Shortest Paths, **Introduction to complexity theory:** The Classes P and NP, NP-Complete Problems.

Text Books:

1. JAVA The Complete Reference: Herbert Schildt: Seventh Edition, TMG Hill.
2. Data Structures and Program Design: Robert Kruse, PHI.
3. Classical Data Structure: Samanta, PHI.
4. ALGORITHMICS: Theory and Practice: Gilles Brassard and Paul Brately, Prentice Hall India Ltd.
5. Introduction to Algorithms: Thomas H. Cormen et.al, Prentice Hall of India.

Reference Books:

1. Java Programming: A Practical Approach: C Xavier; Tata McGraw- Hill Education Private Ltd., 2011
2. Core JAVA Volume-II Advanced Features: Cay S. Horstmann and Gary Cornell; Eighth Edition; Prentice Hall, Sun Microsystems Press, 2008.
3. Schaums Outlines Data structure: Seymour Lipschutz, Tata McGraw Hill 2nd Edition.
4. Data Structures and Algorithms: G A V Pai, Tata McGraw Hill.
5. Computer Algorithms–Introduction to Design and Analysis: Sara Baase and Alien Van Gelder – Addison –Wesley Publishing Company.
6. Minimum 8 practical's based on theory topics using any object oriented tool (eg. C++, Java, etc.)

Lab Syllabus :

Minimum 8 practicals based on theoretical concepts.

SYLLABUS OF SEMESTER - II, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1276 **Course: Cloud Computing**

L: 2 Hrs, P: 2 Hrs, Per Week **Total Credits: 3**

Course Outcomes:

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

1. Exhibit an understanding of virtualization technologies.
2. Analyse architecture, services, and challenges in Cloud computing
3. Exhibit the knowledge of Compute services of the AWS platform and their usage
4. Exhibit the knowledge of Network services of the AWS platform and their usage
5. Exhibit the knowledge of Storage services of the AWS platform and their usage

Syllabus:

Unit - I :

Introduction: Traditional server concept: pros and cons. Need of Virtualized Technology, Benefits of Virtualization. Hypervisors, Types of Hypervisors, Types of virtualizations: Various forms of virtualization: Desktop, Application, Server, Hardware, Storage, Memory and I/O virtualization. Virtualization Vs Containerization, Concept of Containers, Container Orchestration.

Virtualization Technologies. Accomplishing Virtualization. Migration: Migration consideration, Things to do before migration of servers- Discovery, Assessment and Migration.

Unit - II :

Cloud Computing Fundamentals: Cloud deployment models, Cloud service models. Benefits and challenges of cloud computing. Regions, Availability zones, Edge locations. Fundamentals of pricing: Total cost of ownership (TCO) and monthly calculator.

Unit - III :

Compute Services in AWS: Elastic Compute Cloud (EC2) in AWS, Virtual Machine creation in Windows and Linux platforms, Remote Desktop Protocol (RDP), Secure Shell (SSH) protocol, Security Groups, Elastic Beanstalk, AWS Lambda.

Unit - IV :

Concepts of Networking: CIDR Blocks, Subnet Mask, Designing a network. VPC, Subnets, Internet Gateway, Route Table, NAT Gateway, NAT instance. Load balancer, Autoscaling.

Unit - V :

Amazon Web services (AWS): AWS core services: Storage: Simple Storage Service (S3), Elastic Block Store (EBS), Elastic File Store (EFS), Content Delivery Network (CDN), Cloudfront, Snowball, Snowmobile, Route53.

Text Books:

1. Distributed and Cloud Computing : Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, 1st Edition Elsevier
2. Cloud Computing Basics: A Non-Technical Introduction, Anders Lisdorf, Apress Publication.
3. Cloud Computing Bible : Barrie sosinsky, Wiley- India Edition
4. Cloud Computing : A Practical approach for learning and Implementation, A. Srinivasan, J. Suresh, 1stEdition, Pearson Publication

Reference Books:

1. The Complete Cornerstone Guide to Virtualization Best Practices: Ivanka Menken, Paperback, 2nd Edition, Emereo Pty Ltd.
2. Cloud Computing Explained: Implementation Handbook for Enterprise, 2013 Edition, Recursive Press Publication.
3. Enterprise Cloud Computing: Technology, Architecture, Applications, Gautam Shroff, 1st Edition, Cambridge University Press
4. Cloud Computing: Dr. Kumar Saurabh, 2nd Edition, Wiley- India Edition

Lab Syllabus :

Minimum 8 practical's based on theory topics.

SYLLABUS OF SEMESTER - II, MCA (MASTER OF COMPUTER APPLICATIONS)

(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1277 **Course: Artificial Intelligence**

L: 3 Hrs, P: 2 Hrs, Per Week **Total Credits: 4**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Learning the AI fundamentals, intelligent agents, and uninformed search techniques.
2. Apply heuristic search and constraint satisfaction techniques to solve problems.
3. Analyze adversarial search and perform logical reasoning using propositional and first-order logic.
4. Apply learning methods and probabilistic reasoning for decision-making under uncertainty.
5. Understand AI applications including neural networks, deep learning, and robotics.

Syllabus:

Unit - I :

Introduction to Artificial Intelligence: Definition and Concepts, History, Overview, Intelligent Agents, Performance Measure, Rationality, Structure of Agents, Problem-solving agents, Problem Formulation, Uninformed Search Strategies.

Unit - II :

Search and Exploration: A* search, Memory bounded heuristic search, Heuristic functions, inventing admissible heuristic functions, Local Search algorithms, Hill-climbing, Simulated Annealing, Genetic Algorithms, Online search.

Constraint Satisfaction Problems: Backtracking Search, variable and value ordering, constraint propagation, intelligent backtracking, local search for CSPs.

Unit - III :

Adversarial Search: Games, The minimax algorithm, Alpha- Beta pruning.

Knowledge and Reasoning: Knowledge Based Agents, Logic, Propositional Logic, Inference, Equivalence, Validity and satisfiability, Resolution, Forward and Backward Chaining, Local search algorithms.

First Order Logic: Syntax and Semantics of FOL, Inference in FOL, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

Unit - IV :

Learning and Uncertainty: Rote Learning, learning by taking advice, learning in problem solving, learning from examples: Induction, Explanation based learning, Discovery, Analogy. Basic Probability Notations, Axioms of Probability, Baye's Rule and its use.

Unit - V :

Applications of Artificial Intelligence: Introduction to Neural networks-supervised, unsupervised learning algorithms, Introduction to Deep Learning, Introduction to Robotics, Case studies.

Text Books:

1. Artificial Intelligence: A Modern Approach: Stuart Russel and Peter Norvig, Prentice Hall
2. Artificial Intelligence: E. Rich and Knight, Tata McGraw Hill.

