# Shivaji University Vidyanagar, Kolhapur, Maharashtra 416004

## Department of Technology

**As per NEP2020 guidelines**

## Pool of Multidisciplinary Minors for MDM Featured B. Tech (Computer Science and Technology), Detailed Curriculum

# Multidisciplinary Minor
# In
# Embedded Systems

# For
# B.Tech (Computer Science and Technology)

# Shivaji University, Kolhapur
# Department of Technology

## Multidisciplinary Minor in Embedded Systems

### Teaching & Evaluation Scheme

| Sr. No. | Category | Code | Course Title | Hours per week | | | Contact Hours | Credits | Evaluation scheme | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Theory | Practical |
| | | | | L | T | P | | | ISE:ESE | IE:EE |
| 1. | Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode | MDM 1.1 | MCS-51 Microcontroller Architecture and Programming | 03 | - | - | 03 | 03 | 40:60 | 00:00 |
| 2. | | MDM 1.2 | PIC Microcontroller Architecture and Programming | 03 | - | - | 03 | 03 | 40:60 | 00:00 |
| 3. | | MDM 1.3 | ARM and Embedded systems | 03 | - | - | 03 | 03 | 40:60 | 00:00 |
| 4. | Program Based Internship | MDM 1.4 | Industrial Internship* (Minor Program Specific Industry) | One Month | | | | 03 | - | 50:50 |
| 5. | Project Based Learning | MDM 1.5 | Minor Program Based Mini Project* | - | - | - | - | 02 | - | 50:50 |
| | | | | **-** | **-** | **-** | **-** | **14** | **300** | **200** |
| | | | **Total Hours** | **09** | **00** | **00** | **09** | **-** | **-** | **-** |

Note: MDM Program's Internship and Mini Project need to be planned during winter or summer vacation days after 4th semester while respective evaluations will be the part of 7th and 8th Semesters of the B.Tech Major structure.

# Multidisciplinary Minor I: Embedded Systems

| | | | | | |
|---|---|---|---|---|---|
| **Year, Program, Semester** | Multidisciplinary Minor II, 4th Semester onwards | | | | |
| **Course Code** | MDM 1.1 | | | | |
| **Course Category** | Minor Program Core | | | | |
| **Course title** | **MCS-51 Microcontroller Architecture and Programming** | | | | |
| **Teaching Scheme and Credits** | **L** | **T** | **P** | **Total Contact Hours** | **Total Credits** |
| | 03 | - | - | 03 | 03 |
| **Evaluation Scheme** | **ISE:40** | | | **ESE: 60** | **Total=100** |
| **Pre-requisites (if any)** | Prerequisites for this course typically include a solid background in digital electronics | | | | |
| **Course Rationale** | The course provides a comprehensive introduction to the core principles and concepts Embedded systems. It aims to equip students with the foundational knowledge and skills necessary to program and design the embedded systems. | | | | |
| **Course Objectives** | The students will learn<br>1. Basics of processors<br>2. Architecture of MCS-51 family<br>3. MCS-51 Instruction set and assembly language programming<br>4. Embedded C programming<br>5. Peripheral interfacing and programming<br>6. Perform laboratory work or minor project | | | | |
| Course Outcomes | The students will be able to<br>1. Classify between microcontrollers and microprocessors<br>2. Describe the architecture of MCS-51 family<br>3. Illustrate the MCS-51 Instruction set and perform assembly language programming<br>4. Perform embedded C language programming<br>5. Interface peripherals and control through programming<br>6. Complete laboratory work and minor project | | | | |

**Course Outcome and Program Outcome Mapping**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 1 | 1 | 1 | | | | | | | | |
| CO 2 | 3 | 2 | 3 | 3 | | | | | | | | |
| CO 3 | 3 | 2 | 3 | 3 | 3 | | | | | | | |
| CO 4 | 3 | 1 | 3 | 3 | | | | | | | | |
| CO 5 | 3 | 3 | | 1 | | | | | | | | |
| CO 6 | 3 | 2 | 3 | 3 | 3 | | | | | | 3 | 3 |
| PSO1 | 3 | 3 | 3 | 3 | 2 | | | | | | | |
| PSO2 | 2 | 3 | 1 | 3 | 2 | | | | | | | |

Level of Mapping as: Low 1, Moderate 2, High 3

| Unit No. | Course Content | Hours |
|---|---|---|
| 1. | **Microprocessors and microcontroller**<br>Evolution of microprocessors & microcontrollers, microprocessors v/s microcontrollers 8/16/32 bit processors & controllers, CISC v/s RISC architectures, registers, memory & types of memory, bus, interrupts | 06 |
| 2. | **MCS-51 Microcontroller family**<br>Introduction to MCS-51 architecture, 8051 microcontroller hardware, Input /output pins, external memory, register files, counters and timers, interrupts, serial communication, development tools IDE | 06 |
| 3. | **Instruction set and assembly language programming**<br>Addressing modes, instruction set of 8051 microcontroller, assembly language programs | 06 |
| 4. | **Embedded C programming**<br>Comparison of assembly and embedded c language programming, data types, variables, operators, storage classes, arrays, strings, C language programming for 8051 microcontroller | 06 |
| 5. | **MCS-51 Microcontroller interfacing and programming**<br>Interfacing of LEDs, DC motors, stepper motors, buzzers, switches, matrix keyboards, seven segment displays, LCD displays, ADC, DAC, relays, thumbwheel , interfacing $I^2C$,SPI bus devices,RS232 | 06 |
| 6. | **Laboratory work / minor project work**<br>8051 microcontroller based minor project : concept to implementation or the laboratory work based on syllabus | 06 |

| Sr. No. | Reference Books |
|---|---|
| 1. | Kenneth Ayala, "The 8051 Microcontroller Architecture, programming and Applications" Penram Intrnational |
| 2. | Muhammad Ali Mazidi, "The 8051 Microcontroller and Embedded systems" Pearson Education Asia LPE |
| 3. | Ajay Deshmukh, " Microcontrollers: Theory and applications ", Tata McGraw hill edition |
| 4. | Intel or Atmel MCS 51 Family Microcontrollers Data Sheets |
| 5. | Mike Predcko "8051 Microcontrollers programming and practice" |
| **Sr. No.** | **Important web links** |
| 1. | Relevant to the course matter |

| | | | | | |
|---|---|---|---|---|---|
| **Year, Program, Semester** | Multidisciplinary Minor II, 4th Semester onwards | | | | |
| **Course Code** | MDM 1.2 | | | | |
| **Course Category** | Minor Program Core | | | | |
| **Course title** | **PIC Microcontroller Architecture and Programming** | | | | |
| **Teaching Scheme and Credits** | **L** | **T** | **P** | **Total Contact Hours** | **Total Credits** |
| | 03 | - | - | 03 | 03 |
| **Evaluation Scheme** | **ISE:40** | | | **ESE: 60** | **Total=100** |
| **Pre-requisites (if any)** | Prerequisites for this course typically include a solid background in digital electronics | | | | |
| **Course Rationale** | The course provides a comprehensive introduction to the core principles and concepts Embedded systems. It aims to equip students with the foundational knowledge and skills necessary to program and design the embedded systems. | | | | |

| | |
|---|---|
| **Course Objectives** | The students will learn<br>1. Basics of CISC and RISC architectures<br>2. Architecture of PIC 16F8XX microcontroller<br>3. PIC 16F8XX Instruction set and assembly language programming<br>4. Embedded C programming<br>5. Peripheral interfacing and programming<br>6. Perform laboratory work or minor project |
| Course Outcomes | The students will be able to<br>1. Classify between CISC and RISC architectures<br>2. Describe the architecture of PIC 16F8XX family<br>3. Illustrate the PIC 16F8XX architectures Instruction set and perform assembly language programming<br>4. Perform embedded C language programming<br>5. Interface peripherals and control through programming<br>6. Complete laboratory work and minor project |

