NIRMA UNIVERSITY
Institute of Technology
B.Tech. Computer Science and Engineering
Semester - III

L	T	P	C
2	0	2	3

Course Code	**2CS501CC23**
Course Title	**Data Structures**

Course Learning Outcome:

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

1. explain various data structures and relate them to appropriate applications
2. identify the appropriate data structure to design an efficient algorithm for the given application
3. apply various techniques on linear and non-linear data structures for searching and sorting
4. make use of appropriate data structure for the solution of a problem

L	T	P	C
2	0	2	3

Course Code	**2CS502CC23**
Course Title	**Object Oriented Programming**

Course Learning Outcome:

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

1. explain procedural and object-oriented paradigms and principles of (BL-2)
2. relate the concepts of object-oriented design with principles of object-oriented programming
3. apply exception handling, input-output operations and multi-threading concepts for application development
4. make use of object-oriented concepts and design for developing various programs

L	T	P	C
2	0	2	3

Course Code	2CS507CC23
Course Title	Digital Electronics

Course Learning Outcome:

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

1. explain the basic building blocks of various digital circuits
2. build the minimized Boolean logic expression for developing the combinational and sequential circuits
3. design combinational circuits using MSI components
4. develop sequential and combinational logic for implementing digital systems

L	T	P	C
2	1	0	3

Course Code	2CS802CC23
Course Title	Mathematical Foundations for Computer Science

Course Learning Outcome:

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

1. define preliminaries of discrete mathematics, concepts of sets, graphs, digraphs and trees
2. explain properties of relations and functions, identify equivalence and partial order relations, and sketch relations
3. analyze logic propositions
4. prove various theorems using mathematical induction and recurrence

L	T	P	C
2	1	0	3

Course Code	2HS302CC23
Course Title	Economics

Course Learning Outcome:

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

1. Interpret the various basic economic principles.
2. Relate the economic fundamentals with engineering practices.
3. Infer the macroeconomic aspects.
4. Apply microeconomic and macroeconomic aspects in engineering projects.

L	T	P	C
2	1	0	3

Course Code	1MU803CC22
Course Title	Indian Constitution and Citizenship

Course Learning Outcome:

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

1. Explain various facets of Indian Constitution and its impact on political, economic and social lives of citizenry.
2. Develop responsible and active citizens.
3. Interpret social and political aspects of the making of the Indian Constitution.
4. Evaluate political institutions in constitutional framework.

L	T	P	C
0	0	0	3

Course Code	2FT901CC23
Course Title	Internship Community Services

Course Learning Outcome:

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

1. appraise the concerns of community for enhancement of standard of living of the community
2. survey the community to learn its concerns
3. justify the involvement of citizens for community development
4. apply the technological developments for solving the community issues
5. propose the feasible solutions for societal issues

NIRMA UNIVERSITY
Institute of Technology
B.Tech. Computer Science and Engineering
Semester - IV

L	T	P	C
2	1	0	3

Course Code	**2CS504CC23**
Course Title	**Computer Architecture**

Course Learning Outcome:

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

1. outline the basics of various architectural units of the Computer System
2. apply the knowledge of logic circuits to mimic a simple computer architecture
3. design various architectural units of a basic computer system
4. minimise the design cost of architectural units

L	T	P	C
2	0	2	3

Course Code	**2CS505CC23**
Course Title	**Database Management Systems**

Course Learning Outcome:

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

1. describe the various aspects of the database models and integrity constraints
2. apply the normalisation concepts for relational database design
3. make use of indexing techniques for various storage and retrieval operations
4. design queries with various clauses and constructs of SQL

L	T	P	C
2	0	2	3

Course Code	2CS506CC23
Course Title	Operating Systems

Course Learning Outcome:

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

1. explain the services and functionalities of operating systems
2. apply the concepts of processes and memory management for problem solving
3. appraise the mechanisms of operating systems to handle I/O devices and file management
4. make use of shell scripts to demonstrate various concepts of operating system

L	T	P	C
2	0	2	3

Course Code	2CS201CC23
Course Title	Full Stack Web Development

Course Learning Outcome:

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

1. compare the approaches used for web applications development and identify the various components of it.
2. develop user-friendly and responsive user interfaces
3. demonstrate the creation of REST APIs for various backend database functionalities of an application.
4. design and develop end-to-end web applications with various tools and frameworks.

L	T	P	C
2	1	0	3

Course Code	2HS401CC23
Course Title	Organizational Behavior

Course Learning Outcome:

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

1. Apply principles of organizational dynamics relating to systems, culture, structure and change processes.
2. Apply critical analytical skills that will help them diagnose situations pertaining to human behavior and generate effective solutions for the same.
3. Distinguish performance behavior at individual and group levels.
4. Illustrate the ability to lead and motivate others to succeed.