Reference Books :

1. Artificial Intelligence: E. Charniack and D. Mcdermott, Addison Wesley.
2. Introduction to Knowledge Systems: Mark Stefik, Morgan Kaufmann.
3. https://www.coursera.org/learn/gcp-big-data-ml-fundamentals
4. https://www.coursera.org/learn/natural-language-processing

Lab Syllabus :

Minimum 8 practical's implemented using Tensor flow/Torch Tools/Python

SYLLABUS OF SEMESTER - II, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1278 **Course: Data Exploration & Analytics**

L: 2 Hrs, P: 2 Hrs, Per Week **Total Credits: 3**

Course Outcomes:

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

1. Explore fundamental concepts of data analytics, data types, and the analytics lifecycle.
2. Apply data pre-processing techniques including cleaning, transformation, and integration of datasets.
3. Perform exploratory data analysis to summarize data and identify patterns, trends, and relationships.
4. Develop and interpret data visualizations using appropriate tools and techniques.
5. Analyse results and derive meaningful insights to support data-driven decision-making.

Syllabus:

UNIT-I
Introduction to Data Analytics & Tools: Data Analytics vs Data Science, Types of Analytics: Descriptive, Diagnostic, Predictive, Data Analytics lifecycle, Types of data (structured, unstructured, categorical, numerical), Introduction to tools: Excel / Python (Pandas-overview)

UNIT-II
Data Collection and Preprocessing: Types and sources of data: Structured, Unstructured, Semi-structured, Data formats: CSV, JSON, XML, SQL, APIs, handling missing data, duplicate values, and outliers Data transformation: encoding, normalization, scaling, Data wrangling and cleaning, Handling missing data and outliers, Feature engineering and normalization.

UNIT-III
Exploratory Data Analysis (EDA): Concept and importance of EDA, Summary statistics (mean, median, variance, correlation), Univariate, bivariate, multivariate analysis, Pattern identification and hypothesis generation, Outlier detection and feature understanding.

UNIT-IV
Data Visualization Techniques: Principles of data visualization, Charts: bar, pie, histogram, box plot, scatter plot, Correlation heatmaps, Dashboard concepts using Tableau or Python visualization. Storytelling with data.

UNIT-V
Basic Analytics & Interpretation: Descriptive analytics techniques, Introduction to inferential statistics, Correlation vs causation, Trend analysis and pattern recognition.

Text Books:

1. *Data Science for Business* by Foster Provost and Tom Fawcett, published by O'Reilly Media, First Edition, 2013.
2. *Python for Data Analysis* by Wes McKinney, published by O'Reilly Media, Second Edition, 2017 (Third Edition, 2022 may also be referred).
3. *Practical Statistics for Data Scientists* by Peter Bruce, Andrew Bruce, and Peter Gedeck, published by O'Reilly Media, Second Edition, 2020.

Reference Books:

1. *Data Analytics by Anil Maheshwari, published by McGraw Hill Education, First Edition, 2017.*
2. *Business Analytics: The Science of Data-Driven Decision Making by U. Dinesh Kumar, published by Wiley India, First Edition, 2017.*

Lab Syllabus :

Minimum 10 practicals based on theory topics:

1. Basic Data Handling and Type Identification
2. Missing Value Treatment Techniques
3. Data Cleaning: Duplicates and Noise Removal
4. Data Transformation and Normalization
5. Descriptive Statistical Analysis
6. Univariate Data Analysis
7. Bivariate and Multivariate Analysis
8. Data Visualization Techniques
9. Dashboard Development and Reporting
10. End-to-End Data Analysis Case Study

SYLLABUS OF SEMESTER - II, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TH1279-1 **Course: Cyber Laws & Ethics**
L: 3 Hrs, T: 3 Hr, P: 0 Hr, Per Week **Total Credits: 3**

Course Outcomes:

On successful completion, of course student will able to learn:

1. To analyze the role of ethics in IT organization.
2. To analyze ethical and legal issues related to workforce practices such as contingent workers, H-1B visa workers, and outsourcing in IT organizations.
3. To interpret various intellectual property rights,
4. To identify privacy and protection issues in Information Technology field.
5. To describe the ways of precaution and prevention of Cyber Crime as well as Human Rights.

Syllabus:

UNIT I
Ethics in business world & IT professional malpractices, Introduction to firewalls, IDS System, Distortion and fabrication of information

UNIT II
Ethics of IT Organization: Contingent Workers H- IB Workers, Whistle- blowing, Protection for Whistle- Blowers, Handling Whistle- blowing situation, Digital divide.

UNIT III
Intellectual Property: Copyrights, Patents, Trade Secret Laws, Key Intellectual property issues, Plagiarism.

UNIT IV
Privacy: The right of Privacy, Protection, Key Privacy and K- Anonymity issues, Identity Theft, Consumer Profiling.

UNIT V
Cyber laws and rights in today's digital age, Emergence of Cyberspace, Cyber Jurisprudence, Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber terrorism, cyber tort, Cyber Defamation & hate speech, Cybersquatting, The Indian information technology act 2000 /2008 IT Act.

Text Books:

1. George Reynolds, "Ethics in information Technology",5th edition, Cengage Learning
2. Hon C Graff, Cryptography and E-Commerce - A Wiley Tech Brief, Wiley Computer Publisher, 2001.

Reference Books:

1. Michael Cross, Norris L Johnson, Tony Piltzecker, Security, Shroff Publishers and Distributors Ltd.
2. Debora Johnson," Computer Ethics", 3/e Pearson Education.
3. Sara Baase, "A Gift of Fire: Social, Legal and Ethical Issues, for Computing and the Internet," PHI Public at ions.
4. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).
5. Dr Pramod Kr. Singh, "Laws on Cyber Crimes [Along with IT Act and Relevant Rules]" Book Enclave Jaipur India.

SYLLABUS OF SEMESTER- II, MCA (MASTER OF COMPUTER APPLICATIONS)

(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TH1279-2 **Course: Organizational Behaviour**

L: 3 Hrs, P: 0 Hrs, Per Week **Total Credits: 3**

Course Outcomes:

1. Upon Successful completion of this course, the student will be able to – Infer how OB impacts individual and group behaviour in organizations and examine the various factors that shape individual behaviour
2. Detect the influence of personality and perception on the workplace behaviour of an individual.
3. Ascertain workplace attitudes, investigate how motivation theories apply to individual and group behaviour in organization, and expand upon the role of values in organizational contexts.
4. Understand the process of group formation and assess strategies for effective conflict resolution and management.
5. Apply strategies for creating, sustaining, and managing organizational culture and demonstrate strategies for implementing change in organizations

Syllabus:

Unit I:
Introduction to Organization Behaviour: Importance, Fundamental Concepts of OB, Developing an OB Model, Challenges and Opportunities, Foundations of Individual Behaviour

Unit II:
Personality and Perception: Personality – Meaning, Personality Frameworks, Personality and Situations**,** Perceptions – Meaning, Factors Influencing Perception, Perception Process, Perceptual Errors

Unit III:
Attitudes, Motivation, and Values: Attitude – Components of Attitudes, Workplace Attitudes: Organizational Commitment, Job Satisfaction Motivation – Definition, Early Theories of Motivation, Contemporary Theories of Motivation, Values – Sources and Types of Values (Values will be for self-study)

Unit IV:
Work Teams and Conflict Management: Concept of Group & Team, Stages of Group Formation, Group Properties, Creating Effective Teams, Turning individuals into team players, Conflict Management: Types and Loci of Conflict, The Conflict Process

