



Marathwada Mitra Mandal's

COLLEGE OF ENGINEERING, Karvenagar, Pune - 52

An Autonomous Institute affiliated to SPPU

Website: www.mmcoe.edu.in

email id: mmcoe@mmcoe.edu.in

Double Minor Courses

The list of Double Minor courses to be offered from the academic year 2026-27.

Undergraduate Programme	
Branch	Double Minor Courses
Electrical Engineering	Intelligent Energy-Efficient Electrical Technologies
Mechanical Engineering	CAD/CAM
	SAP
Electronics and Telecommunication Engineering	Drone Technology
Information Technology	Full Stack Development
Computer Engineering	Computing Algorithm
Artificial Intelligence and Data Science	Data Science

Dr. H. M. Jadhav
Associate Dean MDM, OE & Honours Degree

Dr. B. P. Vasgi
Dean Academics

Dr. S. R. Sakhare
Principal

Applicability for Double Minor Courses Registration

Sr. No.	Offered by BoS	Double Minor Courses	Courses Applicable to Students from the Departments					
			Electrical Engg.	Mechanical Engg.	E&TC Engg.	IT	Computer Engg.	AI&DS
1	Electrical Engineering	Intelligent Energy-Efficient Electrical Technologies	N	Y	Y	Y	Y	Y
2	Mechanical Engineering	CAD/CAM	Y	N	Y	Y	Y	Y
		SAP	Y	Y	Y	Y	Y	Y
3	E&TC Engineering	Drone Technology	Y	Y	Y	Y	Y	Y
4	IT	Full Stack Development	Y	Y	Y	N	N	N
5	Computer Engineering	Computing Algorithm	Y	Y	Y	N	N	N
6	AI&DS	Data Science	Y	Y	Y	N	N	N

Marathwada Mitra Mandal's College of Engineering

Karvenagar, Pune- 52

An Autonomous Institute Affiliated to SPPU



“येथे बहुतांचे हित”

Curriculum Structure and Syllabus

Double Minor

A.Y. 2026-27

Accredited with A++ grade by NAAC
Recipient of Best College award by SPPU | Accredited by NBA
Recognized under 2(f) and 12(B) of UGC Act 1956
www.mmcoe.edu.in

About Marathwada Mitra Mandal's College of Engineering

MMCOE has been recognised as the BEST COLLEGE by SPPU. MMCOE is one feather in the cap of Marathwada Mitra Mandal's Pune, from the academic year 2006 – 2007.

The Institute offers six undergraduate engineering programmes in Electrical Engineering, Mechanical Engineering, Electronics & Telecommunication Engineering, Information Technology, Computer Engineering, and Artificial Intelligence & Data Science. In addition, it offers six postgraduate programmes M.Tech (Electrical – Power Electronics & Drives), M.Tech (Mechanical – Design Engineering), M.Tech (Electronics & Telecommunication – VLSI & Embedded Systems), M.Tech (Information Technology – Data Science), M.Tech (Computer Engineering), along with a Ph.D. programme in Computer Engineering. It houses 2000+ students and 200 staff members. Along with the focus on core academics, college also takes care of overall personality development of the students.

The college has an active robotics cell, NCC, Training and Placement cell etc. The students are motivated to actively participate in co-curricular and extra-curricular activities. They have brought many laurels to the Institute in the events such as Vinodottam Karandak, Firodiya Karandak, Zest, Dexterity etc.

Institute Vision

To be a globally renowned institution through excellence in engineering education for sustainable and holistic development

Institute Mission

M1: Empower students with cutting-edge technologies and global competencies

M2: Foster culture of research and entrepreneurial mindset

M3: Imbibe social and professional values

M4: Provide an inclusive environment for lifelong learning



**Department of
Electrical Engineering**

“येथे बहुतांचे हित”

Vision and Mission of the Department

- **Vision**

To be center of excellence in electrical engineering by developing globally skilled professionals through innovation, sustainability and technological growth.

- **Mission**

M1: To provide quality education in electrical engineering through multidisciplinary, practical and industry oriented learning.

M2: To develop ethical and skilled engineers with expertise in emerging electrical technologies.

M3: To nurture lifelong learning and adaptability for addressing global, societal and future challenges.

- **Program Specific Outcomes (PSOs)**

After successfully completing the degree program. Electrical engineering graduates will be able to:

PSO1: Design and validate efficient electrical system through core and professional skills .

PSO2: Exhibit multidisciplinary skills in the area of Robotics, AI and Machine Learning for Electrical engineering applications.

PSO3: Formulate sustainable solutions for research in societal and industrial needs pertaining to green technology.

“येथे बहुतांचे हित”

- **Program Outcomes (POs)**

P01: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

P02: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

P03: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

P04: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

P05: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

P06: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

P07: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

P08: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

P09: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

P010: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

P011: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

**Curriculum for B. Tech. with Double
Minor in Intelligent Energy-Efficient
Electrical Technologies**

“येथे बहुतांचे हित”

Department of Electrical Engineering

General Objectives and Scope:

The Double Minor programme is designed to provide undergraduate students with an opportunity to gain additional knowledge and skills in disciplines beyond their primary field of study. It enables students to develop interdisciplinary competencies by pursuing structured courses in two allied or emerging areas, thereby enhancing their academic depth and professional versatility.

The main objective of the Double Minor programme is to broaden the intellectual horizon of students and equip them with multidisciplinary knowledge that complements their core engineering specialization. By studying two minor specializations, students can explore emerging technologies, develop cross-domain expertise, and strengthen their analytical and problem-solving abilities.

The programme encourages flexibility in learning, allowing students to select minor subjects based on their interests, career aspirations, and industry requirements. This approach supports holistic education and promotes innovation by enabling students to integrate concepts from different engineering domains.

Why Intelligent Energy-Efficient Electrical Technologies?

The growing demand for electrical energy, rapid industrialization, and increasing environmental concerns have made it essential to adopt **intelligent and energy-efficient electrical technologies**. These technologies focus on optimizing energy consumption, reducing energy losses, and improving the overall performance and reliability of electrical systems.

One of the primary reasons for adopting intelligent energy-efficient technologies is the **need for energy conservation**. Traditional electrical systems often experience significant energy losses during generation, transmission, distribution, and utilization. Intelligent technologies such as smart monitoring systems, advanced control algorithms, and automated energy management systems help in minimizing these losses and improving overall system efficiency.

Furthermore, these technologies support the development of modern electrical infrastructures, including smart grids, smart buildings, electric vehicles, and intelligent power distribution networks. They play a key role in achieving sustainable development goals and ensuring long-term energy security.



Prerequisites:

- Basic Electrical Engineering
- Electrical Machines
- Power Electronics
- Energy Storage Systems
- Basic Electronics and Sensors
- Fundamentals of Renewable Energy
- Instrumentation and Sensors
- Fundamentals of Energy Management and Renewable Energy



B. TECH DOUBLE MINOR IN Intelligent Energy-Efficient Electrical Technologies

(Semester IV, V, VI, VII, VIII)

Curriculum Structure

Course Code	Course Name	Teaching Scheme (Hrs/week)				Examination Scheme						Credits				
		L	P	T	ODL	CIE	ETE	TW	PR	OR	Total	L	P	T	ODL	Total
Semester IV																
EE24DMN291R	Intelligent Sensors and Smart Instrumentation	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
EE24DMN292R	Intelligent Sensors and Smart Instrumentation TUT	-	-	1	-	-	-	25	-	-	25	-	-	1	-	1
Semester V																
EE24DMN341R	IoT-Based Energy Monitoring and Control	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
EE24DMN342R	IoT-Based Energy Monitoring and Control TUT	-	-	1	-	-	-	25	-	-	25	-	-	1	-	1
Semester VI																
EE24DMN391R	Intelligent Energy Management Systems	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
EE24DMN392R	Intelligent Energy Management Systems TUT	-	-	1	-	-	-	25	-	-	25	-	-	1	-	1
Semester VII																
EE24DMN441R	Course on Microgrids	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
EE24DMN442R	NPTEL Course on Microgrids	-	-	-	1	-	-	25	-	-	25	-	-	-	1	1
Semester VIII																
EE24DMN491R	Capstone Project / Industrial Case Study in Energy Efficiency	-	8	-	-	-	-	100	-	-	100	-	4	-	-	4
Total																
Total		12	8	3	1	160	240	200	-	-	600	12	4	3	1	20

L- Lecture

ETE- End Term Examination

L : 1 Hr= 1 credit

P- Practical

TW- Term work

P: 2 Hr. = 1 Credit

T- Tutorial

PR- Practical

T: 1 Hr. = 1 Credit

CIE-Continuous Internal Evaluation

OR- Oral

ODL-Open Distance Learning

Note: Mode of conduction of ETE will be decided by course coordinator in the supervision of BoS chairperson

Semester-IV														
Course Code: EE24DMN291R					Course Name: INTELLIGENT SENSORS AND SMART INSTRUMENTATION									
Teaching Scheme (Hours/Week)				Examination Scheme						Credits				
L	P	T	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
3	-		-	40	60	-	-	-	100	3	-	-	-	3
Prerequisite: Basic Electronics (analog & digital), Fundamentals of Transducers and Sensors, Signals and Systems / Measurement Systems, Microprocessors / Embedded Systems (desirable)														
Course Objectives: • Introduce intelligent sensors, smart instrumentation, and sensing technologies • Understand signal conditioning, interfacing, and data acquisition techniques • Provide knowledge of sensor fusion and adaptive/virtual sensors • Analyze smart sensor network architectures • Explore recent trends, standards, and applications in intelligent sensing														
Course Outcomes: After learning the course, the students will be able to: C01: Explain the working principles of intelligent sensors and smart instruments C02: Analyze signal conditioning and sensor interfacing techniques C03: Differentiate types of smart sensors and their applications C04: Design basic signal acquisition and processing structures C05: Evaluate standards, trends, and future scopes in intelligent sensing systems														
Unit	Contents										Duration (Hrs.)			
1	Introduction to Sensors and Instrumentation Definition and classification of sensors, transducers, instruments, Static and dynamic characteristics, Error sources, accuracy, precision, resolution, sensitivity, Instrumentation system overview and measurement, Smart vs conventional sensors, Components of smart sensors, Self-validation, self-adaptation, virtual sensors, Soft sensors and sensor fusion basics.										8			
2	Signal Conditioning and Interfacing Need for signal conditioning, Amplification, filtering, linearization, ADC/DAC, bridge circuits, Noise reduction techniques, Microelectromechanical Systems (MEMS), MEMS concepts and fabrication, MEMS accelerometers, pressure sensors, gyros, Integration with electronics and system-on-chip architectures										9			
3	Intelligent Network Sensors Sensor networks and architectures, Wireless Sensor Networks (WSN) basics, Gateway design and sensor-to-Internet communication, IoT integration with sensors, Calibration procedures Analog and digital linearization, Error compensation techniques, Environmental compensation.										8			
4	Data Acquisition and Processing Data acquisition fundamentals, Sampling theorem and aliasing, DAQ hardware and software, Real-time data logging, IEEE 1451 family of smart sensor standards, Interoperability considerations, Sensor plug-and-play concepts, Standard protocols and industrial interfaces										7			
5	Applications of Smart Instrumentation and future directions Industrial automation and process control, Automotive sensor systems, Biomedical and environmental sensing, Robotics and autonomous systems, Intelligent sensing with AI/ML, Edge computing for sensor networks, Security, privacy in sensor data, Smart materials and self-powered sensors.										8			

Total Hours		40
Text Books		
1. A.D. Helfrick & W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI / Pearson, 2016 2. Rangan, C. S., Sarma, G. R., & V. S. V. Mani, "Embedded Systems with ARM Cortex-M Microcontrollers", Instrumentation: Devices and Systems, McGraw-Hill, 2011 3. Stoyan Nihtianov & Antonio Luque, "Smart Sensors and MEMS: Intelligent Devices and Microsystems for Industrial Applications", Woodhead Publishing, 2018		
Reference Books		
1. Randy Frank, "Understanding Smart Sensors", Artech House, 2013 2. John G. Webster & Ramón Pallás-Areny, "Sensors and Signal Conditioning", John Wiley & Sons, 2000. 3. Bela G. Lipták, "Instrument Engineers' Handbook", CRC Press, 2012. 4. Stephan Beeby & Neil White, "Electric Drives: Concepts and Applications", Artech House, 2004.		
Online References		
1. NPTEL Course: Prof. Banibrata Mukherjee, IIT Kharagpur, "Embedded Sensing, Actuation and Interfacing Systems" (https://nptel.ac.in/courses/noc26_ee68). 2. NPTEL Course: Prof. Mitradip Bhattacharjee, IISER Bhopal, "Sensor Technologies: Physics, Fabrication, and Circuits" (https://nptel.ac.in/courses/noc25_ee108) 3. NPTEL Course: Prof. Ankur Gupta, IIT Delhi, "Transducers for Instrumentation" (https://nptel.ac.in/courses/noc26_ee29)		

“येथे बहुतांचे हित”

Second Year B. Tech. Electrical Engineering	
Semester- IV	
Course Code: EE24DMN292R	Course Name: INTELLIGENT SENSORS AND SMART INSTRUMENTATION

Teaching Scheme (Hours/Week)				Examination Scheme						Credits				
L	P	T	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
-	-	1	-	-	-	25	-	-	25	-	-	1	-	1
Prerequisite Basic Electronics (analog & digital), Fundamentals of Transducers and Sensors, Signals and Systems / Measurement Systems, Microprocessors / Embedded Systems (desirable)														
Course Objectives: - Introduce the principles of intelligent sensors and smart instrumentation systems - Develop understanding of sensor characteristics, errors, and calibration - Apply signal conditioning and interfacing techniques - Analyze smart sensor architectures and communication standards - Explore advanced sensing technologies and real-world applications														
Course Outcomes: After learning the course, the students will be able to: C01: Explain the operating principles of intelligent sensors C02: Analyze signal conditioning and data acquisition techniques C03: Apply calibration and compensation methods C04: Design basic smart instrumentation blocks C05: Evaluate advanced sensor systems and emerging trends														
Tutorial	Contents										Duration (Hrs.)			
1	Sensor Characteristics & Performance Analysis - Static and dynamic characteristics - Accuracy, precision, sensitivity, resolution - Error analysis and uncertainty - Performance comparison of sensors										2			
2	Signal Conditioning Techniques - Amplification and filtering - Bridge circuits and linearization - Noise sources and noise reduction - ADC selection and resolution calculation										2			
3	Smart Sensor Architecture - Smart sensor blocks - Embedded intelligence in sensors - Self-calibration and self-diagnostics - Virtual sensors and sensor fusion basics										1			
4	Calibration & Compensation - Calibration procedures - Analog vs digital compensation - Environmental compensation - Case studies on industrial sensors										1			
5	Data Acquisition Systems - Sampling and aliasing - DAQ hardware and software - Multiplexing and timing - Real-time data logging										2			

6	MEMS Sensors - Working principles of MEMS sensors - Accelerometers, pressure sensors, gyroscopes - Sensitivity and bandwidth calculations - MEMS sensor applications	1
7	Sensor Networks & IoT - Wireless sensor networks (WSN) - IoT-based smart instrumentation - Communication protocols - Energy management in sensor nodes	4
8	Smart Sensor Standards - IEEE 1451 smart sensor standard - Plug-and-play sensors - Interoperability issues - Industrial communication standards	1
9	Application-Based Case Studies - Industrial process monitoring - Automotive and EV sensors - Biomedical instrumentation - Environmental monitoring	2
10	Emerging Trends & Research Topics - AI/ML in sensing - Edge computing and intelligent sensors - Self-powered and nano-sensors - Future challenges and opportunities	2
Total Hours		15

Sr.No.	List of Tutorials
1	Numerical problems on static characteristics and error analysis of sensors.
2	Design and analysis of signal conditioning circuits for sensor outputs.
3	Block-level design of a smart sensor system using embedded processing.
4	Calibration and compensation techniques with real industrial examples.
5	DAQ system design and sampling rate calculations.
6	Performance analysis of MEMS accelerometers and gyroscopes.
7	Case study on wireless sensor networks and IoT-based instrumentation.
8	Study and comparison of smart sensor standards (IEEE 1451).
9	Application-oriented case studies (EVs / automation / healthcare).
10	Mini-review on emerging intelligent sensor technologies.

Text Books

- A.D. Helfrick & W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI / Pearson, 2016
- Rangan, C. S., Sarma, G. R., & V. S. V. Mani, "Embedded Systems with ARM Cortex-M Microcontrollers," Instrumentation: Devices and Systems, McGraw-Hill, 2011
- Stoyan Nihtianov & Antonio Luque, "Smart Sensors and MEMS: Intelligent Devices and Microsystems for Industrial Applications", Woodhead Publishing, 2018

Reference Books

- Randy Frank, "Understanding Smart Sensors", Artech House, 2013

- ## Online References

1. NPTEL Course: Prof. Banibrata Mukherjee, IIT Kharagpur, “Embedded Sensing, Actuation and Interfacing Systems”(https://nptel.ac.in/courses/ noc26_ee68).
2. NPTEL Course: Prof. Mitradip Bhattacharjee, IISER Bhopal, “ensor Technologies: Physics, Fabrication, and Circuits”(https://nptel.ac.in/courses/ noc25_ee108)
3. NPTEL Course: Prof. Ankur Gupta, IIT Delhi, “ Transducers for Instrumentation”(https://nptel.ac.in/courses/noc26_ee29)



Third Year B. Tech. Electrical Engineering														
Semester-V														
Course Code: EE24DMN341R					Course Name: IoT-Based Energy Monitoring and control									
Teaching Scheme (Hours/Week)				Examination Scheme						Credits				
L	P	T	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
Prerequisite: Fundamentals of Internet of Things (IoT), Measurement and Instrumentation Theory, Basics of Energy Systems, Sensors and Signal Conditioning, Communication Networks														

Course Objectives:

- Introduce Internet of Things (IoT) principles and architecture.
- Understand energy monitoring and control using connected devices.
- Learn sensor interfacing and data acquisition for energy systems.
- Apply communication and cloud technologies for energy data analytics.
- Explore control strategies for optimized energy usage in buildings and industries.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Explain IoT architecture and components for energy systems

CO2: Implement energy monitoring using IoT sensors and communication

CO3: Apply real-time data acquisition, cloud integration, and analytics

CO4: Design IoT-based control strategies for energy optimization

CO5: Evaluate security, performance, and scalability challenges in IoT energy systems

Unit	Contents	Duration (Hrs.)
1	Fundamentals of IoT and Energy Systems and Data Acquisition for Energy Monitoring IoT definition, components, architecture, IoT platforms and protocols, Energy systems overview, Smart grids and IoT role in energy monitoring, Types of energy sensors (current, voltage, power), Sensor interfacing with IoT nodes, Signal conditioning and ADC basics, Data acquisition strategies.	8
2	Communication Technologies for IoT and control system Wired vs wireless protocols (Wi-Fi, Zigbee, LoRa, NB-IoT), MQTT, CoAP, HTTP communication Protocol selection for energy systems, Microcontrollers (Arduino, ESP32, Raspberry Pi), Edge computing fundamentals, Local decision making for energy control	9
3	Cloud Integration, Big Data and Energy Monitoring Techniques Sensor networks and architectures, Wireless Sensor Networks (WSN) basics, Gateway design and sensor-to-Internet communication, IoT integration with sensors, Calibration procedures Analog and digital linearization, Error compensation techniques, Environmental compensation.	8
4	Control Strategies for Energy Optimization Automated load control, Feedback control loops Scheduling and priority-based control for appliances, Threats and vulnerabilities in IoT networks, Secure communication (TLS/SSL), Authentication and data privacy	7
5	Emerging Trends and Research Directions Smart homes energy control, Industrial IoT energy management, Demand response use-cases, AI/ML for energy prediction and optimization, Digital twins for energy management, Integration with renewable sources, Internet of Energy (IoE) concepts	8
Total Hours		40

Text Books

1. Arshdeep Bahga & Vijay Madisetti, "Internet of Things: A Hands-On Approach", Universities Press, 2015
2. Pethuru Raj & Anupama C. Raman, "Introduction to IoT", CRC Press, 2017
3. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Morgan Kaufmann, 2016

Reference Books

1. Yen Kheng Tan & Mark Wong, "Energy Harvesting Systems for IoT Applications", CRC Press, 2019
2. John G. Webster & Ramón Pallás-Areny, "Sensors and Signal Conditioning", John Wiley & Sons, 2000.
3. Mo Yousef & others, "IoT in Smart Energy Systems", CRC Press, 2012.

- | |
|-------------------|
| Online References |
|-------------------|

1. NPTEL Course: Prof. Sudip Misra, IIT Kharagpur, “Introduction to Internet of Things”(https://nptel.ac.in/courses/ noc26_cs37).
2. NPTEL Course: Prof. Prabhakar T V, “Design for Internet of Things”(https://nptel.ac.in/courses/ noc21_ee85)



Third Year B. Tech. Electrical Engineering														
Semester-V														
Course Code: EE24DMN342R				Course Name: : IoT-Based Energy Monitoring and control										
Teaching Scheme (Hours/Week)				Examination Scheme						Credits				
L	P	T	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
-	-	1	-	-	-	25	-	-	25	-	-	1	-	1
Prerequisite Internet of Things Fundamentals , Sensors & Signal Conditioning, Basics of Energy Systems, Communication Technologies.														

Course Objectives:

- Develop hands-on understanding of IoT concepts applied to energy measurement.
- Analyze sensor interfacing and data acquisition methods for energy systems.
- Apply communication protocols in real-time energy monitoring.
- Understand and simulate control strategies for energy optimization.
- Evaluate security and performance challenges in IoT-based energy systems.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Analyze sensor data and interpret energy usage patterns.

CO2: Implement and troubleshoot interfacing circuits for energy sensors.

CO3: Apply IoT communication protocols to send and receive data.

CO4: Design and simulate energy control logic.

CO5: Identify security and privacy issues in IoT energy systems.

Tutorial	Contents	Duration (Hrs.)
1	Sensor Interfacing and Signal Conditioning • Interface voltage, current, and power sensors with microcontrollers • Signal conditioning circuits (filters, amplifiers) • Calibration and offset compensation techniques	2
2	Data Acquisition and Sampling • ADC operation and resolution impacts • Sampling theorem and aliasing • Practical sampling exercises using Arduino/ESP32	1
3	IoT Communication Protocols • Implementation using MQTT / HTTP / CoAP • Wi-Fi / NB-IoT / LoRa communication basics • Sending data to cloud or dashboard	1
4	Cloud Integration and Dashboard • Connecting sensors to cloud services • Building real-time dashboards (e.g., ThingsBoard / MQTT dashboards) • Visualizing energy data	1
5	Real-Time Energy Monitoring • Load monitoring techniques • Profiling energy consumption • Comparison between real vs expected energy usage	2
6	Automated Control Logic • Control strategies for energy optimization • Feedback loop design • Instant load control using IoT (e.g., relay actions based on thresholds)	1
7	Security and Data Integrity • Threat modeling for energy IoT system • Encryption / authentication techniques • Security best practices for IoT energy systems	2
8	Performance Evaluation • Latency and throughput measurement in IoT energy systems • Energy consumption overhead of IoT devices • Reliability and availability metrics	1

9	Case Study – Smart Home Energy Control • Implementation scenarios • Monitoring and control flowcharts • Energy savings calculation	2
10	Emerging Trends and Research Challenges • AI/ML for energy forecasting • Edge computing for energy optimization • IoT energy systems with renewables and battery storage	2
Total Hours		15

Sr.No.	List of Tutorials
1	Hands-on with current & voltage sensors, calibration, noise reduction.
2	Numerical exercises on ADC resolution, sampling rate, aliasing.
3	Coding exercises to publish sensor data to MQTT broker.
4	DIY dashboard creation with real-time updates and alarms.
5	Recording and profiling consumption patterns.
6	Security checklist and mitigation mapping.
7	Latency and reliability metrics from captured data.
8	Smart Home Use Case Analysis
9	Group presentation on AI/ML and edge computing for energy systems.
10	Using threshold-based automation for appliances.

Text Books

1. Arshdeep Bahga & Vijay Madisetti, "Internet of Things: A Hands-On Approach", Universities Press, 2015
2. Pethuru Raj & Anupama C. Raman, "Introduction to IoT", CRC Press, 2017
3. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Morgan Kaufmann, 2016

Reference Books

1. Yen Kheng Tan & Mark Wong, "Energy Harvesting Systems for IoT Applications", CRC Press, 2019
2. John G. Webster & Ramón Pallás-Areny, "Sensors and Signal Conditioning", John Wiley & Sons, 2000.
3. Mo Yousef & others, "IoT in Smart Energy Systems", CRC Press, 2012.
4. Dawid Witczak, "Monitoring and Control Systems Based on Internet of Things", Artech House, 2019

Online References

1. NPTEL Course: Prof. Sudip Misra, IIT Kharagpur, "Introduction to Internet of Things" (https://nptel.ac.in/courses/noc26_cs37).
2. NPTEL Course: Prof. Prabhakar T V, "Design for Internet of Things" (https://nptel.ac.in/courses/noc21_ee85).



Third Year B. Tech. Electrical Engineering

	approaches in EMS, Rule-based and adaptive control strategies, Predictive and real-time Load shifting, peak shaving, and valley filling, control techniques, Demand response programs and pricing mechanisms, Intelligent control of distributed energy resources, Reliability, stability, and resilience considerations	
5	Renewable Integration, Storage and Applications Integration of solar and wind energy into EMS, Variability and uncertainty of renewable sources, Role of energy storage systems (BESS), Storage sizing and management strategies, Hybrid energy systems and microgrids, EMS for grid-connected and islanded operation, Energy management for electric vehicles and charging stations, Building and industrial energy management systems, Case studies of intelligent EMS implementations, Future trends: AI-driven, autonomous, and self-healing EMS.	8
Total Hours		40
Text Books		
1. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, "Guide to Energy Management", 8th Edition, CRC Press, 2020. 2. Wayne C. Turner, Steve Doty, "Energy Management Handbook", Fairmont Press, 2020. 3. James Momoh, "Smart Grid: Fundamentals of Design and Analysis", Wiley-IEEE Press, 2012.		
Reference Books		
1. Kwang Y. Lee, Mohamed A. El-Sharkawi, "Artificial Intelligence Techniques in Power Systems", Wiley-IEEE Press, 2008. 2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Wiley, 2013 3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid Technology and Applications", Wiley, 2012. 4. Alfred Rufer, "Energy Storage Systems", CRC Press, 2017.		
Online References		
1. NPTEL Course: Prof. Rangan Banerjee, Prof. G. P. Harrison, IIT Madras Energy Resources, Economics and Environment" (https://nptel.ac.in/courses/noc25_hs18). 2. NPTEL Course: Prof. S. Banerjee, IIT Kharagpur, "Renewable Energy Engineering and Technology" (https://nptel.ac.in/courses/108105058) 3. NPTEL Course: Prof. D. P. Kothari, IIT Delhi, "Electric Power Systems" (https://nptel.ac.in/courses/108102047)		

Semester-VI															
Course Code: EE24DMN392R				Course Name: INTELLIGENT ENERGY MANAGEMENT SYSTEMS											
Teaching Scheme (Hours/Week)				Examination Scheme						Credits					
L	P	T	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	OL	ODL	TOTAL
-	-	1	-	-	-	25	-	-	25	-	-	1	-	-	1
Prerequisite: Basic Electrical Engineering, Power Systems Fundamentals, Electrical Measurements and Instrumentation, Basic Computing Skills															
Course Objectives: - Understand the fundamental concepts, architecture, and components of Energy Management Systems - Analyze energy flow, load profiles, and key energy performance indicators (KPIs) using real and simulated energy consumption data. - Apply energy monitoring, data acquisition, and pre-processing techniques for effective energy analysis and decision-making. - Develop basic load forecasting and optimization models for cost minimization, peak demand reduction, and efficient resource scheduling. - Implement intelligent techniques such as fuzzy logic, ANN, and machine learning concepts for energy prediction and control strategies.															
Course Outcomes: After learning the course, the students will be able to: CO1: Explain the architecture, components, and operational principles of conventional and intelligent Energy Management Systems. CO2: Analyze energy consumption data to determine load profiles, KPIs, efficiency indices, and energy savings potential. CO3: Develop and evaluate short-term and long-term load forecasting models using statistical and basic machine-learning approaches. CO4: Solve energy optimization problems related to cost minimization, peak shaving, load scheduling, and demand response under practical constraints. CO5: Implement intelligent control strategies (fuzzy logic, ANN, rule-based control) for load management and distributed energy resources.															
Tutor ial	Contents										Duration (Hrs.)				
1	Fundamentals of EMS - EMS architecture study - KPI calculations - Energy auditing data preparation - EMS case study of industrial plant										2				
2	Energy Flow Modeling - Single line diagram energy flow analysis - Load and energy balance calculations - Efficiency calculations										2				
3	Energy Monitoring and Smart Metering - Smart meter data interpretation - AMI system block diagram development - Sensor selection and calibration exercises										1				

4	Data Acquisition and Analytics • Data sampling and time synchronization • Energy dataset preprocessing • Dashboard design using sample datasets	1
5	Load Profiling and Pattern Analysis • Daily load curve preparation • Peak demand identification • Load factor and diversity factor calculation	2
6	Load Forecasting Techniques • Time series forecasting using historical load data • Regression-based load prediction • Error evaluation methods	1
7	Optimization in EMS • Economic load scheduling problems • Peak load reduction case study • Constraint-based optimization exercises • Energy management in sensor nodes	1
8	Intelligent Control Techniques • Fuzzy logic controller design example • ANN-based energy prediction case study • Demand response strategy analysis	2
9	Renewable Integration and Storage • Solar and wind power variability analysis • Battery sizing calculations • Microgrid energy management study	1
10	Modern EMS Applications • EV charging station energy scheduling • Building energy management simulation • AI-based EMS case study analysis	2
Total Hours		15
Sr.No.	List of Tutorials	
1	Explain EMS architecture with block diagram.	
2	Calculate energy performance indicators for given load data.	
3	Analyze smart meter data and develop load profile.	
4	Perform preprocessing of raw energy dataset.	
5	Forecast load using time-series method.	
6	Solve cost minimization scheduling problem.	