**Course Outcome and Program Outcome Mapping**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 1 | 1 | 1 | | | | | | | | |
| CO 2 | 3 | 2 | 3 | 3 | | | | | | | | |
| CO 3 | 3 | 2 | 3 | 3 | 3 | | | | | | | |
| CO 4 | 3 | 1 | 3 | 3 | | | | | | | | |
| CO 5 | 3 | 3 | | 1 | | | | | | | | |
| CO 6 | 3 | 2 | 3 | 3 | 3 | | | | | | 3 | 3 |
| PSO1 | 3 | 3 | 3 | 3 | 2 | | | | | | | |
| PSO2 | 2 | 3 | 1 | 3 | 2 | | | | | | | |

Level of Mapping as: Low 1, Moderate 2, High 3

| Unit No. | Course Content | Hours |
|---|---|---|
| 1 | **CISC and RISC microcontrollers**<br>CISC v/s RISC microcontrollers, architecture of CISC and RISC microcontrollers, Von-Neumann and Harvard architecture | **06** |
| 2 | **PIC Microcontroller family**<br>PIC 16F877 microcontroller architecture, 16F877 microcontroller hardware, Input /output pins, external memory, register files, counters and timers, interrupts, serial communication | **06** |
| 3 | **Instruction set and assembly language programming**<br>Addressing modes, instruction set of PIC16F8XX microcontroller, assembly language programs | **06** |
| 4 | **Embedded C programming**<br>Comparison of assembly and embedded c language programming, data types, variables, operators, storage classes, arrays, strings, C language programming for PIC 16F8XX microcontroller | **06** |
| 5 | **PIC 16F8XX Microcontroller interfacing and programming**<br>Interfacing of LEDs, DC motors, stepper motors, buzzers, switches, matrix keyboards, seven segment displays, LCD displays, ADC, DAC, relays, thumbwheel , interfacing $I^2C$,SPI bus devices, RS232 | **06** |

| | | |
|---|---|---|
| **6** | **Laboratory work / minor project work**<br>PIC 16F8XX microcontroller based minor project : concept to implementation or the laboratory work based on syllabus | **06** |

| **Sr. No.** | **Reference Books** |
|---|---|
| 1 | Microchip PIC 16F877 family Microcontrollers Data sheet |
| 2 | John B. Peatman, "Design with PIC Microcontrollers " Pearson Education Asia. LPE |

| **Sr. No.** | **Important web links** |
|---|---|
| 1 | Relevant to the course matter |

| | | | | | |
|---|---|---|---|---|---|
| **Year, Program, Semester** | Multidisciplinary Minor II, 4th Semester onwards | | | | |
| **Course Code** | MDM 1.3 | | | | |
| **Course Category** | Minor Program Core | | | | |
| **Course title** | **ARM and Embedded systems** | | | | |
| **Teaching Scheme and Credits** | **L** | **T** | **P** | **Total Contact Hours** | **Total Credits** |
| | 03 | - | - | 03 | 03 |
| **Evaluation Scheme** | **ISE:40** | | | **ESE: 60** | **Total=100** |
| **Pre-requisites (if any)** | Prerequisites for this course typically include a solid background in digital electronics | | | | |
| **Course Rationale** | The course provides a comprehensive introduction to the core principles and concepts Embedded systems. It aims to equip students with the foundational knowledge and skills necessary to program and design the embedded systems. | | | | |
| **Course Objectives** | The students will learn<br>1. 32 bit microcontroller<br>2. Architecture of ARM7TDMI microcontroller<br>3. ARM7TDMI Instruction set and assembly language programming<br>4. Embedded C programming<br>5. Peripheral interfacing and programming<br>6. Perform laboratory work or minor project | | | | |
| **Course Outcomes** | The students will be able to<br>1. Classify between 8/16/32 bit microcontrollers<br>2. Describe the architecture of ARM7TDMI family<br>3. Illustrate the ARM7TDMI architectures Instruction set and perform assembly language programming<br>4. Perform embedded C language programming<br>5. Interface peripherals and control through programming<br>6. Complete laboratory work and minor project | | | | |

**Course Outcome and Program Outcome Mapping**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 1 | 1 | 1 | | | | | | | | |
| CO 2 | 3 | 2 | 3 | 3 | | | | | | | | |
| CO 3 | 3 | 2 | 3 | 3 | 3 | | | | | | | |
| CO 4 | 3 | 1 | 3 | 3 | | | | | | | | |
| CO 5 | 3 | 3 | | 1 | | | | | | | | |
| CO 6 | 3 | 2 | 3 | 3 | 3 | | | | | | 3 | 3 |
| PSO1 | 3 | 3 | 3 | 3 | 2 | | | | | | | |
| PSO2 | 2 | 3 | 1 | 3 | 2 | | | | | | | |

Level of Mapping as: Low 1, Moderate 2, High 3

| Unit No. | Course Content | Hours |
|---|---|---|
| 1 | **INTRODUCTION TO ARM ARCHITECTURE**<br>ARM7TDMI architecture, registers, interrupts, exception process, status registers processor modes, memory, memory mapped I/O, endianness | 06 |
| 2 | **ARM INSTRUCTION SET**<br>ARM instruction set: Data processing instruction, Load, store, Branch, interrupt instruction, program status register instruction, loading constants, conditional execution | 06 |
| 3 | **THE THUMB INSTRUCTION SET**<br>Entering thumb state, Thumb instruction set: Thumb register usage, ARM Thumb Interworking, branch instructions, Data processing, single register load-store, multiple register load-stores, stack instructions, software interrupt instruction | 06 |
| 4 | **INTERRUPTS and MEMORY MANAGEMENT UNIT**<br>Interrupts and exception handling schemes, Memory architecture, Memory access sequence, translation process, access permissions, domains, Aborts | 06 |
| 5 | **EMBEDDED SYSTEMS**<br>Introduction, CISC and RISC architectures, features of 8/16/32 bit microcontrollers, device drivers, Interrupt servicing mechanisms, programming concepts in embedded C and C++, Prototype development phases, software design and implementation , Hardware software co design, Case study: Adaptive cruise control system in car. | 06 |
| 6 | **Laboratory work / minor project work**<br>ARM microcontroller based minor project : concept to implementation or the laboratory work based on syllabus | 06 |