Unit V:
Organization Culture and Organizational Change: Organizational Culture: Purpose of Culture, How Employees Learn Culture, Creating and Sustaining Culture, Influencing Culture Organizational Change: Forces for Change, Planned Change, Resistance to Change, Approaches to Change, Facilitating Change

Textbook:

1. Organizational Behaviour: Robbins, 18th Edition, Pearson Education Asia

References Books:

1. Organizational Behaviour: K. Aswathappa, Himalaya Publishing House
2. Organization Behaviour: Luthans 8th Tata McGraw Hill
3. ORGB: Nelson, Quick, Khandelwal, 2nd, Cengage Learning

SYLLABUS OF SEMESTER - II, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60PR1280 **Course: Software Lab-II**

L: 0 Hrs, P: 2 Hrs, Per Week **Total Credits: 1**

Course Outcomes:

On successful completion of the course, students will be able:

1. To implement basic webpage programming using ASP.NET.
2. To implement a dynamic website using MERN stack.

Syllabus:

Minimum 20 Practical's based on following technologies, but not limited to:

1. **ASP.Net :** Introduction to Asp.Net MVC, Creating controllers, invoking actions, Models, Razor views, HTML helper functions, MVC State management, Routing.
2. **MERN Stack :** Introduction to MERN, Getting started with Node.js, Node modules, Synchronous & Asynchronous programming, Callbacks, Using Express, Routing, EJS Template engine, React : JSX, React components, Properties, state management, Introduction to MongoDB, keyfeatures, databases, collections, MongoDB CRUD operations.

Text Books:

1. Getting MEAN with Mongo, Express, Angular, and Node - *Simon Holmes (Manning).*
2. Mean Web Development - *Amos Q. Haviv, PACKT Publishing.*
3. Asp.Net Web Developer's Guide – Mesbah Ahmed, Chris Garett (Syngress)

SYLLABUS OF SEMESTER - II, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 261D160TH1275-1 **Course: Open Elective**

L: 3 Hrs, P: 0 Hrs, Per Week **Total Credits: 3**

Course Outcomes:

1. Explain fundamental concepts of cloud computing, data analytics, and the cloud data lifecycle.
2. Apply cloud-based tools and techniques to manage, store, and access structured and unstructured data.
3. Analyze data transformation processes, pipelines, and optimization strategies for handling large datasets.
4. Evaluate data visualization techniques, dashboard designs, and storytelling approaches for decision-making.
5. Design and develop an end-to-end cloud data analytics solution, integrating data collection, processing, analysis, and visualization.

Syllabus:

Unit I: Introduction to Cloud Data Analytics

Introduction to cloud computing, Data analytics in cloud environments, Benefits of cloud computing in data analytics, Cloud data lifecycle: data acquisition, storage, processing, visualization, Roles and responsibilities of cloud data analysts, Overview of tools: BigQuery, Google Cloud Storage

Unit II: Data Management and Storage in the Cloud

Data structuring and organization in cloud systems, Data lakehouse architecture, Cloud storage tools: BigQuery, Google Cloud Storage, Dataproc, Data discovery: Analytics Hub, Dataplex, Data lineage and governance concepts, Querying datasets and performance optimization (partitioning)

Unit III: Data Transformation in the Cloud

Data journey: collection to activation, Role of data transformation in analytics , Data pipelines and workflow management, ETL vs ELT processes, Data mapping and transformation planning, Optimization strategies for cloud data processing

Unit IV: Data Visualization and Storytelling

Importance of data visualization in analytics, Visualization workflow: storytelling, planning, exploration, presentation, UI/UX principles in dashboard design, Cloud-native visualization

tools, Data modeling: dimensions and measures, Dashboard and report development, Version control (Git) and semantic modeling (LookML basics)

Unit V: Capstone Project and Professional Preparation

End-to-end cloud data lifecycle project, Problem definition and feasibility analysis, Data collection, processing, and storage, Dashboard development and insight presentation, Troubleshooting data workflow issues, Resume building and interview preparation for data analyst roles

References :

MOOC Course	**Google Platform, NPTEL**

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1375 **Course: Machine Learning**

L: 3 Hrs, P: 2 Hrs, Per Week **Total Credits: 4**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Solve the problems related to the fundamental concepts in machine learning.
2. Analyse the strengths and weaknesses of various machine learning approaches.
3. Apply machine learning algorithms to solve classification, regression and clustering problems.
4. Implement various machine learning models to efficiently solve real-world problems.

Syllabus:

Unit – I :

The concept learning task, General-to-specific ordering of hypotheses, Version spaces, Inductive bias, Decision Tree Learning, Over-fitting, Cross Validation, Experimental Evaluation of Learning Algorithms.

UNIT - II :

Instance-Based Learning: K-Nearest neighbour algorithm, Radial basis functions, Case- based learning. Computational Learning Theory: probably approximately correct (PAC) learning, Sample complexity, Computational complexity of training, Vapnik Chervonenkis dimension.

UNIT – III :

Artificial Neural Networks: Linear threshold units, Perceptron, Multilayer networks and backpropagation, recurrent networks.

UNIT - IV :

Probabilistic Machine Learning: Maximum Likelihood Estimation, MAP, Bayes Classifiers, Naive Bayes, Bayes optimal classifiers, Bayesian Networks, Inference in Bayesian Networks, Minimum description length principle.

UNIT – V :

Clustering and Unsupervised Learning: Unlabelled data: EM, Gaussian Mixture Models, K-means and Hierarchical Clustering., Hidden Markov Models, Support Vector Machines, Ensemble learning: boosting, bagging.

Text Books:

1. Tom Mitchell; Machine Learning- an Artificial Intelligence Approach, Volume-II; Morgan Kaufmann, 1986. 2. Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

Reference Books :

1. Soumen Chakrabarti; Mining the Web: Discovering Knowledge from Hypertext Data, MorganKaufmann, 2003.
2. A. K. Jain and R. C. Dubes; Algorithms for Clustering Data; Prentice Hall PTR, 1988.
3. Ethem Alpaydin, Introduction to Machine Learning, PHI.

Lab Syllabus :

Minimum 8 practical's implemented using Python/NumPy/Tensor flow/PyTorch Tools

1.

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1376 **Course : Business Analytics and Intelligence**
L: 3 Hrs, P: 2 Hr, Per Week **Total Credits : 4**

Course Outcomes :
At the end of the course, the students will be able to:

1. Understand concepts of business analytics, data warehousing, and business intelligence.
2. Analyze business data using statistical and analytical techniques.
3. Design and implement data warehouse and OLAP systems.
4. Apply predictive analytics and data mining techniques for decision making.
5. Evaluate and use appropriate analytics tools for solving real-world business problems.

Syllabus:

Unit I:

Introduction to Business Analytics & Intelligence : Business analytics overview, data vs information, role of analytics in business decision-making, types of analytics (descriptive, predictive, prescriptive), business intelligence, BI architecture, BI lifecycle, analytics challenges.