7	Design fuzzy controller for load management.
8	Compare ANN and statistical forecasting methods.
9	Design battery storage sizing for solar plant.
10	Analyze EMS for EV charging infrastructure.

Text Books

1. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, "Guide to Energy Management", 8th Edition, CRC Press, 2020.
2. Wayne C. Turner, Steve Doty, "Energy Management Handbook", Fairmont Press, 2020.
3. James Momoh, "Smart Grid: Fundamentals of Design and Analysis", Wiley-IEEE Press, 2012.

Reference Books

1. Kwang Y. Lee, Mohamed A. El-Sharkawi, "Artificial Intelligence Techniques in Power Systems", Wiley-IEEE Press, 2008.
2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Wiley, 2013
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid Technology and Applications", Wiley, 2012.
4. Alfred Rufer, "Energy Storage Systems", CRC Press, 2017.

Online References

1. NPTEL Course: Prof. Rangan Banerjee, Prof. G. P. Harrison, IIT Madras Energy Resources, Economics and Environment" (https://nptel.ac.in/courses/noc25_hs18).
2. NPTEL Course: Prof. S. Banerjee, IIT Kharagpur, "Renewable Energy Engineering and Technology" (<https://nptel.ac.in/courses/108105058>)
3. NPTEL Course: Prof. D. P. Kothari, IIT Delhi, "Electric Power Systems" (<https://nptel.ac.in/courses/108102047>)

“येथे बहुतांचे हित”

Final Year B. Tech. Electrical Engineering	
Semester-VII	
Course Code: EE24DMN441R	Course Name: Microgrids

Text Books

1. A. Keyhani & M. Marwali , "Smart Power Grids", Springer,2011
2. Arun Phadke, " Computer Relaying for Power Systems," Second Edition,Wiley,2012.
3. Nikos Hatziargyriou, " Microgrids – Architecture and Control," Wiley,2013

Reference Books

1. Dincer, I., Rosen, M., " Sustainable Energy Systems and Applications", Springer,2012
2. Hughes, A., Drury, B., "Electric Motors and Drives", Elsevier,2019.
3. Yazdani & Iravani, " Voltage Sourced Converters in Power Systems", Wiley,2010
4. Fang Lin Luo & Hong Ye, " Renewable Energy Systems",CRC Press,2012

Online References

1. NPTEL Course: Prof. N. P. Padhy, Prof. Premalata Jena, IIT Roorkee, " Smart Grid:Basics to Advanced Technologies"(https://nptel.ac.in/courses/ noc25_ee79).
2. NPTEL Course: Prof. Amit Jain ,IIT Delhi,"Electric Vehicles Part-I"(https://nptel.ac.in/courses/ noc22_ee53)
3. NPTEL Course: Prof.Kaushal Kumar Jha ,IIT Madras, " Battery Management Systems"(https://nptel.ac.in/courses/ 108106182)



Final Year B. Tech. Electrical Engineering

Semester-VII

Course Code: EE24DMN442R

Course Name: Microgrid (NPTEL Course)

Teaching Scheme (Hours/Week)				Examination Scheme						Credits					
L	P	T	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL	
-	-	-	1	-	-	25	-	-	25	-	-	-	1	1	

Prerequisite: A basic understanding of Power Systems, Fundamentals of Power Electronics, Electrical Machines, Control Systems, Renewable Energy Systems, Basic MATLAB/Simulation knowledge

Course Objectives:

- To understand the concept, architecture, and components of microgrids.
- To study distributed energy resources and their integration into microgrids.
- To analyze microgrid modeling, control strategies, and operational modes.
- To understand energy management techniques for microgrid optimization.
- To study protection, stability, and future developments in microgrid technology.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Explain the concept, architecture, and types of microgrids.

CO2: Analyze distributed energy resources and microgrid components.

CO3: Apply control strategies for grid-connected and islanded microgrid operation.

CO4: Evaluate energy management and optimization techniques in microgrids.

CO5 : Assess protection, stability, and reliability aspects of microgrid systems.

Tutorial	Contents	Duration (Hrs.)
1	Introduction to Microgrids • Definition and concept of microgrid • Drivers for microgrid development • Microgrid benefits and applications • Microgrid vs conventional power grid • Architecture of microgrid systems • Key components of microgrid (DER, loads, storage) • Types of microgrids: AC, DC, and hybrid • Distributed generation overview • Grid-connected and islanded operation modes • Standards, policies, and regulations for microgrid system	4
2	Microgrid Components and Modeling • Distributed Energy Resources (DERs) in microgrids • Solar photovoltaic systems integration • Wind energy systems in microgrids • Energy storage technologies (battery, flywheel, supercapacitor) • Power electronic converters for DER integration • Inverter technologies used in microgrids • Communication infrastructure for microgrid operation • Load characterization and demand profiles • Modeling of AC and DC microgrid networks • Simulation tools for microgrid analysis (MATLAB/Simulink, PSCAD)	2
3	Control and Operation Strategies • Control objectives in grid-connected microgrids • Control strategies for islanded microgrids • Droop control methods • Centralized control architecture	2

	- Decentralized and distributed control strategies - Primary control in microgrids - Secondary control and frequency restoration - Tertiary control for economic optimization - Voltage and frequency regulation techniques - Intelligent control techniques using AI/ML	
4	Energy Management and Optimization - Microgrid Energy Management Systems (EMS) - Load forecasting techniques - Demand response programs - Optimal scheduling of distributed energy resources - Economic dispatch in microgrids - Energy storage management strategies - Pricing mechanisms and electricity markets - Optimization algorithms for microgrid operation - Renewable energy forecasting in microgrids - Smart energy management strategies	4
5	Protection, Stability and Future Trends - Protection challenges in microgrid systems - Fault detection and protection schemes - Adaptive protection strategies - Anti-islanding protection techniques - Stability analysis of microgrids - Voltage and frequency stability - Reliability assessment of microgrid systems - Electric vehicle integration with microgrids - Smart grid interaction with microgrids - Future trends and research directions in microgrid technology	3
Total Hours		15

Text Books

1. A. Keyhani & M. Marwali, "Smart Power Grids", Springer, 2011
2. Arun Phadke, "Computer Relaying for Power Systems," Second Edition, Wiley, 2012.
3. Nikos Hatziargyriou, "Microgrids – Architecture and Control," Wiley, 2013

Reference Books

1. Dincer, I., Rosen, M., "Sustainable Energy Systems and Applications", Springer, 2012
2. Hughes, A., Drury, B., "Electric Motors and Drives", Elsevier, 2019.
3. Yazdani & Iravani, "Voltage Sourced Converters in Power Systems", Wiley, 2010
4. Fang Lin Luo & Hong Ye, "Renewable Energy Systems", CRC Press, 2012

Online References

1. NPTEL Course: Prof. N. P. Padhy, Prof. Premalata Jena, IIT Roorkee, "Smart Grid: Basics to Advanced Technologies" (https://nptel.ac.in/courses/noc25_ee79).
2. NPTEL Course: Prof. Amit Jain, IIT Delhi, "Electric Vehicles Part-I" (https://nptel.ac.in/courses/noc22_ee53)
3. NPTEL Course: Prof. Kaushal Kumar Jha, IIT Madras, "Battery Management Systems" (<https://nptel.ac.in/courses/108106182>)

Final Year B. Tech. Electrical Engineering														
Semester-VIII														
Course Code: EE24DMN491R					Course Name: Capstone Project(Industrial Energy Efficiency)									
Teaching Scheme (Hours/Week)				Examination Scheme						Credits				
L	P	T	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
-	8	-	-	-	-	100	-	-	100	-	4	-	-	4
Prerequisite: Engineering Mathematics, Electrical Machine, Thermodynamics, Power Systems, Measurements and Instrumentation														
Course Objectives: - To understand industrial energy consumption patterns and energy management concepts. - To study energy auditing techniques and performance monitoring methods. - To analyze energy efficiency improvement in industrial utilities such as motors, boilers, compressors and lighting systems. - To evaluate techno-economic feasibility of energy conservation projects. - To design energy efficiency solutions for industrial applications.														
Course Outcomes:														

After learning the course, the students will be able to:

CO1: Explain industrial energy consumption patterns and efficiency concepts.

CO2: Perform basic energy audit and analyze industrial energy usage.

CO3: Evaluate efficiency of industrial electrical and thermal systems.

CO4: Identify energy conservation opportunities in industries.

CO5: Develop energy efficiency improvement plan through mini-projects.

Unit	Contents	Duration (Hrs.)
1	Introduction to Industrial Energy Efficiency - Energy scenario: Global and Indian perspective - Energy consumption in industries - Energy efficiency indicators and benchmarking - Energy conservation laws and regulations - Energy management concepts and ISO 50001	20
2	Energy Auditing and Monitoring - Types of energy audits (preliminary and detailed) - Energy audit methodology - Energy audit instruments and measurements - Load profile analysis - Energy monitoring systems and smart metering	20
3	Energy Efficiency in Electrical Systems - Energy efficient motors - Variable frequency drives (VFD) - Pumps and fans efficiency - Lighting systems efficiency (LED, smart lighting) - Power factor improvement	20
4	Energy Efficiency in Thermal Systems - Boilers and steam systems - Furnaces and process heating - Waste heat recovery systems - Cogeneration and combined heat and power (CHP) - Compressed air system efficiency	20
5	Energy Management and Sustainability - Energy management systems (EMS) - Demand side management - Renewable integration in industries - Economic analysis of energy projects - Environmental impact and sustainability	25
Total Hours		105
Sr.No.	Capstone Project Topics	
1	Industrial Energy Audit and Management - Collection of electrical and thermal energy consumption data - Identification of major energy loads such as motors, compressors, and lighting - Estimation of potential energy savings and cost benefits	
2	Electrical Energy Efficiency in Industrial Drives - Analysis of load variation and energy losses - Evaluation of Variable Frequency Drives (VFD) for energy saving - Recommendation of optimal motor control strategies	
3	Industrial Power Quality and Electrical Optimization	

	• Measurement of power factor and reactive power demand • Design of capacitor bank for power factor correction • Simulation or calculation of improved power factor
4	Smart Energy Monitoring and Automation • Selection of appropriate current and voltage sensors • Integration with microcontrollers or embedded systems • Analysis of energy consumption trends
5	Industrial Utility System Efficiency • Study of HVAC components or compressed air system layout • Calculation of potential energy savings through system optimization • Proposal of energy-efficient control and maintenance strategies
Sr.NO.	PROJECT POLICIES, RULES & REGULATIONS
1	Purpose of the Capstone Project The Double Minor Capstone Project is introduced to: • Ensure experiential and project-based learning • Promote student involvement beyond classroom learning • Strengthen industry relevance and research orientation • Achieve full coverage of syllabus outcomes through applied work
2	Eligibility Criteria • Only Double Minor Program students are eligible • Students must have passed all prerequisite courses • Enrollment permitted at the beginning of the semester
3	Group Formation Policy • Capstone project may be: • Individual OR • Group of maximum 2 students • Interdisciplinary groups are permitted and encouraged • Each group shall be assigned one faculty mentor
4	Project Topic Selection Rules • Topics must be mapped to syllabus units • Project shall cover minimum two major units from the syllabus • Topics may be: • Faculty proposed • Student proposed (with justification) • Innovation, sustainability, and next-generation relevance are mandatory
5	Student Involvement & Engagement Policy Students must demonstrate active involvement through: • Literature survey and problem identification • System design / modeling • Analytical or simulation-based study • Sustainability, energy, or performance evaluation • Report writing and presentation
6	Mentoring & Review Mechanism Faculty Mentorship • Weekly mentoring sessions (minimum 4 hrs/week) • Progress tracked through: • Logbook • Review records

	Interim submissions
7	Submission & Documentation Rules Mandatory submissions include: - Approved project proposal - Literature review summary - Interim review reports - Final project report - Presentation slides
8	Industry / Research / Startup Linkage (Optional) Students are encouraged to: - Undertake industry-defined problems - Use real-world datasets - Align projects with: - Startups - Research labs - Government EV initiatives
Text Books	
- Wayne C. Turner, "Energy Management Handbook", Wiley, 2012. - Barney L. Capehart, Wayne C. Turner, William J. Kennedy, "Guide to Energy Management," CRC Press, 2020. - L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilization", Hemisphere Publishing, 1988.	
Reference Books	
- Albert Thumann, "Handbook of Energy Audits", CRC Press, 2013. S. C. Tripathy, "Utilization of Electrical Energy and Energy Conservation", McGraw Hill, 2018. - Paul O'Callaghan, "Energy Management", McGraw Hill, 2003. - Patrik Thollander, Magnus Karlsson, Patrik Rohdin, Johan Wollin, Jakob Rosenqvist, "Introduction to Industrial Energy Efficiency" Elsevier, 2020	
Online References	
- NPTEL Course: Prof. Harish Hirani, IIT Delhi, "Energy Resources, Economics and Environment" (https://nptel.ac.in/courses/108102157). - NPTEL Course: Dr. K. Shanti Swarup, IIT Madras, "Energy Management Systems and SCADA" (https://nptel.ac.in/courses/108106022) - NPTEL Course: Prof. Shankha Pratim Bhattacharya, IIT Kharagpur, "Building Energy Systems and Auditing" (https://nptel.ac.in/courses/124105552)	



“येथे बहुतांचे हित”

Marathwada Mitra Mandal's College of Engineering Karvenagar, Pune- 52

An Autonomous Institute Affiliated to SPPU



Curriculum Structure and Syllabus Double Minor

A.Y. 2026-27

Accredited with A++ grade by NAAC
Recipient of Best College award by SPPU | Accredited by NBA
Recognized under 2(f) and 12(B) of UGC Act 1956
www.mmcoe.edu.in

About Marathwada Mitra Mandal's College of Engineering

MMCOE has been recognised as the BEST COLLEGE by SPPU. MMCOE is one feather in the cap of Marathwada Mitra Mandal's Pune, from the academic year 2006 – 2007.

The Institute offers six undergraduate engineering programmes in Electrical Engineering, Mechanical Engineering, Electronics & Telecommunication Engineering, Information Technology, Computer Engineering, and Artificial Intelligence & Data Science. In addition, it offers six postgraduate programmes M.Tech (Electrical – Power Electronics & Drives), M.Tech (Mechanical – Design Engineering), M.Tech (Electronics & Telecommunication – VLSI & Embedded Systems), M.Tech (Information Technology – Data Science), M.Tech (Computer Engineering), along with a Ph.D. programme in Computer Engineering. It houses 2000+ students and 200 staff members. Along with the focus on core academics, college also takes care of overall personality development of the students.

The college has an active robotics cell, NCC, Training and Placement cell etc. The students are motivated to actively participate in co-curricular and extra-curricular activities. They have brought many laurels to the Institute in the events such as Vinodottam Karandak, Firodiya Karandak, Zest, Dexterity etc.

Institute Vision

To be a globally renowned institution through excellence in engineering education for sustainable and holistic development

Institute Mission

M1: Empower students with cutting-edge technologies and global competencies

M2: Foster culture of research and entrepreneurial mindset

M3: Imbibe social and professional values

M4: Provide an inclusive environment for lifelong learning

**Department of
Mechanical Engineering**

“येथे बहुतांचे हित”

Vision and Mission of the Department

- **Vision**

To develop globally competent and socially committed mechanical engineers

- **Mission**

- ❖ Develop competent professionals through center of excellence
- ❖ Strengthen industry-academia collaboration for ethically responding real-world problems
- ❖ Provide an inclusive environment for entrepreneurship, research and innovation.
- ❖ Empower students for higher education and lifelong learning.



- **Program Specific Outcomes (PSOs)**

Graduates from our program will:

- ❖ PS0-I: Apply advanced technologies of mechanical and allied engineering to address the challenges faced in Industry 4.0.
- ❖ PS0-II: Contribute to the project in the core and associated domain by using add-on skills like CAD, CAM and CAE.
- ❖ PS0-III: Develop the ability to innovate socially relevant products and systems by effectively utilizing resources.

- **Program Outcomes (POs)**

P01: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

P02: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

P03: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

P04: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

P05: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

P06: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

P07: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

P08: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

P09: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

P010: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

P011: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)



Curriculum Double Minor in CAD/CAM

“येथे बहुतांचे हित”

Department of Mechanical Engineering

General Objectives and Scope:

The CAD/CAM Double Minor program provides students with comprehensive knowledge of modern computer-aided product design, analysis, and manufacturing technologies. The course integrates engineering design principles with advanced digital tools used in industries such as automotive, aerospace, robotics, and product manufacturing.

The program covers the following key areas:

- Computer Aided Design (CAD): 3D modelling, drafting, and product design using advanced software tools.
- Computer Aided Manufacturing (CAM): CNC programming, machining simulations, and manufacturing automation.
- Computer Aided Engineering (CAE): Engineering analysis such as stress analysis, thermal analysis, and simulation.
- Flexible Manufacturing Systems (FMS): Automation, robotics integration, and modern smart manufacturing systems.

Through theoretical knowledge and laboratory practice, students gain hands-on experience with digital product development and modern manufacturing techniques.

The scope of CAD/CAM extends to industries such as:

Automotive manufacturing
Aerospace and defense
Robotics and automation
Tool and die industries
Product design and development
Additive manufacturing and Industry 4.0 systems

Objectives of the CAD/CAM Program

- The main objectives of this course are:
- To develop strong fundamentals of computer-aided product design and modern engineering drafting techniques.
- To introduce students to advanced manufacturing technologies, including CNC machining, automated production, and CAM software.
- To provide knowledge of engineering simulation and analysis through Computer Aided Engineering tools.
- To train students in the integration of design and manufacturing processes for efficient product development.
- To develop practical skills through laboratory work, enabling students to use industry-relevant CAD/CAM tools.
- To prepare students for modern digital manufacturing environments, including smart factories and Industry 4.0 systems.
- To enhance employability and interdisciplinary skills in product design, manufacturing, and engineering analysis.

Why CAD/CAM?

CAD/CAM has become a core technology in modern engineering industries because it enables faster, more accurate, and cost-effective product development.

Key Reasons for Studying CAD/CAM

1. Faster Product Development

Designs can be created, modified, and tested digitally, reducing product development time.

2. High Precision and Accuracy

Computer-based systems ensure highly accurate designs and manufacturing processes.

3. Integration of Design and Manufacturing

CAD models can directly generate CAM programs for CNC machines, improving efficiency.

4. Reduced Manufacturing Cost

Simulation and virtual testing reduce material waste and prototyping costs.

5. Industry Demand

CAD/CAM skills are highly demanded in industries like automotive, aerospace, robotics, and manufacturing.

6. Support for Advanced Technologies

CAD/CAM supports modern technologies such as: CNC machining, Additive manufacturing, (3D printing), Digital twins, Smart manufacturing systems

Prerequisites :

- Engineering Graphics, Engineering Mathematics
- knowledge of earlier studied subjects like Solid Modeling and Drafting, Computer Aided Engineering, Industrial Engineering
- Engineering Mathematics - I and II, Solid Mechanics, Solid Modeling, Numerical Methods, and Optimization
- Information Theory and Models of Computation
- Classical Fourier Transform

B. TECH Double Minor in CAD CAM (Semester IV, V, VI, VII, VIII)

Curriculum Structure

Course Code	Course Name	Teaching Scheme (Hrs/week)				Examination Scheme						Credits				
		L	P	T	ODL	CIE	ETE	TW	PR	OR	Total	L	P	T	ODL	Total
Semester IV																
ME24DMN291R	Computer Aided Designing	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ME24DMN292R	Computer Aided Designing Lab	-	2	-	-	-	-	-	25	-	25		1	-	-	1
Semester V																
ME24DMN341R	Computer Aided Manufacturing	4	-	-	-	40	60	-	-	-	100	4	-	-	-	4
ME24DMN342R	Computer Aided Manufacturing Lab	-	2	-	-	-	-	25	-	25	50		1	-	-	1
Semester VI																
ME24DMN391R	Computer Aided Engineering	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ME24DMN392R	Computer Aided Engineering Lab	-	2		-	-	-	-	25	-	25		1	-	-	1
Semester VII																
ME24HON441R	Flexible Manufacturing System	4	-	-	-	40	60	-	-	-	100	4	-	-	-	4
ME24HON442R	Flexible Manufacturing System Lab	-	2	-	-	-	-	50	-	-	50	-	1	-	-	1
Semester VIII																
ME24HON491R	CAD/CAM Application Project	-	4	-	-	-	-	50	-	-	50	-	2	-	-	2
Total																
Total		14	12	-	-	160	240	125	50	25	600	14	6	-	-	20

L- Lecture

ETE- End Term Examination

L : 1 Hr.= 1 credit

P- Practical

TW- Term work

P: 2 Hr. = 1 Credit

T- Tutorial

PR- Practical

T: 1 Hr. = 1 Credit

CIE-Continuous Internal Evaluation

OR- Oral

ODL-Open Distance Learning

Note: For the semester VI, VII and VIII the ETE will be conducted by course coordinator in concern with BoS chairman.

Second Year B. Tech Mechanical Engineering															
Semester- IV															
Course Code: ME24DMN291R											Course Name: Computer Aided Designing				
Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
3	-	-	-	-	40	60	-	-		100	3	-	-	-	3
Course Objectives: - To understand basic structure of CAD systems and their use to create geometric models of simple engineering parts - To introduce the curves and surfaces and their implement in geometric modeling - To apply basic concepts of 3D modeling, viewing and evaluate mass properties of components and assemblies - To apply geometrical transformations in CAD models - To create engineering drawings, design documentation and use in manufacturing activities															
Course Outcomes: After learning the course, the students will be able to: CO1. UNDERSTAND basic concepts of CAD system, need and scope in Product Lifecycle Management CO2. UTILIZE knowledge of curves and surfacing features and methods to create complex solid geometry CO3. CONSTRUCT solid models, assemblies using various modeling techniques & perform mass property analysis, including creating and using a coordinate system CO4. APPLY geometric transformations to simple 2D geometries CO5. USE CAD model data for various CAD based engineering applications viz. production drawings, 3D printing, FEA, CFD, MBD, CAE, CAM, etc.															
Unit	Contents										Duration (Hrs.)				
1	Fundamentals of 3D Modeling: Introduction, Product Life Cycle, CAD tools in the design process of Product Cycle, Scope of CAD, Software Modules - Operating System (OS) module, Geometric module, application module, programming module, communication module, Computer Aided Design - Features, requirements and applications 3D Modeling approach - Primitive, Features and Sketching, Types of Geometric models - 2½ extrusions, axisymmetric, composite, 3D objects, difference between wireframe, surface & solid modeling.										7				
2	Curves & Surfaces: Curves: Methods of defining Point, Line and Circle, Curve representation - Cartesian and Parametric space, Analytical and Synthetic curves, Parametric equation of line, circle, ellipse, Continuity, Synthetic Curves - Hermit Cubic Spline, Bezier, B-Spline Curve, Non-Uniform Rational B- Spline curves. Surfaces: Surface representation, Types of Surfaces, Bezier, B-Spline, NURBS Surface, Coons patch surface, Surface Modeling										8				

3	Solid Modeling: Introduction, Geometry and Topology, Solid entities, Solid representation, Fundamentals of Solid modeling, half spaces, Boundary representation (B-Rep), Constructive Solid Geometry (CSG), Sweep representation, Analytical solid modeling, Parametric solid modeling, feature based modeling. etc., Euler Equation. Introduction to Assembly Modeling, Assemblies (Top-down and Bottom-up approach), Design for Manufacturing [DFM], Design for Assembly [DFA].	8
4	Geometric Transformation: Introduction, Geometric Transformations, Translation, Scaling, Rotation, Reflection/Mirror, Shear, Homogeneous Transformation, Inverse Transformation, Concatenated Transformation (limited to 2D objects with maximum 3 points only), Coordinate systems - Model (MCS), Working (WCS), Screen (SCS) coordinate system, Mapping of coordinate systems.	8
5	CAD Customization & Automation: Introduction, Limitations of 2D drawings, Introduction to Product and Manufacturing Information (PMI), Model Based Definitions (MBD), Applications of PMI & MBD CAD Customization: Introduction, advantages and disadvantages, Applications of Customization Interfaces, Product Customization Approaches - Part Modeling Customization, Assembly Modeling Customization, CAD Automation.	8
Total Hours		39

Text Books

1. Zeid, I and Sivasubramania, R., (2009), "CAD/CAM : Theory and Practice", 2nd edition, McGraw Hill Education, ISBN-13: 978-0070151345
2. Rao, P. N., (2017), "CAD/CAM: Principles and Applications", 3rd edition, McGraw Hill Education, ISBN-13: 978-0070681934
3. Chang, Kuang-Hua, (2015), "e-Design: Computer-Aided Engineering Design" Academic Press, ISBN-13: 978-0123820389

Reference Books

1. Lee, Kunwoo, (1999), "Principles of CAD/CAM/CAE Systems", Pearson/Addison-Wesley, ISBN-13: 978-0201380361
2. Bordegoni, Monica and Rizzi, Caterina, (2011), "Innovation in Product Design: From CAD to Virtual Prototyping", Springer, ISBN-13: 978-1447161875
3. Vukašinovic, Nikola and Duhovnik, Jože, (2019), "Advanced CAD Modeling: Explicit, Parametric, Free-Form CAD and Re-engineering", Springer, ISBN-13: 978-3030023980

Online References

1. NPTEL Course: Prof. Anoop Chawla, Prof. P.V. Madhusudan Rao, "Computer Aided Design and Manufacturing, IIT Delhi" (<https://nptel.ac.in/courses/112102101>)
2. NPTEL Course: Dr. Anupam Saxena, "Computer Aided Engineering Design, IIT Kanpur" (<https://nptel.ac.in/courses/112104031>).