L	T	P	C
2	0	2	3

Course Code	2CS202CC23
Course Title	Data Communications

Course Learning Outcome:

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

1. explain data/signal transmission over communication media
2. analyse various spread spectrum and multiplexing
3. appraise the mechanisms of modulation techniques
4. apply concepts of data communication to solve various problems

NIRMA UNIVERSITY
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B.Tech. Computer Science and Engineering
Semester - V

L	T	P	C
3	0	2	4

Course Code	**3CS101CC24**
Course Title	**Machine Learning**

Course Learning Outcome:

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

1. explain statistical methods as the basis of the machine learning domain
2. identify the learning algorithms for appropriate applications
3. analyze machine learning techniques to solve problems in applicable domains
4. evaluate algorithms based on different metrics and parameters

L	T	P	C
3	0	2	4

Course Code	**3CS201CC24**
Course Title	**Computer Networks**

Course Learning Outcome:

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

1. summarize the functionalities of different layers of computer network architectures
2. analyze protocols related to various network architecture layers
3. simulate various protocols for different types of networks
4. design computer network configurations

L	T	P	C
3	0	2	4

Course Code	3CS501CC24
Course Title	Design and Analysis of Algorithms

Course Learning Outcome:

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

1. explain notion of algorithmic complexity and logic of fundamental algorithms
2. identify suitable data structures to solve a problem effectively and efficiently
3. apply optimal solution approach for complex problems
4. formulate appropriate algorithm for real life problems

Department Elective - I

L	T	P	C
3	0	2	4

Course Code	3CS103ME24
Course Title	Data Analysis and Visualisation

Course Learning Outcome:

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

1. demonstrate data characteristics using visualisation tools
2. identify common data types and corresponding analysis approaches
3. analyse the data using various statistical tools
4. build data visualisation systems for interdisciplinary problems

L	T	P	C
3	0	2	4

Course Code	3CS202ME24
Course Title	Embedded Systems

Course Learning Outcome:

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

1. summarise the general structure of embedded systems, their design requirements and applications
2. make use of programming languages to develop embedded systems
3. evaluate real-time scheduling strategies as per the application specific needs
4. design interfacing modules for microcontroller applications

L	T	P	C
3	0	2	4

Course Code	3CS502ME24
Course Title	Open Source Technologies

Course Learning Outcome:

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

1. demonstrate proficiency in using popular open-source development tools and frameworks
2. apply open source solutions to real-world problems with various databases
3. inspect suitable open-source tools for the given problem
4. propose solution to data science and AI projects using open source technologies

L	T	P	C
3	0	2	4

Course Code	3CS203ME24
Course Title	Information Theory and Coding

Course Learning Outcome:

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

1. explain the fundamental concepts of information theory such as entropy, mutual information, channel capacity
2. experiment with channel coding, flow control and error control techniques
3. compare the channel coding techniques for noisy channels and its implications
4. solve problems related to different channel coding techniques

L	T	P	C
3	0	2	4

Course Code	3CS503ME24
Course Title	Advanced Java

Course Learning Outcome:

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

1. interpret the basics of Java technologies
2. apply the concepts of Java technologies to design console based, GUI based and web-based applications
3. develop applications using various Java frameworks
4. design multi-tier and enterprise-level Java applications

L	T	P	C
3	0	2	4

Course Code	3CS204ME24
Course Title	Ethical Hacking and Vulnerability Assessment

Course Learning Outcome:

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

1. summarise the core concepts related to malware, hardware and software vulnerabilities and their causes
2. choose state-of-the-art tools to exploit the vulnerabilities related to computer system and networks
3. survey various tools to exploit web applications
4. solve the security issues in web applications

L	T	P	C
3	0	2	4

Course Code	3CS504ME24
Course Title	Mobile Operating Systems

Course Learning Outcome:

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

1. compare the similarities, differences and benefits of the current mobile operating systems
2. identify the functionalities of remote operations and security essential of mobile devices
3. analyse the latest trends in building Mobile OS
4. develop the native applications required to build using mobile OS

L	T	P	C
3	0	2	4

Course Code	3CS505ME24
Course Title	Optimization Techniques

Course Learning Outcome:

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

1. illustrate key concepts and applications of various optimization techniques
2. apply the appropriate optimization technique for the given problem
3. analyse appropriate objective functions and constraints to solve real life optimization problems
4. evaluate optimization solutions, including interpreting results and making informed decisions based on the optimization outcomes

L	T	P	C
3	0	2	4

Course Code	3CS207ME24
Course Title	Quantum Computing

Course Learning Outcome:

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

1. relate the differences between the classical and quantum systems
2. apply the concepts of complex numbers to quantum computing
3. examine the various algorithms using quantum programming
4. develop various quantum applications

L	T	P	C
3	0	2	4

Course Code	3CS401ME24
Course Title	Advanced Computer Architecture

Course Learning Outcome:

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

1. demonstrate an understanding of the fundamental design concepts in computer architecture
2. apply the knowledge of computer organization to quantitatively evaluate the performance of a computer architecture
3. explain the state-of-the-art computer architectures
4. design a prototype of an existing computer architecture module

Core Course I and II (Minor in Data Science)

L	T	P	C
3	0	2	4

Course Code	3CS506IC24
Course Title	Programming for Scientific Computing

Course Learning Outcome:

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

1. develop computational programs at a high level of abstraction
2. inspect standard programming constructs like repetition, selection, functions, composition, modules, aggregated data
3. evaluate the results of scientific computing problems, using established program libraries
4. design software solutions for scientific problems, integrating multiple programming and scientific computing concepts

L	T	P	C
3	0	2	4

Course Code	3CS103ME24
Course Title	Data Analysis and Visualization

Course Learning Outcome:

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

1. demonstrate data characteristics using visualisation tools
2. identify common data types and corresponding analysis approaches
3. analyse the data using various statistical tools
4. build data visualisation systems for interdisciplinary problems

Core Course I and II (Minor in Computer Science)

L	T	P	C
3	0	2	4

Course Code	**3CS507IC24**
Course Title	**Data Structures and Algorithms**

Course Learning Outcome:

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

1. experiment with various techniques for searching and sorting
2. analyse various data structures and their applicability
3. determine the appropriate data structure to design efficient algorithm for the given application
4. estimate trade-offs in the design and implementations of the data structures

L	T	P	C
3	0	2	4

Course Code	**3CS508IC24**
Course Title	**Operating Systems**

Course Learning Outcome:

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

1. illustrate basic components and services of operating systems
2. utilize operating system functions effectively
3. analyse the mechanism of operating systems to handle I/O devices and file management
4. evaluate the mechanism of operating systems to handle processes and memory

Core Course I and II (Minor in Software Engineering)

L	T	P	C
3	0	2	4

Course Code	**3CS509IC24**
Course Title	**Principles of Software Engineering**

Course Learning Outcome:

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

1. explain various phases of software development lifecycle
2. analyse and document the requirement specifications for a software project
3. evaluate the process model using standard tools and methodologies
4. design prototype considering all aspects on SDLC

L	T	P	C
3	0	2	4

Course Code	**3CS510IC24**
Course Title	**Software Testing and Quality Assurance**

Course Learning Outcome:

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

1. identify different levels and types of testing techniques
2. make use of modern software testing strategies in relation to software development
3. evaluate quality assurance practices and principles throughout the software development lifecycle
4. design project test plans, test cases, and test data to conduct test operations

Core Course I and II (Minor in Adaptive AI)

L	T	P	C
3	0	2	4

Course Code	3CS301DC24
Course Title	Computer Vision using Deep Learning

Course Learning Outcome:

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

1. explain various image representation stages for digital image processing applications
2. identify the deep learning algorithms which are appropriate for different types of learning tasks in various domains
3. evaluate deep learning algorithms and solve real-world problems
4. elaborate various deep learning models for computer vision applications

L	T	P	C
3	0	2	4

Course Code	3CS102DC24
Course Title	Natural Language Computing

Course Learning Outcome:

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

1. infer about major issues and solutions related to natural language computing
2. utilize various computational methods to understand language phenomena
3. assess the sequence modelling techniques for various use cases
4. develop applications with natural language capabilities

Core Course I and II (Minor in Cyber Security)

L	T	P	C
3	0	2	4

Course Code	**3CS205DC24**
Course Title	**Information and Network Security**

Course Learning Outcome:

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

1. illustrate fundamental network security concepts, terminologies, and principles
2. analyse common network security threats, vulnerabilities, and attack vectors
3. explain the principles of cryptography and apply cryptographic techniques to protect data and communications
4. develop security policies and procedures to ensure compliance with relevant standards and regulations

L	T	P	C
3	0	2	4

Course Code	**3CS206DC24**
Course Title	**Digital Forensics**

Course Learning Outcome:

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

1. illustrate forensic duplication and file system analysis
2. identify the need of digital forensic and role of digital evidences
3. compare the use of various tools for data recovery
4. assess the network forensics to collect digital evidences

NIRMA UNIVERSITY
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Semester - VI

L	T	P	C
3	0	2	4

Course Code	**3CS402CC24**
Course Title	**Cloud Computing**

Course Learning Outcome:

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

1. explain the core concepts of cloud computing, its services, and models
2. select systems, hardware, and application virtualization and outline their role in enabling cloud services
3. assess the issues related to cloud computing and its application
4. build and deploy cloud applications using fundamental concepts of cloud infrastructures.

L	T	P	C
3	0	2	4

Course Code	**3CS511CC24**
Course Title	**Software Engineering**

Course Learning Outcome:

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

1. explain various phases of the software development life cycle
2. analyze the software requirement specifications for a project
3. evaluate the process model using standard tools and methodologies
4. design prototype considering all aspects of SDLC.

L	T	P	C
2	0	0	0

Course Code	4FT901CC24
Course Title	Research Methodology and Seminar

Course Learning Outcome:

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

1. formulate a research problem for a given engineering domain
2. analyze the available literature for the given research problem
3. solve problems using scientific tools
4. develop technical writing and presentation skills
5. collaborate for research and articulate a document for possible publication

Department Elective – II

L	T	P	C
3	0	2	4

Course Code	3CS208ME24
Course Title	Internet of Things

Course Learning Outcome:

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

1. summarize the architectural components and platforms of the IoT ecosystem
2. apply appropriate access technology and protocols as per the application requirement
3. appraise the role of big data, cloud computing, and data analytics in a typical IoT system
4. design applications with suitable lightweight data processing and communication Methodologies

L	T	P	C
3	0	2	4

Course Code	3CS512ME24
Course Title	UI-UX Design

Course Learning Outcome:

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

1. explain the iterative user-centered design of graphical user interfaces
2. apply the user Interfaces to different devices and requirements
3. evaluate UX design, including information modelling, requirement gathering, and content management
4. create high-fidelity visual designs by converting wireframes, incorporating principles of Gestalt Theory, and considering various screen types

