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

# MDM 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 III** | | | | | | | | | | | | | | | | |
| **Course-I** | MDM | 2 | 2 | - | | 40 | 60 | 25 | - | - | 125 | 2 | 1 | - | - | 3 |
| **Semester V** | | | | | | | | | | | | | | | | |
| **Course-II** | MDM | 3 | 2 | - | - | 40 | 60 | 25 | - | - | 125 | 3 | 1 | - | - | 4 |
| **Semester VI** | | | | | | | | | | | | | | | | |
| **Course-III** | MDM | 3 | - | - | - | 40 | 60 | - | - | - | 100 | 3 | - | - | - | 3 |
| **Semester VII** | | | | | | | | | | | | | | | | |
| **Course-IV** | MDM | - | - | - | 2 | - | - | 50 | - | - | 50 | - | - | - | 2 | 2 |
| **Semester VIII** | | | | | | | | | | | | | | | | |
| **Course-V** | MDM | - | - | - | 2 | - | - | 50 | - | - | 50 | - | - | - | 2 | 2 |
| | | | | | | | | | | | | | | | | |
| **Total** | | **8** | **4** | **-** | **4** | **120** | **180** | **150** | **-** | **-** | **450** | **8** | **2** | **0** | **4** | **14** |

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

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

Dr. Bharati P. Vasgi
Dean Academics

Dr. Sachin Sakhare
Principal

'येथे बहुतांचे हित'

Marathwada Mitra Mandal's

# COLLEGE OF ENGINEERING

Karvenagar, Pune - 52.

An Autonomous Institute affiliated to SPPU

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

# Curriculum Structure and Syllabus

## Multidisciplinary Minor


## Academic Year 2025-26

# Marathwada Mitra Mandal's College of Engineering

## Karvenagar, Pune- 52

***An Autonomous Institute Affiliated to SPPU***

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# Curriculum Structure and Syllabus

# Multidisciplinary Minor



# A.Y. 2025-26

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# DISCLAIMER

This booklet contains the detailed course contents of all Multidisciplinary Minor courses offered by the Institute. It is designed to assist students in selecting their Minor courses while also providing an overview of the key features of the Institute's academic system related to the same. Please note that the specific details of courses or the rules mentioned in this booklet may be subject to modifications or minor changes as approved from time to time in the meetings of the Board of Studies.

# 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

# Preface

In today's rapidly evolving world, engineering education must transcend the boundaries of traditional disciplines to nurture innovation, adaptability, and holistic thinking. In alignment with this vision, the National Education Policy (NEP) has emphasized the introduction of multidisciplinary minor courses as a strategic enhancement to the engineering curriculum.

The NEP 2020 envisions a transformative shift in the educational landscape, emphasizing holistic, flexible, and multidisciplinary learning. At MMCOE, we are committed to integrating this vision through the introduction of our Multidisciplinary Minor (MDM) Programs, designed to broaden students' academic horizons and enhance their professional competencies.

To meet the evolving demands of industry and society, engineering education must go beyond conventional boundaries. In line with this vision, autonomous colleges now offer multidisciplinary minor courses that allow students to broaden their knowledge and skill sets beyond their core engineering disciplines.

These minor programs are designed to provide engineering students with a broader academic experience, equipping them with complementary knowledge and skills outside their core field of study. Whether it is a mechanical engineering student exploring GenAI, a computer engineering student delving into Industrial Robotics and Automation, these courses nurture a well-rounded intellectual profile and encourage creative problem-solving across domains.

The multidisciplinary minor courses reflect the dynamic interplay between technology, society, and industry. They aim to cultivate cross-functional expertise and critical thinking. Encourage innovation through exposure to diverse perspectives. Enhance employability by aligning with emerging industry trends. Prepare students for interdisciplinary research and entrepreneurial ventures.

The Multidisciplinary Minor Programs at MMCOE embody the principles of the Indian National Education Policy 2020, offering a rich, diverse, and flexible educational experience. These programs enable students to explore their interests across disciplines, thereby empowering them to become versatile engineers and responsible global citizens.

# CONTENTS

# MDM 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 III** | | | | | | | | | | | | | | | | |
| **Course-I** | MDM | 2 | 2 | - | | 40 | 60 | 25 | - | - | 125 | 2 | 1 | - | - | 3 |
| **Semester V** | | | | | | | | | | | | | | | | |
| **Course-II** | MDM | 3 | 2 | - | - | 40 | 60 | 25 | - | - | 125 | 3 | 1 | - | - | 4 |
| **Semester VI** | | | | | | | | | | | | | | | | |
| **Course-III** | MDM | 3 | - | - | - | 40 | 60 | - | - | - | 100 | 3 | - | - | - | 3 |
| **Semester VII** | | | | | | | | | | | | | | | | |
| **Course-IV** | MDM | - | - | - | 2 | - | - | 50 | - | - | 50 | - | - | - | 2 | 2 |
| **Semester VIII** | | | | | | | | | | | | | | | | |
| **Course-V** | MDM | - | - | - | 2 | - | - | 50 | - | - | 50 | - | - | - | 2 | 2 |
| | | | | | | | | | | | | | | | | |
| **Total** | | **8** | **4** | **-** | **4** | **120** | **180** | **150** | **-** | **-** | **450** | **8** | **2** | **0** | **4** | **14** |

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

# Guidelines of MDM for UG program

The multidisciplinary minor (MDM) program aims to foster broad-based learning, critical thinking, and creative problem-solving. It encourages students to pursue a secondary area of study beyond their core engineering discipline, offering exposure to various emerging fields. It enables learners to integrate knowledge across domains, cultivate diverse perspectives, and become agile, future-ready professionals equipped for innovation, leadership, and lifelong learning.

By offering a structured yet flexible framework for multidisciplinary engagement, this minor is designed to:

1. Enable students to pursue their individual interests and career aspirations more fully.
2. Encourage innovation by integrating perspectives from different domains.
3. Promote lifelong learning and adaptability in a rapidly changing world.

This initiative seeks to empower learners to become well-rounded, socially conscious, and future-ready individuals, in harmony.

**Guidelines of MDM for UG program:**

- Compulsory Multidisciplinary Minor Subject: 14 Credits.
- Offered during the second year to final year of the UG program.
- The Minor subjects may be from the different disciplines of the Engineering faculty , or they can be from different faculty altogether.

**Instructions to Students:**

1. It is mandatory to choose only one of the eligible domains of MDM at the beginning of the Semester III.
2. A student must stick to the chosen course of MDM for all further semesters and should complete all the multidisciplinary minor courses mentioned under the chosen MDM domain. It is not allowed to switch across domains.
3. Refer table of courses applicable to different programs for eligibility to choose a particular MDM domain.

Important Note:

**MDM once selected and allotted cannot be changed later on.**

# List of MDM Courses

Course Curriculum for Multi-Disciplinary Minor (MDM) offered by different BoS

| Sr. No. | Offered by BoS | MDM Domains | MDM Courses | | | | |
|---|---|---|---|---|---|---|---|
| | | | **Sem-III** | **Sem-V** | **Sem-VI** | **Sem-VII** | **Sem-VIII** |
| 1 | Electrical | **Electric Vehicle Technology** | Fundamentals of Electric Vehicles | Battery Management System | EV Dynamics | EV Powertrain Technologies | EV Charging Infrastructure |
| 2 | Mechanical | **Robotics and Automation** | Industrial Robotics | Smart Fluid Power Systems | 3D Printing Technologies | Product Life Cycle Management | Industrial Automation Systems |
| 3 | E&TC | **Embedded Systems** | Sensors and Applications | Microcontrollers and Embedded Software | Applications of Embedded Systems | Internet of Things | Embedded Product Design |
| 4 | IT | **Privacy and Security Engineering** | Cryptography and Security | Cyber Security | Ethical Hacking | Digital Forensic | Privacy and Security in Online Social Media |
| 5 | Computer | **GenAI** | Mathematical Foundation for GenAI | Foundations of GenAI | Large Language Models | RAG and Fine Tuning with GenAI | Agentic AI and Capstone Project |
| 6 | AI&DS | **Sustainable and Smart Systems** | Foundation of Sustainable and Smart Systems | IOT for Sustainable Systems | Big data Analytics for Smart Systems | Cyber Security for Smart Systems | Smart and Sustainable System Development |