Students will be able to:

- Understand the CAD system, need and scope in product development
- Identify the surfacing features and methods
- Assemble parts using various modeling techniques
- Define a coordinate system

4. Zeid, I and Sivasubramania, R., (2009), "CAD/CAM : Theory and Practice", 2nd edition, McGraw Hill Education, ISBN-13: 978-0070151345
5. Rao, P. N., (2017), "CAD/CAM: Principles and Applications", 3rd edition, McGraw Hill Education, ISBN-13: 978-0070681934
6. Chang, Kuang-Hua, (2015), "e-Design: Computer-Aided Engineering Design" Academic Press, ISBN-13: 978-0123820389

Reference Books

4. Lee, Kunwoo, (1999), "Principles of CAD/CAM/CAE Systems", Pearson/Addison-Wesley, ISBN-13: 978-0201380361
5. Bordegoni, Monica and Rizzi, Caterina, (2011), "Innovation in Product Design: From CAD to Virtual Prototyping", Springer, ISBN-13: 978-1447161875
6. Vukašinovic, Nikola and Duhovnik, Jože, (2019), "Advanced CAD Modeling: Explicit, Parametric, Free-Form CAD and Re-engineering", Springer, ISBN-13: 978-3030023980

Online References

3. NPTEL Course: Prof. Anoop Chawla, Prof. P.V. Madhusudan Rao, "Computer Aided Design and Manufacturing, IIT Delhi" (<https://nptel.ac.in/courses/112102101>)
4. NPTEL Course: Dr. Anupam Saxena, "Computer Aided Engineering Design, IIT Kanpur" (<https://nptel.ac.in/courses/112104031>).

“येथे बहुतांचे हित”

Third Year B. Tech Mechanical Engineering															
Semester-V															
Course Code:ME24DMN341R								Course Name: Computer Aided Manufacturing							
Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
4	-	-	-	-	40	60	-	-		100	4	-	-	-	4
Course Objectives: - Understand and realize need of CIM and factory automation. - Learn to integrate hardware and software elements for CIM. - Generate and Integrate CNC program for appropriate manufacturing techniques. - Learn to integrate processes planning, quality and MRP with computers. - Understand IOT, Industry-4.0 and cloud base manufacturing.															
Course Outcomes: After learning the course, the students will be able to: CO1: Explain CIM and factory automation. CO2: Understand the integration of hardware and software elements for CIM CO3: Apply CNC program for appropriate manufacturing techniques. CO4: Analyze processes planning, quality and MRP integrated with computers. CO6: Analyze the effect of IOT, Industry-4.0 and cloud base manufacturing															
Unit	Contents										Duration (Hrs.)				
1	Introduction to CAM: Need of CAM, Introduction, Evolution, Hardware and software Role of CAM System, Definition of CAM, automation and types of automation, Reasons for automation, Types of Production, Functions in Manufacturing, CAM wheel Computerized element of CAM, Advantages of CAM										10				
2	Data Integration CAD-CAM Integration, Product development through CIM, Design Activities in a networked environment, Networking in a manufacturing company, hardware elements of networking. CIM Database, Database requirements of CIM, Database management, Database Models, EDM, Product Data Management (PDM), Product life cycle Management (PLM)										10				
3	Computer Aided Manufacturing (CAM) Introduction to Computer Aided Manufacturing (CAM), Coordinate system, working principal of CNC Lathe, Turning Centers, Milling Machine, Machining Centers. Steps in developing CNC part program, Tool and geometric compensations, CNC Lathe and Mill part programming, Canned cycles, subroutine and Do loop, CIM Integrable Machines										11				
4	Computer Aided Process Planning and Quality Control Process Planning: Computer Aided Process Planning (CAPP), Benefits of CAPP, Logical steps in Computer Aided Process Planning, Approaches to CAPP, Material Requirement Planning, Capacity Planning, Manufacturing Resource Planning (MRP) - Input, working, outputs and benefits, Concept of dependent demand, structure of MRP system, planning & implementation issues, MRP-II & Enterprise Resource Planning (ERP), Computer Aided Production Scheduling, Control Systems: Shop Floor Control, Inventory Control, Computer Aided Inspection and Quality Control, Manufacturing Execution System(MES)										11				

5	Future Smart Factories Industry 4.0: Functions, Applications and Benefits. Components of Industry 4.0, Introduction to Industry 5.0 Internet of Things (IoT): IoT applications in manufacturing, Big-Data and Cloud Computing for IoT, IoT for smart manufacturing, influence of IoT on predictive maintenance, Supply-Chain Optimization, Supply-Chain & logistics. Internet of Things and M2M Communication Technologies Digital Manufacturing w.r.t. Industry 4.0: Industrial Automation, Cyber-Physical Manufacturing Systems, Digital Twin Driven Smart Manufacturing, Digital Manufacturing, Assembly and Automation Systems, Scheduling and Cloud Manufacturing, Knowledge Management, Digital Supply Chains, Reconfigurable Manufacturing Systems, Web based Application in Manufacturing	10
Total Hours		52
Text Books		
1. Zeid, I and Sivasubramania, R., (2009), "CAD/CAM: Theory and Practice", 2 nd edition, McGraw Hill Education, ISBN-13: 978-0070151345 2. Automation, Production system & Computer Integrated manufacturing, M. P. Groover Person India, 2007 2nd edition 3. Principles of Computer Integrated Manufacturing, S. Kant Vajpayee, Prentice Hall India		
Reference Books		
1. Chang, T.C. and Wysk, R.A., 1997. Computer-aided manufacturing. Prentice Hall PTR. 2. Xu, X., 2009. Integrating Advanced Computer-Aided Design, Manufacturing, and Numerical Control. Information Science Reference. 3. Weatherall, A., 2013. Computer integrated manufacturing: from fundamentals to implementation. Butterworth-Heinemann.		
Online References		
1. NPTEL Course: Prof. J. Ramkumar, Prof. Amandeep Singh Oberoi, "Computer Integrated Manufacturing IIT Kharagpur" (https://onlinecourses.nptel.ac.in/noc26_me48) 2. NPTEL Course: Prof. Sankha Deb, "Computer Integrated Manufacturing: From Concept to Implementation IIT Kharagpur" (https://nptel.ac.in/courses/112105910).		

4. Zeid, I and Sivasubramania, R., (2009), "CAD/CAM: Theory and Practice", 2nd edition, McGraw Hill Education, ISBN-13: 978-0070151345
5. Automation, Production system & Computer Integrated manufacturing, M. P. Groover Person India, 2007 2nd edition
6. Principles of Computer Integrated Manufacturing, S. Kant Vajpayee, Prentice Hall India

Reference Books

4. Chang, T.C. and Wysk, R.A., 1997. Computer-aided manufacturing. Prentice Hall PTR. 2. Xu, X., 2009.
5. Integrating Advanced Computer-Aided Design, Manufacturing, and Numerical Control. Information Science Reference.
6. Weatherall, A., 2013. Computer integrated manufacturing: from fundamentals to implementation. Butterworth-Heinemann.

Online References

3. NPTEL Course: Prof. J. Ramkumar, Prof. Amandeep Singh Oberoi, "Computer Integrated Manufacturing IIT Kharagpur" (https://onlinecourses.nptel.ac.in/noc26_me48)
4. NPTEL Course: Prof. Sankha Deb, "Computer Integrated Manufacturing: From Concept to Implementation IIT Kharagpur" (<https://nptel.ac.in/courses/112105910>).



Third Year B. Tech Mechanical Engineering																
Semester-VI																
Course Code: ME24DMN391R												Course Name: Computer Added Engineering				
Teaching Scheme (Hours/Week)					Examination Scheme							Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL	
3	-	-	-	-	40	60	-	-	-	100	3	-		-	3	
Course Objectives: • Use the direct stiffness method of Finite Element Method (FEM) to determine displacements, and stresses in engineering components. • Apply computational techniques to model and solve complex mechanical problems under various loading conditions. • Understand the role of CAE tools in product design an optimization of products																
Course Outcomes: After learning the course, the students will be able to: CO1: Explain finite element solution procedures and approaches using given engineering problems. CO2: Calculate element stiffness matrices and axial stress–strain responses for 1D bar and truss finite element models. CO3: Estimate stiffness matrices and in-plane stress–strain responses for CST element. CO4: Evaluate the quality of mesh using element quality parameters. CO5: Understand the importance of CAE in design validation and performance evaluation in mechanical engineering components and systems.																
Unit	Contents														Duration (Hrs.)	
1	Concepts of CAE Methodologies to solve engineering problems, governing equations, mathematical modelling of field problems in engineering, discrete and continuous models, CAE Tools - Pre-processor, Solver and Post-Processor, Use of CAE in Product development. Finite Element terminology - Nodes, elements, continuum, DOF, loads & constraints, General steps involved in FEM Different approaches used in FEA: Direct approach														7	
2	1D Finite Element Analysis Types of 1D elements, displacement function, global and local coordinate systems, polynomial form of interpolation functions – linear and quadratic. Bar and Truss Element - Element stiffness matrix, Assembling stiffness Equation, Load vector, treatment of boundary conditions- elimination approach, stress and reaction forces calculations.														8	
3	2D Finite Element Analysis Plane Stress/Strain, Axi-symmetric problems in 2D elasticity. Constant Strain Triangle (CST) - Element Stiffness matrix, Assembling stiffness equation, Load vector, Stress and reaction forces calculations. Post Processing Techniques – Check and validate accuracy of results, Average and Un-average stresses, and special tricks for Post Processing. Interpretation of results and design modifications, CAE reports.														8	

4	Meshing Techniques Discretization of a Structure, 1D, 2D and 3D element Meshing, Element selection criteria, Geometry Cleanup, Refining Mesh, Effect of mesh density in critical region, Use of Symmetry. Element Quality Criterion: - Jacobian, Aspect ratio, Warpage, Minimum and Maximum angles, Average element size, Minimum Length, skewness, Tetra Collapse etc., Higher Order Element vs Mesh Refinement, Geometry Associate Mesh Bolted and welded joints representation, Mesh independent test.	8
5	Applications of CAE Non-Linear Analysis: Comparison of Linear and Nonlinear analysis, Types of Nonlinearities, Stress-strain measures for Nonlinear analysis, Analysis of Geometric, Material Nonlinearity, Solution Techniques for Nonlinear analysis, Essential steps in Nonlinear analysis. Dynamic Analysis: Comparison of Static and Dynamic analysis, Time domain and frequency domain, Types of loading, Simple Harmonic motion, Free vibration, Boundary conditions of free vibration	8
Total Hours		39
Text Books		
1. Gokhale N. S., Deshpande S. S., Bedekar S. V., and Thite A. N., 'Practical Finite Element Analysis, Finite to Infinite,' Pune, 1 st Edition, 2008. 2. S. S. Bhavikatti, 'Finite Element Analysis', New Age International Publishers, Third Edition, 2015. 3. Chandrupatla T. R. and Belegunda A. D., 'Introduction to Finite Elements in Engineering,' Prentice Hall India, 2002. 4. G. Lakshmi Narasaiah, 'Finite Element Analysis,' BS Publications / BSP Books, 2 nd edition, 2020.		
Reference Books		
1. Daryl L. Logan, A First Course in the Finite Element Method, Fourth Edition, Thomson Canada Limited, 2007. 2. Mukhopadhyay M and Sheikh A. H., Matrix and Finite Element Analyses of Structures, Ane Books Pvt. Ltd., 2009 3. J. N. Reddy, 'An Introduction to the Finite Element Method,' McGraw Hill Series in Mechanical, 2005.		
Online References		
1. Edx course, 'A Hands-on Introduction to Engineering Simulations', Cornell University – Link: https://www.edx.org/learn/engineering/cornell-university-a-hands-on-introduction-to-engineering-simulations 2. Ansys training center - https://www.ansys.com/en-in/training-center		

Third Year B. Tech Mechanical Engineering

Semester-VI

Course Code: ME24DMN392R **Course Name: Computer Added Engineering Lab**

Course Code: ME24DMN392R **Course Name: Computer Added Engineering Lab**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
-	2	-	-	-	-	-	-	-	25	25	-	1	-	-	1

Course Objectives:

- Apply computational techniques to model and solve complex mechanical problems under various loading conditions.
- Understand the role of CAE tools in product design and optimization of products

Course Outcomes:

After learning the course, the students will be able to:

C01: Evaluate the quality of mesh using element quality parameters

C02: Calculate axial stress-strain responses for 1D bar and truss finite element models.

CO3: Apply CAE tools & techniques to validate the design and evaluate the performance of mechanical engineering components and systems.

Unit	Contents	Duration (Hrs.)
1	1D Bar Element – Structural Linear Analysis	4
2	Truss Analysis using 1D Element	4
3	Plate/Shell Element – Structural Linear and Non-Linear Analysis	4
4	Non-Linear Buckling Analysis using Beam Elements	4
5	Thermal Analysis – Static/Transient Analysis	4
6	Coupled Analysis- (Structural + Thermal)	2
7	Modal Analysis – Spring -Mass system, Cantilever beam, etc.	2
8	Presentation on advanced applications of FEA, NVH, CFD, Crash, Fatigue, Manufacturing, etc.	4
Total Hours		26

Text Books

5. Gokhale N. S., Deshpande S. S., Bedekar S. V., and Thite A. N., 'Practical Finite Element Analysis, Finite to Infinite,' Pune, 1st Edition, 2008.
6. S. S. Bhavikatti, 'Finite Element Analysis,' New Age International Publishers, Third Edition, 2015.
7. G. Lakshmi Narasaiah, 'Finite Element Analysis,' BS Publications / BSP Books, 2nd edition, 2020.

Online References

3. Edx course, 'A Hands-on Introduction to Engineering Simulations', Cornell University – Link: <https://www.edx.org/learn/engineering/cornell-university-a-hands-on-introduction-to-engineering-simulations>
4. Ansys training center - <https://www.ansys.com/en-in/training-center>

Final Year B. Tech Mechanical Engineering														
Semester-VII														
Course Code: ME24DMN441R										Course Name: Flexible Manufacturing System				
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
4	-	-	-	-	40	60	-	-	-	100	4	-	-	4
Course Objectives: - To understand the fundamental concepts, components, and architecture of Flexible Manufacturing Systems used in modern manufacturing. - To study the role of automation, computer control, CNC machines, and material handling systems in achieving manufacturing flexibility. - To analyze planning, scheduling, and control strategies used in flexible manufacturing environments. - To evaluate the performance, economic aspects, and industrial applications of Flexible Manufacturing Systems for improving productivity and efficiency.														
Course Outcomes: After learning the course, the students will be able to: CO1: Explain fundamentals, classification, and flexibility concepts of Flexible Manufacturing Systems (FMS). CO2: Apply Group Technology (GT) concepts for part classification, coding, and cell formation. CO3: Analyze machining parameters and optimization approaches for improving production rate, cost, and surface quality. CO4: Explain manufacturing databases, data flow, and CAD/CAM considerations in FMS implementation. CO5: Describe Computer Aided Process Planning (CAPP) and automated material handling systems used in modern manufacturing.														
Unit	Contents										Duration (Hrs.)			
1	Basics of FMS Introduction and classification of FMS, Automated production cycle, Need, concept and measurement of flexibility, Types of flexibilities and its measurement, Economic justification and Functional requirements of FMS, FMS processing and quality assurance equipment, e.g., turning and machining centers, Co-ordinate measuring machines, Cleaning and deburring machines, AMHS equipment, cutting tool and tool management, Future trends of Flexible Manufacturing System.										10			
2	Group Technology Introduction of GT, Part family formation-coding and classification systems; Part-machine group analysis, Methods for cell formation, Use of different algorithms, mathematical programming and graph theoretic model approach for part grouping. Determination of machining parameters: effect of parameters on production rate, cost and surface quality, different approaches, advantages of mathematical approach over conventional approach, solving optimization models of machining processes										11			
3	Data bases in Flexible Manufacturing systems and its implementation Manufacturing data systems, manufacturing data flow, computer-aided design and manufacturing considerations when planning for FMS, Implementation objectives, acceptance testing, Performance goals and expectation, maintenance										10			
4	Introduction to CAPP Introduction to CAPP: Role of process planning, advantages of conventional process planning over CAPP, Generative CAPP system: Importance, principle of Generative CAPP system. Determination of manufacturing tolerances: Methods of tolerance allocation, sequential approach, integration of design and manufacturing tolerances. Determination of optimal index positions for executing fixed sequence, Quantitative methods.										11			

5	Material Handling systems & Computer Aided Process Planning Conveyors - AGVs – industrial robots in material handling - AS/RS. Generative and variant types, backward and forward approach, feature based and CAD based CAPP.	10
Total Hours		52 Hrs.
Text Books		
1. A. Ghosh, A. Mallik, Manufacturing Science, East-West Press, 2010 2. P. N. Rao, Manufacturing Technology Volume 1: Foundry, Forming and Welding, McGraw-Hill Education, 2018 3. S. Kalpakjian, S. R. Schmid, Manufacturing Engineering and Technology, Pearson Education, 2014 4. S. K. H. Choudhury, A. K. H. Choudhury, N. Roy, Elements of Workshop Technology Volume 1, Media Promoters & Publishers, 2008 5. R. A. Lindberg, Processes and Materials of Manufacture, Pearson Education, 1990		
Reference Books		
1. P. Beeley, Foundry Technology, Butterworth Heinemann (Elsevier), 2001 2. N. K. Srinivasan, Foundry Engineering, Khanna Publishers, 2001 3. R. W. Heine, C. R. Loper Jr., P. C. Rosenthal, Principles of Metal Casting, Tata McGraw-Hill, 1976 4. R. A. Lindberg, Processes and Materials of Manufacture, Pearson Education, 2006 5. S. Hurst, Metal Casting: Appropriate Technology in the Small Foundry, Practical Action Publishing, 1996		
Online References		
1. NPTEL Course: Flexible Manufacturing Systems https://nptel.ac.in/courses/112106019 2. NPTEL Course: Computer Integrated Manufacturing https://nptel.ac.in/courses/112107143 3. NPTEL Course: Advanced Machining Processes https://nptel.ac.in/courses/112107143 4. NPTEL Course: Computer Integrated Manufacturing https://nptel.ac.in/courses/112107143 5. NPTEL Course: Computer Aided Manufacturing https://nptel.ac.in/courses/112107143		

will be able to:

- integration, and flexibility concepts
- concepts for part classification, cost
- and optimization approaches for
- es, data flow, and CAD/CAM con
- ess Planning (CAPP) and automa

ts of Flexible Manufacturing

in Flexible Manufacturing Sys

on using Group Technology

9. S. K. H. Choudhury, A. K. H. Choudhury, N. Roy, Elements of Workshop Technology Volume 1, Media Promoters & Publishers, 2008
10. R. A. Lindberg, Processes and Materials of Manufacture, Pearson Education, 1990
- 1.

Reference Books

1. P. Beeley, Foundry Technology, Butterworth Heinemann (Elsevier), 2001
2. N. K. Srinivasan, Foundry Engineering, Khanna Publishers, 2001
3. R. W. Heine, C. R. Loper Jr., P. C. Rosenthal, Principles of Metal Casting, Tata McGraw-Hill, 1976
4. R. A. Lindberg, Processes and Materials of Manufacture, Pearson Education, 2006
5. S. Hurst, Metal Casting: Appropriate Technology in the Small Foundry, Practical Action Publishing, 1996

Online References

1. NPTEL Course: Flexible Manufacturing Systems
<https://nptel.ac.in/courses/112106019>
2. NPTEL Course: Computer Integrated Manufacturing
<https://nptel.ac.in/courses/112107143>
3. NPTEL Course: Advanced Machining Processes
<https://nptel.ac.in/courses/112107143>
4. NPTEL Course: Computer Integrated Manufacturing
<https://nptel.ac.in/courses/112107143>
5. NPTEL Course: Computer Aided Manufacturing
6. <https://nptel.ac.in/courses/112107143>

“येथे बहुतांचे हित”

Selection of Project: • The course begins with the identification of a problem. • Students shall initiate and define the project idea independently or in teams. • Interdisciplinary approaches are encouraged during analysis and solution development. • The selected problem shall be exemplary and aligned with intended learning outcomes. • The project should involve at least two of the following components: 3D modelling and assembly design, Engineering	
--	--

Expected Outcomes

1. Apply CAD tools to develop accurate 3D models, assemblies, and engineering drawings for mechanical components or systems.
2. Integrate CAD and CAM concepts to generate tool paths, CNC programs, or manufacturing simulations for designed parts.
3. Analyse and validate design solutions using appropriate engineering methods or simulation tools.
4. Demonstrate problem-solving and project management skills while executing a structured CAD/CAM project.
5. Prepare professional technical documentation and presentations to effectively communicate project results.



Marathwada Mitra Mandal's College of Engineering

Karvenagar, Pune- 52

An Autonomous Institute Affiliated to SPPU



“येथे बहुतांचे हित”

Curriculum Structure and Syllabus

Double Minor

“येथे बहुतांचे हित”

A.Y. 2026-27

Accredited with A++ grade by NAAC
Recipient of Best College award by SPPU | Accredited by NBA
Recognized under 2(f) and 12(B) of UGC Act 1956
www.mmcoe.edu.in

About Marathwada Mitra Mandal's College of Engineering

MMCOE has been recognised as the BEST COLLEGE by SPPU. MMCOE is one feather in the cap of Marathwada Mitra Mandal's Pune, from the academic year 2006 – 2007.

The Institute offers six undergraduate engineering programmes in Electrical Engineering, Mechanical Engineering, Electronics & Telecommunication Engineering, Information Technology, Computer Engineering, and Artificial Intelligence & Data Science. In addition, it offers six postgraduate programmes M.Tech (Electrical – Power Electronics & Drives), M.Tech (Mechanical – Design Engineering), M.Tech (Electronics & Telecommunication – VLSI & Embedded Systems), M.Tech (Information Technology – Data Science), M.Tech (Mechanical Engineering), along with a Ph.D. programme in Mechanical Engineering. It houses 2000+ students and 200 staff members. Along with the focus on core academics, college also takes care of overall personality development of the students.

The college has an active robotics cell, NCC, Training and Placement cell etc. The students are motivated to actively participate in co-curricular and extra-curricular activities. They have brought many laurels to the Institute in the events such as Vinodottam Karandak, Firodiya Karandak, Zest, Dexterity etc.

Institute Vision

To be a globally renowned institution through excellence in engineering education for sustainable and holistic development

Institute Mission

M1: Empower students with cutting-edge technologies and global competencies

M2: Foster culture of research and entrepreneurial mindset

M3: Imbibe social and professional values

M4: Provide an inclusive environment for lifelong learning

**Department of
Mechanical Engineering**

“येथे बहुतांचे हित”

Vision and Mission of the Department

- **Vision**

To develop globally competent and socially committed mechanical engineers

- **Mission**

- ❖ Develop competent professionals through center of excellence
- ❖ Strengthen industry-academia collaboration for ethically responding real-world problems
- ❖ Provide an inclusive environment for entrepreneurship, research and innovation.
- ❖ Empower students for higher education and lifelong learning.



- **Program Specific Outcomes (PSOs)**

Graduates from our program will:

- ❖ PS0-I: Apply advanced technologies of mechanical and allied engineering to address the challenges faced in Industry 4.0.
- ❖ PS0-II: Contribute to the project in the core and associated domain by using add-on skills like CAD, CAM and CAE.
- ❖ PS0-III: Develop the ability to innovate socially relevant products and systems by effectively utilizing resources.

- **Program Outcomes (POs)**

P01: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

P02: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

P03: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

P04: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

P05: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

P06: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

P07: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

P08: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

P09: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

P010: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

P011: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)



Curriculum for Double Minor in SAP

Department of Mechanical Engineering

General Objectives and Scope:

This course aims to provide students with practical exposure to Enterprise Resource Planning (ERP) systems through hands-on project work using SAP. It focuses on bridging the gap between theoretical knowledge and real-world industrial applications by enabling students to identify, analyze, and solve business problems using SAP modules such as Materials Management (MM), Production Planning (PP), and Sales & Distribution (SD). The course develops competencies in system configuration, process integration, data handling, and performance analysis while also enhancing essential professional skills like teamwork, project planning, communication, and technical documentation. The scope of the course includes the complete lifecycle of a project, starting from problem identification and system design to implementation, testing, validation, and presentation, with emphasis on simulating real-time industrial workflows and integrated business processes.

Why SAP?

SAP is one of the most widely adopted ERP systems across various industries, including manufacturing, automotive, logistics, and services, making it highly relevant for engineering graduates. It enables seamless integration of multiple business functions, ensuring efficient resource planning, real-time data processing, and improved decision-making. The use of SAP helps organizations standardize their processes and optimize operations, thereby increasing productivity and competitiveness. Due to its extensive global presence and industry acceptance, proficiency in SAP significantly enhances career opportunities, preparing students for roles such as SAP consultant, business analyst, and ERP specialist.

Prerequisites :

- Basic business process concepts and how different departments like procurement, production, and sales function in a manufacturing organization.
- Basic business process concepts and Process in Sourcing and Procurement.

B. TECH Double Minor IN SAP (Semester IV, V, VI, VII, VIII)

Curriculum Structure

Course Code	Course Name	Teaching Scheme (Hrs/week)				Examination Scheme						Credits				
		L	P	T	ODL	CIE	ETE	TW	PR	OR	Total	L	P	T	ODL	Total
Semester IV																
ME24DMN291R	ERP - SAP	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ME24DMN292R	ERP - SAP lab	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester V																
ME24DMN341R	SAP MM (Materials Management)	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ME24DMN342R	SAP MM (Materials Management) lab	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester VI																
ME24DMN391R	SAP SD (Sales and Distribution)	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ME24DMN392R	SAP SD (Sales and Distribution) lab	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester VII																
ME24DMN441R	SAP PP (Project Planning)	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ME24DMN442R	SAP PP (Project Planning) lab	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester VIII																
ME24DMN491R	Project	-	4	-	-	-	-	50	-	50	100	-	2	-	-	2
Total																
Total		12	12	-	-	160	240	150	-	50	600	12	6	-	-	18

L- Lecture

ETE- End Term Examination

L : 1 Hr.= 1 credit

P- Practical

TW- Term work

P: 2 Hr. = 1 Credit

T- Tutorial

PR- Practical

T: 1 Hr. = 1 Credit

CIE-Continuous Internal Evaluation

OR- Oral

ODL-Open Distance Learning

Note: For the semester VI, VII and VIII the ETE will be conducted by course coordinator in concern with BoS chairman.

