



MANIPAL

ACADEMY *of* HIGHER EDUCATION

(Institution of Eminence Deemed to be University)

Master of Engineering - M.E in Computer Science and Engineering

Syllabus

July 2025 Onwards

**MANIPAL SCHOOL OF INFORMATION SCIENCES
MANIPAL ACADEMY OF HIGHER EDUCATION
MANIPAL - 576104.KARNATAKA. INDIA.**



Program Educational Objectives / Outcomes (PEOs)

PEO1: Enable to draw upon fundamental and advanced knowledge to apply analytical and computational approaches to solve technological problems in computer science.

PEO2: Introduce state of art technologies in computer science and inculcate ethical practices to make industry-ready professionals.

PEO3: Promote scientific and societal advancement through research and entrepreneurship.

Program Objectives / Outcomes (POs)

PO1: An ability to independently carry out research / investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: An ability to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: An ability to develop software based on theoretical principles and practical knowledge.

PO5: An ability to demonstrate knowledge of the underlying principles and evaluation methods for analyzing and decision-making.



Program Structure

I Semester	II Semester
Applied Generative AI and Machine Learning	Deep Learning
Principles of Data Visualization	Modern Databases for Big Data
Cloud Application with JAVA and Database with Java	Device Drivers
Data Structures and Algorithms	Elective - I
Real Time Operating Systems	Elective - II
Mini Project - I	Mini Project - I
Professional Skill Development - I	Professional Skill Development - I

Associated Labs

List of Electives

Elective - I	Elective - II
Convolutional Neural Networks for Computer Vision	Natural Language Processing Principles and Applications
Web Security and Secure Coding	Machine Learning for Cybersecurity
DevOps for Cloud	Cloud Operations
Cloud Security Essentials	IT Project Management
Entrepreneurship	

III & IV Semesters - Project Work



SEMESTER I

Applied Generative AI and Machine Learning

Course Outcomes:

1. Apply different types of supervised and unsupervised machine learning algorithms to practical problems.
2. Analyse different types of machine learning paradigms.
3. Effectively apply large language models for practical problems.

Course Overview:

This is a beginner-level course on core concepts in machine learning and generative AI. Starting with an overview of different types of machine learning, it introduces decision tree models (classification, regression, and pruning), linear regression, and logistic regression. After that, it explores ensemble methods like bagging (random forests) and boosting, as well as clustering techniques (K-means, hierarchical clustering) and dimension reduction (PCA). The final unit dives into practical aspects of generative AI, focusing on prompt engineering, fine-tuning large language models (LLMs), and applying reinforcement learning in real-world AI projects.

Principles of Data Visualization

Course Outcomes:

1. Implement web scrapping techniques to extract data from websites.
2. Organize raw data for analysis using data manipulation techniques.
3. Interpret data using data visualization techniques.

Course Overview:

The main goal of this course is to teach the fundamentals of data visualization and how to communicate effectively with data using appropriate visual aids. This course also introduces state-of-the-art data visualization tools and software with case studies and will equip students with essential skills to create engaging, informative, and compelling stories based on data.

Cloud Application with JAVA and Database with Java

Course Outcomes:

1. Apply Java programming techniques and data interface concepts for application development.
2. Analyze the techniques to be used for high availability and fault tolerant cloud applications.
3. Understand the Cloud application architecture and design principles.



Course Overview:

This course equips students with core Java programming skills and object-oriented principles for application development. It introduces relational database design and integration using JDBC for standalone and web applications. Students explore modern database systems including NoSQL and cloud-based storage solutions. The course emphasizes cloud application architecture, focusing on scalability, availability, and design methodologies like SOA and MVC. It prepares learners to build fault-tolerant, data-driven cloud applications using industry-relevant tools and practices.

Data Structures and Algorithms

Course Outcome

1. Analyze the implementations of elementary data structures.
2. Design and implementation of data structures like trees and graphs.
3. Analyze the concepts of divide and conquer, dynamic programming, greedy, and back tracking techniques to efficiently solve problems.