L	T	P	C
3	0	2	4

Course Code	3CS513ME24
Course Title	Advanced Data Structures

Course Learning Outcome:

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

1. interpret the trade-offs involved in choosing between different data structures
2. apply advanced data structures to solve real-world problems
3. analyze the time and space complexity of algorithms
4. design and implement advanced data structures

L	T	P	C
3	0	2	4

Course Code	3CS209ME24
Course Title	Network Security

Course Learning Outcome:

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

1. demonstrate a clear understanding of fundamental network security concepts, terminologies, and principles
2. analyze common network security threats, vulnerabilities, and attack vectors
3. explain the principles of cryptography and apply cryptographic techniques to protect data and communications
4. develop security policies and procedures to ensure compliance with relevant standards and regulations

L	T	P	C
3	0	2	4

Course Code	3CS514ME24
Course Title	Contemporary Programming

Course Learning Outcome:

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

1. classify the major programming paradigms
2. identify building blocks for various contemporary programming languages
3. defend the principles and techniques involved in the design and implementation of modern programming languages
4. develop hands-on skills in contemporary programming languages

L	T	P	C
3	0	2	4

Course Code	3CS515ME24
Course Title	Graph Theory

Course Learning Outcome:

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

1. explain fundamental graph theory concepts, including graph discovery, definitions, set operations, and matrix representations
2. apply graph theory to solve connected graphs, shortest path, and weighted graph problems
3. analyse properties of trees and graphs with an understanding of combinatorial and geometric aspects
4. elaborate the concepts of graph theory and connect them with applications

L	T	P	C
3	0	2	4

Course Code	3CS516ME24
Course Title	Mobile Application Development

Course Learning Outcome:

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

1. explain the mobile application development approaches, platforms, tools, and development environment
2. make use of basic building blocks, user interface components, and communication components to develop mobile applications
3. develop Android applications through database storage and data sharing
4. elaborate the use of advanced APIs related to sensors, web, networks, and location-based services

L	T	P	C
3	0	2	4

Course Code	3CS517ME24
Course Title	VLSI Programming

Course Learning Outcome:

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

1. identify the various VLSI design styles, approaches, and IC fabrication design process
2. analyse the CMOS-based circuit design
3. design the various digital VLSI circuits
4. develop the verification and testing of the VLSI circuit

L	T	P	C
3	0	2	4

Course Code	3CS104ME24
Course Title	Deep Learning

Course Learning Outcome:

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

1. identify the strengths and weaknesses of the deep network
2. analyse the suitability of different deep networks for problems in various domains
3. interpret the functioning and math behind the deep learning architectures
4. design and implement deep networks for solving problems pertaining to computer science and interdisciplinary research

L	T	P	C
3	0	2	4

Course Code	3CS302ME24
Course Title	Introduction to Game Development

Course Learning Outcome:

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

1. infer the design principles of the gaming application
2. make use of audio and visual effects in game development
3. recommend architectural design using the game development process
4. develop games using various game engines

Minor in Data Science (Core Course - III)

L	T	P	C
3	0	2	4

Course Code	**3CS101CC24**
Course Title	**Machine Learning**

Course Learning Outcome:

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

1. explain statistical methods as the basis of the machine learning domain
2. identify the learning algorithms for appropriate applications
3. analyse machine learning techniques to solve problems in applicable domains
4. evaluate algorithms based on different metrics and parameters

Minor in Computer Science (Core Course - III)

L	T	P	C
3	0	2	4

Course Code	**3CS518IC24**
Course Title	**Database Management Systems**

Course Learning Outcome:

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

1. explain the various aspects of the relational database, like models, different kinds of keys, and constraints
2. apply the relational database concept to normalize the database
3. evaluate various storage and retrieval methods to correlate with the relational model through appropriate indexing
4. interpret queries to use the database system effectively along with transaction management

Minor in Software Engineering (Core Course - III)

L	T	P	C
3	0	2	4

Course Code	**3CS520IC24**
Course Title	**Application Development Frameworks**

Course Learning Outcome:

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

1. explain the key components of the .NET Framework
2. make use of web forms along with a variety of controls
3. develop web-based applications using LINQ, XML, and Web services
4. assess ADO.NET, data providers, data binding techniques, database connectivity, data retrieval using DataSets and DataReaders, and managing multiple tables

Minor in Adaptive AI (Core Course - III)

L	T	P	C
3	0	2	4

Course Code	**3CS108ME24**
Course Title	**Reinforcement Learning**

Course Learning Outcome:

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

1. summarise the fundamental concepts and principles of reinforcement learning
2. make use of tabular methods to solve classical control problems
3. choose suitable approximation solutions for reinforcement learning
4. recommend suitable techniques and applications of reinforcement learning

Minor in Cyber Security (Core Course - III)

L	T	P	C
3	0	2	4

Course Code	**3CS210ME24**
Course Title	**Secured Application Development**

Course Learning Outcome:

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

1. illustrate building blocks for secured application development
2. identify the need of secured application Development and its role
3. build secured web applications considering various design principles for ensuring security standards
4. develop secure code and test applications for vulnerabilities

Minor in Data Science (Elective Course - I)

L	T	P	C
3	0	2	4

Course Code	**3CS105IE24**
Course Title	**Introduction to Deep Learning**

Course Learning Outcome:

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

1. identify the strengths and weaknesses of the deep network
2. analyse the suitability of different deep networks for problems in various domains
3. interpret the functioning and math behind the deep learning architectures
4. choose deep networks for solving problems pertaining to computer science and interdisciplinary research

L	T	P	C
3	0	2	4

Course Code	3CS303IE24
Course Title	Multimedia Analytics

Course Learning Outcome:

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

1. explain the basic concepts of multimedia analytics
2. compare various techniques for image and video processing
3. analyse audio data using multimedia analytics methods
4. interpret applications with multimedia content mining techniques

L	T	P	C
3	0	2	4

Course Code	3CS106IE24
Course Title	Time Series Analysis

Course Learning Outcome:

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

1. illustrate the basics of time series data
2. experiment with time series models and components
3. evaluate time series analysis in practical scenarios
4. interpret the validations of various time series models

L	T	P	C
3	0	2	4

Course Code	3CS107IE24
Course Title	Analytics of IoT

Course Learning Outcome:

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

1. explain the architectural components and platforms of the IoT ecosystem
2. apply appropriate access technology and protocols as per the application requirement
3. appraise the role of big data, cloud computing, and data analytics in a typical IoT system
4. perceive applications with suitable lightweight data processing and communication methodologies

Minor in Computer Science (Elective Course - I)

L	T	P	C
3	0	2	4

Course Code	3CS201CC24
Course Title	Computer Networks

Course Learning Outcome:

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

1. summarise the functionalities of different layers of computer network architectures
2. analyse protocols related to various network architecture layers
3. simulate various protocols for different types of networks
4. interpret computer network configurations

L	T	P	C
3	0	2	4

Course Code	3CS519IE24
Course Title	Web Technologies

Course Learning Outcome:

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

1. illustrate various concepts related to dynamic web pages and validate them using JavaScript
2. apply the concepts of HTML and CSS to design static web pages
3. develop web applications using the concepts of jQuery
4. develop interactive advanced web applications using AngularJS and PHP

L	T	P	C
3	0	2	4

Course Code	3CS101CC24
Course Title	Machine Learning

Course Learning Outcome:

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

1. explain statistical methods as the basis of the machine learning domain
2. identify the learning algorithms for appropriate applications
3. analyse machine learning techniques to solve problems in applicable domains
4. evaluate algorithms based on different metrics and parameters

Minor in Software Engineering (Elective Course - I)

L	T	P	C
3	0	2	4

Course Code	**3CS521IE24**
Course Title	**Software Architectures**

Course Learning Outcome:

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

1. illustrate the importance of software architecture and its impact on software development
2. analyse and compare different architectural styles and patterns
3. evaluate suitable architectural analysis techniques
4. perceive architectural decisions effectively to stakeholders

L	T	P	C
3	0	2	4

Course Code	**3CS403IE24**
Course Title	**Service Oriented Architecture**

Course Learning Outcome:

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

1. infer the key advantages and complexities present in microservice architectures
2. apply appropriate architectural approaches for the design of microservices
3. choose appropriate techniques and technologies to develop microservice applications effectively
4. interpret the deployment of microservice applications on cloud platforms

L	T	P	C
3	0	2	4

Course Code	**3CS522IE24**
Course Title	**UI-UX Design**

Course Learning Outcome:

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

1. explain the iterative user-centered design of graphical user interfaces
2. apply the user Interfaces to different devices and requirements
3. evaluate UX design, including information modelling, requirement gathering, and content management
4. interpret high-fidelity visual designs by converting wireframes, incorporating principles of Gestalt Theory, and considering various screen types

Minor in Adaptive AI (Elective Course - I)

L	T	P	C
3	0	2	4

Course Code	**3CS109ME24**
Course Title	**Soft Computing**

Course Learning Outcome:

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

1. identify the application of fuzzy logic
2. assess optimization problems using Multi-Objective Evolutionary algorithms (MOEAs)
3. solve problems in a variety of application domains using soft computing techniques
4. propose various solutions for optimization problems using genetic algorithms

L	T	P	C
3	0	2	4

Course Code	3CS110ME24
Course Title	Federated Learning

Course Learning Outcome:

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

1. explain the fundamentals of federated learning
2. make use of techniques of federated learning for developing various applications
3. list real-world applications and use cases of federated learning
4. discuss the privacy and security considerations in federated learning

Minor in Cyber Security (Elective Course - I)

L	T	P	C
3	0	2	4

Course Code	3CS211ME24
Course Title	System and Website Audit

Course Learning Outcome:

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

1. explain the role of IT governance and Information Security Policy
2. identify components of information systems and the concept of critical data
3. evaluate the design, implementation, and monitoring of various security controls to ensure that information assets are adequately safeguarded
4. develop various reports after the audit process for information systems, web applications, and information assets

L	T	P	C
3	0	2	4

Course Code	3CS207ME24
Course Title	Quantum Computing

Course Learning Outcome:

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

1. relate the differences between the classical and quantum systems
2. apply the concepts of complex numbers to quantum computing
3. examine the various algorithms using quantum programming
4. develop various quantum applications

L	T	P	C
3	0	2	4

Course Code	3CS212ME24
Course Title	Blockchain and Cryptocurrency

Course Learning Outcome:

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

1. summarize the concept of blockchain technology
2. evaluate security issues relating to Blockchain and cryptocurrency
3. design the applications based on Blockchain technology
4. develop the structure of a Blockchain network

L	T	P	C
3	0	2	4

Course Code	3CS213ME24
Course Title	Data Privacy

Course Learning Outcome:

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

1. summarise the concepts of web security and privacy, hardware and software vulnerabilities, and protection mechanisms
2. identify the need for data privacy and the related technologies
3. analyse the requirements of attacks and secure data-sharing practices with privacy preservation policies
4. design the protection mechanisms against several data-related attacks

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Semester - VII

L	T	P	C
3	0	2	4

Course Code	**4CS501CC25**
Course Title	**Principles of Compiler Design**

Course Learning Outcome:

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

1. summarize the functionalities of various phases of the compiler
2. apply language theory concepts to various phases of compiler design
3. select the appropriate optimization technique for the compilation process
4. implement various compiler phases using the appropriate compiler design tools.

L	T	P	C
0	0	4	4

Course Code	**4FT901CC24**
Course Title	**Research Methodology and Seminar**

Course Learning Outcome:

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

1. formulate a research problem for a given engineering domain
2. analyze the available literature for the given research problem
3. solve problems using scientific tools
4. develop technical writing and presentation skills
5. collaborate for research and articulate a document for possible publication

Department Elective – III

L	T	P	C
3	0	2	4

Course Code	4CS101ME25
Course Title	Big Data Systems

Course Learning Outcome:

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

1. outline the significance and challenges of big data
2. model big data applications using various platforms
3. utilise big data systems for practical business analytics
4. design data analytics algorithms for various datasets

L	T	P	C
3	0	2	4

Course Code	4CS102ME25
Course Title	Information Retrieval Systems

Course Learning Outcome:

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

1. correlate the concepts and various components of information retrieval systems
2. demonstrate the usage of different data/file structures in building computational search engines
3. apply theoretical foundations for the development of information retrieval systems
4. identify design and evaluation parameters for information retrieval systems

L	T	P	C
3	0	2	4

Course Code	4CS301ME25
Course Title	Augmented and Virtual Reality

Course Learning Outcome:

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

1. apply the AR/VR development approaches to build AR/VR applications
2. differentiate between the AR/VR/MR/XR concepts
3. evaluate the usability of AR/VR applications and critique their use of AR/VR capabilities
4. design AR/VR applications using state-of-the-art tools and technologies

L	T	P	C
3	0	2	4

Course Code	4CS201ME25
Course Title	Human-Computer Interface

Course Learning Outcome:

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

1. apply an appropriate interaction style for implementing interaction between human and computer
2. implement the HCI techniques to design multimodal UI
3. evaluate user interfaces to detect usability problems
4. build multimodal applications based on sensory signal-driven UI

L	T	P	C
3	0	2	4

Course Code	3CS510IC24
Course Title	Software Testing and Quality Assurance

Course Learning Outcome:

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

1. identify different levels and types of testing techniques
2. analyse quality assurance practices and principles throughout the software development lifecycle
3. determine modern software testing strategies in relation to software development
4. design project test plans, test cases, and test data to conduct test operations

L	T	P	C
3	0	2	4

Course Code	4CS502ME25
Course Title	Microservice Architecture and Programming

Course Learning Outcome:

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

1. recognise the key advantages and complexities present in microservice architectures
2. apply the appropriate architectural approach for the design of microservices
3. implement microservice applications effectively with suitable techniques and technologies
4. design and deploy microservice applications on cloud platforms

L	T	P	C
3	0	2	4

Course Code	4CS503ME25
Course Title	Programming for Modern Databases

Course Learning Outcome:

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

1. summarise the concept of modern databases
2. model modern databases using different tools and frameworks
3. apply big data techniques for useful business analytic applications
4. design algorithms for mining the data from large volumes

L	T	P	C
3	0	2	4

Course Code	4CS202ME25
Course Title	Wireless Networks

Course Learning Outcome:

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

1. outline design issues involved in different wireless networks
2. analyse the evolution of wireless network architectures with the growing needs
3. evaluate the available technologies to satisfy various application requirements
4. propose technological solutions to satisfy various application requirements

L	T	P	C
3	0	2	4

Course Code	4CS203ME25
Course Title	High Speed Networks

Course Learning Outcome:

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

1. outline design issues involved in different wireless networks
2. analyse the evolution of wireless network architectures with the growing needs
3. evaluate the available technologies to satisfy various application requirements
4. propose technological solutions to satisfy various application requirements

L	T	P	C
3	0	2	4

Course Code	4CS401ME25
Course Title	High Performance Computing

Course Learning Outcome:

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

1. explain parallel processing systems, parallel architectures, and fundamental issues in high performance computing system
2. develop and optimize parallel programs using shared memory programming and message-passing interface
3. develop scientific applications for exploiting the resources of HPC
4. analyse profiling and benchmarking tools to measure the performance of HPC applications

Department Elective – IV

L	T	P	C
3	0	2	4

Course Code	4CS302ME25
Course Title	Social and Multimedia Analytics

Course Learning Outcome:

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

1. relate the basic concepts of social and multimedia analytics
2. identify various techniques for link analysis from a social network perspective
3. analyse and process image and video data using multimedia analytics methods
4. interpret social multimedia analysis, engagement, and visualisation