Second Year B.Tech Mechanical Engineering															
Semester-IV															
Course Code: ME24DMN291R											Course Name: ERP - SAP				
Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	-	3
Course Objectives: - To introduce students to the fundamental concepts and importance of Enterprise Resource Planning (ERP) in organizations. - To introduce students to key SAP modules such as Sales & Distribution, Materials Management, Production Planning, Financial Accounting, and Human Capital Management. - To introduce students to core business processes and master data used in SAP ERP systems. - To introduce students to how different departments and functions in an organization are integrated through ERP systems. - To introduce students to the role of SAP ERP in improving organizational efficiency and decision-making															
Course Outcomes: After learning the course, the students will be able to: CO1: Understand the fundamental concepts and importance of Enterprise Resource Planning (ERP). CO2: Explain the basic structure and functionalities of major SAP modules such as Sales & Distribution, Materials Management, Production Planning, Financial Accounting, and Human Capital Management. CO3: Identify and explain key master data and transaction processes used in SAP ERP systems. CO4: Describe how different business functions and departments are integrated through SAP ERP. CO5: Understand the role of ERP systems in improving efficiency and supporting business decision-making in organizations.															
Unit	Contents										Duration (Hrs.)				
1	<u>Basic Conceptual Foundations for ERP and SD</u> Introduction to ERP, Need for ERP, Advantages of ERP, Integration of Functions and Processes in Major Business Processes. <u>SAP Sales and Distribution:</u> Organizational units, Definition of Organizational Elements, Assignment of Organizational Elements, Customer Master Data, Material Master Data, Condition Master Data, Customer Material Info Record, Output Master, Basic Sales Process including Inquiry, Quotation, Sales Order, Outbound Delivery, Billing and Payment.										9				
2	<u>SAP Materials Management and PP</u> Introduction to enterprise structure and organization structure of SAP Procurement Module, Material Master, Vendor master, Purchase Info Record, Source List, Basic Procurement Process including Request for Quotation, Comparison of Quotations, Purchase Order, Goods Receipt, Invoice Receipt, Billing, Payment. <u>SAP Production Planning</u> Introduction to Organizational Units SAP Production Planning, Master Data in PP, Material Master, Bills of Materials, Work Center, Routing, Processes in Production Planning Cycle including Make to Stock Production, Make to Order Production.										8				

3	<u>SAP Financial Accounting</u> Introduction to Organizational Units of Financial Accounting, Master Data in FI: General Ledger Accounts, Vendor /Customer Master, Processes in Financial Accounting including Journal entries, vendor invoices, customer invoices.	8
4	<u>SAP Human Capital Management</u> Organization Management, Personal Management, Personal Administration, Configure master data elements including: personnel actions, wage types, infotype characteristics, SAP HCM Business Processes: Describe the business processes associated with HCM	8
5	<u>Integration between modules in SAP</u> Understanding how different SAP modules such as Sales & Distribution, Materials Management, Production Planning, Financial Accounting, and Human Capital Management are interconnected and share data within an ERP system. Students will learn how business processes flow across departments and how transactions in one module automatically impact other modules in SAP.	8
Total Hours		39
Text Books		
Study Material will be provided by the trainer.		
Reference Books		
1. Bret Wagner & Ellen Monk, Concepts in Enterprise Resource Planning, Cengage Learning, 2013. 2. Alexis Leon, ERP Demystified, Tata McGraw-Hill Education, 2014. 3. Simha R. Magal & Jeffrey Word, Business Process Integration with SAP ERP, Wiley, 2011. 4. Olaf Schulz, Using SAP ERP: An Introduction for Beginners and Business Users, Espresso Tutorials, 2019. 5. Vinod Kumar Garg & N. K. Venkitakrishnan, Enterprise Resource Planning: Concepts and Practice, PHI Learning, 2006. 6. Simon Monk, "Programming Arduino: Getting Started with Sketches", McGraw Hill Education, 2nd Edition, 2016		
Online References		
1. SAP Learning – https://learning.sap.com/ 2. SAP Training and Certification – https://www.sap.com/training-certification.html 3. SAP Help Portal – https://help.sap.com/ 4. SAP Community – https://community.sap.com/ 5. OpenSAP – https://open.sap.com/		

Second Year B.Tech Mechanical Engineering

Semester-IV

Course Code: ME24DMN292R	Course Name: ERP-SAP Lab
---------------------------------	---------------------------------

Course Name: ERP-SAP Lab

Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
-	2	-	-	-	-	-	25	-	-	25	-	1	-	-	1

Course Objectives:

- To learn the basic navigation and user interface of the SAP ERP system

- To learn the basic navigation and user interface of the SAP ERP system.
- To create and manage basic master data such as customer, vendor, and material records in SAP.
- To gain hands-on experience in executing basic business transactions in modules such as Sales & Distribution, Materials Management, and Production Planning.
- To understand the flow of business processes in SAP through practical exercises.
- To understand to how different SAP modules interact during real-time business transactions.

Course Outcomes:
After learning the course, the students will be able to:

CO1: Understand the basic SAP ERP environment and system navigation.

C02: Create and manage master data such as material, vendor, and customer records in SAP.
C03: Execute basic business transactions in SAP modules such as Sales, Procurement, and

CO3: Execute basic business transactions in SAP modules such as Sales, Procurement, and Production.

C04: Understand the flow of business processes and integration between different SAP modules through practical exercises.

List of Exercises for Hands-on Practice

Sr. No.	Name of the Exercises	Duration (Hrs.)
---------	-----------------------	-----------------

1	SAP Navigation	2
2	Create Master Data in SAP	4
3	Execute Order to Cash Business Process Cycle	4
4	Execute Procure to Pay Business Process Cycle	4
5	Execute Plan to Produce Business Process Cycle	2
6	Execute Record to Report Business Process Cycle	2
7	Execute Retire to Hire Business Process Cycle	4
8	Examine the integration points across different SAP modules by performing practical transactions and observing how data and processes flow between modules.	4
Total Hours		26

Text Books	
------------	--

Study Material will be provided by the trainer.

Reference Books

- | |
|--|
| 1. Bret Wagner & Ellen Monk, Concepts in Enterprise Resource Planning, Cengage Learning, 2013. |
|--|

2. Alexis Leon, ERP Demystified, Tata McGraw-Hill Education, 2014.
3. Simha R. Magal & Jeffrey Word, Business Process Integration with SAP ERP, Wiley, 2011.
4. Olaf Schulz, Using SAP ERP: An Introduction for Beginners and Business Users, Espresso Tutorials, 2019.
5. Vinod Kumar Garg & N. K. Venkitakrishnan, Enterprise Resource Planning: Concepts and Practice, PHI Learning, 2006.
6. Simon Monk, "Programming Arduino: Getting Started with Sketches", McGraw Hill Education, 2nd Edition, 2016

Online References

1. SAP Learning – <https://learning.sap.com/>
2. SAP Training and Certification – <https://www.sap.com/training-certification.html>
3. SAP Help Portal – <https://help.sap.com/>
4. SAP Community – <https://community.sap.com/>
5. OpenSAP – <https://open.sap.com/>



Third Year B.Tech Mechanical Engineering																
Semester-V																
Course Code: ME24DMN341R												Course Name: SAP-MM (Material Management)				
Teaching Scheme (Hours/Week)					Examination Scheme						Credits					
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL	
3	-	-	-	-	40	60	-	-	-	100	3	-	-	-	3	
Course Objectives: ● To introduce students to the concepts and organizational structure of the SAP Materials Management (MM) module. ● To familiarize students with procurement processes and inventory management concepts in SAP MM. ● To introduce students to Configuration required for SAP MM ● To explain the end-to-end procurement cycle of different types of Procurement processes like subcontracting, consignment, third party etc. ● To help students understand the ERP Implementation Methodology.																
Course Outcomes: After learning the course, the students will be able to: CO1: Understand the fundamental concepts and importance of Enterprise Resource Planning (ERP). CO2: Explain the basic structure and functionalities of major SAP modules such as Sales & Distribution, Materials Management, Production Planning, Financial Accounting, and Human Capital Management. CO3: Identify and explain key master data and transaction processes used in SAP ERP systems. CO4: Describe how different business functions and departments are integrated through SAP ERP. CO5: Understand the role of ERP systems in improving efficiency and supporting business decision-making in organizations.																
Unit	Contents												Duration (Hrs.)			
1	<u>SAP MM Enterprise Structure Configuration</u> Company Code, Plant, Storage Location, Purchasing Org, Purchasing Group <u>SAP MM Master Data:</u> Material Master, Vendor Master, Purchasing Info Records, Source List, Quota Arrangement Procurement of Stock : Business Process Cycle of Procurement of Stock												9			
2	<u>Inventory Management</u> – Goods Movement (GR, GI, Transfer), Movement Types, Stock Types, Reservations, Transfer Posting MRP: MRP Process, MRP Types, MRP Controllers, Lot Sizing, MRP Run (MD01N), Stock Requirements List Logistics Invoice Verification: PO-based IV, Non-PO IV, GR/IR Clearing, Subsequent debit/credit, Credit memos.												8			
3	<u>Vendor Subcontracting</u> Subcontracting PO, BOM, Component Provision, Goods Issue to Vendor, GR from Vendor. Vendor Consignment: Consignment Info Records, Consignment PO, GR, Settlement Process Third Party Procurement: Sales Order Linked Procurement, Third-party PO Process, Billing Document Integration												8			

	Contracts and Scheduling Agreements : Outline Agreements, Central Contracts, Contract Creation, SA Creation, Delivery Schedule	
4	Procurement of External services – Service Master, Service PO, Service Entry Sheet, Accept/Reject Services, SES-based Invoicing Pricing Procedure - Pricing Conditions, Calculation Schema, Access Sequence, Condition Records, Discounts/Surcharges Pipeline Procurement and Returnable Transport Packaging- Pipeline Material Creation, Procurement Process, Consumption Posting, RTP Process, Stock Indicators, Tracking RTP Items, Settlement Physical Inventory : Inventory Count, Create PI Document, Enter Count, Post Differences, Cycle Counting	8
5	Automatic Account Determination – Valuation Classes, Transaction Keys, Stock Transport Order - Inter/Intra-Plant STO, Delivery & Billing Integration, One-Step/Two-Step Transfers Stock Transport Order - Inter/Intra-Plant STO, Delivery & Billing Integration, One-Step/Two-Step Transfers Vendor Evaluation and Release Strategy - Evaluation Criteria (Price, Delivery, Quality), Scorecards, Vendor Score Reports, PR/PO Release Strategy, With/Without Classification, Workflow Integration, Approval Process <u>ERP Implementation Methodology:</u> SAP Understanding how different SAP modules such as Sales & Distribution, Materials Management, Production Planning, Financial Accounting, and Human Capital Management are interconnected and share data within an ERP system. Students will learn how business processes flow across departments and how transactions in one module automatically impact other modules in SAP.	8
Total Hours		39
Text Books		
Study Material will be provided by the trainer.		
Reference Books		
1. Martin Murray, Materials Management with SAP ERP: Functionality and Technical Configuration, SAP Press, 2013. 2. Ashfaq Ahmed, The SAP Materials Management Handbook, Apress / Springer, 2014. 3. P. K. Agrawal, SAP MM Inventory Management: Technical Reference and Learning Guide, PHI Learning Pvt. Ltd., 2014. 4. Jawad Akhtar, Materials Management with SAP S/4HANA: Business User Guide, SAP Press, 2019. 5. Mukesh Shukla, Materials Management with SAP ERP, McGraw-Hill Education, 2015		
Online References		
1. SAP Learning – https://learning.sap.com/ 2. SAP Training and Certification – https://www.sap.com/training-certification.html 3. SAP Help Portal – https://help.sap.com/ 4. SAP Community – https://community.sap.com/ 5. OpenSAP – https://open.sap.com/		

0

_____ (_____)

Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
-	2	-	-	-	-	-	25	-	-	25	-	1	-	-	1

- To learn the basic navigation and user interface of the SAP ERP system.
- To create and manage basic master data such as customer, vendor, and material records in SAP.
- To gain hands-on experience in executing basic business transactions in modules such as Sales & Distribution, Materials Management, and Production Planning.
- To understand the flow of business processes in SAP through practical exercises.
- To understand to how different SAP modules interact during real-time business transactions.

After learning the course, the students will be able to:

After learning the course, the students will be able to:

8

CO1: Understand the basic CAD/ERP environment and system navigation

CO1: Understand the basic SAP ERP environment and system navigation.

1000

Sr. No.	Name of the Exercises	Duration (Hrs.)
1	SAP Navigation	2
2	Create Master Data in SAP	4
3	Execute Order to Cash Business Process Cycle	4
4	Execute Procure to Pay Business Process Cycle	4
5	Execute Plan to Produce Business Process Cycle	2
6	Execute Record to Report Business Process Cycle	2
7	Execute Retire to Hire Business Process Cycle	4
8	Examine the integration points across different SAP modules by performing practical transactions and observing how data and processes flow between modules.	4
Total Hours		26

1. Martin Murray, *Materials Management with SAP ERP: Functionality and Technical Configuration*, SAP Press, 2013.

2. Ashfaq Ahmed, The SAP Materials Management Handbook, Apress / Springer, 2014.
3. P. K. Agrawal, SAP MM Inventory Management: Technical Reference and Learning Guide, PHI Learning Pvt. Ltd., 2014.
4. Jawad Akhtar, Materials Management with SAP S/4HANA: Business User Guide, SAP Press, 2019.
5. Mukesh Shukla, Materials Management with SAP ERP, McGraw-Hill Education, 2015

Online References

1. SAP Learning – <https://learning.sap.com/>
2. SAP Training and Certification – <https://www.sap.com/training-certification.html>
3. SAP Help Portal – <https://help.sap.com/>
4. SAP Community – <https://community.sap.com/>
5. OpenSAP – <https://open.sap.com/>



Semester-VI

Course Code: ME24DMN391R	Course Name: SAP-SD (Sales and Distribution)
---------------------------------	---

Course Code: ME24DMN391R	Course Name: SAP-SD (Sales and Distribution)
---------------------------------	---

Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	-	3

Course Objectives:

- Course Objectives:**
- To introduce students to the concepts and organizational structure of the SAP Sales and Distribution (SD) module.
 - To familiarize students with Sales and Distribution processes, Shipping and Delivery Processing in SAP SD.
 - To introduce students to Configuration required for SAP SD.
 - To explain the end-to-end sales cycle of different types of Sales and Distribution processes like Rush to order, Cash Sales consignment, third party etc.
 - To help students understand the ERP Implementation Methodology.

Course Outcomes:

After learning the course, the students will be able to:

C01: Understand the concepts and organizational structure and Master Data of the SAP Sales and Distribution (SD) module.

C02: Explain sales processes and Distribution concepts in SAP SD.

C03: Understand the basic configuration settings required for implementing SAP SD.

C04: Describe the end-to-end sales cycle including different types of sales and distribution processes
C05: Explain the ERP implementation methodology used for deploying SAP systems in organizations.

Unit	Contents	Duration (Hrs.)
1	Introduction to SAP SD and Enterprise Structure Overview of SAP ERP, Role of Sales & Distribution, Organizational Structure – Company Code, Sales Organization, Distribution Channel, Division, Sales Area SAP SD Master Data : Customer Master Data, Material Master (Sales Views), Customer Material Info Record, Condition Master Data	10
2	Overview of Sales Processes (Order-to-Cash Cycle) Inquiry, Quotation, Sales Order Processing, Sales Document Structure Shipping and Delivery Processing : Outbound Delivery, Picking, Packing, Post Goods Issue	10
3	Billing Process in SAP SD Billing Types, Invoice Processing, Debit Memo, Credit Memo Additional Sales Processes: Cash Sales, Rush Orders, Free of Charge Delivery, Third-Party Sales	10
4	Complaints Processing and Outline Agreements Returns Processing, Credit Memo, Contracts, Scheduling Agreements	4
5	Special Sales Functions and Integration Material Determination, Listing & Exclusion, Free Goods, Integration with MM and FI	5
Total Hours		39

Text Books

Study Material will be provided by the trainer.

Reference Books

1. Matt Chudy, Luis Castedo & Ricardo Lopez, Sales and Distribution (SAP SD) in SAP ERP: Business User Guide, SAP Press, 2017.
2. Ricardo Lopez & Ashish Mohapatra, Configuring Sales and Distribution in SAP ERP, SAP Press, 2015.
3. Luis Castedo & Matt Chudy, Sales and Distribution in SAP ERP: A Practical Guide, SAP Press, 2011.
4. James Olcott & Jon Simmonds, Sales and Distribution with SAP S/4HANA: Business User Guide, SAP Press, 2020.
5. Krishna Rungta, Learn SAP SD in 1 Day: Definitive Guide to Learn SAP Sales & Distribution, Guru99 Publications, 2017.

Online References

1. SAP Learning – <https://learning.sap.com/>
2. SAP Training and Certification – <https://www.sap.com/training-certification.html>
3. SAP Help Portal – <https://help.sap.com/>
4. SAP Community – <https://community.sap.com/>
5. OpenSAP – <https://open.sap.com/>



Final Year B.Tech Mechanical Engineering															
Semester-VI															
Course Code: ME24DMN392R						Course Name: SAP-SD (Sales and Distribution) Lab									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
-	2	-	-	-	-	-	25	-	-	25	-	1	-	-	1
Course Objectives: - To introduce students to the organizational structure of SAP Sales and Distribution (SD) module through practical exercises. - To enable students to create and maintain master data such as Customer Master and Material Master in SAP SD. - To provide hands-on experience in executing the sales order processing cycle including inquiry, quotation, sales order, delivery, and billing. - To help students understand special sales processes such as cash sales, rush orders, and free of charge deliveries through practical transactions. - To familiarize students with complaint handling processes and integration of SAP SD with other modules through practical demonstrations.															
Course Outcomes: After learning the course, the students will be able to: CO1: Understand the SAP SD organizational structure and its role in sales processes. CO2: Create and manage master data such as customer and material records in SAP SD. CO3: Execute the end-to-end sales order processing cycle including inquiry, quotation, sales order, delivery, and billing. CO4: Perform special sales processes such as cash sales, rush orders, and returns processing. CO5: Examine the integration between SAP SD and other modules by analyzing document flow and transaction flow in practical exercises.															
List of Exercises for Hands-on Practice															
Sr. No.	Name of the Exercises										Duration (Hrs.)				
1	SAP SD Enterprise Structure Configure and view Company Code, Sales Organization, Distribution Channel, Division, Sales Area										3				
2	Creation of Master Data Create Customer Master Record, Maintain Material Master (Sales Views), Create Customer-Material Info Record										4				
3	Basic Sales Process Creation of Inquiry, Creation of Quotation, Creation of Sales Order										4				
4	Delivery Processing Create Outbound Delivery, Perform Picking and Packing, Post Goods Issue										4				
5	Billing Process Create Billing Document, Generate Invoice, Display Billing Document										3				
6	Special Sales Processes Execute Cash Sales, Rush Order Processing, Free of Charge Delivery										3				
7	Complaints Processing Returns Processing, Creation of Credit Memo Request and Cancellation										3				
8	Integration and Reporting Examine integration between SD and MM/FI modules through document flow and transaction flow analysis										2				
Total Hours											26				

Text Books

Study Material will be provided by the trainer.

Reference Books

1. Matt Chudy, Luis Castedo & Ricardo Lopez, Sales and Distribution (SAP SD) in SAP ERP: Business User Guide, SAP Press, 2017.
2. Ricardo Lopez & Ashish Mohapatra, Configuring Sales and Distribution in SAP ERP, SAP Press, 2015.
3. Luis Castedo & Matt Chudy, Sales and Distribution in SAP ERP: A Practical Guide, SAP Press, 2011.
4. James Olcott & Jon Simmonds, Sales and Distribution with SAP S/4HANA: Business User Guide, SAP Press, 2020.
5. Krishna Rungta, Learn SAP SD in 1 Day: Definitive Guide to Learn SAP Sales & Distribution, Guru99 Publications, 2017.

Online References

1. SAP Learning – <https://learning.sap.com/>
2. SAP Training and Certification – <https://www.sap.com/training-certification.html>
3. SAP Help Portal – <https://help.sap.com/>
4. SAP Community – <https://community.sap.com/>
5. OpenSAP – <https://open.sap.com/>



Final Year B.Tech Mechanical Engineering															
Semester-VII															
Course Code: ME24DMN441R											Course Name: SAP-PP (Production Planning)				
Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	-	3
Course Objectives: - To introduce students to the fundamental concepts and organizational structure of the SAP Production Planning (PP) module. - To familiarize students with master data used in SAP PP such as Material Master, Bill of Materials (BOM), Work Centers, and Routing. - To explain the production planning and control processes in SAP including demand management and material requirements planning (MRP). - To introduce students to different production strategies such as make-to-stock and make-to-order production. - To help students understand the integration of SAP PP with other modules such as Materials Management and Sales & Distribution.															
Course Outcomes: After learning the course, the students will be able to: CO1: Understand the concepts and organizational structure of the SAP Production Planning (PP) module. CO2: Explain the master data required for production planning such as BOM, work centers, and routing. CO3: Describe the production planning cycle including demand management and material requirements planning (MRP). CO4: Differentiate between production strategies such as make-to-stock and make-to-order production. CO5: Understand the integration of SAP PP with other SAP modules in managing manufacturing processes.															
Unit	Contents										Duration (Hrs.)				
1	Introduction to SAP PP and Enterprise Structure Overview of SAP ERP, Role of Production Planning in ERP, Integration with MM and SD, Organizational Structure in SAP PP – Company Code, Plant, Storage Location, Work Center SAP PP Master Data: Material Master (MRP Views), Bill of Materials (BOM), Work Centers, Routing, Production Versions										10				
2	Configuration of Basic Production Planning Settings Define Plant Parameters, MRP Groups, MRP Controllers, Lot Sizing Procedures Demand Management and Material Requirements Planning (MRP): Planned Independent Requirements, MRP Types, MRP Run, Stock/Requirements List										11				
3	Production Order Processing Creation of Production Orders, Order Release, Order Confirmation, Goods Issue and Goods Receipt										09				

	Production Planning Strategies : Make-to-Stock Production, Make-to-Order Production, Planning Strategies in Manufacturing	
4	Shop Floor Control Scheduling, Capacity Planning, Order Execution and Monitoring	4
5	Integration of SAP PP with Other Modules: Integration with Materials Management (MM), Sales and Distribution (SD), and Financial Accounting (FI)	5
Total Hours		39
Text Books		
Study Material will be provided by the trainer.		
Reference Books		
1. Jawad Akhtar, Production Planning with SAP S/4HANA, Rheinwerk Publishing (SAP Press), 2021. 2. Jawad Akhtar, Production Planning and Control with SAP ERP, SAP Press, 2010. 3. Björn Weber, First Steps in the SAP Production Processes (PP), Espresso Tutorials, 2018. 4. Himanshu Goel, Handbook for SAP PP in S/4HANA: Production Planning and Execution, Apress / Springer, 2022. 5. Mahesh Babu MG, PP-DS with SAP S/4HANA, Rheinwerk Publishing, 2020.		
Online References		
1. SAP Learning – https://learning.sap.com/ 2. SAP Training and Certification – https://www.sap.com/training-certification.html 3. SAP Help Portal – https://help.sap.com/ 4. SAP Community – https://community.sap.com/ 5. OpenSAP – https://open.sap.com/		

“येथे बहुतांचे हित”

Final Year B.Tech Mechanical Engineering															
Semester-VII															
Course Code: ME24DMN442R						Course Name: SAP-PP (Production Planning) Lab									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
-	2	-	-	-	-	-	25	-	-	25	-	1	-	-	1
Course Objectives: - To introduce students to the SAP PP environment and organizational structure used in production planning. - To enable students to create and maintain master data such as Material Master, Bill of Materials (BOM), Work Centers, and Routing. - To provide hands-on experience in executing material requirements planning (MRP) and managing production planning activities. - To help students perform production order processing including order creation, confirmation, and goods movements. - To familiarize students with the integration of SAP PP with other modules such as Materials Management and Sales & Distribution through practical exercises.															
Course Outcomes: After learning the course, the students will be able to: CO1: Understand the SAP PP organizational structure and its role in production planning. CO2: Create and maintain production master data such as BOM, work centers, and routing. CO3: Execute material requirements planning (MRP) and analyze production planning requirements. CO4: Perform production order processing including order creation, confirmation, and goods movement. CO5: Examine the integration of SAP PP with other SAP modules through practical production planning transactions.															
List of Exercises for Hands-on Practice															
Sr. No.	Name of the Exercises										Duration (Hrs.)				
1	SAP PP Enterprise Structure View and understand Plant, Storage Location, and Work Center used for production planning										2				
2	Creation of Master Data in SAP PP Create Material Master (MRP Views), Create Bill of Materials (BOM), Create Work Center										6				
3	Routing and Production Version Create Routing, Maintain Production Version for a material										4				
4	Material Requirements Planning (MRP) Maintain MRP Data, Create Planned Independent Requirements, Execute MRP Run										4				
5	Production Order Processing Create Production Order, Release Production Order, Confirm Production Order										4				
6	Goods Movement in Production Perform Goods Issue for raw materials and Goods Receipt for finished products										2				

7	Capacity Planning and Shop Floor Control View capacity requirements and monitor order progress	2
8	Integration of PP with Other Modules Examine integration between PP, MM, and SD through document flow and transaction analysis	2
Total Hours		26
Text Books		
Study Material will be provided by the trainer.		
Reference Books		
1. Matt Chudy, Luis Castedo & Ricardo Lopez, Sales and Distribution (SAP SD) in SAP ERP: Business User Guide, SAP Press, 2017. 2. Ricardo Lopez & Ashish Mohapatra, Configuring Sales and Distribution in SAP ERP, SAP Press, 2015. 3. Luis Castedo & Matt Chudy, Sales and Distribution in SAP ERP: A Practical Guide, SAP Press, 2011. 4. James Olcott & Jon Simmonds, Sales and Distribution with SAP S/4HANA: Business User Guide, SAP Press, 2020. 5. Krishna Rungta, Learn SAP SD in 1 Day: Definitive Guide to Learn SAP Sales & Distribution, Guru99 Publications, 2017.		
Online References		
1. SAP Learning – https://learning.sap.com/ 2. SAP Training and Certification – https://www.sap.com/training-certification.html 3. SAP Help Portal – https://help.sap.com/ 4. SAP Community – https://community.sap.com/ 5. OpenSAP – https://open.sap.com/		

“येथे बहुतांचे हित”

- | | |
|--|--|
| <ul style="list-style-type: none">• Sales order processing using SAP SD• Integrated supply chain management in SAP• Vendor evaluation system• Warehouse management simulation | |
|--|--|

Expected Outcomes

Upon completion of the project course, students are expected to:

1. Develop the ability to apply SAP/ERP concepts to address real-world industrial problems.
2. Demonstrate proficiency in configuring and using relevant SAP modules (MM/PP/SD).
3. Integrate knowledge from different functional areas to develop effective ERP-based solutions.
4. Analyse system outputs and evaluate performance based on business requirements.
5. Exhibit professional skills such as teamwork, communication, project management, and technical documentation.



Marathwada Mitra Mandal's College of Engineering

Karvenagar, Pune- 52

An Autonomous Institute Affiliated to SPPU



Curriculum Structure and Syllabus

Double Minor

A.Y. 2026-27

Accredited with A++ grade by NAAC
Recipient of Best College award by SPPU | Accredited by NBA
Recognized under 2(f) and 12(B) of UGC Act 1956
www.mmcoe.edu.in

About Marathwada Mitra Mandal's College of Engineering

MMCOE has been recognised as the BEST COLLEGE by SPPU. MMCOE is one feather in the cap of Marathwada Mitra Mandal's Pune, from the academic year 2006 – 2007.

The Institute offers six undergraduate engineering programmes in Electrical Engineering, Mechanical Engineering, Electronics & Telecommunication Engineering, Information Technology, Computer Engineering, and Artificial Intelligence & Data Science. In addition, it offers six postgraduate programmes M.Tech (Electrical – Power Electronics & Drives), M.Tech (Mechanical – Design Engineering), M.Tech (Electronics & Telecommunication – VLSI & Embedded Systems), M.Tech (Information Technology – Data Science), M.Tech (Computer Engineering), along with a Ph.D. programme in Computer Engineering. It houses 2000+ students and 200 staff members. Along with the focus on core academics, college also takes care of overall personality development of the students.

The college has an active robotics cell, NCC, Training and Placement cell etc. The students are motivated to actively participate in co-curricular and extra-curricular activities. They have brought many laurels to the Institute in the events such as Vinodottam Karandak, Firodiya Karandak, Zest, Dexterity etc.