| Sr. No. | Reference Books |
|---|---|
| 1 | ARM architecture reference manual |
| 2 | Sloss, Symes, Wright, “ARM system developers guide” Morgan Kaufman, Elsevier, publication |
| 3 | Raj Kamal, "Embedded Systems: Architecture, Programming and Design", TMH, 2003. |
| 4 | Wolf, Wayne, "Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2001 |

| | |
|---|---|
| 5 | Vahid, Frank and Givargi, Tony, "Embedded System Design: A Unified Hardware/Software Introduction", John Wiley & Sons, New York, 2000. |
| 6 | Deshmukh, Ajay V., "Microcontroller Theory and Applications", Tata McGraw-Hill. |
| 7 | ARM7TDMI manual |
| 8 | Philips LPC 2148 manual |
| **Sr. No.** | **Important web links** |
| 1 | Relevant to the course matter |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year, Program, Semester** | Multidisciplinary Minor II, 4th Semester onwards | | | | | | |
| **Course Code** | MDM 1.4 | | | | | | |
| **Course Category** | Program Based Internship | | | | | | |
| **Course title** | **Internship** | | | | | | |
| **Teaching Scheme and Credits** | **L** | **T** | **P** | **Total Contact Hours** | | **Total Credits** | |
| | One Month | | | | | 03 | |
| **Evaluation Scheme** | **ISE** | **ESE** | **IOE** | **IPE** | **EOE** | **EPE** | **Total** |
| | 00 | 00 | 50 | - | 50 | - | 100 |
| **Pre-requisites (if any)** | Prerequisites for this course typically include a solid background in digital electronics, microcontrollers | | | | | | |
| **Course Rationale** | The course provides a comprehensive introduction to the core principles and concepts Embedded systems. It aims to equip students with the foundational knowledge and skills necessary to program and design the embedded systems. | | | | | | |
| **Course Objectives** | The students will learn<br>1. To expose students to real working environment and get acquainted with the organization structure, business operations and administrative functions<br>2. To have hands on experience in the related field to get exposure with the industrial trend<br>3. To promote cooperation and to develop synergetic collaboration between industry and the university<br>4. To set the step for future recruitment<br>5. Get familiarity with professional skills<br>6. Understand the information required for entrepreneurship | | | | | | |
| **Course Outcomes** | The students will be able to<br>1. Know the industrial working environment<br>2. Utilize the technical resources<br>3. Write technical documents and appear for interview / power point presentations/ technical discussions<br>4. Develop attitude of a team player and ability of life-long learning<br>5. Adapt and develop professional skills required for employability<br>6. Motivation for entrepreneurship | | | | | | |

**Course Outcome and Program Outcome Mapping**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 1 | 1 | 1 | | | | | | | 3 | |
| CO 2 | 3 | 2 | 3 | 3 | | | | | | | 3 | |
| CO 3 | 3 | 2 | 3 | 3 | 3 | | | | | | 3 | |
| CO 4 | 3 | 1 | 3 | 3 | | | | | | | 3 | |
| CO 5 | 3 | 3 | | 1 | | | | | | | 3 | |
| CO 6 | 3 | 2 | 3 | 3 | 3 | | | | | | 3 | 3 |
| PSO1 | 3 | 3 | 3 | 3 | 2 | | | | | | 1 | |
| PSO2 | 2 | 3 | 1 | 3 | 2 | | | | | | 2 | |

Level of Mapping as: Low 1, Moderate 2, High 3

| **Unit No.** | **Course Content** | **Duration** |
|---|---|---|
| **1** | One Month(Four-week) industrial training in a reputed industry from stand point view of Embedded systems - electronics engineering is mandatory. Students should learn and understand the concepts of system design, industrial organization and management. They should get familiarity with different departments like R & D, production, quality, purchase, sales & marketing and other. Students should submit detail report in the given format to the department in which all details of internship must be included. Panel of faculty members appointed by the program coordinator will assess the individual student. | **4 week** |

| **Sr. No.** | **Reference Books** |
|---|---|
| 1 | Articles from reputed journals, magazines, websites, real world problems, case studies, Survey reports |
| 2 | Institute's Laboratory Course Manual and equipment wise Standard Operating Procedure to follow. |
| **Sr. No.** | **Important web links** |
| 1 | As per requirement |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Year, Program, Semester** | Multidisciplinary Minor I, 4th Semester onwards | | | | | | | |
| **Course Code** | MDM 1.5 | | | | | | | |
| **Course Category** | Project Based Learning | | | | | | | |
| **Course Title** | **Mini Project** | | | | | | | |
| **Teaching Scheme and Credits** | **L** | **T** | **P** | **Total Contact Hours** | | **Total Credits** | | |
| | - | - | - | - | | 02 | | |
| **Evaluation Scheme** | **ISE** | **ESE** | | **IOE** | **IPE** | **EOE** | **EPE** | **Total** |
| | 00 | 00 | | 50 | - | 50 | - | 100 |
| **Pre-requisites(if any)** | Basics of unit processes and unit operations. | | | | | | | |
| **Course Rationale** | This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this field project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena in the Industry. | | | | | | | |
| **Course Objectives** | The course teacher will<br>1. Facilitate application of theoretical knowledge.<br>2. Guide the students about enhancement of practical skills.<br>3. Explain about development of industry-relevant competencies. | | | | | | | |
| **Course Outcomes** | Upon completion of this course, student should be able to<br>1. Demonstrate application of theoretical concepts with instructor guidance.<br>2. Collaborate effectively in instructor-led team-based projects.<br>3. Communicate findings and insights professionally under instructor supervision. | | | | | | | |

**Course Outcome and Program Outcome Mapping**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | - | - | 2 | - | - | - | 2 | - | - | - |
| CO 2 | - | - | 3 | - | - | - | - | - | 3 | - | 2 | 1 |
| CO 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |

Level of Mapping as: Low 1, Moderate 2, High 3

**Course Content**

Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

**Course Assessment Process**

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:
Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:
• Rubric-based assessment for the project work and its report.
• Peer evaluation for project.
• Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
• Overall course grading based on a weighted average of individual assessments and participation.
The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

# Multidisciplinary Minor
# In
# Industrial Robotics

# For
# B.Tech (Computer Science and Technology)

## Shivaji University, Kolhapur
# Department of Technology

## Multidisciplinary Minor in Industrial Robotics

**Teaching & Evaluation Scheme**

| Sr. No. | Category | Code | Course Title | Hours per week | | | Contact Hours | Credits | Evaluation scheme | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Theory | Practical |
| | | | | L | T | P | | | ISE:ESE | IE:EE |
| 1. | Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode | MDM 2.1 | Introduction to Robotics | 03 | - | - | 03 | 03 | 40:60 | 00:00 |
| 2. | | MDM 2.2 | Microprocessor & Embedded Systems | 03 | - | - | 03 | 03 | 40:60 | 00:00 |
| 3. | | MDM 2.3 | Control of Robotic Systems | 03 | - | - | 03 | 03 | 40:60 | 00:00 |
| 4. | Program Based Internship | MDM 2.4 | Internship | One Month | | | - | 03 | - | 50:50 |
| 5. | Project Based Learning | MDM 2.5 | Mini Project | - | - | - | - | 02 | - | 50:50 |
| | | | | - | - | - | - | 14 | 300 | 200 |
| | | | **Total Hours** | 09 | 00 | 00 | 09 | - | - | - |

Note: MDM Program's Internship and Mini Project need to be planned during winter or summer vacation days after 4th semester while respective evaluations will be the part of 7th and 8th Semesters of the B.Tech Major structure.