L	T	P	C
3	0	2	4

Course Code	4CS204ME25
Course Title	Blockchain Technology

Course Learning Outcome:

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

1. explain the architectural components and platforms of the IoT ecosystem
2. apply appropriate access technology and protocols as per the application requirement
3. appraise the role of big data, cloud computing, and data analytics in a typical IoT system
4. design applications with suitable lightweight data processing and communication methodologies

L	T	P	C
3	0	2	4

Course Code	4CS205ME25
Course Title	Analytics of IoT

Course Learning Outcome:

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

1. summarise the architectural components and platforms of the IoT ecosystem
2. apply appropriate access technology and protocols as per the application requirement
3. analyse the role of big data, cloud computing, and data analytics in a typical IoT system
4. design applications with suitable lightweight data processing and communication methodologies

L	T	P	C
3	0	2	4

Course Code	4CS206ME25
Course Title	Robotics and Automation

Course Learning Outcome:

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

1. explain the basic concepts associated with the design, functioning, and applications of Robots
2. examine the drives and sensors used in Robots
3. appraise fundamentals of robot kinematics and robot programming
4. interpret algorithms related to mobile robotic path planning

L	T	P	C
3	0	2	4

Course Code	4CS504ME25
Course Title	Software Project Management

Course Learning Outcome:

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

1. explain basic project management concepts, framework, and process models
2. experiment with various software process models and software effort estimation techniques
3. evaluate the checkpoints, project reporting structure, project progress, and tracking mechanisms using project management principles
4. develop skills in the use of modern software project management and development tools

L	T	P	C
3	0	2	4

Course Code	4CS505ME25
Course Title	Cloud Native Applications and DevOps

Course Learning Outcome:

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

1. summarise the cloud computing services used in modern applications
2. identify the key characteristics of cloud-native applications, including microservices architecture, containerization, and auto-scaling
3. analyse the impact of microservices on application scalability and maintenance.
4. develop a cloud-native application using microservices architecture and containerization technologies

L	T	P	C
3	0	2	4

Course Code	4CS506ME25
Course Title	Agile Software Development

Course Learning Outcome:

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

1. implement continuous integration using essential design principles, refactoring, and version control
2. examine customer needs and market conditions, ensuring that the software they develop remains relevant and valuable
3. evaluate the significance of integrating agile methodologies and development practices within the business
4. develop testing activities seamlessly within the framework of an agile project

L	T	P	C
3	0	2	4

Course Code	4CS507ME25
Course Title	Advances in Programming

Course Learning Outcome:

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

1. illustrates techniques for GPU- GPU-accelerating applications with CUDA
2. analyse the Parallel Computing Platform and Programming Model
3. develop the client-server model in networking applications
4. develop scalable and high-performance applications using GO programming language

L	T	P	C
3	0	2	4

Course Code	4CS207ME25
Course Title	Network Administration and Security

Course Learning Outcome:

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

1. demonstrate the principles and practices of network administration
2. solve network infrastructure issues
3. design and implement network infrastructure
4. plan, secure, and optimize network infrastructure

L	T	P	C
3	0	2	4

Course Code	4CS208ME25
Course Title	Web Performance Optimization

Course Learning Outcome:

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

1. summarise the importance of Web Performance
2. apply Optimization Techniques to improve the web performance
3. analyse the web performance data using tools and metrics
4. create a web performance improvement plan, implementing various optimization techniques

Minor in Data Science (Elective Course - II)

L	T	P	C
3	0	2	4

Course Code	**4CS101ME25**
Course Title	**Big Data Systems**

Course Learning Outcome:

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

1. outline the significance and challenges of big data
2. model big data applications using various platforms
3. utilise big data systems for practical business analytics
4. compare data mining algorithms for extracting knowledge from extensive datasets

L	T	P	C
3	0	2	4

Course Code	**3CS402CC24**
Course Title	**Cloud Computing**

Course Learning Outcome:

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

1. explain the importance of virtualization in support of cloud computing
2. classify the services and deployment models of the cloud
3. determine the issues related to cloud computing
4. develop an application exhibiting the features of the cloud

L	T	P	C
3	0	2	4

Course Code	4CS212IE25
Course Title	Financial Data Security Management

Course Learning Outcome:

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

1. identify the different data security technologies and their management
2. compare cryptographic techniques for data security
3. evaluate cybersecurity threats and vulnerabilities for financial data security
4. design the applications based on blockchain technology for the financial sector

L	T	P	C
3	0	2	4

Course Code	4CS106IE25
Course Title	Information Retrieval and Systems

Course Learning Outcome:

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

1. relate the concepts and various components of information retrieval systems
2. apply theoretical foundations for the development of information retrieval systems
3. choose design and evaluation parameters for information retrieval systems
4. develop practical skills to handle and design information retrieval systems

Minor in Computer Science (Elective Course - II)

L	T	P	C
3	0	2	4

Course Code	**4CS508IE25**
Course Title	**Object Oriented Programming**

Course Learning Outcome:

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

1. explain procedural and object-oriented paradigms and principles
2. relate the concepts of object-oriented design with principles of object-oriented programming
3. apply exception handling, input-output operations, and multi-threading concepts for application development
4. develop programs using object-oriented concepts