Course Overview:

Introduction, Algorithm Analysis Techniques, Elementary data structures, Sorting & Searching Techniques, Operations on Sets, Trees, Graphs, Algorithm Design Techniques

Real Time Operating Systems

Course Outcome

1. Evaluate the features of OS, RTOS, processes and process scheduling algorithms.
2. Analyze various techniques for addressing synchronization, deadlock and memory management.
3. Evaluate schedulability in real time systems.

Course Overview:

Introduction to OS and RTOS, Process Management, Multithreaded Programming, Process Scheduling, Synchronization, Deadlocks, Memory Management, Real Time Systems.



SEMESTER II

Deep Learning

Course Outcomes:

1. Design and analyze deep learning models for application problems.
2. Formulate techniques for improving the way neural networks learn.
3. Select appropriate deep learning models for application problems.

Course Overview:

This course provides a comprehensive introduction to deep learning and its impactful real-world applications. Students will explore essential concepts like neural networks, deep learning algorithms, and frameworks, along with its practical uses. The course combines theoretical insights with hands-on exercises to show how deep learning can foster innovation and enhance decision-making. Participants will learn to apply deep learning techniques to solve real-world problems. By the end, students will be prepared to use deep learning to drive strategic growth and gain a competitive edge.

Modern Databases for Big Data

Course Outcomes:

1. Analyze different types of data models and design queries to handle different data types.
2. Evaluate different consistency models.
3. Apply the knowledge of SQL and NoSQL data models.

Course Overview:

Introduction to growth of traditional and modern database systems, introduction to RDBMS, SQL - NoSQL Database, Distribution models for scalability, Consistency Models, Case study: Key-Value Databases, Beyond NoSQL

Device Drivers

Course Outcomes:

1. Demonstrate the development of character drivers.
2. Examine the importance of time and handle concurrency in device drivers.
3. Examine the usage of dynamic memory and communication with hardware.

Course Overview:



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Introduction to Device Drivers, Building & Running Modules, Character Driver, Debugging Techniques, Concurrency and Race Condition, Advanced Character Driver Operations, Time, Delay and Deferred Work, Allocating Memory, Communicating with Hardware, Interrupt Handling, PCI Drivers, USB Drivers

ELECTIVES - I

Convolutional Neural Networks for Computer Vision:

Course Outcomes:

1. Analyze computer vision techniques and CNNs for solving real-world problems.
2. Analyze the building blocks of CNNs.
3. Evaluate CNN architecture for real-world application problems.

Course Overview:

This course covers key concepts in computer vision and Convolutional Neural Networks (CNNs). It begins with an introduction to computer vision, exploring image processing, convolution's role in image enhancement, and various colour models. It then delves into CNNs, covering network layers, loss functions, and techniques like region of interest pooling. The second unit focuses on CNN training, including weight initialization, regularization, and different gradient descent methods, as well as tackling overfitting and underfitting. The final unit examines CNN architectures and their applications in image classification, segmentation, and object detection/localization.

Web Security and Secure Coding:

Course Outcome

1. Analyse common web application threats, vulnerabilities, and threat modeling strategies to assess risk and propose appropriate counter measures.
2. Apply secure coding practices to mitigate client-side attacks by implementing appropriate counter measures.
3. Evaluate API vulnerabilities and implement security measures.

Course Overview:

Hacking Web Applications, Client-Side Attacks, Defenses & Secure Coding, API Security & Secure Coding Practices, Web Application Infrastructure Security, Web Threat Modelling.

DevOps for Cloud

Course Outcomes:

1. Understand existing Software Methodologies and DevOps Life Cycle stages.
2. Analyze and implement software product development using DevOps methodologies and tools.



3. Apply configuration management and automation templates to provision infrastructure and

Course Overview:

DevOps course provides a comprehensive introduction to modern software development and IT operations practices. It covers essential tools and concepts including Continuous Integration/Continuous Deployment (CI/CD), version control with Git, containerization using Docker, and orchestration with Kubernetes. Learners will explore infrastructure as code with tools like Ansible and Terraform, along with monitoring and logging using Prometheus and Grafana. The course emphasizes automation, collaboration, and agility to bridge the gap between development and operations teams. Ideal for developers, system admins, and IT professionals aiming to enhance software delivery and system reliability.

Cloud Security Essentials

Course Outcomes:

1. Demonstrate the use of identity and access management features of AWS.
2. Demonstrate the available methods for securing data and infrastructure.
3. Examine logging and monitoring services to identify the incidence.