# Applicability for Courses Registration

| Sr. No. | Offered by BoS | MDM Domain | Courses Applicable to Students from the Departments | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | AI&DS | Computer Engg. | E&TC | Electrical Engg. | IT | Mechanical Engg. |
| 1 | Electrical | Electric Vehicle Technology | Y | Y | Y | Y | Y | Y |
| 2 | Mechanical | Robotics and Automation | Y | Y | Y | N | Y | Y |
| 3 | E&TC | Embedded Systems | Y | Y | N | Y | Y | Y |
| 4 | IT | Privacy and Security Engineering | Y | N | Y | Y | Y | Y |
| 5 | Computer | GenAI | N | Y | Y | Y | Y | Y |
| 6 | AI&DS | Sustainable and Smart Systems | Y | Y | Y | Y | N | Y |

# SEMESTER III

# MDM Curriculum Structure Semester - III

| Second Year B.Tech Semester - III | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Course Type | Teaching Scheme (Hrs./week) | | | | Examination Scheme | | | | | | Credits | | | |
| | | | L | P | T | ODL | CIE | ETE | TW | PR | OR | Total | L | P | T | Total |
| **EE24MDM204** | Fundamentals of Electric Vehicles | MDM | 2 | - | - | - | 40 | 60 | - | - | - | 100 | 2 | - | - | 2 |
| **EE24MDM207** | Fundamentals of Electric Vehicles Lab | MDM | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 1 |
| **ME24MDM204** | Industrial Robotics | MDM | 2 | - | - | - | 40 | 60 | - | - | - | 100 | 2 | - | - | 2 |
| **ME24MDM207** | Industrial Robotics Lab | MDM | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 1 |
| **ET24MDM204** | Sensors and Applications | MDM | 2 | - | - | - | 40 | 60 | - | - | - | 100 | 2 | - | - | 2 |
| **ET24MDM207** | Sensors and Applications Lab | MDM | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 1 |
| **IT24MDM204** | Cryptography and Security | MDM | 2 | - | - | - | 40 | 60 | - | - | - | 100 | 2 | - | - | 2 |
| **IT24MDM207** | Cryptography and Security Lab | MDM | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 1 |
| **CE24MDM204** | Mathematical Foundation for GenAI | MDM | 2 | - | - | - | 40 | 60 | - | - | - | 100 | 2 | - | - | 2 |
| **CE24MDM207** | Mathematical Foundation for GenAI Lab | MDM | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 1 |
| **AI24MDM204** | Foundation of Sustainable and Smart Systems | MDM | 2 | - | - | - | 40 | 60 | - | - | - | 100 | 2 | - | - | 2 |
| **AI24MDM207** | Foundation of Sustainable and Smart Systems Lab | MDM | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 1 |

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

# Multi- Disciplinary Minor (MDM)

# in

# Electric Vehicle Technology

**Second Year B.Tech Electrical Engineering**

**Semester-III**

**Course Code: EE24MDM204** **Course Name: Fundamentals of Electric Vehicles**

| Teaching Scheme (Hours/Week) | | | | | Examination Scheme | | | | | | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | P | T | OL | ODL | CIE | ETE | TW | OR | PR | TOTAL | L | P | T | TOTAL |
| 2 | - | - | - | - | 40 | 60 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:** Basic knowledge of electrical engineering, mechanical systems, and introductory physics.

**Course Objectives:**

- To introduce the basic concepts and evolution of electric and hybrid electric vehicles.
- To explain the architecture and key components of electric vehicle systems.
- To provide knowledge on energy storage technologies, electric motors, and drive-train configurations.
- To familiarize students with EV performance metrics, safety standards, and regulatory frameworks.

**Course Outcomes:**

After learning the course, the students will be able to:
CO1: Understand basics of electric and hybrid electric vehicles and its major parts.
CO2: Explain EV architecture and key performance parameters.
CO3: Describe battery basics, its types and motor drive characteristics.
CO4: Identify various drive system and charging standards of the vehicles.
CO5: Understand EV standards, safety rules, and regulations.

| Unit | Contents | Duration (Hrs.) |
|---|---|---|
| 1 | **History of Electric Vehicles**<br>Electric vehicles (EV) development, past, present and future, comparison with IC engine driven vehicles, vehicle fundamental<br>**Hybrid Electric Vehicle**<br>Fuel cell Vehicles, Hybrid Electric Vehicles (HEV), series, parallel and series-parallel (split) systems. | 5 |
| 2 | **EV Architecture**<br>Fixed & variable gearing, single & multiple motor drive, Inwheel drives, EV Parameters: Weight, size, force, energy & performance parameters. | 5 |
| 3 | **Storage Unit**<br>Batteries (Li-ion, Lead Acid, Solid State), fuel cells, ultracapacitors, Flywheel, Supercapacitor, Nickel Degree of Hybridization<br>**Motors and drives**<br>Different types of motors used in EV and General characteristics. | 6 |
| 4 | **Electric drive-trains**<br>Basic concept of electric traction - introduction to various electric drive-train topologies - power flow control in electric drive-train topologies, Types & levels of charging. | 5 |
| 5 | **Safety and Automotive Standards**<br>Overview of Types of standards used for EV and Safety rules and regulations. | 5 |
| | Total Hours | 26 |

**Text Books**

1. Sandeep Dharmeja, "Electric Vehicle Battery Systems, 1st Edition", Newnes, 2001.

2. K.T.Chau, Zheng Wang, "Chaos in Electrical Drive Systems: Analysis, Control & Applications", 1st Edition, John Wiley and Sons, 2011.
3. Johan G. Hayes, "Electric Power train Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles", John Wiley and Sons, 2018.
4. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, and Ali Emadi "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles" by , CRC Press 2005.

**Reference Books**

1. Chung Chow Chan, K.T.Chau, Modern Electric Vehicle Technology, 1st Edition, Oxford University Press, 2001.
2. Rodrigo Garcia-Valle, João A. Peças Lopes, Springer Books, Electrical Vehicle Integration into Modern Power Networks, Nov. 2012.
3. John Lowry, John Wiley and Sons, Electrical Vehicle Technology Explained-James Larminie, 1st Edition, 2003.

**Online References**

1. NPTEL Course: Dr. Praveenkumar & Prof. S. Majhi, IIT Guwahati, "Introduction to Hybrid and Electric Vehicles" (https://nptel.ac.in/courses/108/103/108103009/)
2. NPTEL Course: Prof. Amitkumar Jain, IIT Delhi, "Electric Vehicles" (https://nptel.ac.in/courses/108/102/108102121/)
3. Web Resource: Hybrid Electric Vehicle – ScienceDirect Topics (https://www.sciencedirect.com/topics/social-sciences/hybrid-electric-vehicle)

**Second Year B.Tech Electrical Engineering**

**Semester-III**

**Course Code: EE24MDM207** **Course Name Fundamentals of Electric Vehicles Lab**

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

**Prerequisite:** Basic understanding of electrical machines, power electronics, and circuit theory, Familiarity with MATLAB/Simulink and control systems is desirable.

**Course Objectives:**

- To introduce the working principles of electric and hybrid electric vehicles.
- To provide hands-on experience with motor control, battery modeling, and simulation tools.
- To develop skills in analyzing EV components such as batteries, motors, and control systems.
- To enhance understanding of energy storage systems and regenerative braking in electric vehicles.

**Course Outcomes:**

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

CO1: Understand the operation and control of electric motors used in EVs.

CO2: Estimate and analyze the State of Charge (SOC) for lithium-ion batteries.

CO3: Simulate key EV functionalities such as regenerative braking and charging / discharging behaviors.

CO4: Evaluate battery management systems and motor performance characteristics.

CO5: Apply simulation tools like MATLAB/Simulink for electric vehicle system modeling.

**List of Experiments**

| Sr. No. | Name of the Experiment | Duration (Hrs.) |
|---|---|---|
| 1 | Speed Control of BLDC Motor using MATLAB/Simulink | 04 |
| 2 | State of Charge (SOC) Estimation for Lithium-Ion Battery | 04 |
| 3 | Case Study on Lithium-Ion Battery Performance and Applications | 04 |
| 4 | Regenerative Braking Simulation using MATLAB/Simulink | 02 |
| 5 | Simulation of Battery Charging and Discharging Curves | 04 |
| 6 | Study of Battery Management Systems (BMS) | 02 |
| 7 | Speed Control of Permanent Magnet Synchronous Motor (PMSM) using MATLAB/Simulink | 04 |
| 8 | Torque-Speed Characteristics of BLDC Motors | 02 |
| | Total Hours | 26 |

**Text Books**

1. Sandeep Dharmeja, "Electric Vehicle Battery Systems, 1st Edition", Newnes, 2001.
2. K.T.Chau, Zheng Wang, "Chaos in Electrical Drive Systems: Analysis, Control & Applications", 1st Edition, John Wiley and Sons, 2011.