# Multidisciplinary Minor II: Industrial Robotics

| | | | | | |
|---|---|---|---|---|---|
| **Year, Program, Semester** | Multidisciplinary Minor II, 4th Semester onwards | | | | |
| **Course Code** | MDM 2.1 | | | | |
| **Course Category** | Minor Program Core | | | | |
| **Course title** | **Introduction to Robotics** | | | | |
| **Teaching Scheme and Credits** | **L** | **T** | **P** | **Total Contact Hours** | **Total Credits** |
| | 03 | - | - | 03 | 03 |
| **Evaluation Scheme** | **ISE:40** | | | **ESE: 60** | **Total=100** |
| **Pre-requisites (if any)** | Basic understanding of mathematics, physics, control system, programming skills and problem-solving skills. | | | | |
| **Course Rationale** | This course acquaints students with fundamental principles, technologies, and interdisciplinary skills necessary to comprehend, design, and program robotic systems, equipping them for careers in domains shaped by automation and technological advancement. It aims to cultivate problem-solving abilities, promote STEM education, and address ethical considerations surrounding the deployment of robotic technologies in diverse societal contexts. | | | | |
| **Course Objectives** | Teachers will be able to:<br>1. Introduce students to the basic concepts and principles of robotics.<br>2. Enhance the knowledge of students of grippers and sensors in Robots.<br>3. Establish knowledge of drives, actuators and control system in Robotics.<br>4. Provide students with the skills to program robots using programming languages such as VAL, RAIL, AML, Python, ROS.<br>5. Introduce Socio-Economic aspect, Safety for robot and new trends in Robotics.<br>6. Enhance knowledge of advanced techniques in Robotics. | | | | |
| **Course Outcomes** | Students will be able to:<br>1. Express his views as per terminologies related to Robotics technology.<br>2. Classify and apply different grippers and sensors foe various applications in Robotics.<br>3. Apply knowledge of drives and actuators in Robotics.<br>4. Apply programming language in robots.<br>5. Understand the socio-economic aspect for Robot.<br>6. Understand ways to update knowledge in the required area of robotic technology. | | | | |

**Course Outcome and Program Outcome Mapping**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 1 | 1 | 1 | | | | | | | | |
| CO 2 | 3 | 2 | 3 | 3 | | | | | | | | |
| CO 3 | 3 | 2 | 3 | 3 | 3 | | | | | | | |
| CO 4 | 3 | 1 | 3 | 3 | | | | | | | | |
| CO 5 | 3 | 3 | | 1 | | | | | | | | |
| CO 6 | 3 | 2 | 3 | 3 | 3 | | | | | | | 3 |
| PSO1 | 3 | 3 | 3 | 3 | 2 | | | | | | | |
| PSO2 | 2 | 3 | 1 | 3 | 2 | | | | | | | |

**Level of Mapping as: Low 1, Moderate 2, High 3**

| Unit No. | Course Content | Hours |
|---|---|---|
| **1.** | **Introduction to robotics**<br>Brief History, Basic Concepts of Robotics such as Definition , Three laws, Elements of Robotic Systems i.e. Robot anatomy, DOF, Misunderstood devices etc., Classification of Robotic systems on the basis of various parameters such as work volume, type of drive, etc., Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device etc., Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation, Industrial applications of robot. | **06** |
| **2.** | **Grippers and Sensors for Robotics**<br>Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper system.<br>Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Need for sensors and vision system in the working and control of a robot. | **06** |
| **3.** | **Drives and Control for Robotics**<br>Drive - Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system. Control Systems: Types of Controllers, Introduction to closed loop control | **06** |
| **4.** | **Programming and Languages for Robotics**<br>Robot Programming: Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, Python, ROS etc., Development of languages since WAVE till ROS. | **06** |
| **5.** | **Related Topics in Robotics**<br>Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and standards, Introduction to Artificial Intelligence, AI techniques, Need and application of AI, New trends & recent updates in robotics. | **06** |
| **6.** | **Advanced Robotic Systems and Emerging Technologies**<br>Advanced Robotic Systems: Surgical Robots, Autonomous Vehicles, Swarm Robotics, Exoskeletons<br>Emerging Technologies: Machine Learning, Deep Learning, Neural Networks, Reinforcement Learning, Human-Robot Interaction: Cognitive Robotics, Emotion Recognition, Natural Language Processing, Bio-inspired Robotics, Ethical Considerations in Robotics, Future Trends and Speculations. | **06** |

| Sr. No. | Text/ Reference Books |
|---|---|
| 1. | S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014) |
| 2. | Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006) |
| 3. | Dilip Kumar Pratihar, Fundamentals of Robotics, Narosa Publishing House, (2019) |
| 4. | R. K. Mittal, I. J. Nagrath, Robotics and Control, TATA McGraw Hill Publishing Co Ltd, New Delhi (2003) |
| 5. | S. B. Niku, Introduction to Robotics – Analysis, Contro, Applications, 3rd edition, John Wiley & Sons Ltd., (2020) |
| 6. | J. Angeles, Fundamentals of Robotic Mechanical Systems Theory Methods and Algorithms, Springer (1997) |
| 7. | Mikell Groover, Mitchell Weiss, Roger N. Nagel, Nicholas Odrey, Ashish Dutta, Industrial Robotics 2nd edition, SIE, McGraw Hill Education (India) Pvt Ltd (2012) |
| 8. | R. D. Klafter, Thomas A. Chmielewski, and Mechael Negin, Robotic Engineering – An Integrated Approach, EEE, Prentice Hall India, Pearson Education Inc. (2009) |
| **Sr. No.** | **Important web links** |
| 1. | https://nptel.ac.in/courses/107106090 |
| 2. | https://onlinecourses.nptel.ac.in/noc21_ee32/preview |