Course Overview:

This course focuses on cloud security fundamentals with a strong emphasis on AWS identity and access management (IAM) practices. It introduces threat modeling, shared responsibility models, and securing access to cloud resources. Learners will explore how to protect cloud infrastructure using VPCs, subnets, security groups, and data encryption. The course also covers securing SQL databases, monitoring AWS environments using built-in logging tools, and effectively responding to security incidents. Real-world AWS examples and best practices are integrated throughout for hands-on learning.

Entrepreneurship

Course Outcomes:

1. Explain the importance of entrepreneurship and entrepreneurial development model, and social responsibilities of business.
2. Describe Entrepreneurial Traits and Factors affecting Entrepreneurship process.
3. Discuss Business Start-up Process.
4. Summarize a business and marketing plan for entrepreneurs.

Course Overview:

This course provides a comprehensive introduction to entrepreneurship, beginning with its definition, key theories, and the distinction between entrepreneurs and managers. It explores entrepreneurial traits and types, followed by the process and factors influencing entrepreneurship. The course then covers the business start-up process, including idea generation and environmental analysis, and guides students in writing effective business plans. It concludes with case studies of Indian and international entrepreneurs to illustrate real-world applications.



ELECTIVES - II

Natural Language Processing Principles and Applications

Course Outcomes:

1. Understand text processing for information extraction and retrieval.
2. Compare and contrast state-of-the-art word vectorization models for real-world problems.
3. Apply deep learning-based approaches for natural language processing tasks.

Course Overview:

This course introduces students to the field of natural language processing (NLP) and its real-world applications. Students will learn foundational techniques such as text processing, language modeling, and word embeddings, along with practical tools for sentiment analysis and recommender systems. The syllabus also covers advanced concepts like transformer-based language models, providing insights into cutting-edge NLP technologies. With a focus on real-world examples, the course equips students to leverage NLP for solving challenging business problems

Machine Learning for Cybersecurity

Course Outcomes:

1. Demonstrate various data analytics and data visualization techniques for cybersecurity applications.
2. Implement and assess various machine learning models to detect and mitigate security threats.
3. Analyze adversarial machine learning techniques and generative AI for cybersecurity applications.

Course Overview:

Introduction to Data Analytics, Visualization Techniques for Security Data, Introduction to Machine Learning, Machine Learning Algorithms for Security, Adversarial Machine Learning & Attacker Techniques, Generative AI and Cybersecurity Applications

Cloud Operations

Course Outcomes:

1. Understand the architectural decisions and use cloud services to build decoupled serverless microservices.
2. Analyze the tools specific to cloud operations engineer to create reusable compute and networking cloud infrastructures.
3. Apply cloud architecting solutions to manage, automate, secure, and monitor highly available and fault tolerant infrastructures.

Course Overview:



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This course focuses on designing decoupled, serverless microservices architectures using AWS services like Lambda, ECS, SQS, and API Gateway. Students will learn to build resilient cloud-native applications with caching, disaster recovery, and hybrid storage strategies. It introduces tools for cloud operations including IAM, CLI, AWS Systems Manager, and automation techniques. Key topics include scaling, load balancing, DNS management with Route 53, and monitoring using CloudWatch and CloudTrail. The course also covers infrastructure as code, configuration management, and CI/CD practices for managing highly available and fault-tolerant cloud environments.

IT Project Management

Course Outcomes:

1. Illustrate the importance of project planning.
2. Discuss and demonstrate various tools applicable for different phases of the software project.
3. Illustrate the importance of Change management.
4. Illustrate the importance of teamwork and demonstrate the usefulness of tools in effective handling of the project.
5. Compare the problems in projects that don't follow the process and discuss new trends in software life cycle.

Course Overview:

This course introduces the fundamentals of software project planning and emphasizes its critical role in successful project execution. Students will explore key estimation techniques, scheduling, and commitment management across multiple projects. The course covers various review methodologies like inspections and walkthroughs, along with best practices in requirements gathering, design, programming, and testing. Topics also include change management, leadership, outsourcing challenges, and continuous process improvement to ensure software quality and project success.

Director
Manipal School of Information Sciences