Institute Vision

To be a globally renowned institution through excellence in engineering education for sustainable and holistic development

Institute Mission

- M1: Empower students with cutting-edge technologies and global competencies
- M2: Foster culture of research and entrepreneurial mindset
- M3: Imbibe social and professional values
- M4: Provide an inclusive environment for lifelong learning

**Department of
Electronics and Telecommunication
Engineering**

“येथे बहुतांचे हित”

Vision and Mission of the Department

• Vision

To cultivate globally competent Electronics and Telecommunication Engineers for developing sustainable solutions

• Mission

Our Mission is to:

M1: To empower students with foundational and emerging technologies in Electronics and Telecommunication Engineering, fostering global competencies

M2: To foster a research and collaborative learning ecosystem that encourages entrepreneurship, holistic and sustainable development

M3: To inculcate ethical values, leadership, adaptability, and a lifelong learnability in a diverse, global engineering

1. Program Specific Outcomes (PSOs)

Students will be able,

PSO1: To apply principles of Embedded Systems, VLSI, Communication, and Automation using modern hardware and software tools to develop effective E&TC solutions.

PSO2: To design and develop multidisciplinary, innovative, sustainable solutions through project-based learning to address industrial, societal, and environmental needs.

• Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

P05: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

P06: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

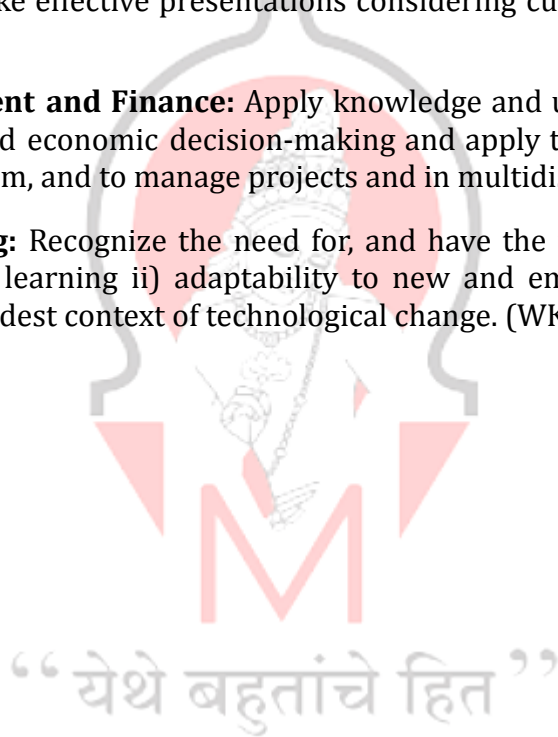
P07: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

P08: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

P09: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

P010: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

P011: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)



“येथे बहुतांचे हित”

**Curriculum for B. Tech. with Double Minor
in Drone Technology**

“येथे बहुतांचे हित”

Department of Electronics and Telecommunication Engineering

General Objectives and Scope:

The scope of a Double Minor course in engineering is mainly about gaining extra knowledge and skills outside your main engineering branch, which can improve career opportunities and flexibility.

Students learn subjects from two additional fields, helping them understand technologies beyond their core branch. A double minor can make students eligible for more job roles in different industries because they have broader technical knowledge.

It helps students pursue postgraduate studies or research in specialized or interdisciplinary fields. Students can work on advanced projects, research, and startups combining multiple technologies.

Why Drone Technology?

- Provides additional specialization along with the main engineering branch. Opens career opportunities such as drone engineer, UAV operator, drone software developer, and drone data analyst.
- Used in many industries like agriculture, construction, disaster management, defense, media, and logistics.
- Offers opportunities for higher studies and research in robotics, AI, and autonomous drone systems.
- Supports startup and entrepreneurship opportunities in drone services like mapping, surveillance, and aerial photography.

Prerequisites :

- Basic Engineering Mathematics
- Basic Physics (Mechanics)
- Programming fundamentals (Python / C / MATLAB)
- Electronics fundamentals
- Microcontrollers
- Sensors and embedded systems
- Control systems basics

B. TECH HONORS IN DRONE TECHNOLOGY (Semester IV, V, VI, VII, VIII)

Curriculum Structure

Course Code	Course Name	Teaching Scheme (Hrs/week)				Examination Scheme						Credits				
		L	P	T	ODL	CIE	ETE	TW	PR	OR	Total	L	P	T	ODL	Total
Semester IV																
ET24DMN295R	Drone Technology and Systems	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ET24DMN296R	Drone Technology and Systems Lab	-	-	2	-	-	-	25	-	-	25	-	-	1	-	1
Semester V																
ET24DMN345R	Drone Electronics	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ET24DMN346R	Drone Electronics Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester VI																
ET24DMN395R	Drone Programming	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ET24DMN396R	Drone Programming Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester VII																
ET24DMN445R	Matlab course on Quadcopter Modeling and Simulation	-	4	-	-	-	-	50	-	-	50	-	2	-	-	2
Semester VIII																
ET24DMN495R	Capstone Project	-	8	-	-	-	-	100	-	-	100	-	4	-	-	4
Total		9	16	2	-	120	180	225	-	-	525	9	8	1	-	18

L- Lecture

ETE- End Term Examination

L : 1 Hr.= 1 credit

P- Practical

TW- Term work

P : 2 Hr. = 1 Credit

T- Tutorial

PR- Practical

T: 1 Hr. = 1 Credit

CIE-Continuous Internal Evaluation

OR- Oral

ODL-Open Distance Learning

“येथे बहुतांचे हित”

1. K. P. Valavanis and G. J. Vachtsevanos, Handbook of Unmanned Aerial Vehicles, Dordrecht, Netherlands: Springer, 2015.
2. B. K. Tripathy, J. Anuradha, and S. N. Panda, Drone Technology and Applications, New Delhi, India: CRC Press / Taylor & Francis, 2021.

Reference Book

1. A. R. Jha, Theory, Design and Applications of Unmanned Aerial Vehicles, Boca Raton, FL, USA: CRC Press, 2016.
2. D. H. Titterton and J. L. Weston, Strapdown Inertial Navigation Technology, 2nd ed., London, U.K.: IET Press, 2004.

Online References

1. NPTEL, "Introduction to Unmanned Aerial Vehicles (UAVs)," IIT Kanpur / IIT Bombay. Available: <https://nptel.ac.in>
2. SWAYAM, "Fundamentals of UAV and Drone Technology," Government of India Online Learning Platform. Available: <https://swayam.gov.in>
3. DGCA India, "Drone Rules 2021 and Digital Sky Platform." Available: <https://digitalsky.dgca.gov.in>



1. NPTEL, "Introduction to Unmanned Aerial Vehicles (UAVs)," IIT Kanpur / IIT Bombay. Available: <https://nptel.ac.in>
2. SWAYAM, "Fundamentals of UAV and Drone Technology," Government of India Online Learning Platform. Available: <https://swayam.gov.in>
3. DGCA India, "Drone Rules 2021 and Digital Sky Platform." Available: <https://digitalsky.dgca.gov.in>



Third Year B. Tech Electronics and Telecommunication Engineering															
Semester-V															
Course Code: ET24DMN345R								Course Name: Drone Electronics							
Teaching Scheme (Hours/Week)				Examination Scheme						Credits					
L	P	T	ODL	CIE	ETE	TW	PR	OR	TOTAL	L	P	T	ODL	TOTAL	
3	-	-	-	40	60	-	-	-	100	3	-	-	-	3	
Prerequisite: Basic Electronics, Electrical Machines (fundamental level), Microcontrollers and Embedded Systems, Sensors and Communication Basics															
Course Objectives: The Course aims to: 1. To introduce the basic power system and batteries used in drones. 2. To understand the working and selection of motors used in drone propulsion. 3. To learn about important sensors used for drone navigation and stability. 4. To understand the role of controllers and electronic circuits used in drone control. 5. To understand basic communication and interfacing methods used in drone electronics.															
Course Outcomes: After learning the course, the students will be able to: CO1: Explain the basic power system and battery management used in drones. CO2: Describe the working principle and selection of motors used in drones. CO3: Identify important sensors used for navigation and control in drones. CO4: Explain the function of radio control systems, flight controllers and ESC used in drones. CO5: Describe basic communication interfaces and microcontroller connections used in drone electronics.															
Unit	Contents												Duration (Hrs.)		
1	Drone Power Systems and Battery Management Power requirements of drones, introduction to batteries used in drones, Lithium Polymer (Li-Po) battery basics, battery ratings (capacity, voltage, C-rating), charging and discharging methods, battery safety, maintenance and selection criteria for drone applications.												7		
2	Motors Used in Drones Overview of motors used in drones, difference between AC and DC motors, brushed vs brushless motors, working principle of BLDC motor, motor performance parameters (KV rating, thrust), motor selection criteria for drone systems.												7		
3	Sensors and Navigation Devices Introduction to sensors used in drones, GPS receiver, gyroscope, accelerometer, magnetometer, barometer, distance sensors (ultrasonic / ToF), overview of cameras and image sensors used in drones..												8		
4	Drone Control Electronics Introduction to radio control systems, transmitter and receiver, flight controllers and their functions, electronic speed controller (ESC) basics, Battery Eliminator Circuit (BEC), overview of firmware used in ESCs.												7		
5	Interfacing and Communication in Drone Systems Introduction to device interfacing in drones, UART communication basics, RS-232 overview, connectors used in drone electronics, basic microcontroller interfacing of sensors and controllers.												7		
Total Hours													36		

Text Books
1. R. Austin, <i>Unmanned Aircraft Systems: UAVS Design, Development and Deployment</i>, 1st ed., Chichester, U.K.: Wiley, 2010. 2. K. P. Valavanis and G. J. Vachtsevanos, <i>Handbook of Unmanned Aerial Vehicles</i>, Dordrecht, Netherlands: Springer, 2015.
Reference Books
1. A. R. Jha, <i>Theory, Design and Applications of Unmanned Aerial Vehicles</i>, Boca Raton, FL, USA: CRC Press, 2016. 2. D. H. Titterton and J. L. Weston, <i>Strapdown Inertial Navigation Technology</i>, 2nd ed., London, U.K.: IET Press, 2004. 3. S. Waharte and N. Trigoni, <i>Supporting Search and Rescue Operations with UAVs</i>, IEEE International Conference on Emerging Security Technologies, 2010.
Online References
1. NPTEL, "Introduction to Unmanned Aerial Vehicles (UAVs)," IIT Kanpur / IIT Bombay. Available: https://nptel.ac.in 2. SWAYAM, "Fundamentals of UAV and Drone Technology," Government of India Online Learning Platform. Available: https://swayam.gov.in 3. DGCA India, "Drone Rules 2021 and Digital Sky Platform." Available: https://digitalsky.dgca.gov.in 4. ISRO IIRS Outreach Programme, "Basics of Remote Sensing and GIS." Available: https://elearning.iirs.gov.in

“येथे बहुतांचे हित”

Third Year B. Tech Electronics and Telecommunication Engineering

Semester V

Course Code: ET24DMN346R

Course Name: Drone Electronics Lab

**Teaching Scheme
(Hours/Week)**

Examination Scheme

Credits

L	P	T	ODL	CIE	ETE	TW	PR	OR	TOTAL	L	P	T	ODL	TOTAL
-	2	-	-	-	-	25	-	-	25	-	1	-	-	1

Course Objectives:

- To study power systems and Li-Po batteries used in drones.
- To understand BLDC motors and electronic speed controllers used in drone propulsion.
- To identify sensors used for drone navigation and stabilization.
- To understand flight controllers and radio control systems.
- To integrate basic electronic subsystems used in drone systems

Course Outcomes:

After completing the course, the students will be able to:

CO1: Explain battery parameters and power systems used in drones.

CO2: Describe the working of BLDC motors and ESC used in drones.

CO3: Identify sensors used in drone navigation and control.

CO4: Explain the role of flight controllers and radio control systems.

CO5: Integrate basic electronic components used in drone systems.

Week	Contents	Hrs
1	Study of Li-Po battery parameters, ratings (capacity, voltage, C-rating).	4
2	Study of safety precautions used in drones.	4
3	Demonstration of Electronic Speed Controller (ESC) and control of BLDC motor speed.	4
4	Study of sensors used in drones (Gyroscope, Accelerometer, GPS module) and their role in stabilization and navigation.	4
5	Study of flight controller, transmitter and receiver used in radio control drone systems.	4
6	Basic Drone Electronics Integration Experiment: Integration of battery, ESC, BLDC motor, flight controller and sensors to understand drone electronic architecture	6
Total Hours		26

Text Books

1. R. Austin, *Unmanned Aircraft Systems: UAVS Design, Development and Deployment*, Chichester, U.K.: Wiley, 2010.
2. A. R. Jha, *Theory, Design and Applications of Unmanned Aerial Vehicles*, Boca Raton, FL, USA: CRC Press, 2016.

Reference Book

1. P. Horowitz and W. Hill, *The Art of Electronics*, 3rd ed., Cambridge, U.K.: Cambridge University Press, 2015.
2. M. H. Rashid, *Power Electronics: Circuits, Devices and Applications*, 4th ed., Pearson Education, 2014.

Online References

1. NPTEL: Introduction to Unmanned Aerial Vehicles (UAVs) <https://nptel.ac.in>
2. NPTEL: Sensors and Actuators- <https://nptel.ac.in>
3. DGCA Digital Sky Platform (Drone Rules) <https://digitalsky.dgca.gov.in>

3. Modern Control Engineering- Katsuhiko Ogata
4. The Complete Guide to Drones – Adam Juniper

Reference Books

1. Drone Technology and Applications – K. R. Rao
2. Mastering STM32 – Carmine Noviello

Online References

1. NPTEL, "Introduction to Unmanned Aerial Vehicles (UAVs)," IIT Kanpur / IIT Bombay. Available: <https://nptel.ac.in>
2. SWAYAM, "Drone Systems and control. Available: <https://swayam.gov.in>



1. MathWorks, "Drone Simulation and Control (Quadcopter Modelling & Simulation)",
<https://www.mathworks.com/help/sps/ug/quadcopter-drone.html>



“येथे बहुतांचे हित”

the students will be able to:
 • Promote electronic circuits and embedded systems
 • To integrate sensors, controllers, and actuators for various applications..

Students are expected to undertake projects based on electronics, Drone Programming, and Robotics. Projects may involve design, simulation, or implementation. Examples include:
 • Modeling and control of robotic systems
 • Surveillance systems
 • Navigation or path planning
 • Image processing applications
 • AI-based drone applications

Evaluation will be carried out by the **guide and/or examiner** based on:

- Topic selection and relevance
- Technical content and innovation
- Implementation and results
- Presentation and viva performance
- Regularity, punctuality, and timely completion
- Quality of report



Marathwada Mitra Mandal's College of Engineering Karvenagar, Pune- 52

An Autonomous Institute Affiliated to SPPU



“येथे बहुतांचे हित”

Curriculum Structure and Syllabus

Double Minor

A.Y. 2026-27

Accredited with A++ grade by NAAC
Recipient of Best College award by SPPU | Accredited by NBA
Recognized under 2(f) and 12(B) of UGC Act 1956
www.mmcoe.edu.in

About Marathwada Mitra Mandal's College of Engineering

MMCOE has been recognised as the BEST COLLEGE by SPPU. MMCOE is one feather in the cap of Marathwada Mitra Mandal's Pune, from the academic year 2006 – 2007.

The Institute offers six undergraduate engineering programmes in Electrical Engineering, Mechanical Engineering, Electronics & Telecommunication Engineering, Information Technology, Computer Engineering, and Artificial Intelligence & Data Science. In addition, it offers six postgraduate programmes M.Tech (Electrical – Power Electronics & Drives), M.Tech (Mechanical – Design Engineering), M.Tech (Electronics & Telecommunication – VLSI & Embedded Systems), M.Tech (Information Technology – Data Science), M.Tech (Computer Engineering), along with a Ph.D. programme in Computer Engineering. It houses 2000+ students and 200 staff members. Along with the focus on core academics, college also takes care of overall personality development of the students.

The college has an active robotics cell, NCC, Training and Placement cell etc. The students are motivated to actively participate in co-curricular and extra-curricular activities. They have brought many laurels to the Institute in the events such as Vinodottam Karandak, Firodiya Karandak, Zest, Dexterity etc.

Institute Vision

To be a globally renowned institution through excellence in engineering education for sustainable and holistic development

Institute Mission

M1: Empower students with cutting-edge technologies and global competencies

M2: Foster culture of research and entrepreneurial mindset

M3: Imbibe social and professional values

M4: Provide an inclusive environment for lifelong learning

**Department of
Information Technology**



“येथे बहुतांचे हित”

Vision and Mission of the Department

- **Vision**

To emerge as a globally competent center in education, research and innovation in Information Technology, fostering sustainable development with a holistic vision.

- **Mission**

M1 : To impart IT education that develops globally competent professionals

M2 : To promote innovation through research and entrepreneurship.

M3 : To encourage lifelong learning and a holistic commitment towards societal development.

1. Program Specific Outcomes (PSOs)

Information Technology graduates will be able to :

- Design and develop information systems using principles of computing to solve real-world problems.
- Integrate emerging IT technologies to innovate and improve technological ecosystems.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

P06: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

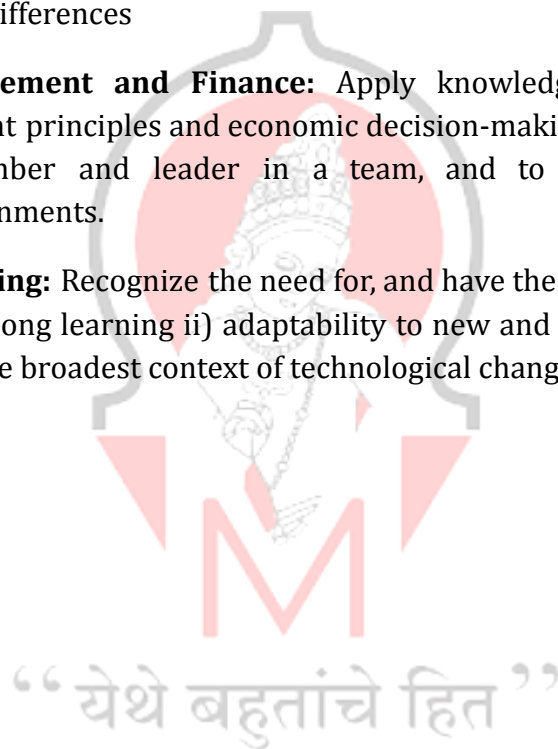
P07: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

P08: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

P09: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

P010: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

P011: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)



Curriculum for Double Minor in Full Stack Development

“येथे बहुतांचे हित”

Department of Information Technology

General Objectives and Scope:

The Double Minor in Full Stack Development aims to provide students with comprehensive knowledge of modern web development technologies used for building dynamic and scalable applications. The program focuses on developing skills in both front-end and back-end technologies, enabling students to design, develop, test, and deploy complete web-based systems.

The scope of this program includes learning programming languages, web frameworks, database management, API integration, and deployment techniques used in real-world applications. It also emphasizes hands-on learning through practical projects, helping students gain industry-relevant skills and preparing them for careers in software development, web development, and related IT domains.

Why Full Stack Development ?

Full Stack Development is important because modern software applications require integration of both front-end technologies (user interface and user experience) and back-end technologies (server-side logic, databases, and APIs). A full stack developer has the ability to understand and develop the entire architecture of a web application, ensuring efficient communication between different components of the system.

Learning Full Stack Development helps students gain practical knowledge of modern development frameworks and tools used in the IT industry. It enables them to build complete, scalable web applications and enhances their problem-solving and programming skills. Due to the increasing demand for versatile developers in the software industry, full stack development skills significantly improve employability and career opportunities.

Prerequisites :

1. Basic Computer Knowledge,
2. Programming Fundamentals,
3. UI/UX Basics



B. TECH DOUBLE MINOR IN FULL STACK DEVELOPMENT (Semester V, VI, VII, VIII)

Curriculum Structure

Course Code	Course Name	Teaching Scheme (Hrs/week)				Examination Scheme						Credits				
		L	P	T	ODL	CIE	ETE	TW	PR	OR	Total	L	P	T	ODL	Total
Semester IV																
IT24DMN241R	Foundation of Web Development	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
IT24DMN242R	Web Development Laboratory	-	4	-	-	-	-	25	-	25	50	-	2	-	-	2
Semester V																
IT24DMN341R	Frontend Development	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
IT24DMN342R	Frontend Development Laboratory	-	4	-	-	-	-	25	-	25	50	-	2	-	-	2
Semester VI																
IT24DMN391R	PHP and Server-Side Web Development	2	-	-	-	40	60	-	-	-	100	2	-	-	-	2
IT24DMN392R	PHP and Server-Side Web Development Laboratory	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester VII																
IT24DMN441R	Backend Development	2	-	-	-	40	60	-	-	-	100	2	-	-	-	2
IT24DMN442R	Backend Development Laboratory	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester VIII																
IT24DMN491R	Capstone Project	-	8	-	-	-	-	25	-	100	125	-	4	-	-	4
Total																
Total		10	20	-	-	160	240	125	-	150	675	10	10	-	-	20

L- Lecture

ETE- End Term Examination

L : 1 Hr= 1 credit

P- Practical

TW- Term work

P: 2 Hr. = 1 Credit

T- Tutorial

PR- Practical

T: 1 Hr. = 1 Credit

CIE-Continuous Internal Evaluation

OR- Oral

ODL-Open Distance Learning

	Working with JavaScript : Arrays and objects in JavaScript, DOM manipulation using JavaScript Event handling click, mouseover, etc. , Advanced JavaScript Concepts JSON: Introduction to JSON, parsing and stringifying JSON data, Asynchronous JavaScript: Promises, async/await, Error handling in JavaScript Introduction to jQuery : JQuery, Basic jQuery syntax and selectors,DOM manipulation with jQuery,jQuery effects and animations,Using jQuery plugins	
5	Modern UI Development ES6 features (let, const, arrow functions, modules),Introduction to UI frameworks: Bootstrap / Tailwind CSS,Responsive UI components,Web accessibility basics (ARIA concepts),Performance optimization basics	8
Total Hours		39
Text Books		
1. Kogent Learning Solutions Inc, Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Blackbook, Dreamtech Press, Second Edition, ISBN: 9788177228496. 2. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley Publications. 3. Jon Duckett, JavaScript and JQuery: Interactive Front-End Web Development, Wiley Publications.		
Reference Book		
1. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition,978- 81-265-1635-3 2. Dr. Hiren Joshi, Web Technology and Application Development, DreamTech, First,ISBN:978-93-5004-088-1 3. Ivan Bayross,"Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP,BPB Publications,4th Edition,ISBN:978-8183330084. 4. Adam Bretz& Colin J Ihrig, Full Stack Javascript Development with MEAN, SPD, First Edition, ISBN:978-0992461256. 5. David Flanagan, <i>JavaScript: The Definitive Guide – Master the World's Most-Used Programming Language</i> , 7th Edition, O'Reilly Media, 2020, ISBN: 978-1491952023. 6. Ethan Brown, <i>Web Development with Node and Express: Leveraging the JavaScript Stack</i> , 2nd Edition, O'Reilly Media, 2019, ISBN: 978-1492053514. 7. Adam Bretz and Colin J. Ihrig, <i>Full Stack JavaScript Development with MEAN, SPD / SitePoint</i> , First Edition, 2015, ISBN: 978-0992461256.		
Online References		
1. SWAYAM Course: "Web Design and Development", SWAYAM Online Course (https://onlinecourses.swayam2.ac.in/nou24_cs09/preview). 2. Coursera Specialization: Johns Hopkins University, Instructor: Yaakov Chaikin, "HTML, CSS, and Javascript for Web Developers" (https://www.coursera.org/specializations/html-css-javascript-for-web-developers). 3. Coursera Specialization: Logical Operations, Instructor: Bill Rosenthal, "Web Development with HTML5, CSS, and JavaScript" (https://www.coursera.org/specializations/web-design).		

Second Year B.Tech Information Technology													
Semester- IV													
Course Code : IT24DMN242R							Course Name: Web Development Laboratory						
Teaching Scheme (Hours/Week)					Examination Scheme						Credits		
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	Total
-	4	-	-	-	-	-	25	-	25	50	-	2	2
Course Objectives: - To understand the architecture of the Internet and World Wide Web. - To learn the fundamentals of HTML for developing structured web pages. - To apply CSS for styling and responsive webpage design. - To implement JavaScript for creating interactive web applications. - To develop modern responsive interfaces using frameworks like Bootstrap or Tailwind CSS.													
Course Outcomes : After completing the course, the students will be able to: C01: Understand the fundamental concepts in designing web based applications and apply frontend and backend technologies. C02: Apply the client side and server side technologies for web application development. C03: Analyze the web technology languages, frameworks and services. C04: Create effective web applications for business functionalities using the latest web development platforms.													
Sr. No	Activities											Duration (Hrs)	
1	Demonstrate the working of Internet and World Wide Web by exploring client-server architecture, URLs, domain names, and HTTP/HTTPS protocols using browser developer tools.											4	
2	Design structured web pages using HTML elements, attributes, lists, tables, images, and hyperlinks.											4	
3	Develop interactive web forms using various input types and incorporate multimedia elements such as audio, video, and canvas.											4	
4	Create semantically structured web pages using HTML5 elements such as header, nav, section, article, and footer.											4	
5	Apply CSS styling using inline, internal, and external stylesheets along with selectors (element, class, ID) to enhance webpage presentation.											4	
6	Design visually appealing web pages by applying CSS properties including text formatting, backgrounds, borders, margins, padding, display, and positioning techniques.											4	
7	Implement modern CSS layout techniques using Flexbox and Grid to create responsive and structured webpage layouts.											4	
8	Develop responsive web pages using media queries and apply CSS animations and transitions for enhanced user experience.											6	

9	Implement JavaScript programs to demonstrate variables, data types, control structures, functions, arrays, and objects.	6
10	Develop dynamic web pages by performing DOM manipulation and handling events such as click and mouseover using JavaScript.	6
11	Implement asynchronous JavaScript concepts including JSON handling, Promises, async/await, and error handling for dynamic data processing	46
Total Hours		52
Text Books		
1. AJon Duckett, HTML and CSS: Design and Build Websites, John Wiley & Sons, 1st Edition, 2011, ISBN: 978-1118008188. 2. Jon Duckett, JavaScript and JQuery: Interactive Front-End Web Development, John Wiley & Sons, 1st Edition, 2014, ISBN: 978-1118531648. 3. Kogent Learning Solutions Inc., Web Technologies: HTML, JavaScript, PHP, Java, JSP, XML and AJAX (Black Book), Dreamtech Press, 2nd Edition, ISBN: 978-8177228496.		
Reference Books		
1. David Flanagan, <i>JavaScript: The Definitive Guide – Master the World's Most-Used Programming Language</i>, 7th Edition, O'Reilly Media, 2020, ISBN: 978-1491952023. 2. Ethan Brown, <i>Web Development with Node and Express: Leveraging the JavaScript Stack</i>, 2nd Edition, O'Reilly Media, 2019, ISBN: 978-1492053514. Adam Bretz and Colin J. Ihrig, <i>Full Stack JavaScript Development with MEAN</i>, SPD / SitePoint, 1st Edition, 2015, ISBN: 978-0992461256. 3. Steven M. Schafer, <i>HTML, XHTML and CSS: Comprehensive</i>, Wiley India, 4th Edition, ISBN: 978-8126516353.		
Online References		
1. SWAYAM Course: "Web Design and Development", SWAYAM Online Course (https://onlinecourses.swayam2.ac.in/nou24_cs09/preview). 2. Coursera Specialization: Johns Hopkins University, Instructor: Yaakov Chaikin, "HTML, CSS, and Javascript for Web Developers" (https://www.coursera.org/specializations/html-css-javascript-for-web-developers). 3. Coursera Specialization: Logical Operations, Instructor: Bill Rosenthal, "Web Development with HTML5, CSS, and JavaScript" (https://www.coursera.org/specializations/web-design).		