3. Johan G. Hayes, "Electric Power train Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles", John Wiley and Sons, 2018.
4. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, and Ali Emadi "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles" by , CRC Press 2005.

**Reference Books**

1. Chung Chow Chan, K.T.Chau, Modern Electric Vehicle Technology, 1st Edition, Oxford University Press, 2001.
2. Rodrigo Garcia-Valle, João A. Peças Lopes, Springer Books, Electrical Vehicle Integration into Modern Power Networks, Nov. 2012.
3. John Lowry, John Wiley and Sons, Electrical Vehicle Technology Explained-James Larminie, 1st Edition, 2003.

**Online References**

1. NPTEL Course: Dr. Praveenkumar & Prof. S. Majhi, IIT Guwahati, "Introduction to Hybrid and Electric Vehicles" (https://nptel.ac.in/courses/108/103/108103009/)
2. NPTEL Course: Prof. Amitkumar Jain, IIT Delhi, "Electric Vehicles" (https://nptel.ac.in/courses/108/102/108102121/)
3. Web Resource: Hybrid Electric Vehicle – ScienceDirect Topics (https://www.sciencedirect.com/topics/social-sciences/hybrid-electric-vehicle)

# Multi- Disciplinary Minor (MDM)

# in

# Robotics and Automation

**Second Year B.Tech Mechanical Engineering**

**Semester-III**

**Course Code: ME24MDM204** **Course Name: Industrial Robotics**

| Teaching Scheme (Hours/Week) | | | | | Examination Scheme | | | | | | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | P | T | OL | ODL | CIE | ETE | TW | OR | PR | TOTAL | L | P | T | TOTAL |
| 2 | - | - | - | - | 40 | 60 | - | - | | 100 | 2 | | - | 2 |

**Prerequisite:** Engineering Mathematics - I and II, Engineering Physics, Engineering Mechanics, Fundamentals of Programming Languages, Mechanical Testing & Measurement, Basics of Electronics Technology, Basics of Electrical Technology

**Course Objectives:**

- To introduce students to the fundamental concepts and terminology of robotics.
- To provide knowledge of embedded systems and microcontroller programming.
- To equip students with the ability to select and integrate appropriate actuators, sensors, and end effectors.
- To develop an understanding of kinematic modeling.
- To explain the architecture and functionality of robotic control systems.

**Course Outcomes:**

After learning the course, the students will be able to:
CO1: Understand the fundamental concepts of robotics.
CO2: Apply fundamentals of embedded systems to interface sensors.
CO3: Select appropriate actuators, sensors, and end effectors for specific robotic tasks.
CO4: Apply the principles of forward and inverse kinematics to analyze robot motion.
CO5: Explain the control systems in Robotics.

| Unit | Contents | Duration (Hrs.) |
|---|---|---|
| 1 | **Fundamentals of Robotics:** Evolution of Industrial Robotics, Classification of robots, Asimov's laws of robotics, Robot Anatomy, Robot Degrees of Freedom, Work volume and work envelope, Robot Joints and symbols, Robot Coordinates, Robot Reference Frames, Resolution, accuracy and precision of Robot, Work cell control, Industrial Applications. | 6 |
| 2 | **Programmable Hardware Systems:** Microprocessor, Micro-controllers, Embedded Systems, Serial Communication, Raspberry Pi, Arduino: Digital pins, Analog Pins, PWM, Arduino IDE functions, ROS. | 5 |
| 3 | **Robot Actuators and Sensors:** Introduction to Sensors and Actuators, Classification of Actuators, Types of Drives, Types of Sensors, Sensor selection parameter, Introduction to End effector, Types of Grippers-Mechanical Grippers, Magnetic Grippers, Vacuum Grippers, Advance Grippers- Adaptive grippers, Soft Robotics Grippers, Tactile Sensor Gripper. | 6 |
| 4 | **Robot Kinematics and Dynamics:** Kinematics: Fundamentals of robot Kinematics, Kinematic chain and linkages, Forward and inverse kinematics. Dynamics: Force and Torque Analysis, Trajectory Planning. | 5 |
| 5 | **Robot Control Systems:** Introduction to control systems in robotics, Types of Control Systems- Open loop, Closed loop, Point to point, Continuous path, PID control in Robotics. | 4 |
| | Total Hours | 26 |

**Text Books**


1. Debashis Das, "Robotics and Industrial Automation", Vikas Publishing House, Revised Edition, 2020.
2. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill Education, 1st Edition, 2017.
3. Clarence W. de Silva, "Sensors and Actuators: Engineering System Instrumentation", CRC Press, 2nd Edition, 2015.
4. Muhammad Ali Mazidi, Rolin D. McKinlay, Danny Causey, "The 8051 Microcontroller and
5. Embedded Systems: Using Assembly and C", Pearson Education, 2nd Edition, 2008.
6. J. Norberto Pires, "Industrial Robots Programming: Building Applications for the Factories of the Future", Springer, 1st Edition, 2007.


**Reference Books**


1. Matt Richardson & Shawn Wallace, "Getting Started with Raspberry Pi", Maker Media, 4th Edition, 2021.
2. Saeed B. Niku, "Introduction to Robotics: Analysis, Control, Applications", Wiley India Pvt Ltd, 3rd Edition, 2020.
3. Thomas Bräunl, "Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems", Springer, 3rd Edition, 2019.
4. Mikell P. Groover, "Industrial Robotics: Technology, Programming, and Applications", McGraw Hill Education, 2nd Edition, 2019.
5. John J. Craig, "Introduction to Robotics: Mechanics and Control", Pearson Education, 4th Edition, 2018.
6. Simon Monk, "Programming Arduino: Getting Started with Sketches", McGraw Hill Education, 2nd Edition, 2016.


**Online References**

1. NPTEL Course: Prof. Santhakumar Mohan, IIT Palakkad, "Mechanics and Control of Robotic Manipulators" (https://onlinecourses.nptel.ac.in/noc25_me105/preview)
2. NPTEL Course: Prof. Bishakh Bhattacharya, IIT Kanpur, "Foundations of Cognitive Robotics" (https://onlinecourses.nptel.ac.in/noc25_me126/preview)
3. NPTEL Course: Prof. Arun Dayal Udai, IIT-ISM Dhanbad, "Industrial Robotics: Theories for Implementation" (https://onlinecourses.nptel.ac.in/noc25_me161/preview)

**Second Year B.Tech Mechanical Engineering**

**Semester-III**

**Course Code: ME24MDM207** **Course Name: Industrial Robotics Lab**

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

**Prerequisite:** Engineering Mathematics - I and II, Engineering Physics, Engineering Mechanics, Fundamentals of Programming Languages, Mechanical Testing & Measurement, Basics of Electronics Technology, Basics of Electrical Technology.

**Course Objectives:**

- To understand the fundamentals of Robotic System.
- To enable students to interface and integrate sensors and actuators for robotic control applications.
- To understand the significance of kinematic simulation and robotic motion control.
- To expose students to real-world robotic systems through advanced projects and industrial visits.

**Course Outcomes:**

After learning the course, the students will be able to:
CO1: Understand the fundamentals of Robotic System.
CO2: Interface and integrate sensors and actuators for robotic control applications.
CO3: Understand the significance of kinematic simulation and robotic motion control.
CO4: Expose students to real-world robotic systems through advanced projects and industrial visits

**List of Experiments**

| Sr. No. | Name of the Experiment | Duration (Hrs.) |
|---|---|---|
| 1 | Assembly and Exploration of Fundamental Robotic Component | 2 |
| 2 | Programming digital pins and timings control using Arduino | 2 |
| 3 | Interfacing sensor (IR/Ultrasonic/Temperature) with Arduino and display the data. | 2 |
| | **OR** | |
| 4 | Design code for pick and place robot using Arduino | 2 |
| 5 | Demonstration of actuators and gripper using feeder station/KUKA Robot. | 2 |
| 6 | Simulate forward and inverse kinematics using MATLAB | 4 |
| 7 | Development of Robot systems using Arduino (Line follower /voice controlled / Bluetooth or Wifi controlled / Colour sensing Robotic System) | 6 |
| 8 | Industrial visit to a Robotic Enabled Manufacturing Unit. | 4 |
| 9 | Robotic Simulation of Spot Welding | 4 |
| | **OR** | |
| 10 | Creating and Controlling a ROS Node | 4 |
| | Total Hours | 26 |

**Text Books**


1. Debashis Das, "Robotics and Industrial Automation", Vikas Publishing House, Revised Edition, 2020.
2. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill Education, 1st Edition, 2017.
3. Clarence W. de Silva, "Sensors and Actuators: Engineering System Instrumentation", CRC Press, 2nd Edition, 2015.
4. Muhammad Ali Mazidi, Rolin D. McKinlay, Danny Causey, "The 8051 Microcontroller and
5. Embedded Systems: Using Assembly and C", Pearson Education, 2nd Edition, 2008.
6. J. Norberto Pires, "Industrial Robots Programming: Building Applications for the Factories of the Future", Springer, 1st Edition, 2007.