| | | | | | |
|---|---|---|---|---|---|
| **Year, Program, Semester** | Multidisciplinary Minor II, 4th Semester onwards | | | | |
| **Course Code** | MDM 2.2 | | | | |
| **Course Category** | Minor Program Core | | | | |
| **Course title** | **Microprocessor & Embedded Systems** | | | | |
| **Teaching Scheme and Credits** | **L** | **T** | **P** | **Total Contact Hours** | **Total Credits** |
| | 03 | - | - | 03 | 03 |
| **Evaluation Scheme** | **ISE:40** | | | **ESE: 60** | **Total=100** |
| **Pre-requisites (if any)** | Prerequisites: Understanding of digital electronics, basic programming concepts, and familiarity with fundamental electrical circuits. Proficiency in programming languages such as C/C++ is highly recommended, along with prior exposure to microcontroller architectures and operating principles. Additionally, a foundational understanding of robotics principles including sensors, actuators, and control systems, would be beneficial for students to effectively engage with the course material. | | | | |
| **Course Rationale** | The course provides students with the theoretical knowledge and practical skills required to understand, design, and implement embedded systems solutions tailored specifically for the intricacies of robotic applications. | | | | |
| **Course Objectives** | 1. Understand the fundamental principles of microprocessors and microcontroller architectures.<br>2. Learn about the role of embedded systems in robotics and their applications in real-world scenarios.<br>3. Explore interfacing techniques between microcontrollers and various sensors, actuators, and peripherals commonly used in robotics.<br>4. Develop skills in designing and implementing embedded systems solutions for robotic control, including motor control, sensor data processing, and communication protocols.<br>5. Explore emerging trends and technologies in the field of microprocessor and embedded systems for robotics, such as edge computing, machine learning inference on embedded devices, and Internet of Things (IoT) integration. | | | | |
| **Course Outcomes** | Students will be able to:<br>1. Describe the block diagram of embedded systems and identify trends in the embedded industry.<br>2. Identify the pin configuration and functions of the 8086 Microprocessor.<br>3. Learn about memory interfacing and programmable peripheral interfacing.<br>4. Understand the applications of microcontroller interfacing through case studies.<br>5. Gain proficiency in embedded C programming for advanced embedded processors.<br>6. Gain practical experience in data acquisition using both microprocessors and microcontrollers. | | | | |

**Course Outcome and Program Outcome Mapping**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 1 | 1 | 1 | | | | | | | | |
| CO 2 | 3 | 2 | 3 | 3 | | | | | | | | |
| CO 3 | 3 | 2 | 3 | 3 | 3 | | | | | | | |
| CO 4 | 3 | 1 | 3 | 3 | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 5 | 3 | 3 | | 1 | | | | | | | | |
| CO 6 | 3 | 2 | 3 | 3 | 3 | | | | | | | 3 |
| PSO1 | 3 | 3 | 3 | 3 | 2 | | | | | | | |
| PSO2 | 2 | 3 | 1 | 3 | 2 | | | | | | | |

Level of Mapping as: Low 1, Moderate 2, High 3

| Unit No. | Course Content | Hours |
|---|---|---|
| 1 | **Introduction to Embedded Systems and microcomputers**<br>Introduction to Embedded Systems, Embedded System Applications, Block diagram of embedded systems, Trends in Embedded Industry, Basic Embedded System Models, Embedded System development cycle, Challenges for Embedded System Design, Evolution of computing systems and applications. Basic Computer architecture: Von-Neumann and Harvard Architecture. Basics on Computer organizations. Computing performance, Throughput and Latency, Basic high performance CPU architectures, Microcomputer applications to Embedded systems and Mechatronics. Sensors and sensing mechanisms | **08** |
| 2 | **Microprocessor and Microcontrollers**<br>Basics of microprocessor and microcontrollers, CISC v/s RISC architecture , 8051 architecture and assembly and C language programming. | **06** |
| 3 | **Microprocessor Interfacing:**<br>Introduction to interfacing, Memory Interfacing, Programmable Peripheral Interfacing, Programmable I/O, Programmable Interrupt Controller, Programmable Timers, Programmable DMA Controller, Programmable Key Board Controller, Data acquisition Interfacing: ADC, DAC, Serial and parallel data Communication interfacing. Microcontroller: Introduction to Microcontroller and its families, Criteria for Choosing Microcontroller. Microcontroller Architecture, programming model, addressing modes, Instruction sets, Assembly and C programming for Microcontroller, I/O programming using assembly and C language, Interrupt Controller, I/O interfacing, Timers, Real Time Clock, Serial and parallel Communication protocols, SPI Controllers. LCD Controller. | **08** |
| 4 | **Microcontroller Interfacing**<br>Introduction to Microcontroller Interfacing and applications: case studies: Display Devices, controllers and Drivers for DC, Servo and Stepper Motor. | **04** |
| 5 | **Introduction to Advanced Embedded Processor and Software**<br>ARM Processor, Unified Model Language (UML), Embedded OS, Real Time Operating System (RTOS), Embedded C. | **04** |

| | | |
|---|---|---|
| **6** | **Microprocessor and Embedded System Laboratories:**<br>Basic C language programming implementation on Microprocessor and Microcontroller. Interfacing Displays, Key boards and sensors with Microprocessors and Microcontrollers, Data Acquisition using Microprocessor and Microcontroller, Implementation of Controlling schemes for DC, Servo, Stepper motor using C programming in microprocessors and Microcontrollers. | **06** |

| **Sr. No.** | **Text/Reference Books** |
|---|---|
| 1 | K. V. Shibu, Introduction to Embedded Systems, McGRAW Hill Publications (2009). |
| 2 | Raj Kamal, Embedded Systems, TATA McGRAW Hill Publications (2003). |
| 3 | M. Morris Mano, Computer System Architecture, 3ed, Pearson Publication, (2007). |
| 4 | M. A. Mazidi, , 8051 Microcontrollers and Embedded Systems, Pearson Publications, (2008). |
| 5 | B. B. Brey, The Intel Microprocessors, Prentice Hall Publications, 8th ed, (2018). |
| 6 | M. A. Mazidi, R.D. Mckinlay and D. Casey, PIC Microcontrollers and Embedded Systems, Pearson Publications, (2008). |
| 7 | M. Predko, Programming and Customizing the PIC Microcontroller, McGRAW Hill Publications. 3ed, (2017). |
| 8 | R. Barnett, L. O'Cull and S. Cox, Embedded C Programming and Microchip PIC, Cengage Learning, (2003). |
| **Sr. No.** | **Important web links** |
| 1 | https://nptel.ac.in/courses/108102045 |
| 2 | https://onlinecourses.nptel.ac.in/noc22_ee12/preview |