Unit II: Data Warehousing and OLAP

Data warehousing concepts, characteristics, data marts, metadata, ETL process, data warehouse architecture, OLAP vs OLTP, OLAP operations, multidimensional models, schemas (star, snowflake).

Unit III: Data Mining and Statistical Analysis

Data mining concepts, classification, clustering, association rules, regression, correlation, hypothesis testing, business applications.

Unit IV: Predictive Analytics & Visualization

Predictive analytics, forecasting, time series analysis, machine learning basics, data visualization, dashboards, reporting tools (Tableau/Power BI), storytelling.

Unit V: Business Intelligence Applications & Tools

Decision support systems, BI tools, big data analytics, text/web mining, real-time analytics, applications in finance, marketing, healthcare, supply chain, e-commerce.

Text Books:

1. Rick Sherman – *Business Intelligence Guidebook*
2. Arun K. Pujari – *Data Mining Techniques*
3. James R. Evans – *Business Analytics*

Reference Books:

1. Thomas H. Davenport – *Competing on Analytics*
2. Eric Siegel – *Predictive Analytics*
3. Foster Provost & Tom Fawcett – *Data Science for Business*
4. Larissa T. Moss – *Business Intelligence and Analytics*

Lab Syllabus :

Minimum 8 practical's implemented based on theory.

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1377 Course: Vulnerability Assessment and Penetration Testing

L: 3 Hrs, P: 2 Hrs, Per Week **Total Credits: 4**

Course Outcomes:

On completion of the course the student will be able to

1. Apply penetration testing concepts to networks and applications.
2. Identify vulnerabilities in target technology and exploit them.
3. Carry out privilege escalation activities in breached networks.
4. Implement social engineering and physical attacking methods for penetration testing.
5. Design custom hacking scripts

Syllabus:

Unit I: Setting up virtual lab, Configuring the Network for Your Virtual Machine, Setting Up Android Emulators, Target Virtual Machines, setting a Static IP Address, setting up external servers, Using Kali Linux, Programming

Unit II: Tools of the trade, Using Metasploit Framework, Types of Shells, Msfcli, creating standalone payloads, Information gathering, red team recon, Finding Vulnerabilities, Capturing Traffic

Unit III: Exploitation, Exploiting WebDAV default credentials, Exploiting Open phpMyAdmin, Exploiting Third-party Web Applications, Exploiting NFS shares, Password attacks, Client-side exploitation - Browser, PDF, Java etc.

Unit IV: Social engineering, Mass email attacks, Multipronged attacks, Compromising the network, Bypassing anti-virus applications, Post exploitation, Privilege escalation, Lateral movement, Pivoting, Persistence

Unit V: Web application testing, Using BurpSuite, SQL injection, XPath injection, LFI, RFI, CSRF, XSS, Wireless attacks, Physical attacks, Stack-based buffer overflowin linux and windows, known vulnerability in War-FTP, Locating & controlling EIP. Structured exception handler overwrites, finding attack string in memory, using a short jump, Fuzzing, finding bugs with code review, porting exploits, replacing shellcode, Writing Metasploit modules, Exploitation mitigation techniques.

Textbooks:

1. Penetration Testing: A Hands-On Introduction to Hacking by Georgia Weidman|2014 Edition. No Starch Press.
2. The Hacker Playbook 3: Practical Guide to Penetration Testing by Peter Kim

Lab Syllabus :

Minimum 8 practical's implemented based on theory.

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60PR1378 **Course : Digital Forensics**

L: 0 Hrs, P:2 Hr, Per Week **Total Credits : 1**

Course Outcomes:

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

1. Explain various cyber laws and types of cybercrimes and their impact on individuals and organizations.
2. Apply social media investigation techniques to identify and interpret digital evidence in cybercrime cases.
3. Use communication device investigation methods, including CDR analysis and VoIP tracking, in practical scenarios.
4. Apply mobile forensic techniques to extract, preserve, and analyze data from mobile devices.
5. Analyze financial fraud cases and cybercrime investigations (ATM frauds, online transactions, bank frauds) using legal procedures and case-based reasoning.

Syllabus:

Unit I: Introduction to Cyber Laws – In this module the students will get the basic understanding all the cyber laws that are currently in effect. Types of cybercrimes – In this module the students will learn the different types of cybercrimes along with analysis on different case studies.

Unit II: Social Media Investigation – This module will be a detailed case study analysis module which will focus on different social media crimes and the way they are investigated.

Unit III: Communication Device Based Investigation– In this module the students shall get in depth knowledge of introduction to the communication devices, knowledge on laws related to interception, knowledge on CDR, CDR formats, CDR analysis and investigations on VOIP communications using case studies.

Unit IV: Mobile Forensics – In this module the students will learn about the introduction to mobile forensics, types of memories on mobile phones, techniques of mobile forensics and the investigation process.

Unit V: Investigation on Financial Frauds and Cybercrime– In this module the students will learn about Introduction to investigation of financial frauds and cybercrime, steps to follow in case of financial frauds, Investigation on ATM withdrawal frauds, online transaction frauds, bank to bank transfer frauds and about the indicative notice under 91 CrPC issued to the banks.

Textbooks:

1. Combating Cyber Crimes ,National Center for Justice and the Rule of Law, NCJRL (USA)
2. National Cyber Crime Reference Handbook, NCSSS (with Govt. of India support) NCSSS / MeitY / Ministry of Defence,2014 (1st Ed.), 2016 (2nd Ed.)

Reference Books :

1. Electronic Crime Scene Investigation: A Guide for Law Enforcement U.S. Department of Justice, National Institute of Justice, https://www.ojp.gov/pdffiles1/nij/187736.pdf
2. National Cyber Crime Reference Handbook – III Edition, Indian Institute of Technology Tirupati (IIT Tirupati), Computer Centre,

Lab Syllabus :

Minimum 10 practical's implemented based on the above topics.

SYLLABUS OF SEMESTER -III, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1379-1 **Course: Enterprise Resource Planning**

L: 3 Hrs, P: 2 Hr, Per Week **Total Credits: 4**

Course Outcomes:

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

1. Define and explain the fundamental concepts, evolution, and architecture of Enterprise Resource Planning (ERP) systems
2. Apply ERP concepts to integrate various business functions such as finance, HR, and supply chain in organizational scenarios
3. Analyze different ERP modules and their interactions to evaluate their role in improving organizational efficiency and decision-making
4. Evaluate ERP implementation strategies, critical success factors, risks, and challenges in real-world case studies
5. Design and develop ERP-based solutions or frameworks for solving real-world business problems using modern ERP tools and technologies

Syllabus:

Unit I: Introduction to ERP

Introduction to Enterprise Resource Planning (ERP), evolution from MRP to MRP II to ERP, need and benefits of ERP systems, characteristics and advantages of ERP, ERP architecture including client-server and three-tier architecture, Business Process Reengineering (BPR), comparison of ERP with traditional systems

Unit II: ERP Modules and Functional Areas

Core ERP modules including Finance and Accounting, Human Resource Management, Manufacturing/Production, Sales and Distribution, Materials Management, Supply Chain Management, integration of Customer Relationship Management (CRM) and Supplier Relationship Management (SRM), data warehousing and data mining in ERP, inter-module integration and data flow