**Reference Books**


1. Matt Richardson & Shawn Wallace, "Getting Started with Raspberry Pi", Maker Media, 4th Edition, 2021.
2. Saeed B. Niku, "Introduction to Robotics: Analysis, Control, Applications", Wiley India Pvt Ltd, 3rd Edition, 2020.
3. Thomas Bräunl, "Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems", Springer, 3rd Edition, 2019.
4. Mikell P. Groover, "Industrial Robotics: Technology, Programming, and Applications", McGraw Hill Education, 2nd Edition, 2019.
5. John J. Craig, "Introduction to Robotics: Mechanics and Control", Pearson Education, 4th Edition, 2018.
6. Simon Monk, "Programming Arduino: Getting Started with Sketches", McGraw Hill Education, 2nd Edition, 2016.


**Online References**

1. NPTEL Course: Prof. Santhakumar Mohan, IIT Palakkad, "Mechanics and Control of Robotic Manipulators" (https://onlinecourses.nptel.ac.in/noc25_me105/preview)
2. NPTEL Course: Prof. Bishakh Bhattacharya, IIT Kanpur, "Foundations of Cognitive Robotics" (https://onlinecourses.nptel.ac.in/noc25_me126/preview)
3. NPTEL Course: Prof. Arun Dayal Udai, IIT-ISM Dhanbad, "Industrial Robotics: Theories for Implementation" (https://onlinecourses.nptel.ac.in/noc25_me161/preview)

# Multi- Disciplinary Minor (MDM)

# in

# Embedded Systems

**Second Year B.Tech Electronics and Telecommunication Engineering**

**Semester-III**

**Course Code: ET24MDM204** **Course Name: Sensors and Applications**

| Teaching Scheme (Hours/Week) | | | | | Examination Scheme | | | | | | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | P | T | OL | ODL | CIE | ETE | TW | OR | PR | TOTAL | L | P | T | TOTAL |
| 2 | - | - | - | - | 40 | 60 | - | - | | 100 | 2 | - | - | 2 |

**Prerequisite:** Applied Physics, Applied Chemistry, Basics of Electronics Technology

**Course Objectives:**

- Enable students to understand the operating principles, characteristics, and performance parameters of various types of sensors.
- Impart foundational knowledge of sensor technologies by introducing the fundamental principles, transduction mechanisms, and classifications of sensors.
- Develop students' ability to demonstrate the functioning of advanced sensors.
- Enable students to select suitable sensors and actuators based on application requirements.

**Course Outcomes:**

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

CO1: Comprehend the characteristics and performance parameters of various sensors.
CO2: Summarize the fundamental principles of sensors.
CO3: Demonstrate operation of advanced sensors for real world applications.
CO4: Select sensors and actuators for specific applications.
CO5: Implement a basic sensor-based system for a real-world application.

| Unit | Contents | Duration (Hrs.) |
|---|---|---|
| 1 | **Static and Dynamic Characteristics of Sensors**<br>Introduction to Sensors, Classification, Static Characteristics: Accuracy, precision, resolution,sensitivity, threshold, drift, error, repeatability, reproducibility, dead zone, hysteresis, range, span, bias,isolation, grounding ; Concept of dynamic Characteristics, Characterization of sensor. | 5 |
| 2 | **Basic Sensors**<br>Comparison between sensors and transducers, strain gauge, Load cell, inductive sensors,Capacitive sensor, piezoelectric sensor, ultrasonic sensor,Thermal sensor, Hall effect sensor, LVDT, Radiation Sensor : Photodiodes, phototransistors, LDR; Photovoltaic cell, Factors affecting radiation measurement, Concept of Signal conditioning circuit,wheatstone bridge. | 5 |
| 3 | **Advanced Sensors**<br>On Board automobile sensors:Flow rate sensor,pressure sensor,temperature sensor,Oxygen sensor, torque and position sensor; Home appliance sensor, Sensors for manufacturing ,Medical diagnostic sensor, Sensors for environmental monitoring ; Gas sensors, CCD sensor. | 5 |
| 4 | **Actuators and Final Control Elements**<br>Introduction to Actuators, Classification of actuators, Comparison between sensor & actuators, Working of actuators : BLDC motor,stepper motor, Servo motor; Solenoids, Relays- SPST, SPDT, DPDT,concept of solid state relay. | 5 |
| 5 | **Sensors-Their Applications**<br>Concept of smart sensors, recent trends in sensor technologies, MEMS, Aerospace sensor,Monitoring strain, force, thrust & acceleration in Aircraft.<br>Case Studies: Sensors for Anti Lock Braking systems in EV, Healthcare systems,Industrial Automation . | 6 |
| | Total Hours | 26 |

**Text Books**


1. D. Patranabis, Sensors and Transducers, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2023.
2. J. Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, 4th ed. New York, NY, USA: Springer, 2010.
3. S. Y. Yurish, Sensors, Transducers, Signal Conditioning and Wireless Sensors Networks. Barcelona, Spain: IFSA Publishing, 2021.
4. R. Pallas-Areny and J. G. Webster, Sensors and Signal Conditioning, 2nd ed. Hoboken, NJ, USA: Wiley-Blackwell, 2001.
5. N. Ida, Sensors, Actuators, and Their Interfaces: A Multidisciplinary Introduction. Norwich, NY, USA: SciTech Publishing, 2014.


**Reference Books**


1. S. J. Rupitsch, Piezoelectric Sensors and Actuators: Fundamentals and Applications, 1st ed. Cham, Switzerland: Springer, 2018.
2. Dr. K.S. Balamurugan, Dr. K. Anjaneyulu, Dr. A.N. Venkateswarlu, and Dr. Mirza Shafi Shahsavar, Sensors & Its Applications, Royal Book Publishing, 2024.
3. S. Soloman, Sensors Handbook, Second Edition, New York, NY, USA: McGraw-Hill, 2010


**Online References**

1. NPTEL Course: Prof. Hardik Jeetendra Pandya, IISc Bangalore, "Sensors and Actuators" (https://onlinecourses.nptel.ac.in/noc21_ee32)

**Second Year B.Tech Electronics and Telecommunication Engineering**

**Semester-III**

**Course Code: ET24MDM207** **Course Name: Sensors and Applications Lab**

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

**Prerequisites:** Applied Physics, Applied Chemistry, Basics of Electronics Technology

**Course Objectives:**

- Develop a conceptual and practical understanding of static and dynamic characteristics of light-based sensors (e.g., LDR, photodiode, phototransistor) by analyzing their response and behavior under different conditions.
- Examine performance, precision, and accuracy of sensors used in real-world measurement systems such as load cells and photovoltaic systems, considering external factors like temperature.
- Foster application of electronic sensor technologies through case study analysis in various domains such as industry, environment, healthcare, and IoT.
- Enable students to select suitable sensors and actuators based on application requirements, performance parameters, and operating conditions.

**Course Outcomes:**

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

CO1: Analyze the static and dynamic characteristics of light-dependent sensors such as LDRs, photodiodes, and phototransistors through experimental investigation.

CO2: Evaluate the accuracy, precision, and real-time performance of sensors used in measurement systems, including load cells and photovoltaic modules.

CO3: Interface and test sensor-actuator circuits using software and hardware for automation and control applications.

CO4: Demonstrate the ability to present real-world applications of sensor technologies through case studies in various domains such as industrial, biomedical, environmental, automotive, or IoT systems.