| | | | | | |
|---|---|---|---|---|---|
| **Year, Program, Semester** | Multidisciplinary Minor II, 4th Semester onwards | | | | |
| **Course Code** | MDM 2.3 | | | | |
| **Course Category** | Minor Program Core | | | | |
| **Course title** | **Control of Robotic Systems** | | | | |
| **Teaching Scheme and Credits** | **L** | **T** | **P** | **Total Contact Hours** | **Total Credits** |
| | 03 | - | - | 03 | 03 |
| **Evaluation Scheme** | **ISE:40** | | | **ESE: 60** | **Total=100** |
| **Pre-requisites (if any)** | Prerequisites: A solid understanding of robotics principles, encompassing kinematics, dynamics, and robot modeling. Proficiency in mathematical concepts such as calculus, linear algebra, and differential equations | | | | |
| **Course Rationale** | The course equips students with the theoretical foundations and practical skills necessary to design, analyze, and implement advanced control strategies for enhancing the performance and autonomy of robotic systems in diverse applications. | | | | |
| **Course Objectives** | Teachers will be able to:<br>1. Introduce basic concepts of control systems.<br>2. Explain proportional (P), proportional-integral (PI), and proportional-integral-derivative (PID) controllers.<br>3. Explain design of controllers for non-linear systems using describing function method.<br>4. Explain the design of force control and hybrid position/force control systems for robotic applications.<br>5. Enhance knowledge of students about Utilizing sensing and perception for closed-loop control in robotic systems.<br>6. Integrate machine learning and artificial intelligence methods for autonomous robotic control. | | | | |
| **Course Outcomes** | Students will be able to:<br>1. Interpret Bode, polar, and Nyquist plots for frequency domain analysis.<br>2. Implement proportional (P), proportional-integral (PI), and proportional-integral-derivative (PID) controllers.<br>3. Identify common physical non-linear systems and their characteristics.<br>4. Design force control and hybrid position/force control systems for robotic applications.<br>5. Integrate multiple sensor modalities using sensor fusion techniques.<br>**6.** Explore advanced control techniques including adaptive control and robust control. | | | | |

**Course Outcome and Program Outcome Mapping**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 1 | 1 | 1 | | | | | | | | |
| CO 2 | 3 | 2 | 3 | 3 | | | | | | | | |
| CO 3 | 3 | 2 | 3 | 3 | 3 | | | | | | | |
| CO 4 | 3 | 1 | 3 | 3 | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 5 | 3 | 3 | | 1 | | | | | | | | |
| CO 6 | 3 | 2 | 3 | 3 | 3 | | | | | | | 3 |
| PSO1 | 3 | 3 | 3 | 3 | 2 | | | | | | | |
| PSO2 | 2 | 3 | 1 | 3 | 2 | | | | | | | |

Level of Mapping as: Low 1, Moderate 2, High 3

| Unit No. | Course Content | Hours |
|---|---|---|
| 1 | **Basics of Control**<br>Differential Equation, Transfer function, Frequency response, Routh-Hurwitz test, relative stability, Root locus design, construction of root loci, phase lead and phase-lag design, lag-lead design, Bode, polar, Nyquist plot. | 06 |
| 2 | **Linear Control**<br>Concept of states, state space model, different form, controllability, observability; pole placement by state feedback, observer design, P, PI & PID Controller, control law partitioning, modelling and control of a single joint. | 06 |
| 3 | **Non-Linear Control System**<br>Common physical non-linear system, phase plane method, system analysis by phase plane method, stability of non-linear system, stability analysis by describing function method, Liapunov's stability criterion, the control problems for manipulators. | 06 |
| 4 | **Motion Control**<br>Point to Point Control, trajectory generation, Continuous Path Control, Joint based control, Cartesian Control, Force Control, hybrid position/force control system. | 06 |
| 5 | **Sensing and Perception for Robotic Control**<br>Overview of sensors and perception systems used in robotics Sensor fusion techniques for integrating multiple sensor modalities Applications of sensing and perception in closed-loop control of robotic systems. | 06 |
| 6 | **Advanced Topics in Robotic Control**<br>Exploration of advanced control techniques such as adaptive control and robust control Integration of machine learning and artificial intelligence for autonomous robotic control Case studies and practical examples demonstrating the application of advanced control methods in robotics. | 06 |

| Sr. No. | Reference Books |
|---|---|
| 1 | M. Gopal, Control Systems, McGraw-Hill (2012) |
| 2 | K. Ogata, "Modern Control Engineering", Prentice Hall India (2009). |
| 3 | M. Spong, M. Vidyasagar, S. Hutchinson, Robot Modeling and Control, Wiley & Sons, (2005). |
| 4 | J. J. Craig, "Introduction to Robotics: Mechanics and Control", 3rd edition, Addison-Wesley (2003). |
| 5 | S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014). |
| 6 | Thomas Kailath, "Linear Systems", Prentice Hall (1980). |
| 7 | Alok Sinha, "Linear Systems: Optimal and Robust Control", Taylor & Francis (2007). |

| Sr. No. | Important web links |
|---|---|
| 1 | https://onlinecourses.nptel.ac.in/noc24_me18/preview |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year, Program, Semester** | Multidisciplinary Minor II, 4th Semester onwards | | | | | | |
| **Course Code** | MDM 2.4 | | | | | | |
| **Course Category** | Program Based Internship | | | | | | |
| **Course title** | **Internship** | | | | | | |
| **Teaching Scheme and Credits** | **L** | **T** | **P** | **Total Contact Hours** | | **Total Credits** | |
| | One Month | | | | | 03 | |
| **Evaluation Scheme** | **ISE** | **ESE** | **IOE** | **IPE** | **EOE** | **EPE** | **Total** |
| | 00 | 00 | 50 | - | 50 | - | 100 |
| **Pre-requisites (if any)** | Prerequisites for this course typically include a solid background in digital electronics, microcontrollers ,Programming | | | | | | |
| **Course Rationale** | The course provides a comprehensive introduction to the core principles and concepts of Robotics. It aims to equip students with the foundational knowledge and skills necessary to program and design the Robotic systems. | | | | | | |
| **Course Objectives** | The students will learn<br>1. To expose students to real working environment and get acquainted with the organization structure, business operations and administrative functions<br>2. To have hands on experience in the related field to get exposure with the industrial trend<br>3. To promote cooperation and to develop synergetic collaboration between industry and the university<br>4. To set the step for future recruitment<br>5. Get familiarity with professional skills<br>6. Understand the information required for entrepreneurship | | | | | | |
| Course Outcomes | The students will be able to<br>1. Know the industrial working environment<br>2. Utilize the technical resources<br>3. Write technical documents and appear for interview / power point presentations/ technical discussions<br>4. Develop attitude of a team player and ability of life-long learning<br>5. Adapt and develop professional skills required for employability<br>6. Motivation for entrepreneurship | | | | | | |

**Course Outcome and Program Outcome Mapping**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 1 | 1 | 1 | | | | | | | 3 | |
| CO 2 | 3 | 2 | 3 | 3 | | | | | | | 3 | |
| CO 3 | 3 | 2 | 3 | 3 | 3 | | | | | | 3 | |
| CO 4 | 3 | 1 | 3 | 3 | | | | | | | 3 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 5 | 3 | 3 | | 1 | | | | | | | 3 | |
| CO 6 | 3 | 2 | 3 | 3 | 3 | | | | | | 3 | 3 |
| PSO1 | 3 | 3 | 3 | 3 | 2 | | | | | | 1 | |
| PSO2 | 2 | 3 | 1 | 3 | 2 | | | | | | 2 | |