Unit III: ERP System Design and Architecture

ERP system design principles, ERP life cycle, System Development Life Cycle (SDLC) for ERP, customization versus standardization, ERP selection criteria, ERP architecture models, overview of ERP vendors such as SAP, Oracle, Microsoft, cloud ERP versus on-premise ERP

Unit IV: ERP Implementation Lifecycle

ERP implementation phases including pre-implementation, implementation and post-implementation, ERP project planning and management, change management and user training, success and failure factors in ERP implementation, risk management in ERP projects, case studies of ERP implementation

Unit V: ERP Extensions, Trends and Applications

ERP integration with e-commerce, Supply Chain Management (SCM), Customer Relationship Management (CRM), Business Intelligence (BI), ERP security and ethical issues, emerging trends including cloud ERP, mobile ERP, artificial intelligence in ERP, blockchain in ERP, industry applications and case studies in manufacturing, banking and healthcare

Text Books:

1. Concepts in Enterprise Resource Planning by Authors: Ellen Monk, Bret Wagner
2. Enterprise Resource Planning by Alexis Leon, McGraw-Hill

Reference Books:

1. ERP Demystified by Alexis Leon
2. Management Information Systems by James A. O'Brien, McGraw-Hill

Lab Syllabus :

Minimum 8 practical's based on ABAP and other similar ERP software

SYLLABUS OF SEMESTER -IV, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1477-2 **Course: DevOps Fundamentals**

L: 3 Hrs, P: 2 Hr, Per Week **Total Credits: 4**

Course Outcomes

1. Analyse the DevOps culture and transition from monolithic to microservices architectures.
2. Execute robust version control and Continuous Integration (CI) workflows for automated builds.
3. Design Continuous Delivery and Deployment (CD) pipelines to ensure rapid, reliable releases.
4. Orchestrate scalable, containerised infrastructure using "Infrastructure as Code" (IaC) principles.
5. Implement comprehensive monitoring, logging, and feedback loops to maintain system health.

Syllabus :

Unit 1: Foundations of DevOps & Culture

- The DevOps Evolution: History, the "Wall of Confusion," and the shift-left philosophy.
- Methodologies: Comparing Waterfall, Agile, and DevOps; The CAMS Model (Culture, Automation, Measurement, Sharing).
- Architecture Evolution: From Monoliths to Microservices; Introduction to 12-Factor Apps.
- Value Stream Mapping: Identifying bottlenecks in the delivery pipeline.

Unit 2: Source Code Management & Continuous Integration (CI)

- Advanced Git: Branching strategies (GitFlow, Trunk-based development), Rebasing, and Merge Conflict resolution.
- The Build Process: Automation of builds using tools like Maven, Gradle, or NPM.
- Continuous Integration: Setting up CI servers (Jenkins, GitHub Actions, or GitLab CI).
- Static Analysis: Integrating code quality gates (SonarQube) and automated unit testing.

Unit 3: Continuous Delivery & Deployment (CD)

- Artifact Management: Storing and versioning binaries using Nexus or JFrog Artifactory.
- Deployment Strategies: Blue-Green deployments, Canary releases, and Rolling updates.
- Automated Testing in CD: Integration testing, Smoke testing, and User Acceptance Testing (UAT) automation.
- Secret Management: Handling credentials securely using Vault or Environment variables.

Unit 4: Infrastructure as Code (IaC) & Containerization

Containerization with Docker: Creating Dockerfiles, managing images, and container networking, Orchestration with Kubernetes: Pods, Services, Deployments, and Scaling in a K8s cluster.

Provisioning with Terraform: Declarative infrastructure, providers, and state management.

Configuration Management: Using Ansible or Chef for automated server setup and consistency.

Unit 5: Observability, Feedback, & SRE

Continuous Monitoring: Setting up dashboards with Prometheus and Grafana., Log Aggregation: Centralized logging using the ELK Stack (Elasticsearch, Logstash, Kibana) or Splunk. Site Reliability Engineering (SRE): Understanding SLIs (Indicators), SLOs (Objectives), and Error Budgets. Incident Management: Automated alerting, root cause analysis (RCA), and blameless post-mortems.

Text Books :

1. Fundamentals of Devops and Software Delivery: A Hands-On Guide to Deploying and Managing Software in Production by Yevgeniy Brikman - O'Reilly**.**

Lab Syllabus :

Minimum 8 practical's implemented based on theory.

SYLLABUS OF SEMESTER -III, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1379-3 **Course: Generative AI and its Applications**

L: 3 Hrs, P: 2 Hr, Per Week **Total Credits: 4**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Define and illustrate the fundamental concepts and techniques in Natural Language Processing.
2. Describe and analyse the Neural language models and encoder-decoder architecture.
3. Analyse and solve the problems related to Attention Mechanism for sequence-to-sequence models.
4. Analyse and solve the problems related to Self-Attention Mechanism for sequence-to-sequence models.
5. Demonstrate the requirement of Positional encoding and Normalization in Transformer models to efficiently solve the NLP problems.

Syllabus:

Unit-I:

Course Introduction, Introduction to NLP (NLP Pipeline, Applications of NLP), Word Embeddings, Word2Vec, Types of Word2Vec, Continuous Bag of Words [CBOW], Skip-gram, Evaluation metrics.

Unit-II:

Neural Language Models, CNN, RNN, LSTM, GRU, Encoder Decoder Architecture, Problems in encoder decoder Architecture.

Unit-III:

Attention Mechanism in Encoder Decoder Architecture, Variants of Attention Mechanism, Introduction to Transformers.

Unit-IV:

Self-Attention, The Problem of average meaning, Query, Key and Value Vectors in self-attention, Scaled dot product Attention. Multi-Head Attention.

Unit-V:

Positional Embedding, Types of Positional Embeddings, Internal covariate shift, Batch Normalization, Layer Normalization, Transformer Encoder block, Transformer Decoder block.

Text Books:

1. Tanmoy Chakraborty, Introduction to Large Language Models, Wiley India, 1st Edition

Reference Books:

1. Dan Jurafsky and James H. Martin, Speech and Language Processing, 2nd edition, Pearson Press, 2008.
2. Jacob Eisenstein, Natural Language Processing, First edition,The MIT Press, 2019.

Lab Syllabus :

Minimum 8 practical's implemented based on theory.

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60PR1380 **Course: Software Lab-III**

L: 0 Hrs, P:2 Hrs, Per Week **Total Credits: 1**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Learn about the features and installation of Flutter
2. Learn about the basic programming constructs of Dart
3. To implement the Materials and Widgets for design in Flutter.
4. To connect with APIs and handling user input

Syllabus:

Minimum 8 practical's based on Flutter App development

1. Environment setup & Dart essentials
2. Stateless vs Stateful widgets
3. Layout widgets
4. Material & Cupertino components
5. State Management : setState & lifting state up
6. Navigation
7. Networking, storage & forms

Text Books :

1. Beginning App Development with Flutter: Create Cross-Platform Mobile Apps First Edition by Rap Payne, Apress.
2. Flutter in Action, First Edition by Eric Windmill – Manning.