**List of Experiments**

| Sr. No. | Name of the Experiment | Duration (Hrs.) |
|---|---|---|
| 1 | Study of Static and Dynamic Characteristics of LDR. | 02 |
| 2 | Experimental study of dynamic Characteristics of Photodiode / Phototransistor. | 04 |
| 3 | Testing of Load Cells in Digital Weighing Machines for the Precision and Accuracy. | 02 |
| 4 | Monitor the Real-Time Performance of Photovoltaic System- Power vs. Temperature Analysis. | 02 |
| 5 | Build and Test Relay Driver Circuit for Motor Driving Applications. | 02 |
| 6 | Interface a sensor hardware circuit using LabVIEW software. | 04 |
| 7 | Study of integration of sensors and actuators used in PLC based Automatic Conveyor belt system | 02 |
| 8 | Project/Presentation based on any one case study: Investigation of Electronic Sensor Technologies in Industrial and Consumer Systems / Electronic Sensors | 08 |

| | | |
|---|---|---|
| | for Environmental Monitoring Applications / Utilization of Electronic Sensors in Automotive Safety and Control Systems/ Electronic Sensors in Biomedical Instrumentation / Performance Evaluation of Electronic Sensors in IoT-Based Smart Systems/Drone based system. | |
| | Total Hours | 26 |

**Text Books**


1. D. Patranabis, Sensors and Transducers, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2023.
2. J. Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, 4th ed. New York, NY, USA: Springer, 2010.
3. S. Y. Yurish, Sensors, Transducers, Signal Conditioning and Wireless Sensors Networks. Barcelona, Spain: IFSA Publishing, 2021.
4. R. Pallas-Areny and J. G. Webster, Sensors and Signal Conditioning, 2nd ed. Hoboken, NJ, USA: Wiley-Blackwell, 2001.
5. N. Ida, Sensors, Actuators, and Their Interfaces: A Multidisciplinary Introduction. Norwich, NY, USA: SciTech Publishing, 2014.


**Reference Books**


1. S. J. Rupitsch, Piezoelectric Sensors and Actuators: Fundamentals and Applications, 1st ed. Cham, Switzerland: Springer, 2018.
2. Dr. K.S. Balamurugan, Dr. K. Anjaneyulu, Dr. A.N. Venkateswarlu, and Dr. Mirza Shafi Shahsavar, Sensors & Its Applications, Royal Book Publishing, 2024.
3. S. Soloman, Sensors Handbook, Second Edition, New York, NY, USA: McGraw-Hill, 2010


**Online References**

1. NPTEL Course: Prof. Hardik Jeetendra Pandya, IISc Bangalore, "Sensors and Actuators" (https://onlinecourses.nptel.ac.in/noc21_ee32)

# Multi- Disciplinary Minor (MDM)

# in

# Privacy and Security Engineering

**Second Year B.Tech Information Technology**

**Semester-III**

**Course Code: IT24MDM204** **Course Name: Cryptography and Security**

| Teaching Scheme (Hours/Week) | | | | | Examination Scheme | | | | | | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | P | T | OL | ODL | CIE | ETE | TW | OR | PR | TOTAL | L | P | T | TOTAL |
| 2 | - | - | - | - | 40 | 60 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:** Basics of Mathematics

**Course Objectives:**

- To Understand the Foundations of Information Security and Cryptographic Techniques.
- To explore Symmetric and Asymmetric Cryptographic Algorithms.
- To learn Key Management and Secure Key Exchange Protocols.
- To learn Authentication and Integrity Mechanisms.

**Course Outcomes:**

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

CO1: Demonstrate understanding of symmetric encryption techniques, including block cipher structures and modes of operation.

CO2: Analyze the design principles and security features of private-key Cryptography.

CO3: Analyze the design principles and security features of public-key Cryptography.

CO4: Evaluate symmetric and asymmetric key distribution methods, including hierarchical and decentralized key management strategies.

CO5: Apply cryptographic hash algorithms, key management techniques, and authentication protocols to implement secure communication systems.

| Unit | Contents | Duration (Hrs.) |
|---|---|---|
| 1 | **Introduction :** Introduction information Security, goals, security mechanism, security model<br>**Cryptographic Techniques:** Classical Encryption Techniques-Symmetric Cipher Model, Cryptanalysis & Brute Force Attack, Mono and Poly alphabetic Cipher, Stream Ciphers and block Ciphers, modes: Electronic Code Book (ECB) Mode., Cipher Block Chaining (CBC) Mode., Cipher Feedback Mode (CFB) , Output Feedback (OFB) Mode. | 6 |
| 2 | **Private-Key Cryptography:** Motivation for the Feistel Cipher structure, the Feistel Cipher, The data encryption standard: DES, attacks and strength of DES, AES: encryption and Decryption, strength and weakness,Linear Cryptanalysis and Differential Cryptanalysis | 6 |
| 3 | **Public Key Cryptography:** Principles of public-key cryptosystems. Applications and requirements, Computational aspects: GCD, Fermat's little theorem, Chinese remainder theorem, Public-key cryptanalysis, RSA algorithm, Security of RSA. Other Public-Key Cryptosystems: Elgamal Cryptographic systems, Elliptic curve cryptography | 6 |

| | | |
|---|---|---|
| 4 | **Key Management and Distribution:** Symmetric key distribution using Symmetric encryption, Hierarchical key control, session key lifetime, Decentralized key control, Symmetric key distribution using asymmetric encryption, simple secret key distribution with confidentiality and authentication, distribution of public keys, public keys certificates, X.509 certificates, public key infrastructure. Diffie Hellman key exchange algorithm , Man in the middle attack. | 6 |
| 5 | **Hash Algorithms:** SHA-1, MD5, Updation, Digital Certificate, Digital Signature, One Way Authentication, Mutual Authentication, User Authentication, federated identity management, identity management, verification, Kerberos version 4 & 5, Remote user Authentication using Asymmetric encryption. | 6 |
| | **Total Hours** | **30** |

**Text Books**

1. William Stallings, "Cryptography and Network Security, Principles and practice" Pearson, 6th edition,2013.
2. V K Pachghare, "Cryptography and Information Security", PHI, 2nd edition, 2015.
3. Nina Godbole, " Information Systems Security", Wiley India Pvt. Ltd, ISBN-978-81-265-1692-6,2017.

**Reference Books**

1. CK Shyamala et el., "Cryptography and Security", Wiley India Pvt. Ltd, ISBN 978-81-265-2285-9, 2011.
2. Berouz Forouzan, "Cryptography and Network Security", 2 edition, TMH, ISBN:9780070702080 ,2011.
3. Bernard Menezes, "Network Security and Cryptography", Cengage Learning, ISBN-978-81-315- 1349-1, 2010.
4. B.L. Menezes, R. Kumar, "Cryptography, Network Security, and Cyber Laws", Cengage Learning India Pvt. Ltd.,2018.
5. C. Kaufman, R. Perlman, M. Speciner, R. Perlner, "Network Security: Private Communication in a Public World", Pearson Education, 3rd edition, 2024 .

**Online References**

1. Coursera : Cryptography (https://www.coursera.org/learn/crypto#modules )
2. NPTEL Course: Prof. Sourav Mukhopadhyay, IIT Kharagpur, "Cryptography And Network Security" (https://onlinecourses.nptel.ac.in/noc22_cs90/preview )
3. UDEMY: Cryptography and Hashing Fundamentals in Python and Java (https://www.udemy.com/course/learn-cryptography-basics-in-python/?couponCode=NVDIN35)

**Second Year B. Tech Information Technology**

**Semester-III**

**Course Code: IT24MDM207** **Course Name: Cryptography and Security Lab**

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

**Prerequisite:** C /C++/Java/Python Programming,Computer network basics

**Course Objectives:**

- To understand and implement classical and modern cryptographic algorithms.
- To learn number theory concepts in cryptographic systems.
- To explore digital signatures, hash algorithms (SHA1, MD5), and authentication protocols for securing information exchange.
- To Demonstrate secure client-server communication with real-time cryptographic protocols.

**Course Outcomes:**

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

CO1: Implement symmetric and asymmetric encryption algorithms.

CO2: Apply number theory concepts (e.g., GCD, Fermat's theorem, Chinese Remainder Theorem) in the development of secure cryptographic systems.

CO3: Demonstrate the use of hashing and digital signature techniques (SHA-1, MD5, RSA Signature) for data integrity and authentication.

CO4: Develop secure client-server applications using RSA, DES, and Diffie-Hellman to ensure confidentiality, authentication, and secure key exchange.