Third Year B. Tech Information Technology													
Semester- V													
Course Code : IT24DMN341R										Course Name: Frontend Development			
Teaching Scheme Hours/Week				Examination Scheme						Credits			
L	T	OL	ODL	CIE	ETE	TW	PR	OR	TOTAL	L	P	T	TOTAL
3	-	-	-	40	60		-	-	100	3	-	-	3
Course Objectives: - To introduce modern JavaScript frameworks and their role in frontend development. - To enable students to design user interfaces using component-based architecture. - To develop skills in state management, routing, and API integration. - To apply responsive design principles and best practices for building scalable web applications.													
Course Outcomes : After completing the course, the students will be able to: C01: Understand and compare modern JavaScript frameworks and frontend development concepts. C02: Design and implement reusable UI components using framework-based architecture. C03: Develop interactive web applications with state management, routing, and API integration. C04: Build responsive, accessible, and optimized frontend applications following best practices.													
Unit	Contents										Duration (Hrs.)		
1	Introduction to JavaScript Frameworks Evolution of frontend development, Overview of modern JavaScript frameworks: React, Angular, Vue, Features and comparison of frameworks, Single Page Applications (SPA) vs Multi Page Applications (MPA), Setting up development environment (Node.js, npm, CLI tools), Introduction to project structure in frameworks										8		
2	Component-Based Architecture Concept of components and reusability, Functional and class-based components, Props and data binding, Component lifecycle methods/hooks, Event handling in components, Designing modular UI using components										8		
3	State Management Introduction to state and its importance, Local vs global state, State management in React (useState, useContext), Introduction to Redux / Vuex / Angular services, Data flow and state updates, Handling forms and controlled components										7		
4	Routing and API Integration Client-side routing concepts, Routing in React / Angular / Vue, Navigation and route parameters, Introduction to RESTful APIs, Fetch API and Axios for HTTP requests, Handling API responses and errors, Connecting frontend with backend services										8		
5	Responsive UI Design and Best Practices Principles of responsive web design, CSS Flexbox and Grid, Using UI frameworks (Bootstrap / Material UI), Media queries and mobile-first design, Accessibility basics, Performance optimization techniques, Deployment basics (build and hosting)										8		

Total Hours		39
Text Books		
1. Alex Banks and Eve Porcello, <i>Learning React</i>, 2nd Edition, O'Reilly Media, 2020, ISBN: 978-1492051725. 2. Stoyan Stefanov, <i>React: Up & Running</i>, O'Reilly Media, 2016, ISBN: 978-1491931820.		
Reference Book		
1. Adam Freeman, <i>Pro Angular</i>, Apress, Latest Edition, ISBN: 978-1484259979. 2. Marijn Haverbeke, <i>Eloquent JavaScript</i>, 3rd Edition, No Starch Press, 2018, ISBN: 978-1593279509.		
Online References		
1. SWAYAM Course: Web Technologies / Web Design and Development , Introduction to web technologies including HTML, CSS, JavaScript, responsive design, and modern web development fundamentals. (https://onlinecourses.swayam2.ac.in/nou24_cs09/preview)		



Third Year B.Tech Information Technology														
Semester- V														
Course Code : IT24DMN342R										Course Name: Frontend Development Laboratory				
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	TOTAL	
-	4	-	-	-	-	-	25	-	25	50	-	2	2	
Course Objectives: • To introduce modern JavaScript frameworks and their role in frontend development. • To enable students to design user interfaces using component-based architecture. • To develop skills in state management, routing, and API integration. • To apply responsive design principles and best practices for building scalable web applications.														
Course Outcomes : After completing the course, the students will be able to: C01: Understand and compare modern JavaScript frameworks and frontend development concepts. C02: Design and implement reusable UI components using framework-based architecture. C03: Develop interactive web applications with state management, routing, and API integration. C04: Build responsive, accessible, and optimized frontend applications following best practices.														
Sr. No	Activities											Duration (Hrs)		
1	Install and configure development environment using Node.js, npm, and framework CLI tools; create and explore a basic project structure.											4		
2	Design and implement basic functional and class-based components to display static content in a frontend application.											5		
3	Implement props and data binding techniques to enable communication between parent and child components.											5		
4	Develop interactive user interfaces by handling events such as click, input, and form submission.											5		
5	Demonstrate component lifecycle methods and hooks to manage side effects and rendering behavior.											4		
6	Develop applications using local state management techniques such as useState and controlled components											5		
7	Implement advanced state management using Context API / Redux / Vuex / Angular services for sharing data across components.											5		
8	Design and implement client-side routing to navigate between multiple pages and handle route parameters.											5		
9	Integrate RESTful APIs using Fetch API or Axios to retrieve, display, and manage data with proper error handling											5		
10	Design responsive user interfaces using CSS Flexbox, Grid, media queries, and UI frameworks like Bootstrap or Material UI.											4		

11	Develop a mini project by integrating components, routing, state management, API handling, and responsive design into a complete frontend application.	5
Total Hours		52
Text Books		
1. Alex Banks and Eve Porcello, <i>Learning React</i>, 2nd Edition, O'Reilly Media, 2020, ISBN: 978-1492051725. 2. Stoyan Stefanov, <i>React: Up & Running</i>, O'Reilly Media, 2016, ISBN: 978-1491931820.		
Reference Book		
• Adam Freeman, <i>Pro Angular</i>, Apress, Latest Edition, ISBN: 978-1484259979. • Marijn Haverbeke, <i>Eloquent JavaScript</i>, 3rd Edition, No Starch Press, 2018, ISBN: 978-1593279509.		
Online References		
4. SWAYAM Course: Web Technologies / Web Design and Development , Introduction to web technologies including HTML, CSS, JavaScript, responsive design, and modern web development fundamentals. (https://onlinecourses.swayam2.ac.in/nou24_cs09/preview)		

“येथे बहुतांचे हित”

The End Term Examination (ETE) of 60 marks will be conducted at the department level. The mode, tools, and methodology for conducting the examination will be decided by the Course Coordinator, with due approval from the Chairperson of the Board of Studies (BoS).

Text Books

1. PHP & MySQL: Server-side Web Development – Comprehensive guide covering PHP, MySQL, and dynamic web application development with practical examples.
2. PHP & MySQL Web Development – Focuses on building real-world database-driven web applications using PHP.

Reference Book

1. Learning PHP, MySQL & JavaScript – Covers full-stack development concepts integrating PHP with frontend technologies.
2. Head First PHP & MySQL – Beginner-friendly, visual approach with interactive learning techniques.
3. Beginning PHP and MySQL – Strong foundation in PHP programming and database connectivity.

Online References

1. PHP Official Documentation – Authoritative and up-to-date PHP reference.
2. MDN Web Docs – Web development standards and server-side concepts.

“येथे बहुतांचे हित”

Third Year B. Tech Information Technology														
Semester- VI														
Course Code : IT24DMN392R					Course Name: PHP and Server-Side Web Development Laboratory									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	
-	2	-	-	-	-	-	25	-	-	25	-	1	1	
Course Objectives: - To understand the fundamentals of server-side web development and PHP programming. - To develop dynamic web applications using forms, sessions, and database integration. - To implement secure and efficient data handling techniques in web applications. - To introduce modern development practices and frameworks for scalable web solutions.														
Course Outcomes : After completing the course, the students will be able to: CO1: Understand and apply PHP syntax and server-side scripting concepts. CO2: Develop dynamic web pages using forms, sessions, and user input handling. CO3: Implement database-driven applications using PHP and MySQL with CRUD operations. CO4: Design secure and structured web applications using best practices and basic frameworks.														
Sr. No	Activities										Duration (Hrs)			
1	Write a program demonstrating variables, data types, operators, and control structures										3			
2	Implement user-defined functions and perform operations on indexed and associative arrays.										3			
3	Design an HTML form and process data using GET and POST methods.										3			
4	Implement server-side validation for user input (e.g., login/registration form).										3			
5	Create, read, and write data to files using PHP.										3			
6	Develop a session-based login system and demonstrate cookie usage										3			
7	Connect PHP with MySQL using MySQLi/PDO and display records										4			
8	Perform Insert, Update, Delete, and Fetch operations on a database table.										4			
											Total Hours		26	
Text Books														
1. PHP & MySQL: Server-side Web Development – Comprehensive guide covering PHP, MySQL, and dynamic web application development with practical examples. 2. PHP & MySQL Web Development – Focuses on building real-world database-driven web applications using PHP.														

Reference Book

1. Learning PHP, MySQL & JavaScript – Covers full-stack development concepts integrating PHP with frontend technologies.
2. Head First PHP & MySQL – Beginner-friendly, visual approach with interactive learning techniques.
3. Beginning PHP and MySQL – Strong foundation in PHP programming and database connectivity.

Online References

1. PHP Official Documentation – Authoritative and up-to-date PHP reference.
2. MDN Web Docs – Web development standards and server-side concepts.



5	Deployment and Best Practices API testing using Postman, Deployment basics (cloud platforms), Introduction to Docker (basic), Logging and monitoring, Performance optimization techniques	6
Total Hours		30
Note for Course Coordinator		
The End Term Examination (ETE) of 60 marks will be conducted at the department level. The mode, tools, and methodology for conducting the examination will be decided by the Course Coordinator, with due approval from the Chairperson of the Board of Studies (BoS).		
Text Books		
1. Ethan Brown, <i>Web Development with Node and Express</i>, 2nd Edition, O'Reilly Media, 2019. 2. David Herron, <i>Node.js Web Development</i>, 4th Edition, Packt Publishing.		
Reference Book		
1. Adam Bretz and Colin J. Ihrig, <i>Full Stack JavaScript Development with MEAN</i>, SitePoint. 2. Martin Kleppmann, <i>Designing Data-Intensive Applications</i>, O'Reilly Media.		
Online References		
1. Database Management System, Instructor: Prof. P. P. Chakrabarti, Institution: IIT Kharagpur Platform: NPTEL / SWAYAM, Link: https://nptel.ac.in/courses/106105175 2. Introduction to Database Systems, Instructor: Prof. S. Sudarshan, Institution: IIT Bombay Platform: NPTEL, Link: https://nptel.ac.in/courses/106101061		

“येथे बहुतांचे हित”

2. David Herron, *Node.js Web Development*, 4th Edition, Packt Publishing.

Reference Book

1. Adam Bretz and Colin J. Ihrig, *Full Stack JavaScript Development with MEAN*, SitePoint.
2. Martin Kleppmann, *Designing Data-Intensive Applications*, O'Reilly Media.

Online References

1. Database Management System, Instructor: Prof. P. P. Chakrabarti, Institution: IIT Kharagpur
Platform: NPTEL / SWAYAM, Link: <https://nptel.ac.in/courses/106105175>
2. Introduction to Database Systems, Instructor: Prof. S. Sudarshan, Institution: IIT Bombay
Platform: NPTEL, Link: <https://nptel.ac.in/courses/106101061>



2. **Week 03–04:** Literature survey and study of existing full stack applications and database solutions.
3. **Week 05–06:** Requirement analysis and system design including **database schema design**.
4. **Week 07–08:** Development of **frontend interfaces, backend services, and application modules**.
5. **Week 09–10:** **Database integration, implementation, and testing** of the system.
6. **Week 11:** Preparation of **project report and presentation slides**.
7. **Week 12:** **Final project demonstration and evaluation**.

Guidelines for Capstone Project Report

Contents of the Project Report

- Title Page with project title, student name, roll number, guide name, department, institution, year, and university.
- Project Approval Certificate
- Abstract and Keywords
- Acknowledgement
- Table of Contents, List of Figures, and List of Tables

Chapters

1. Introduction and problem statement
2. Literature Survey
3. System Design and Architecture
4. Database Design and Implementation
5. Application Development and Results
6. Discussion and Conclusion
7. Future Scope
8. References (IEEE Format)

Plagiarism Check Report

Students are encouraged to use open-source tools for documentation, referencing, and plagiarism detection.

Guidelines for Assessment

The Capstone Project will be evaluated based on **Term Work (TW) and Oral/Practical (OR)**.

Term Work (TW) – 50 Marks

Criteria	Marks
Project topic relevance and problem definition	5
Literature review and technical depth	5
Project design and implementation progress	5
Project report documentation	5
Attendance and regular interaction with guide	5
Total	25

Oral / Practical Examination (OR) – 100 Marks

Criteria	Marks
Demonstration of working project	40
Understanding of concepts and implementation	25
Innovation and technical contribution	15
Presentation and communication skills	10
Question and answer session	10
Total	100

Marathwada Mitra Mandal's College of Engineering

Karvenagar, Pune- 52

An Autonomous Institute Affiliated to SPPU



“येथे बहुतांचे हित”

Curriculum Structure and Syllabus

Double Minor

A.Y. 2026-27

Accredited with A++ grade by NAAC
Recipient of Best College award by SPPU | Accredited by NBA
Recognized under 2(f) and 12(B) of UGC Act 1956
www.mmcoe.edu.in

About Marathwada Mitra Mandal's College of Engineering

MMCOE has been recognised as the BEST COLLEGE by SPPU. MMCOE is one feather in the cap of Marathwada Mitra Mandal's Pune, from the academic year 2006 – 2007.

The Institute offers six undergraduate engineering programmes in Electrical Engineering, Mechanical Engineering, Electronics & Telecommunication Engineering, Information Technology, Computer Engineering, and Artificial Intelligence & Data Science. In addition, it offers six postgraduate programmes M.Tech (Electrical – Power Electronics & Drives), M.Tech (Mechanical – Design Engineering), M.Tech (Electronics & Telecommunication – VLSI & Embedded Systems), M.Tech (Information Technology – Data Science), M.Tech (Computer Engineering), along with a Ph.D. programme in Computer Engineering. It houses 2000+ students and 200 staff members. Along with the focus on core academics, college also takes care of overall personality development of the students.

The college has an active robotics cell, NCC, Training and Placement cell etc. The students are motivated to actively participate in co-curricular and extra-curricular activities. They have brought many laurels to the Institute in the events such as Vinodottam Karandak, Firodiya Karandak, Zest, Dexterity etc.

Institute Vision

To be a globally renowned institution through excellence in engineering education for sustainable and holistic development

Institute Mission

M1: Empower students with cutting-edge technologies and global competencies

M2: Foster culture of research and entrepreneurial mindset

M3: Imbibe social and professional values

M4: Provide an inclusive environment for lifelong learning

**Department of
Computer Engineering**

“येथे बहुतांचे हित”

Vision and Mission of the Department

- **Vision**

To excel in computer engineering education for sustainable development.

- **Mission**

M1: To develop globally competent professionals through interdisciplinary learning and Center of Excellence.

M2: To empower research, innovation, and entrepreneurial thinking

M3: To promote ethical values and holistic development

M4: To prepare graduates for lifelong learning and dynamic careers

- **Program Specific Outcomes (PSOs)**

A Graduate of the Computer Engineering Program will be able to

PSO1: Apply problem solving skills to design effective solutions in High Performance Computing, Artificial Intelligence and Cyber Security

PSO2: Develop advanced skill-based solutions using standard Software Engineering practices

- **Program Outcomes (POs)**

P01: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

P02: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

P03: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

P04: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

P05: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

P06: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

P07: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

P08: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

P09: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

P010: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

P011: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Department of Computer Engineering

General Objectives and Scope:

A double minor degree in engineering means that a student studies their main engineering branch along with two additional specialized subjects. This approach helps students gain interdisciplinary knowledge and develop skills beyond their core field. For example, an engineering student might major in mechanical engineering while taking minors in Artificial Intelligence and Data Science. The scope of a double minor is good because industries increasingly prefer engineers who understand multiple domains, especially with the growth of technologies related to Robotics and Cybersecurity. Having a double minor can improve job opportunities, allow students to apply for a wider range of roles during campus placements, and make it easier to pursue higher studies in different fields. Although it requires additional coursework and good time management, a double minor can significantly enhance a student's knowledge, versatility, and employability in the competitive engineering job market.

Why Computing Algorithms?

A double minor in Computing Algorithms is valuable in engineering because algorithms are essential for efficient problem-solving and the development of modern computing systems. Knowledge of algorithms helps students improve logical thinking, analytical ability, and programming efficiency, which are important skills for solving complex technical problems. It also supports rapidly growing fields such as Artificial Intelligence, Data Science, and Machine Learning, where optimized algorithms are required to process large amounts of data and build intelligent applications. With this additional specialization, engineering students gain a broader technical skill set and a competitive advantage in technology-driven industries, increasing their opportunities in areas like software development, research, and advanced computing.

Prerequisites :

- Fundamentals of Programming Languages
- Mathematics

**Curriculum for B. Tech. with Double Minor
in Computing Algorithm**



B. TECH DOUBLE MINOR IN COMPUTING ALGORITHM (Semester IV, V, VI, VII, VIII)

Curriculum Structure

Course Code	Course Name	Teaching Scheme (Hrs/week)				Examination Scheme						Credits				
		L	P	T	ODL	CIE	ETE	TW	PR	OR	Total	L	P	T	ODL	Total
Semester IV																
CE24DMN294R	Programming and Database Fundamentals	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
CE24DMN295R	Programming and Database Fundamentals Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester V																
CE24DMN345R	Foundations of Algorithms	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
CE24DMN346R	Foundations of Algorithms Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester VI																
CE24DMN395R	Advanced Data Structures	3	-	-	-	40	60*	-	-	-	100	3	-	-	-	3
CE24DMN396R	Advanced Data Structures Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester VII																
CE24DMN444R	Analysis of Algorithms	-	-	-	3	40	60*	-	-	-	100	-	-	-	3	3
CE24DMN445R	Analysis of Algorithms Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester VIII																
CE24DMN493R	Capstone Project	-	8	-	-	-	-	100	-	-	100	-	4	-	-	4
Total		09	16	-	03	160	240	200	-	-	600	09	08	-	03	20

* Mode of conduction of ETE will be decided by course coordinator in the supervision of BOS chairperson.

L- Lecture	P- Practical	T- Tutorial	CIE-Continuous Internal Evaluation
ETE- End Term Examination	TW- Term work	PR- Practical	OR- Oral
L : 1 Hr.= 1 credit	P: 2 Hr. = 1 Credit	T: 1 Hr. = 1 Credit	ODL-Open Distance Learning

Dr. K. S. Thakre
BOS Chairperson

Second Year B. Tech Computer Engineering														
Semester IV														
Course Code: CE24DMN294R					Course Name: Programming and Database Fundamentals									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Course Objectives: ● To learn basic principles of programming languages and programming paradigms. ● To learn advanced Java features including inheritance, packages, interfaces, exception handling, and file input/output for building robust applications. ● To demonstrate database concepts, design principles, and ER/EER modeling. ● To solve SQL queries and PL/SQL subroutines for efficient data processing.														
Course Outcomes: After learning the course, the students will be able to: CO1: Analyze different programming languages based on their core principles and features. CO2: Apply Object-Oriented Programming concepts to implement fundamental Java constructs. CO3: Implement the principles of inheritance, encapsulation, and package usage. CO4: Demonstrate the fundamentals of DBMS,ER/EER modeling. CO5: Apply SQL queries and PL/SQL subroutines to manage and manipulate relational data.														
Unit	Contents										Hrs			
1	Fundamentals of Programming Importance of Studying Programming Languages, History of Programming Languages, Role of Programming Languages, Programming Environments. Binding & Binding Times. Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms- procedural, object oriented, functional, and logic and rule based.										7			
2	Object Oriented Programming Classes & Methods: class basics, objects, constructors, this, garbage collection, method overloading, argument passing, access control, static, final, command-line & variable-length arguments, Arrays: 1D and multi-dimensional arrays, alternative declarations, String Handling: String class and common methods										8			
3	Inheritances, Packages and Interfaces Inheritance: member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, Packages and Interfaces: defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces, variables in interfaces										7			
4	Introduction to Database Management Systems and ER Model Introduction, Purpose of Database Systems, Database-System Applications, View of Data, Database Languages, Database System Architecture and Structure, Data Models. Database Design and ER Model: Entity, Attributes, Relationships, Constraints, Keys, Design Process, ER Diagram, Design Issues, Extended E-R Features, converting ER and EER diagrams into tables.										7			

	Case Study: Study of Architecture of any DBMS like Oracle or MySQL. Design a database schema	
5	Relational Databases and SQL Basics Relational Model: Concepts, Attributes, Domains, E. F. Codd's Rules, Integrity Constraints: Domain, Referential, Entity Integrity, SQL Basics: Data Types, DDL, DML, DCL, TCL SQL Queries: SELECT, Joins, Aggregate Functions, Nested Subqueries, Introduction to PL/SQL: Procedures, Functions, Cursors, Triggers, Case Study: Student Course Management System (basic design and queries)	7
Total Hours		36
Text Books		
• T. W. Pratt, M. V. Zelkowitz, "Programming Languages Design and Implementation, 4th Ed, PHI, ISBN 81-203-2035-2. • Sebesta R., "Concepts of Programming Languages", 12th Edition, Pearson Education, ISBN-81-7808-161-X. • Herbert Schildt, "The Complete Reference Java", 13th Ed, TMH, ISBN: 978-0-07-180856-9 • Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 7th edition • Connally T., Begg C., "Database Systems", 4th Edition, Pearson Education, 2002, ISBN 8178088614 • D T Editorial Services "BIG DATA Black Book", Dreamtech Press ISBN 13 : 978935119931		
Reference Books		
1. Dr. R. Nageshwar Rao, "Core Java: An Integrated Approach", 8th Ed, Dreamtech Press, ISBN 9789351199250 2. Carlo Ghezzi, Mehdi Jazayeri, "Programming Language Concepts", 3rd Ed, Wiley Publication ISBN : 978-81-265-1861-6 3. C J Date, "An Introduction to Database Systems", Addison-Wesley, ISBN: 0201144719 4. S.K. Singh, "Database Systems: Concepts, Design and Application", Pearson Education, ISBN 978-81-317-6092-5 5. Kristina Chodorow, Michael Dierolf, "MongoDB: The Definitive Guide", O'Reilly Publications, ISBN: 978-1-449-34468-9 6. Adam Fowler, "NoSQL For Dummies", John Wiley & Sons, ISBN-1118905628		
Online References		
• https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384205303214_080010965_shared/overview • https://spoken-tutorial.org/tutorial-search/?search_foss=java&search_language= • https://www.codechef.com/roadmap/java-dsa • NPTEL Course: Prof. Debasis Samanta, IIT Kharagpur, "Programming in Java" https://nptel.ac.in/courses/106105191 • SQL and Relational Theory a. (How to Write Accurate SQL code), C.J. Date, O'REILLY Publication. • SQL A Beginner's Guide, Andy Oppel, Robert Sheldon, McGraw Hill Publication • NPTEL Course: Prof. Sreenivasa Kumar, IIT Madras, "Introduction to Database Systems" https://nptel.ac.in/courses/106106220		
Coding Practice:		
1. https://www.hackerrank.com/domains/java 2. https://leetcode.com/problemset		

	1	2	3
1	1		
2		1	
3			1

[illegible]

- | | | | | | |
|--|-------|---|---|---|-----|
| | K K S | C | S | A | G G |
|--|-------|---|---|---|-----|

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 84

0	0	1	0	1
---	---	---	---	---

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[illegible]

-

[illegible]

- | | |
|-----------|-------|
| 1997-1998 | 1998-1999 | 1999-2000 | 2000-2001 | 2001-2002 | 2002-2003 | 2003-2004 | 2004-2005 | 2005-2006 | 2006-2007 | 2007-2008 | 2008-2009 | 2009-2010 | 2010-2011 | 2011-2012 | 2012-2013 | 2013-2014 | 2014-2015 | 2015-2016 | 2016-2017 | 2017-2018 | 2018-2019 | 2019-2020 | 2020-2021 | 2021-2022 | 2022-2023 | 2023-2024 | 2024-2025 | 2025-2026 | 2026-2027 | 2027-2028 | 2028-2029 | 2029-2030 | 2030-2031 | 2031-2032 | 2032-2033 | 2033-2034 | 2034-2035 | 2035-2036 | 2036-2037 | 2037-2038 | 2038-2039 | 2039-2040 | 2040-2041 | 2041-2042 | 2042-2043 | 2043-2044 | 2044-2045 | 2045-2046 | 2046-2047 | 2047-2048 | 2048-2049 | 2049-2050 | 2050-2051 | 2051-2052 | 2052-2053 | 2053-2054 | 2054-2055 | 2055-2056 | 2056-2057 | 2057-2058 | 2058-2059 | 2059-2060 | 2060-2061 | 2061-2062 | 2062-2063 | 2063-2064 | 2064-2065 | 2065-2066 | 2066-2067 | 2067-2068 | 2068-2069 | 2069-2070 | 2070-2071 | 2071-2072 | 2072-2073 | 2073-2074 | 2074-2075 | 2075-2076 | 2076-2077 | 2077-2078 | 2078-2079 | 2079-2080 | 2080-2081 | 2081-2082 | 2082-2083 | 2083-2084 | 2084-2085 | 2085-2086 | 2086-2087 | 2087-2088 | 2088-2089 | 2089-2090 | 2090-2091 | 2091-2092 | 2092-2093 | 2093-2094 | 2094-2095 | 2095-2096 | 2096-2097 | 2097-2098 | 2098-2099 | 2099-2100 | 2100-2101 | 2101-2102 | 2102-2103 | 2103-2104 | 2104-2105 | 2105-2106 | 2106-2107 | 2107-2108 | 2108-2109 | 2109-2110 | 2110-2111 | 2111-2112 | 2112-2113 | 2113-2114 | 2114-2115 | 2115-2116 | 2116-2117 | 2117-2118 | 2118-2119 | 2119-2120 | 2120-2121 | 2121-2122 | 2122-2123 | 2123-2124 | 2124-2125 | 2125-2126 | 2126-2127 | 2127-2128 | 2128-2129 | 2129-2130 | 2130-2131 | 2131-2132 | 2132-2133 | 2133-2134 | 2134-2135 | 2135-2136 | 2136-2137 | 2137-2138 | 2138-2139 | 2139-2140 | 2140-2141 | 2141-2142 | 2142-2143 | 2143-2144 | 2144-2145 | 2145-2146 | 2146-2147 | 2147-2148 | 2148-2149 | 2149-2150 | 2150-2151 | 2151-2152 | 2152-2153 | 2153-2154 | 2154-2155 | 2155-2156 | 2156-2157 | 2157-2158 | 2158-2159 | 2159-2160 | 2160-2161 | 2161-2162 | 2162-2163 | 2163-2164 | 2164-2165 | 2165-2166 | 2166-2167 | 2167-2168 | 2168-2169 | 2169-2170 | 2170-2171 | 2171-2172 | 2172-2173 | 2173-2174 | 2174-2175 | 2175-2176 | 2176-2177 | 2177-2178 | 2178-2179 | 2179-2180 | 2180-2181 | 2181-2182 | 2182-2183 | 2183-2184 | 2184-2185 | 2185-2186 | 2186-2187 | 2187-2188 | 2188-2189 | 2189-2190 | 2190-2191 | 2191-2192 | 2192-2193 | 2193-2194 | 2194-2195 | 2195-2196 | 2196-2197 | 2197-2198 | 2198-2199 | 2199-2200 | 2200-2201 | 2201-2202 | 2202-2203 | 2203-2204 | 2204-2205 | 2205-2206 | 2206-2207 | 2207-2208 | 2208-2209 | 2209-2210 | 2210-2211 | 2211-2212 | 2212-2213 | 2213-2214 | 2214-2215 | 2215-2216 | 2216-2217 | 2217-2218 | 2218-2219 | 2219-2220 | 2220-2221 | 2221-2222 | 2222-2223 | 2223-2224 | 2224-2225 | 2225-2226 | 2226-2227 | 2227-2228 | 2228-2229 | 2229-2230 | 2230-2231 | 2231-2232 | 2232-2233 | 2233-2234 | 2234-2235 | 2235-2236 | 2236-2237 | 2237-2238 | 2238-2239 | 2239-2240 | 2240-2241 | 2241-2242 | 2242-2243 | 2243-2244 | 2244-2245 | 2245-2246 | 2246-2247 | 2247-2248 | 2248-2249 | 2249-2250 | 2250-2251 | 2251-2252 | 2252-2253 | 2253-2254 | 2254-2255 | 2255-2256 | 2256-2257 | 2257-2258 | 2258-2259 | 2259-2260 | 2260-2261 | 2261-2262 | 2262-2263 | 2263-2264 | 2264-2265 | 2265-2266 | 2266-2267 | 2267-2268 | 2268-2269 | 2269- |
|-----------|-------|

3. C J Date, "An Introduction to Database Systems", Addison-Wesley, ISBN: 0201144719
4. S.K.Singh, "Database Systems: Concepts, Design and Application", Pearson Education, ISBN 978-81-317-6092-5
5. Kristina Chodorow, Michael Dierolf, "MongoDB: The Definitive Guide", O'Reilly Publications, ISBN: 978-1-449-34468-9
6. Adam Fowler, "NoSQL For Dummies", John Wiley & Sons, ISBN-1118905628

Online references

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384205303214080_010965_shared/overview
2. https://spoken-tutorial.org/tutorial-search/?search_foss=java&search_language=
3. <https://www.codechef.com/roadmap/java-dsa>
4. NPTEL Course: Prof. Debasis Samanta, IIT Kharagpur, "Programming in Java"
<https://nptel.ac.in/courses/106105191>
5. SQL and Relational Theory a. (How to Write Accurate SQL code), C.J. Date, O'REILLY Publication.
6. SQL A Beginner's Guide, Andy Oppel, Robert Sheldon, McGraw Hill Publication
7. NPTEL Course: Prof. Sreenivasa Kumar, IIT Madras, "Introduction to Database Systems"
<https://nptel.ac.in/courses/106106220>

Coding Practice:

1. <https://www.hackerrank.com/domains/java>
2. <https://leetcode.com/problemset>



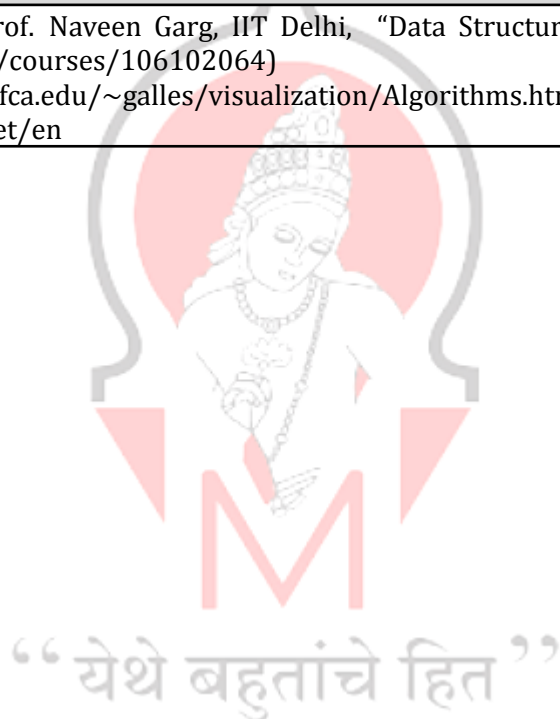
- Michael T. Goodrich, Roberto Tamassia, David M. Mount, "Data Structures and Algorithms in C++", ISBN-13 978-8126512607 Publisher WILEY INDIA EDITION, Publication date 1 January 2015.