Level of Mapping as: Low 1, Moderate 2, High 3

| Unit No. | Course Content | Duration |
|---|---|---|
| **1** | One Month (Four-week) industrial training in a reputed industry from stand point view of Robotic systems is mandatory. Students should learn and understand the concepts of system design, industrial organization and management. They should get familiarity with different departments like R & D, production, quality, purchase, sales & marketing and other. Students should submit detail report in the given format to the department in which all details of internship must be included. Panel of faculty members appointed by the program coordinator will assess the individual student. | **4 week** |
| | | |
| **Sr. No.** | **Reference Books** | |
| 1 | Articles from reputed journals, magazines, websites, real world problems, case studies, Survey reports | |
| 2 | Institute's Laboratory Course Manual and equipment wise Standard Operating Procedure to follow. | |
| **Sr. No.** | **Important web links** | |
| 1 | As per requirement | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year, Program, Semester | Multidisciplinary Minor II, 4th Semester onwards | | | | | | | | | | | | |
| Course Code | MDM 2.5 | | | | | | | | | | | | |
| Course Category | Project Based Learning | | | | | | | | | | | | |
| Course Title | **Mini Project** | | | | | | | | | | | | |
| Teaching Scheme and Credits | **L** | **T** | **P** | **Total Contact Hours** | | | | | **Total Credits** | | | | |
| | - | - | - | - | | | | | 02 | | | | |
| Evaluation Scheme | **ISE** | | **ESE** | | **IOE** | | **IPE** | | **EOE** | | **EPE** | | **Total** |
| | 00 | | 00 | | 50 | | - | | 50 | | - | | 100 |
| Pre-requisites(if any) | Basics of unit processes and unit operations. | | | | | | | | | | | | |
| Course Rationale | This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this field project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena for Industrial Robotics applications. | | | | | | | | | | | | |
| Course Objectives | The course teacher will<br>1. Facilitate application of theoretical knowledge.<br>2. Guide the students about enhancement of practical skills.<br>3. Explain about development of industry-relevant competencies. | | | | | | | | | | | | |
| Course Outcomes | Upon completion of this course, student should be able to<br>1. Demonstrate application of theoretical concepts with instructor guidance.<br>2. Collaborate effectively in instructor-led team-based projects.<br>3. Communicate findings and insights professionally under instructor supervision. | | | | | | | | | | | | |

**Course Outcome and Program Outcome Mapping**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | - | - | 2 | - | - | - | 2 | - | - | - |
| CO 2 | - | - | 3 | - | - | - | - | - | 3 | - | 2 | 1 |
| CO 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |

Level of Mapping as: Low 1, Moderate 2, High 3

**Course Content**

Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets with respect to application of AI & ML.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

**Course Assessment Process**

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:
Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:
• Rubric-based assessment for the project work and its report.
• Peer evaluation for project.
• Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
• Overall course grading based on a weighted average of individual assessments and participation.
The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

# Multidisciplinary Minor
# In
# Internet of Things

# For
# B.Tech (Computer Science and Technology)

## Shivaji University, Kolhapur
# Department of Technology

## Multidisciplinary Minor in Internet of Things

### Teaching & Evaluation Scheme

| Sr. No. | Category | Code | Course Title | Hours per week | | | Contact Hours | Credits | Evaluation scheme | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Theory | Practical |
| | | | | L | T | P | | | ISE:ESE | IE:EE |
| 1. | Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode | MDM 3.1 | Introduction to Internet of Things | 03 | - | - | 03 | 03 | 40:60 | 00:00 |
| 2. | | MDM 3.2 | Embedded Systems for IoT | 03 | - | - | 03 | 03 | 40:60 | 00:00 |
| 3. | | MDM 3.3 | IoT with Arduino, ESP, and Raspberry Pi | 03 | - | - | 03 | 03 | 40:60 | 00:00 |
| 4. | Program Based Internship | MDM 3.4 | Internship | One Month | | | - | 03 | - | 50:50 |
| 5. | Project Based Learning | MDM 3.5 | Mini Project | - | - | - | - | 02 | - | 50:50 |
| | | | | - | - | - | - | **14** | **300** | **200** |
| | | | **Total Hours** | **09** | **00** | **00** | **09** | - | - | - |

Note: MDM Program's Internship and Mini Project need to be planned during winter or summer vacation days after 4th semester while respective evaluations will be the part of 7th and 8th Semesters of the B.Tech Major structure.

# Multidisciplinary Minor III: Internet of Things

| | | | | | |
|---|---|---|---|---|---|
| **Year, Program, Semester** | Multidisciplinary Minor II, 4th Semester onwards | | | | |
| **Course Code** | MDM 3.1 | | | | |
| **Course Category** | Minor Program Core | | | | |
| **Course title** | **Introduction to Internet of Things** | | | | |
| **Teaching Scheme and Credits** | **L** | **T** | **P** | **Total Contact Hours** | **Total Credits** |
| | 03 | - | - | 03 | 03 |
| **Evaluation Scheme** | **ISE:40** | | | **ESE: 60** | **Total=100** |
| **Pre-requisites (if any)** | Knowledge of Embedded systems, microcontroller, computer networking | | | | |
| **Course Rationale** | The Introduction to Internet of Things (IoT) course aims to provide students with a foundational understanding of the principles, technologies, and applications of the IoT. In the modern world, the proliferation of connected devices has become integral to various industries and daily life. This course is designed to equip students with the knowledge and skills necessary to comprehend, design, and implement IoT solutions. By exploring the fundamental concepts, architectures, and practical applications of IoT, students will be prepared to engage with the evolving landscape of connected systems. | | | | |
| **Course Objectives** | 1. To make students know the IoT ecosystem.<br>2. To provide an understanding of the technologies and the standards relating to the Internet of Things.<br>3. To develop skills on IoT technical planning.<br>4. To learn the basics of security and various types of security issues<br>5. To study different cryptography techniques available and various security attacks.<br>6. Explore network security and how they are implemented in real world. | | | | |
| **Course Outcomes** | 1. To understand the technology and standards relating to IoTs.<br>2. To understand the critical ecosystem required to mainstream IoTs.<br>3. To Acquire skills on developing their own national and enterprise level technical strategies.<br>4. Analyze and compare different IoT architectures and frameworks.<br>5. Select and configure appropriate sensors for specific IoT applications.<br>6. Identify and implement suitable communication protocols for IoT applications. | | | | |

## Course Outcome and Program Outcome Mapping

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 3 | | | | | | | | | | | 3 | 3 |
| CO 2 | 3 | 3 | 2 | 1 | 1 | | | | | | | | 3 | |
| CO 3 | 3 | | | | | | | | | | | | 3 | 2 |
| CO 4 | 2 | | | | | | | | | | | | 3 | 2 |
| CO 5 | 1 | | | | | | | | | | | | 2 | 3 |
| CO 6 | 2 | | | | | | | | | | | | 3 | 3 |