**List of Experiments**

| Sr. No | Content | Duration (Hrs.) |
|---|---|---|
| 1 | Develop a program to encrypt and decrypt a message using the AES algorithm. | 2 |
| 2 | Develop a program to implement Feistel Cipher structure. | 2 |
| 3 | Develop a program based on number theory such as Chinese remainder. | 2 |
| 4 | Implement a client and a server on different computers. Perform the encryption of the message of sender between these two entities by using DES Algorithm and use Diffie Hellman method for exchange of keys. | 2 |
| 5 | Implement a client and a server on different computers. Perform the authentication of sender between these two entities by using RSA digital signature cryptosystem. | 4 |
| 6 | Develop a program to sign a message with a private key and check the signature using a public key. | 4 |
| 7 | Write a program to implement an RSA algorithm for key generation and cipher verification. | 4 |
| 8 | Write a program to implement SHA1 algorithm using libraries (API) | 4 |
| 9 | Write a program to implement MD5 algorithm using libraries(API) | 4 |
| 10 | Write a program to execute User authentication using passkey hash | 2 |
| | **Total Hours** | **30** |

| Text Books |
|---|
| 1. William Stallings, "Cryptography and Network Security, Principles and practice" Pearson, 6th edition,2013.<br>2. V K Pachghare, "Cryptography and Information Security", PHI, 2nd edition, 2015.<br>3. Nina Godbole, " Information Systems Security", Wiley India Pvt. Ltd, ISBN-978-81-265-1692-6,2017. |
| **Reference Books** |
| 1. CK Shyamala et el., "Cryptography and Security", Wiley India Pvt. Ltd, ISBN 978-81-265-2285-9, 2011.<br>2. Berouz Forouzan, "Cryptography and Network Security", 2 edition, TMH, ISBN:9780070702080 ,2011.<br>3. Bernard Menezes, "Network Security and Cryptography", Cengage Learning, ISBN-978-81-315-1349-1, 2010.<br>4. B.L. Menezes, R. Kumar, "Cryptography, Network Security, and Cyber Laws", Cengage Learning India Pvt. Ltd.,2018.<br>5. C. Kaufman, R. Perlman, M. Speciner, R. Perlner, "Network Security: Private Communication in a Public World", Pearson Education, 3rd edition, 2024 . |
| **Online References** |
| 1. Coursera : Cryptography (https://www.coursera.org/learn/crypto#modules )<br>2. NPTEL Course: Prof. Sourav Mukhopadhyay, IIT Kharagpur, "Cryptography And Network Security" (https://onlinecourses.nptel.ac.in/noc22_cs90/preview )<br>3. UDEMY: Cryptography and Hashing Fundamentals in Python and Java (https://www.udemy.com/course/learn-cryptography-basics-in-python/?couponCode=NVDIN35) |

# Multi- Disciplinary Minor (MDM)

# in

# GenAI

**Second Year B.Tech Computer Engineering**

**Semester- III**

**Course Code:CE24MDM204** **Course Name: Mathematical Foundation for GenAI**

| Teaching Scheme (Hours/Week) | | | | | Examination Scheme | | | | | | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | P | T | OL | ODL | CIE | ETE | TW | OR | PR | TOTAL | L | P | T | TOTAL |
| 2 | - | - | - | - | 40 | 60 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:** Fundamentals of Programming Languages (CE24PCC101)

**Course Objectives:**

- To understand the concepts of sets and propositions.
- To apply relation and counting principles using permutations and combinations.
- To understand graph theory to get solutions for real time problems .
- To implement the concept of statistical methods on relevant data .
- To use the concept of Testing of Hypothesis.

**Course Outcomes:**

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

CO1: Design real world engineering problems by applying set theory, propositional logic and construct proofs using mathematical induction.
CO2: Apply equivalence relations and counting Principle to solve real world problems.
CO3: Solve computing problems using graph theory.
CO4: Use appropriate statistical methods to collect, organize, display, and analyze relevant data.
CO5: Understand tests for hypothesis and its significance.

| Unit | Contents | Duration (Hrs.) |
|---|---|---|
| 1 | **Sets and Propositions**<br>Sets, Combination of sets, Finite and Infinite sets, Uncountably infinite sets, Principle of inclusion and exclusion, multisets. Propositions, Conditional Propositions, Logical Connectivity, Propositional calculus, Universal and Existential Quantifiers, Normal forms, methods of proofs, Mathematical Induction. | 5 |
| 2 | **Relations and Counting Principles**<br>Relations and their Properties, n-ary relations and their applications, Representing relations, Closures of relations, Equivalence relations, Partial orderings.<br>**Counting Principles**<br>Permutations and Combinations: Rule of sum and product, Permutations, Combinations. | 5 |
| 3 | **Graph Theory**<br>Basic terminology, multigraphs and weighted graphs, paths and circuits, Hamiltonian and Euler paths and circuits, Single source shortest path-Dijkstra's Algorithm,factors of a graph, planar graph and Travelling salesman problem | 5 |
| 4 | **Descriptive Statistics**<br>**Data Types:** Qualitative vs. quantitative, discrete vs. continuous. Data Collection Methods: Sampling techniques (simple random sampling, stratified sampling).Data Summarization: Measures of central tendency, **Measures of Dispersion, Skewness and Kurtosis:** Dispersion, Characteristics for an Ideal Measure of Dispersion, Measures of Dispersion, Range, Quartile Deviation, Mean Deviation,Standard Deviation and Root Mean Square Deviation, Coefficient of Dispersion, Coefficient of Variation, Skewness, Kurtosis | 6 |

| | | |
|---|---|---|
| 5 | **Statistical Inference -**<br>Testing of Hypothesis, Non-parametric Methods and Sequential Analysis: Introduction, Statistical Hypothesis (Simple and-Composite), Test of a Statistical Hypothesis, Null Hypothesis, Alternative Hypothesis, Critical Region, Two Types of Errors, level of Significance, Power of the Test | 5 |
| | **Total Hours** | 26 |

**Text Books**


1. C. L. Liu, "Elements of Discrete Mathematics", TMH, ISBN 10:0-07-066913-9.
2. N. Biggs, "Discrete Mathematics", 3rd Ed, Oxford University Press, ISBN 0 –19-850717–8.
3. Glen Cowan, " Statistical Data Analysis" , University of Siegen, Clarendon Press, Oxford, 1998, ISBN: 0198501552
4. S. C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics (A Modern Approach)", Sultan Chand & Sons Educational Publishers, Tenth revised edition, ISBN: 81-7014-791-3


**Reference Books**


1. Kenneth H. Rosen, "Discrete Mathematics and its Applications"||, Tata McGraw-Hill, ISBN 978- 0-07-288008-3.
2. Bernard Kolman, Robert C. Busby and Sharon Ross, "Discrete Mathematical Structures"||, Prentice-Hall of India /Pearson, ISBN: 0132078457, 9780132078450.
3. Narsingh Deo, "Graph with application to Engineering and Computer Science", Prentice Hall of India, 1990, 0 – 87692 – 145 – 4.
4. Eric Gossett, "Discrete Mathematical Structures with Proofs", Wiley India Ltd, ISBN:978-81-265-2758-8.
5. Sriram P.and Steven S., "Computational Discrete Mathematics", Cambridge University Press, ISBN 13: 978-0-521-73311-3.
6. Glen Cowan, " Statistical Data Analysis" , University Of Siegen, Clarendon Press, Oxford, 1998, ISBN: 0198501552.


**Online References**

1. NPTEL Course: Prof. Viraj Kumar, IISc Bangalore, "Programming with Generative AI" , (https://onlinecourses.nptel.ac.in/noc25_cs137/preview)
2. NPTEL Course: Sudarshan Iyengar, IIT Ropar, "Discrete Mathematics", ( https://nptel.ac.in/courses/106106183)
3. NPTEL Course: Prof. Monalisa Sarma, "Statistical Learning for Reliability Analysis, IIT Kharagpur", ( https://nptel.ac.in/courses/106105239)

**Second Year B.Tech Computer Engineering**

**Semester- III**

**Course Code:CE24MDM207** **Course Name: Mathematical Foundation for GenAI Lab**

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

**Prerequisite:** Fundamentals of Programming Languages Tutorial (CE24PCC102), Engineering Exploration Lab-2 (CE24VSE151)

**Course Objectives:**

The course aims to:

- To implement computational approaches for discrete mathematical problems.
- To compute and interpret fundamental statistical measures such as mean, median, mode, standard deviation, and variance.
- To implement statistical hypothesis testing methods to provide statistical significance.

**Course Outcomes:**

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

CO1: Design and implement computational solutions for fundamental discrete mathematical problems, including set operations, combinatorial calculations,and graph algorithms.

CO2: Develop and execute programs to compute essential statistical measures.

CO3: Implement and utilize statistical hypothesis testing procedures to analyze given data, draw conclusions and interpret the results.