1.

SYLLABUS OF SEMESTER - III, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60PR1381 **Course: Capstone Project Phase-I**

L: 0 Hrs, P:6 Hrs, Per Week **Total Credits: 3**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Analyze real-world problems by identifying requirements, constraints, and appropriate computational approaches for developing a software-based solution.

2. Design a comprehensive system architecture and project plan by evaluating alternative technologies, tools, and methodologies suitable for the proposed solution.

3. Develop and implement a complete software solution using appropriate programming languages, frameworks, and tools while adhering to coding standards and best practices.

4. Evaluate the performance, usability, and reliability of the developed system, and effectively communicate project outcomes through technical reports, documentation, and presentations.

Syllabus:

Project work to be carried out under the supervision of one internal guide.

1.

SYLLABUS OF SEMESTER -IV, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1475 **Course: Deep Learning**

L: 3 Hrs, P: 2 Hrs, Per Week **Total Credits: 4**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Train fully connected deep neural networks to real world problem.
2. Evaluate the performance of different deep learning models with respect to the optimization, bias variance trade-off, overfitting and underfitting etc.
3. Apply the convolution networks in context with real world problem solving.
4. Apply recurrent neural networks in context with real world problem solving.

Syllabus:

Unit - I :Basic of Deep Learning

History of Deep Learning, Thresholding Logic Perceptrons, Perceptron Learning Algorithm and Convergence, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed forward Neural Networks.

Unit - II : Training of feedforward Neural Network

Representation Power of Feed forward Neural Networks, Training of feed forward neural network, Gradient Descent, Activation Function and Initialization Methods: Sigmoid, Tanh, Relu, Xavier and He initialization.

Unit - III : Optimization and Regularization

Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Regularization: Bias and variance, Overfitting, Hyperparameters tuning, L1 and L2 regularizations, Data Augmentation and early stopping, Parameter sharing and tying.

Unit-IV: Convolution Neural Network (CNN)

Convolutional Neural Networks, 1D convolution network, 2D convolution network Visualizing Convolutional Neural Networks, Guided Backpropagation

Unit-V: Recurrent Neural Network (RNN)

Recurrent Neural Networks, Backpropagation through Time (BPTT), Vanishing and Exploding Gradients, Long Short Term Memory (LSTM) Cells, Gated Recurrent Units (GRUs)

Text Books:

1. Sandro Skansi, Introduction to Deep Learning ,Springer.
2. Charu C. Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2019.
3. Ian Goodfellow and Yoshua Bengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.
4. Dr. S Lovelyn Rose, Dr. L Ashok Kumar, Dr. D Karthika Renuka, Deep Learning using Python, Willey Publication.

Reference Books :

1. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. A. Ravindran, K. M. Ragsdell , and G. V. Reklaitis, Engineering Optimization: Methods and applications , John Wiley & Sons, Inc. , 2016.

Lab Syllabus :

Minimum 8 practical's based on theory topic and Nvidia platform.

SYLLABUS OF SEMESTER -IV, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60PR1476 **Course: Product Management**

L: 3 Hrs, P: 0 Hrs, Per Week **Total Credits: 3**

Course Outcomes:

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

1. Exhibit the role and responsibilities of a product and project manager in different organizations
2. Learn techniques for market research, customer discovery, competitive analysis, effective communication, team collaboration, and stakeholder engagement
3. Develop skills in product and project strategy formulation, including segmentation, targeting, and positioning, project planning, scheduling, budgeting, and resource management
4. Learn essential product and project management terminology, concepts, and methodologies
5. Apply product and project management tools and software for planning and tracking

Syllabus:

Unit I:
Introduction to Product Management

Fundamentals of Product Management, Product Lifecycle, Types of Products, Product Strategy

Unit II:
Introduction to Project Management
Basics of Project Management, Project Constraints, Project Management Methodologie
Waterfall model , Agile methodology , Scrum basics (roles, ceremonies, artefacts)

Tools & Software: Introduction to tools like Microsoft Project, Jira, Trello

Unit III:
Market Research, Competitor Analysis, Red Ocean & Blue Ocean, SWOT Analysis, Segment, Target, Position, Pricing Strategy

Unit IV:
User Persona & Experience, Interview your Users, Persona Builder, Wireframes

Unit V:

Case Study for Product and Project Management, Practical Case Study x 3, Mobile App, SaaS App, Consumer Goods & Services, Investors Deck, Product Deck, Project Tracker

Textbooks:

1. Inspired: How to Create Products Customers Love , by Marty Cagan
2. A Guide to the Project Management Body of Knowledge (PMBOK Guide)

SYLLABUS OF SEMESTER -IV, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1477-1 Course: Customer Relationship Management

L: 3 Hrs, P: 2 Hr, Per Week Total Credits: 4

Course Outcomes:

On successful completion of the course, students will be able to:

1. Understand the fundamentals of Salesforce and its role in CRM.
2. Gain practical skills in configuring and managing Salesforce environments.
3. Apply the basics of Salesforce development using Apex to customize the platform.
4. Develop modern web applications on the Salesforce platform using Lightning Web Components.
5. Integrate Salesforce with external systems and deploy applications in a production environment.

Syllabus:

Unit I :
Introduction to CRM and Salesforce : Definition and importance of CRM, Key CRM concepts, Benefits of CRM for businesses, Introduction to Salesforce, Salesforce's role in business processes, Salesforce Cloud offerings , Overview of Salesforce architecture, Multi-tenant cloud architecture, Salesforce Data Model (Objects, Records, Fields), Understanding Tabs, Apps, and Objects

Unit II :
Salesforce Administration Basics : Understanding Salesforce Setup menu, Creating and managing users, Profiles, Roles, and Permission Sets, Organizing security settings (Organization-Wide Defaults, Sharing Rules), Data Validation Rules, Creating and customizing Objects, Object Relationships, Creating and managing Fields, Workflow Rules, Process Builder, and Flow.

Unit III:
Introduction to Apex Programming : Apex basics (Syntax, Variables, Methods), Apex classes and triggers, Working with SOQL and SOSL (Salesforce Object Query Language, Handling exceptions in Apex, Apex Triggers, Writing Apex triggers to handle database events, Trigger context variables and best practices, Governor limits and optimization techniques.

Unit IV:
Advanced Salesforce Development – Lightning Web Components (LWC) : Overview of Lightning Web Components (LWC), LWC architecture and lifecycle, Creating and deploying LWC components, Handling events in LWC, Working with Apex from LWC, LWC Integration with Salesforce Data, Displaying Salesforce data in LWC, Handling record pages and lightning layouts, Best practices for LWC development.

UNIT V :
Salesforce Integration and Deployment, Salesforce Reports: Overview of integration in Salesforce, Integration tools: REST API, SOAP API, and Bulk API, Salesforce Connect, Introduction to Mulesoft for Salesforce integration, Introduction to Salesforce DX, Source-driven development and version control, Continuous Integration and Continuous Delivery (CI/CD) in Salesforce., Introduction to reports, types of reports, report builder, formatting reports, dashboard introduction, dashboard generation, charts in dashboards, limitations of Salesforce reports.