L	T	P	C
3	0	2	4

Course Code	**3CS509IC24**
Course Title	**Principles of Software Engineering**

Course Learning Outcome:

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

1. explain various phases of the software development lifecycle
2. analyse and document the requirement specifications for a software project
3. evaluate the process model using standard tools and methodologies
4. design a prototype considering all aspects of SDLC

L	T	P	C
3	0	2	4

Course Code	**4CS107IE25**
Course Title	**Data Science**

Course Learning Outcome:

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

1. relate statistical and pre-processing methods as the basis of the data science domain
2. select appropriate techniques and computing environments for applications under consideration
3. apply and evaluate a variety of algorithms on different types of data
4. design new solutions to solve problems in diverse domains

Minor in Software Engineering (Elective Course - II)

L	T	P	C
3	0	2	4

Course Code	**4CS506IE25**
Course Title	**Agile Software Development**

Course Learning Outcome:

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

1. implement continuous integration using essential design principles, refactoring, and version control
2. examine customer needs and market conditions, ensuring that the software they develop remains relevant and valuable
3. evaluate the significance of integrating agile methodologies and development practices within the business
4. develop testing activities seamlessly within the framework of an agile project

L	T	P	C
3	0	2	4

Course Code	4CS510IE25
Course Title	Secured Software Engineering

Course Learning Outcome:

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

1. explain the significance of incorporating security during the development of software systems
2. apply the security measures to various stages of the software development process
3. analyse approaches for identifying security defects and vulnerabilities in software systems
4. compare the security testing tools for secure software systems

L	T	P	C
3	0	2	4

Course Code	4CS504ME25
Course Title	Software Project Management

Course Learning Outcome:

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

1. explain basic project management concepts, framework, and process models
2. experiment with various software process models and software effort estimation techniques
3. evaluate the checkpoints, project reporting structure, project progress, and tracking mechanisms using project management principles
4. develop skills in the use of modern software project management and development tools

Minor in Adaptive AI (Elective Course - II)

L	T	P	C
3	0	2	4

Course Code	**4CS103DE25**
Course Title	**Explainable AI**

Course Learning Outcome:

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

1. demonstrate the concepts within Explainable AI and interpretable machine learning
2. identify current techniques for generating explanations from black-box machine learning methods
3. analyse current ethical, social, and legal challenges related to Explainable AI skills and abilities
4. assess Explainable AI methods for the given applications

L	T	P	C
3	0	2	4

Course Code	**4CS104DE25**
Course Title	**MLOps**

Course Learning Outcome:

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

1. apply version control techniques to manage machine learning code and models
2. implement data pipelines and feature engineering workflows for machine learning projects
3. build scalable and reproducible machine learning pipelines using containerization
4. deploy ML models ensuring scalability, reliability including strategies for model retraining, updates, CI/CD

L	T	P	C
3	0	2	4

Course Code	**4CS105DE25**
Course Title	**Securing AI Models**

Course Learning Outcome:

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

1. explain the security fundamentals related to AI models and their standards
2. apply ethical considerations and responsibilities associated with AI development and security
3. make use of the best practices for handling sensitive data in AI applications while ensuring compliance with relevant laws and standards
4. analyse the security measures for AI models, including projects for deployment purpose

Minor in Cyber Security (Elective Course - II)

L	T	P	C
3	0	2	4

Course Code	**4CS209DE25**
Course Title	**Intrusion Detection and Prevention Systems**

Course Learning Outcome:

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

1. outline various IDPS technologies, both signature-based and anomaly-based, including their strengths and weaknesses
2. interpret the fundamental concepts and principles of cybersecurity, including the importance of intrusion detection and prevention
3. examine various IDPS to assess its effectiveness in identifying and preventing intrusions
4. evaluate different deployment strategies for IDPS in various network environments, including host-based, network-based, and hybrid solutions

L	T	P	C
3	0	2	4

Course Code	4CS210DE25
Course Title	Embedded System Security

Course Learning Outcome:

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

1. relate the fundamentals of embedded firmware, hardware, and software vulnerabilities and their causes
2. apply the knowledge of tools and technologies to exploit the vulnerabilities related to embedded systems
3. implement appropriate countermeasures against the introduced attacks
4. design hardware-based trust platforms and implement physically unclonable functions

L	T	P	C
3	0	2	4

Course Code	4CS211DE25
Course Title	Surveillance and Analytics

Course Learning Outcome:

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

1. illustrate types of surveillance systems and their components and summarize objectives of analysing surveillance data
2. identify key surveillance system components and analytical pipeline, applying preprocessing techniques to enhance video analysis
3. assess different analytics tasks on surveillance data and adapt existing techniques and models for them
4. create intelligent models using machine learning and deep learning for different surveillance tasks

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L	T	P	C
0	0	0	12

Course Code	**4FT902CC25**
Course Title	**Internship / Research Project**

Course Learning Outcome:

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

1. identify and outline problem(s) related to industry needs
2. select the appropriate modern tool(s) and technique(s) for problem solving
3. take part in collaborative activities and team work
4. appraise and adapt work culture and processes of the industry
5. value the health, environment, safety and ethical practices
6. compile the technical report and present amongst peers and faculty / mentors
7. develop life-long learning skills for a productive career