**List of Experiments**

| Sr. No. | Name of the Experiment | Duration (Hrs.) |
|---|---|---|
| 1 | **Set Operations:**<br>Write a program to implement set operations to manage membership in school clubs.A school has two clubs: the Drama Club and the Science Club.<br>Set A={students in the Drama Club}<br>Set B={students in the Science Club}<br>Perform following tasks :<br>● Find Students in at least one club.<br>● Find Students in both clubs.<br>● Find students in the Drama Club but not in the Science Club.<br>● Find Students in the Science Club but not in the Drama Club.<br>● If a student is not a member of any club | 4 |
| 2 | **Inclusion and Exclusion Principle:**<br>Write a program to implement principle of Inclusion and Exclusion for finding student participation in Sports Club and Music Club in a university survey.The university has 200 students, and the data collected from the survey is as follows:<br>● 120 students are members of the Sports Club.<br>● 90 students are members of the Music Club.<br>● 50 students are members of both the Sports Club and the Music Club.<br>Using the Inclusion-Exclusion Principle, Perform following tasks :<br>1. The total number of students who are members of at least one of the clubs (either Sports Club, Music Club, or both).<br>2. The number of students who are only members of the Sports Club. | 4 |

| | | |
|---|---|---|
| | 3. The number of students who are only members of the Music Club.<br>4. The number of students who are members of neither of the two clubs. | |
| 3 | **Permutation :**<br>Write a program to implement permutations for a competition with 12 participants. Calculate the number of ways to arrange the top 5 participants if 3 positions are awarded gold, silver, and bronze medals, and the remaining 2 positions receive participation certificates. | 4 |
| 4 | **Combination:**<br>Write a program to implement combinations to determine the number of different teams of 3 students that can be formed from a group of 20 students selected for a debate competition | 4 |
| 5 | **Floyd-Warshall algorithm:**<br>Write a program for a city planner which needs to design a traffic system that minimizes the travel time between various intersections. Each road has a different travel time, and the planner wants to ensure that the shortest routes between all intersections are identified. | 2 |
| 6 | **Measures of Central Tendency:**<br>A teacher wants to analyze the performance of students in a recent examination to understand the overall class achievement and identify common score trends.Write a program to calculate the mean, mode, and median, which can be applied to student scores. | 2 |
| 7 | **Measures of Dispersion :**<br>Write a program for given two datasets representing the number of hours spent on studying in a week by two different groups of students:<br>● Group A: 6, 8, 7, 5, 6, 9, 7, 8<br>● Group B: 10, 12, 13, 11, 10, 9, 8, 14<br>Find out the range, variance, and standard deviation for both datasets. | 2 |
| 8 | **Hypothesis Testing:**<br>A manufacturer claims that the mean lifetime of a certain type of battery is at least 1000 hours. A consumer agency tests a random sample of 36 batteries and finds the sample mean is 980 hours with a population standard deviation of 60 hours.<br>Perform following tasks-<br>● State the null and alternative hypotheses.<br>● Perform a hypothesis test at the 5% significance level.<br>● Find the critical value and the test statistic.<br>● Conclude whether the claim can be accepted or rejected. | 4 |
| | **Total Hours** | 26 |

**Guidelines for Laboratory Conduction:**

1. All the assignments on all concepts are mandatory.
2. Assignments on all concepts covered on Linked list, stack , Queue, Tree and Graph are mandatory and should be implemented on coding platforms such as HackerRank, CodeChef,GitHub, Leetcode.
3. Operating System recommended: - 64-bit Open-source Linux or its derivative.
4. Programming tools recommended: - G++/GCC, Eclipse/Geany/Jupyter Notebook

**Guidelines for Students:**

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Journal consists of Vision Mission of Institute, Department, certificate, table of contents and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes,Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept,algorithm, time complexity, sample input and expected output, conclusion).

**Guidelines for Laboratory Assessment:**

1. Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of students.
2. Each Laboratory assignment assessment should assign grade/marks based on rubrics with appropriate weightage.
3. Suggested rubrics for overall assessment as well as each Laboratory assignment assessment include timely completion, performance, innovation, efficiency, punctuality and neatness.

**Text Books**


1. C. L. Liu, "Elements of Discrete Mathematics", TMH, ISBN 10:0-07-066913-9.
2. N. Biggs, "Discrete Mathematics", 3rd Ed, Oxford University Press, ISBN 0 –19-850717–8.
3. Glen Cowan, " Statistical Data Analysis" , University of Siegen, Clarendon Press, Oxford, 1998, ISBN: 0198501552
4. S. C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics (A Modern Approach)", Sultan Chand & Sons Educational Publishers, Tenth revised edition, ISBN: 81-7014-791-3


**Reference Books**


1. Kenneth H. Rosen, "Discrete Mathematics and its Applications"||, Tata McGraw-Hill, ISBN 978- 0-07-288008-3.
2. Bernard Kolman, Robert C. Busby and Sharon Ross, "Discrete Mathematical Structures"||, Prentice-Hall of India /Pearson, ISBN: 0132078457, 9780132078450.
3. Narsingh Deo, "Graph with application to Engineering and Computer Science", Prentice Hall of India, 1990, 0 – 87692 – 145 – 4.
4. Eric Gossett, "Discrete Mathematical Structures with Proofs", Wiley India Ltd, ISBN:978-81-265-2758-8.
5. Sriram P.and Steven S., "Computational Discrete Mathematics", Cambridge University Press, ISBN 13: 978-0-521-73311-3.
6. Glen Cowan, " Statistical Data Analysis" , University Of Siegen, Clarendon Press, Oxford, 1998, ISBN: 0198501552.


**Online References**

1. NPTEL Course: Prof. Viraj Kumar, IISc Bangalore, "Programming with Generative AI", (https://onlinecourses.nptel.ac.in/noc25_cs137/preview)
2. NPTEL Course: Sudarshan Iyengar, IIT Ropar, "Discrete Mathematics", ( https://nptel.ac.in/courses/106106183)
3. NPTEL Course: Prof. Monalisa Sarma, "Statistical Learning for Reliability Analysis, IIT Kharagpur", ( https://nptel.ac.in/courses/106105239)

# Multi- Disciplinary Minor (MDM)

# in

# Sustainable and Smart Systems

**Second Year B.Tech Artificial Intelligence and Data Science Engineering**

**Semester-III**

**Course Code: AI24MDM204 Course Name: Foundation of Sustainable and Smart Systems**

| Teaching Scheme (Hours/Week) | | | | | Examination Scheme | | | | | | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | P | T | OL | ODL | CIE | ETE | TW | OR | PR | TOTAL | L | P | T | TOTAL |
| 2 | - | - | - | - | 40 | 60 | - | - | | 100 | 2 | | - | 2 |

**Prerequisite:** Knowledge about Internet of Things.

**Course Objectives:**

- To understand the core concepts of sustainability, smart systems, and the Sustainable Development Goals (SDGs).
- To explore the use of IoT and embedded technologies in sustainable system design.
- To develop skills in using tools like Python, Excel, OpenLCA, and QGIS for sustainability analysis.
- To design and prototype smart solutions for environmental monitoring and resource optimization.

**Course Outcomes:**

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

CO1: Understand and Apply Principles of Smart and Sustainable Systems.
CO2: Utilize Frameworks and Analytical Tools to Measure Sustainability Metrics.
CO3: Analyze Climate Science and Model Sustainable Solutions Using Geospatial and Simulation Tools.
CO4: Prototype Smart Environmental Solutions Using IoT and Embedded Technologies.
CO5: Build Data-Driven Dashboards and Models for Sustainable Decision-Making.