Text Books:

1. Jason Ouellette; Development with the Force.com Platform, Second Edn, Addison Wesley, 2011. 2. Mohith Shrivastava; Salesforce Lightning Application Development, 2018.
2. Mohith Shrivastava; Salesforce Lightning Application Development, 2018
3. Judith W .Kincaid , Customer Relationship Management Getting it Right, Pearson Education
4. Customer Centricity –Focus on right customer for strategic advantage, by Peter Fader, Wharton Digital Press

Reference Books:

1. Learning Salesforce Development with Apex – Paul Battisson
2. Salesforce for Beginners – Sharif Shaalan

SYLLABUS OF SEMESTER -IV, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1477-2 **Course: Augmented and Virtual Reality**

L: 3 Hrs, P: 2 Hrs, Per Week **Total Credits: 4**

Course Objectives :

The objective of this course is to introduce students to the specialized field of Virtual Reality (VR) development using the Unity engine. Following the Unity Certified User: VR Developer roadmap, the course covers XR (Extended Reality) terminology, VR-specific hardware setup, the XR Interaction Toolkit, locomotion systems, and performance optimization to create comfortable and immersive digital environments.

Course Outcomes:

On successful completion of the course, the student shall be able to:

1. Explain the fundamental principles of XR and differentiate between various VR hardware and tracking systems.
2. Configure Unity projects for VR development using XR Plugin Management and OpenXR.
3. Design and implement complex interactions using the XR Interaction Toolkit.
4. Develop user-friendly locomotion and navigation systems that prioritize user comfort.
5. Optimize and deploy VR applications for high-performance delivery on standalone and tethered devices.

Syllabus:

Unit I: Introduction to XR Concepts and Hardware

Definition of VR, AR, and MR – History and evolution of immersive technology – VR hardware landscapes (Tethered vs. Standalone) – Understanding Degrees of Freedom (3DoF vs. 6DoF) – Field of View (FOV) and Interpupillary Distance (IPD) – Sensor tracking types (Inside-out vs. Outside-in) – Human factors: VR sickness, latency, and comfort settings – The VR development lifecycle.

Unit II: VR Scene Setup and XR Plugin Management

Introduction to Unity XR Plugin Management – Configuring OpenXR and specific SDKs (Oculus, Windows Mixed Reality) – The XR Origin (Action-based) architecture – Camera Offset and tracking origins – Stereo Rendering modes (Multi-pass vs. Single-pass instanced) – Setting up the VR environment: Lighting, Skyboxes, and 360-degree media – Controller mapping and Input Actions.

Unit III: Interaction Design with XR Interaction Toolkit
Fundamentals of the XR Interaction Toolkit (XRI) – XR Direct Interactor vs. XR Ray Interactor – XR Grab Interactable components – Configuring physics-based interactions – Implementation of Haptic feedback – Working with Socket Interactors for inventory systems – UI interaction in 3D space: World Space Canvases and Tracked Device Graphic Raycasters.

Unit IV: Locomotion and User Navigation
Spatial navigation challenges in VR – Teleportation mechanics (Teleportation Area vs. Teleportation Anchor) – Snap Turn and Continuous Turn providers – Continuous Movement (Thumbstick-driven) – Implementing Vignettes to reduce motion sickness – Building boundaries and safety systems (Guardian/Chaperone) – Scripting custom movement behaviors.

Unit V: Optimisation and Deployment for VR
Performance bottlenecks in VR: Draw calls, Vertices, and Frame timing – Using the Unity Profiler and Frame Debugger – Mobile VR optimization (Oculus Quest/Android) – Occlusion Culling and Level of Detail (LOD) – Building and deploying VR applications to headsets – Overview of AR Foundation for basic AR integration – Practice for the Unity Certified User: VR Developer examination.

Text Books:

1. Jonathan Linowes, Unity Virtual Reality Projects, 3rd Edition, Packt Publishing.
2. Unity Technologies, Unity Learn: VR Development Pathway (Official Certification Guide).

Certificate Source:
https://unity.com/products/unity-certifications/vr-developer

Lab Syllabus :

Minimum 8 practical's implemented based on theory.

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TP1477-3 **Course: Agentic AI**

L: 3 Hrs, P: 2 Hr, Per Week **Total Credits: 4**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Explain the foundational models and types of intelligent agents.
2. Classify environments and describe agent-environment interactions.
3. Apply planning and learning algorithms within agentic systems.
4. Design autonomous agents capable of goal-driven behavior.
5. Evaluate ethical, safety, and application aspects of agentic AI systems.

Syllabus:

Unit I: Foundations of Agentic AI:
Definition and scope of agentic AI, Rational agents and agent-based systems, PEAS (Performance measure, Environment, Actuators, Sensors), Types of agents – reflex, model-based, goal-based, utility-based, learning agents, Agent architectures and design paradigms

Unit II: Environment and Agent Interactions:
Agent-environment interface, Task environments and their classification, Properties of environments – deterministic vs stochastic, fully vs partially observable, discrete vs continuous, multi-agent systems and communication, Cooperation, competition, and coordination in agent systems

Unit III: Learning and Planning in Agentic Systems:
Introduction to planning in intelligent agents, Search algorithms for planning, Reactive vs deliberative planning, Learning agents and reinforcement learning basics, Exploration vs exploitation, Model-based and model-free learning in agentic systems

Unit IV: Autonomous and Goal-Oriented Behavior:
Autonomy in agents, Goal formulation andintention recognition, Goal hierarchies and utility-based decision making, Agent deliberation cycles, Meta-reasoning and self-adaptive agents, Integration of learning and reasoning in autonomous agents

Unit V: Applications and Ethics in Agentic AI:
Applications in robotics, smart assistants, autonomous vehicles, multi-agent simulation and gaming, Trust, safety, and ethics in agentic behavior, Value alignment and human-agent collaboration, Future directions in AGI and agent-based AI

Text Books :

1. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig, Pearson, 4th Edition
2. Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations by Yoav Shoham and Kevin Leyton-Brown, Cambridge University Press, 1st Edition

Reference Books :

1. Intelligent Agents: Foundations and Applications by Gerhard Weiss, Springer, 1st Edition
2. Reinforcement Learning: An Introduction by Richard S. Sutton and Andrew G. Barto, MIT Press, 2nd Edition

Lab Syllabus :

Minimum 8 practical's implemented based on theory.

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TH1478 **Course: Research Methodology**

L: 2 Hrs, P: 0 Hr, Per Week **Total Credits: 2**

Course Outcomes:

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

1. Demonstrate an understanding of the research process, including the identification of research problems and the formulation of research hypotheses.
2. Develop proficiency in sampling techniques and data collection methods, and they will be able to apply statistical methods to analyze research data effectively.
3. Exhibit ethical behavior in their research practices, including avoiding plagiarism and maintaining integrity in data collection and reporting.

Syllabus:

Unit - I : Introduction to Research:

The concept of research, characteristics of good research, Application of Research, Meaning and sources of Research problem, characteristics of good Research problem, Research process, outcomes, application of Research, Meaning and types of Research hypothesis, Importance of Review of Literature, Organizing the Review of Literature.