Reference Books

1. E. Balagurusamy, "Object Oriented Programming with C++", Eighth Edition, ISBN-13 978-9389949186, McGraw Hill, 24 September 2020
2. Yashavant Kanetkar, "Let us C++", BPB Publications (16 September 2020), ISBN-10 : 9388176642, ISBN-13 : 978-9388176644.
3. G.A.V. PAI, "Data Structures and Algorithms, Concepts, Techniques and Applications", Tata McGraw-Hill, Volume1 1st Edition, 2017. ISBN-10: 0070667268/ ISBN-13: 978-0070667266.
4. Richard F. Gilberg & Behrouz A. Forouzan, "Data Structures, Pseudo code Approach with C", Cengage Learning India Edition, 2nd Edition, 2007, ISBN 10: 8131503143 ISBN 13: 9788131503140.
5. Y. Langsam, M. Augenstein, A. Tannenbaum, "Data Structures using C & C++", Pearson Education India, Second Edition, 2015, ISBN 10: 9332549311, ISBN 13: 978-9332549319.

Online References

- NPTEL Course: Prof. Naveen Garg, IIT Delhi, "Data Structures And Algorithms" ([Link: https://nptel.ac.in/courses/106102064](https://nptel.ac.in/courses/106102064))
- <https://www.cs.usfca.edu/~galles/visualization/Algorithms.html>
- <https://visualgo.net/en>



		A	C	C
--	--	---	---	---

--	--	--

[illegible]

Table 1. The number of cases of *Salmonella* infection in the United Kingdom, 1990-1999, by serotype and age group

- | | | | | | | | |
|--|---|---|---|---|---|---|---|
| | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
|--|---|---|---|---|---|---|---|

	1	2	3	4
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				
60				
61				
62				
63				
64				
65				
66				
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				
92				
93				
94				
95				
96				
97				
98				
99				
100				

	A	B	C
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	0	0	0
27	0	0	0
28	0	0	0
29	0	0	0
30	0	0	0
31	0	0	0
32	0	0	0
33	0	0	0
34	0	0	0
35	0	0	0
36	0	0	0
37	0	0	0
38	0	0	0
39	0	0	0
40	0	0	0
41	0	0	0
42	0	0	0
43	0	0	0
44	0	0	0
45	0	0	0
46	0	0	0
47	0	0	0
48	0	0	0
49	0	0	0
50	0	0	0
51	0	0	0
52	0	0	0
53	0	0	0
54	0	0	0
55	0	0	0
56	0	0	0
57	0	0	0
58	0	0	0
59	0	0	0
60	0	0	0
61	0	0	0
62	0	0	0
63	0	0	0
64	0	0	0
65	0	0	0
66	0	0	0
67	0	0	0
68	0	0	0
69	0	0	0
70	0	0	0
71	0	0	0
72	0	0	0
73	0	0	0
74	0	0	0
75	0	0	0
76	0	0	0
77	0	0	0
78	0	0	0
79	0	0	0
80	0	0	0
81	0	0	0
82	0	0	0
83	0	0	0
84	0	0	0
85	0	0	0
86	0	0	0
87	0	0	0
88	0	0	0
89	0	0	0
90	0	0	0
91	0	0	0
92	0	0	0
93	0	0	0
94	0	0	0
95	0	0	0
96	0	0	0
97	0	0	0
98	0	0	0
99	0	0	0
100	0	0	0

	▲	▲	○	○	○
--	---	---	---	---	---

- _____

--

- _____

3. G.A.V. PAI, "Data Structures and Algorithms, Concepts, Techniques and Applications", Tata McGraw-Hill, Volume1 1st Edition, 2017. ISBN-10: 0070667268/ ISBN-13: 978-0070667266.
4. Richard F. Gilberg& Behrouz A. Forouzan, "Data Structures, Pseudo code Approach with C", Cengage Learning India Edition, 2nd Edition, 2007, ISBN 10: 8131503143 ISBN 13: 9788131503140.
5. Y. Langsam, M. Augensteinand, A. Tannenbaum,"Data Structures using C & C++",Pearson Education India, Second Edition,2015, ISBN 10: 9332549311, ISBN 13: 978-9332549319.

Online references

- NPTEL Course: Prof. Naveen Garg, IIT Delhi, "Data Structures And Algorithms" ([Link: https://nptel.ac.in/courses/106102064](https://nptel.ac.in/courses/106102064))
- <https://www.cs.usfca.edu/~galles/visualization/Algorithms.html>
- <https://visualgo.net/en>



Mode of conduction of ETE will be decided by the course coordinator in the supervision of the chairperson.

Suggested tools for evaluation (Any 2):

1. Coding Marathon
2. Mini Project
3. Certification (NPTEL/SWAYAM/MOOC)

Text Books

1. Sartaj Sahni, Ellis Horowitz, "Fundamentals of Data Structures in C", Orient blackswan, 2nd Edition, 2010, ISBN 81- 7515-257-5.
2. Michael T. Goodrich, Roberto Tamassia, David M. Mount, "Data Structures and Algorithms in C++", ISBN-13 978-8126512607 Publisher WILEY INDIA EDITION, Publication date 1 January 2015.

Reference Books

1. E. Balagurusamy, "Object Oriented Programming with C++", Eighth Edition, ISBN-13 978-9389949186, McGraw Hill, 24 September 2020
2. Yashavant Kanetkar, "Let us C++", BPB Publications (16 September 2020), ISBN-10 : 9388176642, ISBN-13 : 978-9388176644.
3. G.A.V. PAI, "Data Structures and Algorithms, Concepts, Techniques and Applications", Tata McGraw-Hill, Volume1 1st Edition, 2017. ISBN-10: 0070667268/ ISBN-13: 978-0070667266.
4. Richard F. Gilberg & Behrouz A. Forouzan, "Data Structures, Pseudo code Approach with C", Cengage Learning India Edition, 2nd Edition, 2007, ISBN 10: 8131503143 ISBN 13: 9788131503140.
5. Y. Langsam, M. Augenstein, A. Tannenbaum, "Data Structures using C & C++", Pearson Education India, Second Edition, 2015, ISBN 10: 9332549311, ISBN 13: 978-9332549319.

Online References

- NPTEL Course: Prof. Naveen Garg, IIT Delhi, "Data Structures And Algorithms" ([Link: https://nptel.ac.in/courses/106102064](https://nptel.ac.in/courses/106102064))
- <https://www.cs.usfca.edu/~galles/visualization/Algorithms.html>
- <https://visualgo.net/en>

“येथे बहुतांचे हित”

Students will be able to:

- Trees and graphs in Data Structures.
- Breadth-First Search and Depth-First Search
- Data organization.

• Binary Tree creation and traversal (Inorder, Preorder, Postorder)

• Binary Search Tree operations (insertion, deletion, search)

• Graph representation using adjacency list and matrix

• Breadth First Search (BFS) traversal.

• Depth First Search (DFS) traversal.

2. Yashavant Kanetkar, "Let us C++", BPB Publications (16 September 2020), ISBN-10 : 9388176642, ISBN-13 : 978-9388176644.
3. G.A.V. PAI, "Data Structures and Algorithms, Concepts, Techniques and Applications", Tata McGraw-Hill, Volume1 1st Edition, 2017. ISBN-10: 0070667268/ ISBN-13: 978-0070667266.
4. Richard F. Gilbert& Behrouz A. Forouzan, "Data Structures, Pseudo code Approach with C", Cengage Learning India Edition, 2nd Edition, 2007, ISBN 10: 8131503143 ISBN 13: 9788131503140.
5. Y. Langsam, M. Augenstein, A. Tannenbaum, "Data Structures using C & C++", Pearson Education India, Second Edition, 2015, ISBN 10: 9332549311, ISBN 13: 978-9332549319.

Online References

- NPTEL Course: Prof. Naveen Garg, IIT Delhi, "Data Structures And Algorithms" ([Link: https://nptel.ac.in/courses/106102064](https://nptel.ac.in/courses/106102064))
- <https://www.cs.usfca.edu/~galles/visualization/Algorithms.html>
- <https://visualgo.net/en>



Text Books

1. Sartaj Sahni, Ellis Horowitz, "Fundamentals of Data Structures in C", Orient blackswan, 2nd Edition, 2010, ISBN 81- 7515-257-5.
2. Michael T. Goodrich, Roberto Tamassia, David M. Mount, "Data Structures and Algorithms in C++", ISBN-13 978-8126512607 Publisher WILEY INDIA EDITION, Publication date 1 January 2015.

Reference Books

1. E. Balagurusamy, "Object Oriented Programming with C++", Eighth Edition, ISBN-13 978-9389949186, McGraw Hill, 24 September 2020
2. Yashavant Kanetkar, "Let us C++", BPB Publications (16 September 2020), ISBN-10 : 9388176642, ISBN-13 : 978-9388176644.
3. G.A.V. PAI, "Data Structures and Algorithms, Concepts, Techniques and Applications", Tata McGraw-Hill, Volume1 1st Edition, 2017. ISBN-10: 0070667268/ ISBN-13: 978-0070667266.
4. Richard F. Gilberg & Behrouz A. Forouzan, "Data Structures, Pseudo code Approach with C", Cengage Learning India Edition, 2nd Edition, 2007, ISBN 10: 8131503143 ISBN 13: 9788131503140.
5. Y. Langsam, M. Augenstein, A. Tannenbaum, "Data Structures using C & C++", Pearson Education India, Second Edition, 2015, ISBN 10: 9332549311, ISBN 13: 978-9332549319.

Online References

- NPTEL Course: Prof. Naveen Garg, IIT Delhi, "Data Structures And Algorithms" ([Link: https://nptel.ac.in/courses/106102064](https://nptel.ac.in/courses/106102064))
- <https://www.cs.usfca.edu/~galles/visualization/Algorithms.html>
- <https://visualgo.net/en>

“येथे बहुतांचे हित”

3. G.A.V. PAI, "Data Structures and Algorithms, Concepts, Techniques and Applications", Tata McGraw-Hill, Volume1 1st Edition, 2017. ISBN-10: 0070667268/ ISBN-13: 978-0070667266.
4. Richard F. Gilberg& Behrouz A. Forouzan, "Data Structures, Pseudo code Approach with C", Cengage Learning India Edition, 2nd Edition, 2007, ISBN 10: 8131503143 ISBN 13: 9788131503140.
5. Y. Langsam, M. Augensteinand, A. Tannenbaum,"Data Structures using C & C++",Pearson Education India, Second Edition,2015, ISBN 10: 9332549311, ISBN 13: 978-9332549319.

Online References

- NPTEL Course: Prof. Naveen Garg, IIT Delhi, "Data Structures And Algorithms" ([Link: https://nptel.ac.in/courses/106102064](https://nptel.ac.in/courses/106102064))
- <https://www.cs.usfca.edu/~galles/visualization/Algorithms.html>
- <https://visualgo.net/en>



- Algorithm Design

Identify suitable algorithms (string matching, randomized algorithms, greedy algorithms, approximation algorithms).

- Implementation

Implement the solution using a programming language such as Python, Java, or C++.

- Performance Analysis

Evaluate the algorithm using time complexity, space complexity, or experimental analysis.

- Documentation

Prepare a report including: Problem statement, Algorithm design, Implementation details, Results and analysis

- Presentation / Demonstration

Demonstrate the working solution and explain the algorithm used.



Marathwada Mitra Mandal's College of Engineering Karvenagar, Pune- 52

An Autonomous Institute Affiliated to SPPU



“येथे बहुतांचे हित”

Curriculum Structure and Syllabus Double Minor

A.Y. 2026-27

Accredited with A++ grade by NAAC
Recipient of Best College award by SPPU | Accredited by NBA
Recognized under 2(f) and 12(B) of UGC Act 1956
www.mmcoe.edu.in

About Marathwada Mitra Mandal's College of Engineering

MMCOE has been recognised as the BEST COLLEGE by SPPU. MMCOE is one feather in the cap of Marathwada Mitra Mandal's Pune, from the academic year 2006 – 2007.

The Institute offers six undergraduate engineering programmes in Electrical Engineering, Mechanical Engineering, Electronics & Telecommunication Engineering, Information Technology, Computer Engineering, and Artificial Intelligence & Data Science. In addition, it offers six postgraduate programmes M.Tech (Electrical – Power Electronics & Drives), M.Tech (Mechanical – Design Engineering), M.Tech (Electronics & Telecommunication – VLSI & Embedded Systems), M.Tech (Information Technology – Data Science), M.Tech (Computer Engineering), along with a Ph.D. programme in Computer Engineering. It houses 2000+ students and 200 staff members. Along with the focus on core academics, college also takes care of overall personality development of the students.

The college has an active robotics cell, NCC, Training and Placement cell etc. The students are motivated to actively participate in co-curricular and extra-curricular activities. They have brought many laurels to the Institute in the events such as Vinodottam Karandak, Firodiya Karandak, Zest, Dexterity etc.

Institute Vision

To be a globally renowned institution through excellence in engineering education for sustainable and holistic development

Institute Mission

M1: Empower students with cutting-edge technologies and global competencies

M2: Foster culture of research and entrepreneurial mindset

M3: Imbibe social and professional values

M4: Provide an inclusive environment for lifelong learning

**Department of
Artificial Intelligence and Data Science**

“येथे बहुतांचे हित”

Vision and Mission of the Department

- **Vision**

Emerge globally as a leading center for Artificial Intelligence and Data Science education, contributing to sustainable development.

- **Mission**

M1: Equip students with advanced Artificial Intelligence knowledge for industry-ready skills.

M2: Cultivate a culture of research and entrepreneurship to drive innovation and problem-solving.

M3: Inculcate social and professional values to develop sustainable AI solutions.

M4: Foster a lifelong learning that supports upskilling and global engagement.

- **Program Specific Outcomes (PSOs)**

Upon successful completion of the program, graduates will be able to:

PSO1: Demonstrate the ability to understand, apply, and develop fundamental computer programs and AI and Data Science solutions using key concepts such as data analytics, machine learning, deep learning and natural language processing.

PSO2: Develop and implement AI and data-driven models by critically analyzing complex problems, designing effective solutions, and evaluating their impact across diverse real-world applications.

PSO3: Utilize emerging AI and Data Science technologies to innovate, promote entrepreneurial ventures, and develop successful careers in industry and research, while embracing lifelong learning and higher education.

- **Program Outcomes (POs)**

P01: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop the solution of complex engineering problems.

P02: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

P03: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

P04: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

P05: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

P06: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

P07: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

P08: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

P09: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

P010: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

P011: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Department of Artificial Intelligence and Data Science

General Objectives and Scope:

A double minor degree in engineering allows a student to pursue their primary engineering discipline while simultaneously studying additional specialized fields. This approach helps students gain interdisciplinary knowledge and develop skills beyond their core field. For example, an engineering student might major in mechanical engineering while taking minors in Artificial Intelligence and Data Science. The industries prefer engineers who understand multiple domains, especially with the growth of technologies related to Robotics and Cybersecurity. Having a double minor can improve job opportunities, allow students to apply for a wider range of roles during campus placements, and make it easier to pursue higher studies in different fields. Although it requires additional coursework and good time management, a double minor can significantly enhance a student's knowledge, versatility, and employability in the competitive engineering job market.

Why Data Science?

Data Science is an interdisciplinary field that focuses on extracting meaningful insights and knowledge from large volumes of data using statistical methods, programming, and machine learning techniques. In a Data Science double minor course, students learn how to collect, clean, analyze, and visualize data to support data-driven decision making. Using tools and programming languages such as Python and SQL, data science professionals build models that identify patterns, predict outcomes, and help organizations understand complex datasets. Unlike traditional data analysis, modern data science integrates advanced algorithms, automation, and computational power to handle massive and diverse data sources efficiently.

Data Science is becoming an essential discipline across many sectors including healthcare, finance, marketing, technology, and research. As organizations increasingly rely on data to guide strategy and innovation, the demand for skilled data science professionals continues to grow rapidly. The field also plays a significant role in emerging technologies such as Artificial Intelligence, machine learning, predictive analytics, and big data systems. A Data Science double minor course equips students with analytical thinking, problem-solving

abilities, and technical skills needed to work with real-world data and contribute to modern data-driven industries.

Prerequisites :

- Introduction to Programming
- Linear Algebra
- Probability and Statistics
- Database Management Systems



**Curriculum for B. Tech. with Double Minor
in Data Science**

“येथे बहुतांचे हित”

B. TECH honours IN Data Science (Semester IV, V, VI, VII, VIII)

Curriculum Structure

Course Code	Course Name	Teaching Scheme (Hrs/week)				Examination Scheme						Credits				
		L	P	T	ODL	CIE	ETE	TW	PR	OR	Total	L	P	T	ODL	Total
Semester IV																
AI24DMN294R	Foundations of Data Science	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
AI24DMN295R	Foundations of Data Science Laboratory	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester V																
AI24DMN345R	Programming for Data Analysis	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
AI24DMN346R	Programming for Data Analysis Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester VI																
AI24DMN395R	Machine Learning for Data Science	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
AI24DMN396R	Machine Learning for Data Science Laboratory	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester VII																
AI24DMN444R	Advanced Data Analytics and Data Visualization	-	-	-	3	40	60	-	-	-	100	-	-	-	3	3
AI24DMN445R	Advanced Data Analytics and Data Visualization Laboratory	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Semester VIII																
AI24DMN493R	Capstone Project	-	8	-	-	-	-	100	-	-	100	-	4	-	-	4
Total																
Total		09	16	-	03	160	240	200	-	-	600	09	08	-	03	20

*** Mode of conduction of ETE will be decided by course coordinator in the supervision of BOS chairperson.**

L- Lecture P- Practical T- Tutorial CIE-Continuous Internal Evaluation
 ETE- End Term Examination TW- Term work PR- Practical OR- Oral
 L : 1 Hr.= 1 credit P: 2 Hr. = 1 Credit T: 1 Hr. = 1 Credit ODL-Open Distance Learning

Dr.Dhanraj Dhotre
BOS Chairperson

Second Year B.Tech Artificial Intelligence & Data Science															
Semester-IV															
Course Code: AI24DMN294R										Course Name: Foundation of Data Science					
Teaching Scheme (Hours/Week)				Examination Scheme						Credits					
L	P	T	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL	
3	-	-	-	40	60	-	-	-	100	3	-	-	-	3	
Prerequisite: Discrete mathematics, Applied statics															
Course Objectives: - To Understand the complete data science lifecycle - To Apply statistical and computational techniques to real datasets - To Use programming tools for data analysis and visualization - To Extract meaningful insights for decision-making - To Build a foundation for advanced analytics and machine learning															
Course Outcomes: C01: Explain the fundamentals of Data Science, its lifecycle, and its role in solving real-world problems across different domains. C02: Identify, collect, and preprocess data from multiple sources by applying data cleaning, transformation, and preparation techniques C03: Analyse datasets using descriptive statistics and exploratory data analysis techniques to identify patterns, trends, and anomalies. C04: Apply probability and statistical concepts to support data-driven reasoning and uncertainty analysis in practical scenarios. C05: Develop basic data visualizations and analytical reports using appropriate tools to communicate insights effectively for decision-making.															
Unit	Contents										Duration (Hrs.)				
1	Introduction to Data Science & Real-World Context What is Data Science? Data Science lifecycle, Types of data: structured, unstructured, semi-structured, Data collection, data preprocessing Roles, Data Analyst, Data Scientist, Data Engineer.										8				
Activity/ Case Study:	- Explore public datasets (Kaggle / data.gov.in) - Case study: “How Netflix uses data”.														
2	Data Collection & Data Preprocessing Core Concepts: Data sources: CSV, Excel, APIs, Web data, Data cleaning and data wrangling, Handling missing values, duplicates, and outliers, Data transformation and normalization										8				
Activity/ Case Study:	1.Clean a real dataset using Python / Excel 2.Mini project: Prepare rainfall or sales data for analysis														
3	Exploratory Data Analysis (EDA) & Visualization, Core Concepts: Descriptive statistics, Measures of central tendency and dispersion, Data visualization principles, Charts: bar, line, pie, histogram, box plot										8				

Activity/ Case Study:	1. Perform EDA on Titanic or Payroll dataset 2. Visualization using Matplotlib / Seaborn / Power BI	
4	Probability & Statistics for Data Science Core Concepts: Probability basics, Random variables, Probability distributions, Correlation and covariance, Sampling and bias, Data privacy and security, Bias and fairness in data.	8
Activity/ Case Study:	1. Probability simulation using Python 2. Case study: Loan approval analysis	
5	Introduction to Data Analytics & Decision Making, Core Concepts Types of analytics: descriptive, diagnostic, predictive, prescriptive, Data-driven decision making, KPIs and metrics, Ethical issues in AI and analytics, Data protection laws.	8
Activity/ Case Study:	1. Build a simple dashboard 2. Analyse customer churn dataset	
Total Hours		40
Text Books		
- Foundations of Data Science — Avrim Blum, John Hopcroft & Ravindran Kannan A comprehensive introduction to the mathematical and algorithmic foundations of data science, including probability, linear algebra, clustering, and learning algorithms. Suitable for undergraduate/graduate foundational understanding. - Foundations of Data Science with Python — John M. Shea A modern, application-driven textbook that teaches data manipulation, visualization, and statistics with Python and real datasets		
Reference Books		
- Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python — Peter Bruce, Andrew Bruce & Peter Gedeck Excellent reference for statistical concepts used in data science (distributions, hypothesis testing, regression, sampling). - Think Stats: Probability and Statistics for Programmers — Allen B. Downey A computationally oriented reference that explains statistical inference using Python examples. - An Introduction to Statistical Learning — Gareth James, Daniela Witten, Trevor Hastie & Robert Tibshirani		
Online References		
Extract, Transform and Load Data in Power BI (Coursera) Data Preparation and Visualization with Power BI (Coursera) Power BI: Data Analytics with Power BI Bootcamp (Udemy)		

Second Year B.Tech Artificial Intelligence & Data Science														
Semester-IV														
Course Code: AI24DMN295R					Course Name: Foundation of Data Science Laboratory									
Teaching Scheme (Hours/Week)				Examination Scheme						Credits				
L	P	T	ODL	CI E	ET E	TW	O R	PR	TOT AL	L	P	T	OD L	TOTAL
-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Prerequisite: Programming in C/C++/Java, Data structures, Discrete mathematics														
Course Objectives: - To introduce students to the fundamentals of data science and its real-world applications using public datasets. - To provide hands-on experience in data collection, cleaning, preprocessing, and transformation techniques. - To develop skills in exploratory data analysis and effective data visualization using modern tools. - To apply basic probability and statistical concepts for data analysis and decision making. - To enable students to analyze real-world datasets ethically and derive meaningful, data-driven insights through mini projects and dashboards.														
Course Outcomes: C01: Identify different types of data and data sources, and collect real-world datasets from public repositories and APIs. C02: Clean, preprocess, and transform raw data by handling missing values, duplicates, and outliers using appropriate tools. C03: Perform exploratory data analysis using descriptive statistics and visualize data using charts and plots. C04: Apply probability and statistical techniques to analyze datasets, identify patterns, and support decision making. C05: Analyze real-world case studies (e.g., customer churn, loan approval) while considering ethical, privacy, and fairness issues in data usage.														
Sr. No.	List of Experiment										Duration (Hrs.)			
1	Explore public datasets from Kaggle and data.gov.in Identify structured, semi-structured, and unstructured data. Case discussion: How Netflix uses data for recommendations										2			
2	Import data from CSV and Excel files Collect data using APIs (introductory level) Web data collection basics (manual or automated) Understand data attributes and metadata										2			
3	Handle missing values (mean, median, mode, deletion) Remove duplicates and detect outliers Perform data wrangling operations Data transformation and normalization techniques										4			
4	Select a real dataset (Rainfall / Sales / Population) Perform data cleaning, transformation, and normalization Prepare dataset for further analysis and visualization										4			
5	Compute descriptive statistics Measures of central tendency and dispersion Identify patterns and trends in data										4			