| Unit | Contents | Duration (Hrs.) |
|---|---|---|
| 1 | **Introduction to Smart and Sustainable Systems**<br>Definition, scope, applications, and challenges; an overview of the Sustainable Development Goals (SDGs), implementation challenges. Introduction to smart systems and their role in implementing sustainable systems, Fundamentals of sustainability and smart systems, Overview of the 3 sustainability pillars (economic, environmental, social), Role of technology (IoT, embedded systems) in supporting SDGs, Use of dashboards, mobile/web tools for monitoring sustainability metrics. | 6 |
| 2 | **Practicing Sustainability: Frameworks, Indicators, and Tools**<br>Relevant policies and programs; key challenges and decision-making considerations; Policies, programs, and stakeholder roles in SDG implementation, Environmental KPIs: carbon, water, ecological footprint – calculated using Excel, Python, or online tools, Circular economy and regenerative models with case studies, OpenLCA for Life Cycle Assessment, GEMI Metrics Navigator for sustainability metrics, EcoInvent database for emissions and product data.Circular economy modeling using Circularity Indicators Tool (WBCSD), Case analysis using UNEP case studies and MIT Solve challenge solutions. | 6 |
| 3 | **Climate Science and Sustainable Action**<br>Climate science, terminology, and risk mapping, Cross-national case studies and policy evaluation (e.g., Paris Agreement)., Tools: Climate Watch by WRI for emissions & policy tracking, ClimSim and En-ROADS for interactive climate scenario simulation, QGIS or ArcGIS Online for climate vulnerability and adaptation mapping, NASA EarthData and Google Earth Engine for satellite data analysis. | 6 |

| | | |
|---|---|---|
| 4 | **Smart Environmental Technologies**<br>Smart solutions for resource management: air, water, waste, energy, Design and prototyping using:Arduino + Sensors (DHT11, Soil Moisture, etc), Raspberry Pi / Node-MCU for IoT-based automation, Blynk, ThingSpeak, and IFTTT for real-time cloud monitoring and control.<br>Case studies: Smart irrigation, smart bin alert system, occupancy-based lighting, Renewable energy dashboards using PVWatts or HOMER Energy (for microgrid simulation). | 6 |
| 5 | **Technical Tools for Sustainable Decision-Making**<br>Tools and programming frameworks for sustainability problem-solving, Platforms: Power BI, Tableau Public, or Google Data Studio for sustainability dashboards, Python with Pandas/Plotly for carbon & water footprint analysis, EnergyPlus or DesignBuilder for green building energy modeling, OpenStreetMap + Leaflet.js for visualizing SDG-aligned geo-projects, Use case design projects: building optimization, energy audit simulator, urban SDG mapping. | 6 |
| | Total Hours | 30 |

**Text Books**

1. Tom Theis, "Problem-Solving, Metrics, and Tools for Sustainability", 12th Media Services Publications, 2018.
2. McClellan, S., Jimenez, J.A., Koutitas, A., "Smart Cities: Applications, Technologies, Standards, and Driving Factors", Springer Nature Publications , 2018.

**Reference Book**

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-On Approach", Orient Blackswan Private Limited Publication, 2014.

**Online References**

1. NPTEL Course: Prof.Sharmistha Banerjee, IIT Guwahati, " System Design for Sustainability" (https://nptel.ac.in/courses/107103081)

**Second Year B.Tech Artificial Intelligence and Data Science Engineering**

**Semester-III**

**Course Code:AI24MDM207** **Course Name: Foundation of Sustainable and Smart Systems Lab**

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

**Prerequisite:** Basic knowledge of Python programming, web technologies and data visualization tools.

**Course Objectives:**

- To identify key sectors and real-world use cases that require sustainable system interventions.
- To analyze and interpret sustainability-related data using sensors, APIs, and open data sources.
- To develop predictive models and data visualizations addressing sustainability challenges.
- To design interactive dashboards for supporting data-driven decision-making in sustainable systems.

**Course Outcomes:**

After learning the course, the students will be able to:
CO1: Understand and Apply Principles of Smart and Sustainable Systems.
CO2: Utilize Frameworks and Analytical Tools to Measure Sustainability Metrics.
CO3: Analyze Climate Science and Model Sustainable Solutions Using Geospatial and Simulation Tools.
CO4: Prototype Smart Environmental Solutions Using IoT and Embedded Technologies.
CO5: Build Data-Driven Dashboards and Models for Sustainable Decision-Making.

**List of Experiments**

| Sr. No. | Name of the Experiment | Duration (Hrs.) |
|---|---|---|
| 1 | Sustainable Systems: Identify the potential sectors where sustainable development and systems are required, identify the potential use cases in the selected sectors for sustainable systems, survey of possible solutions to the identified problems. | 02 |
| 2 | Sustainability Dashboard Design : Design an interactive web-based dashboard to track sustainability KPIs like energy usage, carbon footprint, or water consumption. | 02 |
| 3 | Sensor based Air Quality Visualization using Open Data: Fetch air quality data from open APIs (e.g., OpenWeatherMap, AQICN) and visualize pollution trends.- alert, python | 02 |
| 4 | Smart Commute Analysis: Analyze city transport data to identify peak congestion times and suggest optimizations. | 02 |
| 5 | Solar Energy Prediction : Forecast solar energy output using weather data. | 02 |
| 6 | Water Usage in Smart Farming: Recommend irrigation schedules based on rainfall and soil moisture data | 02 |
| 7 | Smart Agriculture Dashboard: Design a dashboard to display soil moisture, temperature, and crop health based on dummy/simulated data. Also create a system to generate periodic alerts for farmers. | 04 |

| | | |
|---|---|---|
| 8 | Waste Bin Overflow Forecast: Predict when bins will overflow using sensor data | 02 |
| 9 | E-Waste Heatmap Creation: Visualize areas with high e-waste generation and plan drop-off centers. | 02 |
| 10 | Air Quality Alert System: Predict and visualize air quality index (AQI) across regions. | 02 |
| 11 | Global Warming Trend Analysis: Track global temperature changes and $CO_2$ levels over the decades. | 02 |
| 12 | Study of ESG of industries and find solutions for reducing emissions gap | 02 |
| | Total Hours | 26 |

**Text Books**


1. Tom Theis, "Problem-Solving, Metrics, and Tools for Sustainability", 12th Media Services Publications, 2018.
2. McClellan, S., Jimenez, J.A., Koutitas, A., "Smart Cities: Applications, Technologies, Standards, and Driving Factors", Springer Nature Publications , 2018.


**Reference Book**


1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-On Approach", Orient Blackswan Private Limited Publication, 2014.


**Online References**

1. NPTEL Course: Prof.Sharmistha Banerjee, IIT Guwahati, " System Design for Sustainability" (https://nptel.ac.in/courses/107103081)

## AICTE Approved Programmes

| Branch | Intake | | | Career Options |
|---|---|---|---|---|
| | B.Tech. | M.Tech. | Working Professional Direct Second Year | |
| Computer Engineering | 180 | Computer Engineering:18 | --- | Data Science, Artificial Intelligence (AI), Big Data Analytics, High Performance Computing (HPC), Machine Learning, Database Engineering, Computer Networks, Cyber Security, IOT |
| Electrical Engineering | 60 | Power Electronics & Drives: 06 | 30 | Public Sector, Power Sector, Software Development, Maintenance Engineering, Contractor & Supervisor, Energy Auditor, Internet of Things (IoT), Robotics and Automation, Industry 4.0, Chartered Engineer, Electric Vehicles, |
| Electronics & Telecommunications Engineering | 180 | VLSI and Embedded System: 06 | --- | Internet of Things (IoT), Robotics and Automation, Industry 4.0, Wireless Communication 4G, 5G, 6G, Artificial Intelligence, VLSI, Embedded Systems, Satellite Communication, Data Science, Power Electronics, Computer Networking, Blockchain Technology, Signal Processing, Electronic Design |
| Information Technology | 180 | Data Science: 06 | --- | Software Development &Testing, Cyber Security, Cloud Computing, Big Data Analytics, IoT, Machine Learning, Artificial Intelligence, Blockchain, Database Management, Data Engineer, Data Science |
| Mechanical Engineering | 120 | Design Engineering: 06 | 30 | Machine Design, System Modeling, Simulation, Robotics, Mechatronics, Rapid Prototyping, 3D Printing, Composite Materials, Automotive & Electrical Vehicles, Manufacturing Sector, HVAC Systems, Energy Engineering and Process Industry, Robotics, Data Science, Public Sector, Power Sector, Software Development, Mechanical Design Engineer, Design Quality Assurance Manager, Engineering, Service, Teaching, Designing Machines & Tools |
| Artificial Intelligence and Data Science | 180 | --- | --- | Cyber Security Analyst, Software Development Expert, Artificial Intelligence Engineer, Data Scientist, Data Analysis, Machine Learning Engineer, Machine Learning Architect, Product Analyst, Software Architect, Data Warehouse Engineer, Product Manager, Front-end Developer, Full Stack Developer |
| Ph.D Research Center in Computer Engineering. | | | | |

## Industry Connect through Professional Bodies / Students' Chapters

- CII
- ISHRAE
- ACM
- ISRD
- GDSC
- IE(I)
- TATA
- ASHRAE
- IETE
- DICCI
- IEEE
- ISACA
- MCCIA
- SAEINDIA
- CSI
- ISTE
- STP

## OUR PROMINENT RECRUITERS