Unit - II : Types of Research:

Types of research, pure (basic, fundamental) and applied research, qualitative and, quantitative. Research Design: Meaning, need, types of research design – Exploratory, Descriptive, Casual research Design, Components of research design, and Features of good Research design, Experiments, surveys and case study Research design.

Unit - III : Sampling, Data Collection and analysis:

Types and sources of data – Primary and secondary, Methods of collecting data, Concept of sampling and sampling methods – sampling frame, sample,, characteristics of good sample, simple random sampling, purposive sampling, convenience sampling, snowball sampling, classification and tabulation of data, graphical representation of data, graphs and, charts – Histograms, frequency polygon and frequency curves, bell shaped curve and its properties., Statistical Methods for Data Analysis : Applications of Statistics in Research,, measures of central, tendency and dispersion

Unit - IV : Research Report:

Research report and its structure, journal articles –, Components of journal article., Explanation of various components. Structure of an abstract and keywords. Thesis and dissertations, components of thesis and dissertations. Referencing styles and bibliography.

Unit - V : Ethics in Research:

Plagiarism - Definition, ICT Tools for Research: Role of computers in research, maintenance of data using software such as Mendeley, Endnote, Tabulation and graphical presentation of research data and software tools, Web search: Introduction to Internet, use of Internet and WWW, using search engines and Advanced Tools like Generative AI.

Text Books:

1. Donald Cooper and PS Schindler (2009) Business Research Methods, 9th edition, Tata McGraw Hill
2. Kothari C. R Research Methodology
3. Uma Sekaran (2010) Research Methods for Business, 4th edition, Wiley.

Reference Book:

1. Ranjit Kumar (2009) Research Methodology, 2nd edition, Pearson Education
2. Naresh Malhotra and S Dash (2009) Marketing Research, 5th edition, Pearson Prentice Hall.

SYLLABUS OF SEMESTER -IV, MCA (MASTER OF COMPUTER APPLICATIONS)

(Artificial Intelligence and Machine Learning)

Course Code: 26MC60PR1479 **Course: Capstone Project Phase-II**

L: 0 Hrs, P: 10 Hrs, Per Week **Total Credits: 5**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Analyze real-world problems by identifying requirements, constraints, and appropriate computational approaches for developing a software-based solution.

2. Design a comprehensive system architecture and project plan by evaluating alternative technologies, tools, and methodologies suitable for the proposed solution.

3. Develop and implement a complete software solution using appropriate programming languages, frameworks, and tools while adhering to coding standards and best practices.

4. Evaluate the performance, usability, and reliability of the developed system, and effectively communicate project outcomes through technical reports, documentation, and presentations.

Syllabus:

Project work to be carried out under the supervision of one internal guide.

One Year Internship (Semester-III and IV)

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60PR1391 **Course: Project Work (Phase-I)**

L: 0 Hrs, T:0 Hr P: 44 Hrs, Per Week **Total Credits: 22**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Implement comprehensive project planning, designing and development process.
2. Acquire and understand Software industry needs.

Syllabus:

A full-time project work to be carried out under the supervision of one external guide from industry and one internal guide.

SYLLABUS OF SEMESTER - IV, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60PR1491 **Course: Project Work (Phase-II)**

L: 0 Hrs, T:0 Hr P: 34 Hrs, Per Week **Total Credits: 17**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Implement comprehensive project planning, designing and development process.
2. Acquire and understand Software industry needs.

Syllabus:

A full-time project work to be carried out under the supervision of one external guide from industry and one internal guide.

Bridge Courses

SYLLABUS OF SEMESTER - I, MCA (MASTER OF COMPUTER APPLICATIONS)
(Artificial Intelligence and Machine Learning)

Course Code: 26MC60TH1199 **Course: Discrete Structures and Digital Logic**

L: 2 Hrs, T:1hr P: 0 Hrs, Per Week **Total Credits: 0**

Course Objectives

Students can study the basics of set theory, relations and functions, Algebraic Structure and Combinatorics. Students can explore several mathematical topics in order to understand the relation between exploration, Logic concept and discovery and proof. Students can learn to introduce number systems, codes, basic postulates of Boolean algebra, methods for simplifying Boolean expressions. Also, it will help to outline the formal procedures for the analysis and design of combinational circuits and sequential circuits.

Course Outcomes:

On successful completion of the course, students will be able to:

1. Solve the problems based on set theory, relations and functions, Algebraic Structure and Combinatorics.
2. Translate statements and reasoning from natural language to propositional and predicate logical language
3. Perform arithmetic operations with different number systems, use various optimization techniques to minimize and design digital circuits.
4. Analyze and design various combinational logic circuits and sequential circuits.

Syllabus:

Unit-I

Set Theory: Introduction, Combination of sets, Multisets, Ordered pairs, Set Identities.
Relations: Definition, Operations on relations, Properties of relations, Composite Relations, Equality of relations, Order of relations.
Functions: Definition, Classification of functions, Operations on functions.

Unit-II

Algebraic Structures: Definition, Groups, Subgroups and order, Semigroups, Monoids, Cyclic Groups, Cosets.
Combinatorics: Sum and product rule, Principle of Inclusion Exclusion, Permutations and Combination, Pigeon Hole Principle, Linear Recurrence relations.

Unit-III

Methods of Proof: Proof by Contrapositive, Proofs by Cases, Proofs by Contradiction, The Principle of Mathematical Induction.

Propositional Logic: Proposition, well-formed formula, Truth tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Normal forms, Theory of Inference, Natural Deduction.

Predicate Logic: First order predicate, well-formed formula of predicate, quantifiers, Inference theory of predicate logic.

Unit-IV

Binary Systems: Digital Computers and Digital Systems, Number Systems, Representation of Signed Numbers and Binary Arithmetic in Computers,Binary Codes.

Logic gates:Truth table, properties and symbolic representation of NOT, AND, OR, NOR, NAND, EX-OR, EX-NOR gates. NOR and NAND gates as a universal gate.

Boolean algebra: Axioms and Laws of Boolean Algebra, Duality, Canonical and Standard Forms, Minimization of switching functions: 2, 3, 4 variable Karnaugh map.

Unit-V

Combinational Logic - Adders, Subtractors (Half and Full), Decoders, Encoders, Multiplexers, Demultiplexers, code converter.

Sequential Logic - Flip-Flop, Concept of clock, Counters- Ring Counter, Johnson Counter.

Text Books:

1. Bernard Kolman, Robert Busby, Sharon C. Ross, Discrete Mathematical Structures, Pearson
2. Jean Paul Trembley, R Manohar, Discrete Mathematical Structures with Application to Computer Science, McGraw-Hill
3. Digital Design: M. M. Mano, Prentice Hall.
4. Fundamentals of Digital Circuits: A. Anand Kumar, PHI.

Reference Books:

1. Liu and Mohapatra, “Elements of Discrete Mathematics”, McGraw Hill
2. Discrete Mathematics and its Applications - Kenneth H. Rosen 7th Edition -Tata McGraw Hill Publishers
3. Modern Digital Electronics: R.P.Jain.