6	Create visualizations using Matplotlib / Seaborn / Power BI Bar chart, Line chart, Pie chart Histogram and Box plot Visualization best practices	4
7	Probability basics and random variables Probability distributions Correlation and covariance analysis Sampling techniques and bias identification	4
8	Loan approval dataset analysis Identify factors affecting approval Study bias, fairness, and ethical considerations Discuss data privacy and security concerns	4
Total Hours		28
Text Books		
• Introduction to Data Science: Practical Approach with R and Python – B. Uma Maheswari & R. Sujatha • Python Data Science Handbook – Jake VanderPlas		
Reference Books		
• Fundamentals of Data Science – Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare • Data Science Fundamentals and Practical Approaches – Gypsy Nandi & Rupam Kumar Sharma (BPB) • Foundations of Data Science: A Practical Introduction to Data Science with Python – Jonathan Dinu		
Online References		
• https://nptel.ac.in/courses/106106131		

“येथे बहुतांचे हित”

Third Year B.Tech Artificial Intelligence & Data Science														
Semester- V														
Course Code: AI24DMN345R					Course Name: Programming for Data Analysis									
Teaching Scheme (Hours/Week)				Examination Scheme						Credits				
L	P	T	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
3		-	-	40	60	-	-		100	3	-	-	-	3
Prerequisite: Applies Statistics														
Course Objectives: - To develop programming skills for handling data - To understand data manipulation, analysis, and visualization - To apply Python libraries for real-world data analysis - To build a foundation for machine learning and AI applications														
Course Outcomes: After learning the course, the students will be able to: CO1: Apply Python programming for data analysis tasks CO2: Manipulate and preprocess datasets effectively CO3: Visualize data for insights CO4: Perform basic exploratory data analysis CO5: Implement small data analysis projects														
Unit	Contents										Duration (Hrs.)			
1	Introduction to Programming & Data Analysis Role of programming in data analysis, Overview of data analysis workflow, Introduction to Python, Python basics: variables, data types, operators, Control structures: if-else, loops, Functions and modules, Basic input/output, Introduction to Jupyter Notebook										8			
2	Data Structures & File Handling: Python data structures: Lists, Tuples, Sets, Dictionaries, String operations, File handling (CSV, TXT), Exception handling, Introduction to NumPy, Arrays, indexing, slicing, Vectorized operations Basic mathematical functions										8			
3	Data Manipulation using Pandas Introduction to Pandas, Series and DataFrames, Reading datasets (CSV/Excel), Data inspection and cleaning, Handling missing values, Sorting, filtering, grouping, Merge and join operations, Basic statistical operations										8			
4	Data Visualization Importance of visualization, Matplotlib basics, Line plots, bar charts, pie charts, histograms, scatter plots, Introduction to Seaborn, Styling and customization of plots, Visual exploration of datasets										8			
5	Introduction to Exploratory Data Analysis (EDA) Introduction, EDA Process / Workflow, Statistical Techniques in EDA, Univariate, bivariate, and multivariate analysis, Handling missing values, duplicates, and inconsistent data, Outlier detection and treatment methods, Correlation analysis and feature relationships										8			
Total Hours										40				
Text Books														
1. Python for Data Analysis by Wes McKinney 2. Python Programming for Data Analysis by José Unpingco														

Reference Books

1. Python Data Analytics: With Pandas, NumPy, and Matplotlib – Fabio Nelli
2. Pandas for Everyone: Python Data Analysis – Daniel Y. Chen

Online References

1. <https://youtu.be/GPVsHOIRBBI>
2. <https://www.youtube.com/watch?v=VaSijMrq24&list=PLjVLYmrlmjGdRs1sGqRrTE-EMraLclIga>



Third Year B.Tech Artificial Intelligence & Data Science															
Semester-V															
Course Code: AI24DMN346R				Course Name: Programming for Data Analysis Laboratory											
Teaching Scheme (Hours/Week)				Examination Scheme						Credits					
L	P	T	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL	
-	2	-	-	-	-	25	-	-	25	-	1	-	-	1	
Prerequisite: Applies Statistics															
Course Objectives: • Provide hands-on experience in Python programming for data analysis applications. • Develop problem-solving skills using control structures, functions, and modular programming. • Introduce core data structures and their use in organizing and analyzing data efficiently. • Enable students to process, clean, and analyze real-world datasets using files and libraries. • Familiarize students with numerical and data analysis libraries such as NumPy and Pandas.															
Course Outcomes: After learning the course, the students will be able to: C01: Apply Python programming fundamentals to solve basic data analysis problems using conditional and iterative constructs. C02: Design modular Python programs using functions and reusable components for analytical tasks. C03: Utilize appropriate data structures (lists, dictionaries, sets, tuples) to model and analyze structured datasets. C04: Implement robust file handling techniques to read, process, and manage real-world data with proper exception handling. C05: Perform efficient numerical computations and statistical analysis using NumPy arrays and vectorized operations.															
List of Experiments															
Sr. No.		Name of the Experiment											Duration (Hrs.)		
1		Develop a Python program to process a dataset of student marks stored in a list. The program should: • Use conditional statements to assign grades • Use iterative constructs to compute total and average marks • Implement functions for modularity • Compare the performance of for and while loops for the same task											04		
2		Create a Python program to analyze employee data using appropriate data structures: • Use lists to store employee records • Use dictionaries to map departments to employees • Use sets to identify unique job roles • Perform operations such as filtering high-salary employees, counting department-wise employees, and searching records efficiently											04		
3		Develop a Python application to read and process data from CSV and TXT files containing sales records. The program should: • Handle file input/output operations • Implement exception handling for missing files and invalid data • Validate and clean input data • Generate summary statistics such as total sales and average revenue											04		

4	Using NumPy, design a program to perform numerical analysis on a large dataset of numerical values. The program should: • Perform vectorized operations such as mean, standard deviation, and matrix multiplication • Compare execution time with equivalent Python list-based computations	04
5	Create a Pandas-based data analysis workflow to process a dataset containing customer transactions. The program should: • Load data into DataFrames • Merge multiple datasets • Perform indexing, filtering, grouping, and aggregation • Extract insights such as top customers and monthly sales trends	06
6	Develop a data preprocessing pipeline using Python and Pandas for a real-world dataset. The pipeline should: • Detect and handle missing values • Identify and treat outliers • Remove duplicate records • Correct inconsistent data types	06
	Total Hours	28
Text Books		
1. Python for Data Analysis — Wes McKinney 2. Python Programming for Data Analysis — José Unpingco		
Reference Books		
1. <i>Python Data Analytics: Data Analysis and Science using pandas, matplotlib and the Python Programming Language</i> — Fabio Nelli 2. <i>Python Data Analysis – Third Edition</i> — Avinash Navlani & Ivan Idris		
Online References		
1. https://youtu.be/GPVsHOIRBBI 2. https://www.youtube.com/watch?v=VaSjiIMrq24&list=PLjVLYmrlmjGdRs1sGqRrTE-EMraLclJga		

“येथे बहुतांचे हित”

Third Year B.Tech Artificial Intelligence & Data Science																
Semester-VI																
Course Code: AI24DMN395R								Course Name: Machine Learning for Data Science								
Teaching Scheme (Hours/Week)					Examination Scheme						Credits					
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL	
3	-	-	-	-	40	60	-	-	-	100	3	-	-	-	3	
Prerequisite: Basic knowledge of Python programming, linear algebra, probability and statistics, data handling, and an understanding of supervised and unsupervised machine learning concepts.																
Course Objectives: • Provide strong foundations in machine learning concepts for data science. • Enable students to build, evaluate, and optimize ML models. • Develop practical skills through real-world datasets and applications. • Introduce ethical considerations and deployment of ML systems. • Equip students with the ability to select appropriate machine learning techniques and tools for solving domain-specific data science problems.																
Course Outcomes: C01: Explain the fundamentals of the Data Science lifecycle, data types, EDA, mathematical foundations, machine learning paradigms, and basic optimization. C02: Design and implement supervised learning models for regression and classification tasks and evaluate their performance. C03: Apply advanced machine learning techniques such as SVMs and ensemble models for complex data science problems. C04: Utilize unsupervised learning techniques to discover hidden patterns and reduce dimensionality in large datasets. C05: Develop end-to-end machine learning solutions considering ethical issues and deploy models for practical applications.																
Unit I	Foundations of Data Science and Machine Learning											Duration (Hrs.)				
	Data Science lifecycle and problem formulation, Types of data: structured, semi-structured, unstructured, Exploratory Data Analysis (EDA) and data visualization, Mathematical foundations: Linear algebra for ML (vectors, matrices, eigenvalues), Probability and statistics for ML, Machine learning paradigms: Supervised, unsupervised, semi-supervised learning, Batch learning vs online learning, Optimization basics: loss functions and gradient descent.											8				
Activity /Case Study	EDA on real-world datasets, data visualization, problem formulation case studies.															
Unit-II	Supervised Learning – Regression and Classification															
	Regression techniques: Simple and multiple linear regression, Polynomial regression, Regularization: Ridge, Lasso, Elastic Net. Classification techniques: Logistic regression, k-Nearest Neighbors (k-NN), Naïve Bayes classifier, Decision trees, Model evaluation: Train-test split and cross-validation, Performance metrics for regression and classification, Bias-variance trade-off											8				
Activity	House price prediction, medical diagnosis, credit risk analysis.															

/Case Study		
Unit-III	Advanced Machine Learning Models	
	Support Vector Machines: Linear and non-linear SVM, Kernel functions. Ensemble learning techniques : Bagging and boosting, Random Forest, Gradient Boosting (XGBoost, LightGBM – overview). Model optimization: Hyperparameter tuning, Feature engineering, Model pipelines.	8
Activity /Case Study	Fraud detection, customer churn prediction, performance comparison of models.	
Unit-IV	Unsupervised Learning and Dimensionality Reduction	
	Clustering techniques: k-Means clustering, Hierarchical clustering, DBSCAN, Cluster evaluation techniques, Dimensionality reduction: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), t-SNE (visualization), Association rule mining: Apriori algorithm, FP-Growth algorithm.	8
Activity /Case Study	Customer segmentation, anomaly detection, market basket analysis.	
Unit-V	Machine Learning Applications and Deployment	
	Applied machine learning systems : Recommendation systems, Time series forecasting, Introduction to Natural Language Processing. Ethical and responsible AI : Bias, fairness, and transparency, Data privacy and security. Model deployment : Model serialization, Building APIs using Flask/FastAPI, Introduction to MLOps and model monitoring.	8
Activity /Case Study	End-to-end ML project, real-world case studies, basic model deployment.	
Total Hours		40
Text Books		
1. Tom M. Mitchell, <i>Machine Learning</i> , McGraw-Hill. 2. Aurélien Géron, <i>Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow</i> , O'Reilly. 3. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publication, 2012, ISBN0-07-120413-X. 4. Jiawei Han, Micheline Kamber, and Jian Pie, "Data Mining: Concepts and Techniques" Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807.		
Reference Books		
1. Christopher M. Bishop, <i>Pattern Recognition and Machine Learning</i> , Springer. 2. Ian Goodfellow et al., <i>Deep Learning</i> , MIT Press. 3. EMC Education Services, "Data Science and Big Data Analytics- Discovering, analyzing Visualizing and Presenting Data" 1st Edition.		

4. DT Editorial Services, "Big Data, Black Book", DT Editorial Services, ISBN: 9789351197577, 2016 Edition.
5. Chirag Shah, "A Hands-On Introduction To Data Science", Cambridge University Press, (2020), ISBN : ISBN 978-1-108-47244-9.
6. Wes McKinney, "Python for Data Analysis ", O' Reilly media, ISBN: 978-1-449-31979-3. 5. Trent Hauk, "Scikit-learn Cookbook", Packt Publishing, ISBN: 9781787286382.
7. Jenny Kim, Benjamin Bengfort, "Data Analytics with Hadoop", O'Reilly Media, Inc., ISBN: 9781491913703

Online References

1. An Introduction to Statistical Learning by Gareth James
<https://www.ime.unicamp.br/~dias/Intoduction%20to%20Statistical%20Learning.pdf>
2. Python Data Science Handbook by Jake VanderPlas
<https://tanthiamhuat.files.wordpress.com/2018/04/pythondatasciencehandbook.pdf>
3. Hadoop Tutorial :
https://www.tutorialspoint.com/hadoop/hadoop_tutorial.pdf?utm_source=7_&utm_medium=affiliate&utm_content=5f34cd37cdf1050001b09537&utm_campaign=Admitad&utm_term=761c575424fc4a6b48d02f72157eb578
4. Learning with Python; How to think like a computer scientist:
<http://openbookproject.net/thinkcs/python/english3e/>
5. Scikit Learn Tutorial <https://scikit-learn.org/stable/>
6. Python for everybody: http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf
7. An introduction to data Science :
<https://docs.google.com/file/d/0B6iefdnF22XQeVZDSkxjZ0Z5VUE/edit?pli=1>

“येथे बहुतांचे हित”

Third Year B.Tech Artificial Intelligence & Data Science															
Semester-VI															
Course Code: AI24DMN396R Course Name: Machine Learning for Data Science Laboratory															
Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
-	2	-	-	-	-	-	25	-	-	25	-	1	-	-	1
Prerequisite: Basic knowledge of Python programming, linear algebra, probability and statistics, data handling, and an understanding of supervised and unsupervised machine learning concepts.															
Course Objectives: The objectives of this laboratory course are to: • Provide hands-on experience with data preprocessing, exploratory data analysis, and feature engineering using real-world datasets. • Enable students to implement and experiment with supervised and unsupervised machine learning algorithms using appropriate tools and libraries. • Develop skills to train, validate, tune, and compare machine learning models based on performance metrics. • Familiarize students with practical issues such as overfitting, bias-variance trade-off, and model interpretability. • Encourage ethical, reproducible, and responsible implementation of machine learning workflows and deployment-ready solutions.															
Course Outcomes: After completing this laboratory course, the students will be able to: C01: Perform data collection, cleaning, preprocessing, and exploratory data analysis using suitable programming tools and libraries. C02: Implement supervised learning algorithms for regression and classification problems and evaluate their performance using appropriate metrics. C03: Apply advanced machine learning techniques such as Support Vector Machines and ensemble methods on real-world datasets. C04: Implement unsupervised learning techniques including clustering and dimensionality reduction to extract meaningful insights from large datasets. C05: Develop and present end-to-end machine learning solutions with proper documentation, ethical considerations, and basic model deployment practices.															
Sr. No.	Suggested Lab List:										Duration (Hrs.)				
1	Customer Churn Analysis for a Telecom Service Provider Problem Scenario (Case Study) A telecom company is experiencing a high customer churn rate. The management wants to understand why customers are leaving and identify key factors influencing churn so that targeted retention strategies can be designed. You are hired as a Data Science Intern and are provided with raw customer data collected from multiple sources such as billing systems, customer service logs, and demographic records. The dataset is noisy, incomplete, and inconsistent. Your task is to collect, clean, preprocess, and analyze the data to extract meaningful insights that can later be used for building machine learning models.										6				
2	Predicting House Prices and Customer Churn Using Supervised Learning Algorithms Problem Scenario (Case Study) A data analytics firm works with clients from different domains and needs predictive models for both numerical and categorical outcomes. You are assigned two tasks:										4				

	Regression Task: A real estate company wants to predict house prices based on property features to assist buyers and sellers in pricing decisions. Classification Task: A telecom company wants to predict customer churn to proactively retain customers at risk of leaving. Your responsibility is to build supervised learning models, train them on historical data, and evaluate their performance using suitable metrics.	
3	Credit Risk Assessment Using Support Vector Machines and Ensemble Learning Problem Scenario (Case Study) A financial institution provides loans to customers from diverse economic backgrounds. Incorrect loan approval decisions can result in financial loss or missed business opportunities. The bank wants to build a robust predictive system that can classify applicants as low-risk or high-risk based on historical data. Due to the complexity and non-linearity of financial data, traditional models are insufficient. As a Data Scientist, you are tasked with applying advanced machine learning techniques, specifically Support Vector Machines (SVMs) and ensemble methods, to improve prediction accuracy and reliability.	4
4	Customer Segmentation Using Clustering and Dimensionality Reduction Problem Scenario (Case Study) An e-commerce company serves thousands of customers with diverse purchasing behaviors. The marketing team wants to design personalized campaigns, but lacks labeled data indicating customer types. As a Data Analyst, your task is to apply unsupervised learning techniques to: Group customers into meaningful segments Reduce data dimensionality for visualization and insight discovery These insights will help the company target customers more effectively.	4
5	End-to-End Disease Risk Prediction System with Ethical AI Considerations Problem Scenario (Case Study) A public healthcare organization aims to identify patients at high risk of developing diabetes so that early preventive care can be provided. The organization wants a machine learning-based decision support system that is: Accurate and interpretable Ethically responsible Easy to deploy for use by healthcare staff You are assigned as a Machine Learning Engineer to design, implement, document, and deploy an end-to-end ML solution.	6
Total Hours		30
Text Books		
1. Hands-On Machine Learning with Scikit-Learn and Scientific Python Toolkits — a practical guide to build ML models using Python and Scikit-Learn, covering regression, classification, unsupervised learning, model evaluation and pipelines.		
Reference Books		
1. Machine Learning: Master Supervised and Unsupervised Learning Algorithms with Real Examples — covers a broad set of ML algorithms with real examples (regression, classification, clustering).		
Online References		
1. https://www.oreilly.com/library/view/hands-on-machine-learning/9781838826048/ 2. https://reference-global.com/book/9789391392352		

Final Year B.Tech Artificial Intelligence & Data Science															
Semester-VII															
Course Code: AI24DMN444R								Course Name: Advanced data analytics and data visualization							
Teaching Scheme (Hours/Week)				Examination Scheme						Credits					
L	P	T	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL	
-	-	-	3	40	60	-	-	-	100	-	-	-	3	3	
Prerequisite: Statistics and programming skills															
Course Objectives: - To understand advanced data analytics concepts, data ecosystems, and their role in business decision-making. - To apply statistical and predictive modeling techniques to generate actionable insights. - To build, tune, and evaluate machine learning models for classification, clustering, and association tasks. - To create effective visualizations and dashboards to communicate insights clearly. - To develop advanced visual analytics, including interactive, geospatial, and network-based visualizations, to support decisions.															
Course Outcomes: After learning the course, the students will be able to: C01: Collect, preprocess, and explore structured and unstructured data using Python, R, SQL, and analytics platforms. C02: Analyze data using statistical techniques, including hypothesis testing, regression, forecasting, and dimensionality reduction. C03: Build and optimize supervised and unsupervised machine learning models for large and imbalanced datasets. C04: Design effective static and interactive visualizations and dashboards to communicate insights. C05: Develop advanced visual analytics with interactive, geospatial, and network-based dashboards for decision support.															
Unit	Contents										Duration (Hrs.)				
1	Foundations of Advanced Data Analytics: Overview of advanced analytics and its role in decision-making, Types of analytics: descriptive, diagnostic, predictive, prescriptive, Data ecosystems: structured, semi-structured, unstructured data, Data collection methods and data quality assessment, Data preprocessing: cleaning, transformation, normalization, feature engineering, Exploratory Data Analysis (EDA) techniques, Tools overview: Python, R, SQL, Jupyter, analytics platforms										8				
2	Statistical & Predictive Analytics: Advanced descriptive statistics and probability distributions, Hypothesis testing and confidence intervals, Correlation and regression analysis (linear, multiple, logistic), Time series analysis and forecasting models, Dimensionality reduction techniques (PCA, factor analysis), Model evaluation and validation metrics, Case studies in predictive analytics										8				
3	Machine Learning for Data Analytics: Supervised learning algorithms: Decision Trees, Random Forests, k-NN, SVM Unsupervised learning techniques: Clustering (K-means, hierarchical, DBSCAN) Association rule mining, Model tuning and optimization, Handling imbalanced and large-scale datasets, Ethical considerations in										8				

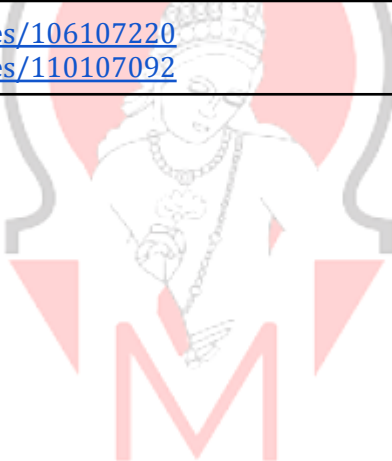
	analytics and AI, Applications in business, healthcare, finance, and social analytics	
4	Data Visualization Principles & Techniques: Importance of data visualization in analytics, Visual perception and cognitive principles, Data storytelling and narrative visualization Visualization types: Comparative, relational, temporal, geospatial, hierarchical, Dashboard design principles and best practices, Data visualization tools: Tableau, Power BI, Python (Matplotlib, Seaborn, Plotly), R (ggplot2), Avoiding misleading and biased visualizations	8
5	Advanced Visualization & Real-World Applications: Interactive and dynamic visualizations, Visual analytics for big data, Geospatial visualization and mapping, Network and graph visualizations, Integrating analytics with visualization for decision support, Industry case studies and real-world datasets, Capstone project: end-to-end analytics and visualization solution	8
Total Hours		40
ETE Evaluation Guidelines:		
Mode of conduction of ETE will be decided by the course coordinator in the supervision of the chairperson. Suggested tools for evaluation (Any 2): 1. Presentation 2. Case study 3. Certification (NPTEL/SWAYAM/MOOC)		
Text Books		
1. Vasant Dhar, Data Science and Predictive Analytics, Publisher: Pearson, ISBN: 978-0134544682 2. Alberto Cairo, The Functional Art: An Introduction to Information Graphics and Visualization, Publisher: New Riders, ISBN: 978-0321834734 3. Kelleher, John D., and Tierney, Brendan, Data Science: An Introduction, Publisher: CRC Press, ISBN: 978-0367342746 4. Tobiasz Nowak, Advanced Data Analytics Using Python and R, Publisher: Packt Publishing, ISBN: 978-1800202401		
Reference Books		
1. Hadley Wickham, Garrett Golemund, R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, Publisher: O'Reilly Media, ISBN: 978-1491910399 2. Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data, Publisher: O'Reilly Media, ISBN: 978-1491912058 3. Andy Kirk, Data Visualization: A Handbook for Data Driven Design, Publisher: Sage, ISBN: 978-1526468920 4. Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Publisher: Wiley, ISBN: 978-1118874052		
Online References		
1. https://www.coursera.org/professional-certificates/google-data-analytics 2. https://www.tableau.com/learn 3. https://www.coursera.org/courses?query=data+analytics		

Final Year B.Tech Artificial Intelligence & Data Science														
Semester-VII														
Course Code: AI24DMN445R					Course Name: Advanced data analytics and data visualization Lab									
Teaching Scheme (Hours/Week)				Examination Scheme						Credits				
L	P	T	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
Prerequisite: Statistics and programming skills														
Course Objectives: - To understand different types of data and analytics approaches for solving business problems. - To perform data quality assessment, cleaning, preprocessing, and feature engineering using Python, R, and SQL. - To conduct exploratory data analysis (EDA), statistical analysis, and hypothesis testing to derive actionable insights. - To build, evaluate, and interpret predictive models for business problems such as customer churn, house price prediction, and revenue optimization. - To design ethical, interactive, and insight-driven data visualizations and dashboards for decision support, including geospatial and network analytics.														
Course Outcomes: After learning the course, the students will be able to: CO1: Classify datasets and select appropriate analytics approaches to solve real-world business problems. CO2: Apply data cleaning, preprocessing, transformation, and feature engineering techniques to prepare data for analysis. CO3: Conduct EDA, statistical summaries, and hypothesis testing to identify trends, patterns, and key business drivers. CO4: Develop and evaluate predictive models using machine learning algorithms to support data-driven decision-making. CO5: Create ethical and interactive visualizations and dashboards that integrate analytics for managerial insights and strategic decision support.														
List of Experiments														
Sr. No.	Name of the Experiment										Duration (Hrs.)			

1	A retail company wants to improve its business decision-making by analyzing historical sales data. The company has collected transactional data containing information about customer purchases, product categories, sales amounts, dates, and store locations. However, the data is incomplete, inconsistent, and has not yet been analyzed. Tasks to be Performed • Classify the dataset as structured, semi-structured, or unstructured and identify the type of analytics (descriptive, diagnostic, predictive, prescriptive) applicable to this business problem. • Perform data quality assessment to detect missing values, duplicates, and inconsistencies. • Clean and preprocess the data using Python or R by handling missing values, correcting data types, and removing anomalies. • Apply data transformation and normalization techniques and perform feature engineering to create new analytical attributes. • Conduct exploratory data analysis using statistical summaries and visualizations to identify trends and patterns. • Use Python/R and SQL to implement the analytics workflow and document insights that support managerial decision-making.	04
2	Customer Churn Prediction and Revenue Optimization for TelecomCo Perform descriptive statistics to summarize customer usage, revenue, and churn patterns. Tasks to be Performed • Conduct hypothesis testing to compare churn rates across customer segments (e.g., age, plan type, region). • Build predictive models (logistic regression, decision trees, or random forests) to classify customers as likely to churn or stay. • Apply correlation and regression analysis to identify key factors influencing churn and revenue. • Evaluate model performance using metrics such as accuracy, ROC-AUC, precision, recall, and F1-score. • Provide recommendations to optimize retention and maximize revenue.	04
3	House Price Prediction (Finance / Real Estate) Predict housing prices based on property and location features.	04
4	Social Media Sentiment & Trend Analysis (Social Analytics) Analyze social media posts to identify trending topics and user sentiment.	04
5	Designing an Ethical and Insight-Driven Data Visualization Dashboard for Regional Healthcare & Retail Performance Analysis A multi-sector analytics firm works with retail chains and healthcare providers across multiple regions. Decision-makers struggle to understand performance trends because they rely on raw tables and poorly designed charts, leading to misinterpretation and biased decisions.	06

Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Practical Examples and Toolboxes by
 Aurélien Géron and Garrett Grolemund, "R for Data Science", O'Reilly

[courses/106107220](#)
[courses/110107092](#)



“येथे बहुतांचे हित”

Final Year B.Tech Artificial Intelligence & Data Science														
Semester-VIII														
Course Code: AI24DMN493R											Course Name: Capstone Project			
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	8	-	-	-	-	-	100	-	-	100	-	4	-	4
Course Objectives: ● Apply data science techniques to solve real-world problems. ● Develop skills in data analysis, modeling, and machine learning. ● Implement practical data science solutions using programming tools.														

Course Outcomes:

After learning the course, the students will be able to:

CO1: Identify problems and design suitable data science models.

CO2: Implement and evaluate machine learning algorithms on datasets.

CO3: Analyze results and present findings effectively.

Sr. No.	Suggested Capstone project List:	Duration (Hrs.)
1	Student Performance Prediction System Develop a model that predicts students' final exam performance based on factors such as attendance, study hours, and previous grades using classification or regression algorithms.	52
2	House Price Prediction Model Create a system that predicts house prices based on features such as location, area, number of bedrooms, and amenities using regression algorithms.	
3	Spam Email Detection System Build a program that classifies emails as spam or not spam by analyzing text data using machine learning classification algorithms.	
4	Customer Churn Prediction Design a model that predicts whether customers are likely to stop using a service based on customer usage data and behavior patterns.	
5	Movie Recommendation System Develop a recommendation system that suggests movies to users based on their viewing history and ratings using collaborative filtering techniques.	
Total Hours		52
Capstone Project Guidelines - Group of 3-4 students - Problem Selection Choose a real-world problem related to data science (data analysis, prediction, classification, recommendation systems, etc.) - Algorithm Design Identify suitable data science / machine learning algorithms (linear regression, decision trees, clustering algorithms, classification algorithms, etc.). - Implementation Implement the solution using a programming language such as Python, R, or Java along with data science libraries. - Performance Analysis Evaluate the model using performance metrics such as accuracy, precision, recall, F1-score, RMSE, or experimental analysis. - Documentation Prepare a report including: Problem statement, Dataset description, Algorithm/model design, Implementation details, Results and analysis. 5. Presentation / Demonstration Demonstrate the working model, results, visualizations, and explain the data science techniques used.		