Level of Mapping as: Low 1, Moderate 2, High 3

| Unit No. | Course Content | Hours |
|---|---|---|
| 1. | **Introduction to Internet of Things:** IoT & Web Technology: The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics. | **06** |
| 2. | **M2M to IoT –** A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, an emerging industrial structure for IoT, the international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. | **06** |
| 3. | **IoT Architecture -State of the Art –** Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views | **06** |
| 4. | **IoT Applications for Value Creations** Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry, | **06** |
| 5. | **Internet of Things Privacy, Security and Governance** Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities, Security. | **06** |
| 6. | **IoT application in different areas:** IOT for health application, IoT for Environment application | **06** |

| Sr. No. | Reference Books |
|---|---|
| 1. | Nitesh Dhanjani, Abusing the Internet of Things, Shroff Publisher/O'Reilly Publisher. |
| 2. | Internet of Things, RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, John Wiley and Sons. |
| 3. | Internet of Things, Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, John Wiley & Sons. |
| 4. | Cuno Pfister, "Getting Started with the Internet of Things", Shroff Publisher/Maker Media. |
| 5. | Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications. |
| 6. | Massimo Banzi, Michael Shiloh Make: Getting Started with the Arduino, Shroff Publisher/Maker Media Publishers. |

| Sr. No. | Important web links |
|---|---|
| 1. | https://www.coursera.org/specializations/internet-of-things |

| | | | | | |
|---|---|---|---|---|---|
| **Year, Program, Semester** | Multidisciplinary Minor II, 4th Semester onwards | | | | |
| **Course Code** | MDM 3.2 | | | | |
| **Course Category** | Minor Program Core | | | | |
| **Course title** | **Embedded Systems for IoT** | | | | |
| **Teaching Scheme and Credits** | **L** | **T** | **P** | **Total Contact Hours** | **Total Credits** |
| | 03 | - | - | 03 | 03 |
| **Evaluation Scheme** | **ISE:40** | | | **ESE: 60** | **Total=100** |
| **Pre-requisites (if any)** | Knowledge of Embedded systems, microcontroller, computer networking | | | | |
| **Course Rationale** | The proliferation of the Internet of Things (IoT) has led to an increased demand for professionals skilled in designing and developing embedded systems tailored for IoT applications. This course is designed to provide students with a deep understanding of embedded systems and their integration within the IoT ecosystem. It aims to equip students with the knowledge and skills necessary to design, program, and optimize embedded systems for efficient communication, data processing, and control in IoT environments. | | | | |
| **Course Objectives** | 1. To make students know the basic concept and architecture of embedded systems.<br>2. Different design platforms used for an embedded system for IoT applications.<br>3. To have knowledge about the IoT enabled technology. | | | | |
| **Course Outcomes** | 1. Understand the embedded system concepts and architecture of embedded systems.<br>2. Understand the different hardware/software co-design techniques for microcontroller-based embedded systems, apply techniques in IoT applications.<br>3. Understand and implement communication protocols suitable for IoT devices.<br>4. To be able to design web/cloud based IoT applications.<br>5. Design and implement interfaces for connecting sensors and actuators to embedded system<br>6. Identify and address security challenges specific to embedded systems in IoT. | | | | |

## Course Outcome and Program Outcome Mapping

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | | 2 | 2 | | | | | | | | | 3 | 3 |
| CO 2 | 3 | | | 2 | | | | | | | | | 3 | |
| CO 3 | 3 | | 2 | | | | | | | | | | | 2 |
| CO 4 | | | 3 | | | | | | | | | | | 2 |
| CO 5 | | | 3 | | 3 | | | | | | | | | |
| CO 6 | | | | | 3 | | | | | | | | 3 | 3 |

Level of Mapping as: Low 1, Moderate 2, High 3

| Unit No. | Course Content | Hours |
|---|---|---|
| 1. | **Purpose and requirement specification, IoT level specification**, Functional view specification, Operational view specification, Device and component integration, Pillars of Embedded IoT and Physical Devices: The internet of devices. | 06 |
| 2. | **Design of Embedded Systems:** Common Sensors, Actuators, Embedded Processors, Memory Architectures, Software architecture | 06 |
| 3. | **Inputs and Outputs**: Digital Inputs and Outputs, Digital Inputs, Digital Outputs, BusIn, BusOut, and BusInOut, Analog Inputs and Outputs, Analog Inputs, Analog Outputs, Pulse Width Modulation (PWM), Accelerometer and Magnetometer, SD Card, Local File System (LPC1768). | 06 |
| 4. | **IoT Enabling Technologies**: Communications, RFID and NFC (Near-Field Communication), Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee, Z-Wave, LoRa, Protocols, HTTP, WebSocket, MQTT, CoAP, XMPP, Node-RED, Platforms, IBM Watson IoT—Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT, ThingWorx, GE Predix, Xively, macchina.io, Carriots. | 06 |
| 5. | **Web of Things and Cloud of Things**: Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Cloud of Things. IoT Physical Servers, | 06 |
| 6. | **Cloud Offerings and IoT Case Studies**: Introduction to Cloud Storage Models, Communication API. | 06 |

| Sr. No. | Reference Books |
|---|---|
| 1. | RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, Internet of Things, John Wiley and Sons. |
| 2. | Klaus Elk, “Embedded Software for the IoT”. |
| 3. | Elizabeth Gootman et. al, “Designing Connected Products”, Shroff Publisher/O’Reilly Publisher. |
| 4. | Perry Xiao, “Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed”. |

| Sr. No. | Important web links |
|---|---|
| 1. | https://www.coursera.org/learn/iot |

| | | | | | |
|---|---|---|---|---|---|
| **Year, Program, Semester** | Multidisciplinary Minor II, 4th Semester onwards | | | | |
| **Course Code** | MDM 3.3 | | | | |
| **Course Category** | Minor Program Core | | | | |
| **Course title** | **IoT with Arduino, ESP, and Raspberry Pi** | | | | |
| **Teaching Scheme and Credits** | **L** | **T** | **P** | **Total Contact Hours** | **Total Credits** |
| | 03 | - | - | 03 | 03 |
| **Evaluation Scheme** | **ISE:40** | | | **ESE: 60** | **Total=100** |
| **Pre-requisites (if any)** | Knowledge of Embedded systems, microcontroller, computer networking | | | | |
| **Course Rationale** | The Internet of Things (IoT) has become a pivotal aspect of modern technology, and understanding how to create IoT solutions using popular platforms like Arduino, ESP (Espressif), and Raspberry Pi is essential. This course is designed to provide students with hands-on experience in building IoT applications using these widely used hardware platforms. It aims to enable students to design, develop, and deploy IoT projects by combining hardware, software, and connectivity elements. | | | | |
| **Course Objectives** | 1. To give students hands-on experience using different IoT architectures.<br>2. To provide skills for interfacing sensors and actuators with different IoT architectures.<br>3. To develop skills on data collection and logging in the cloud. | | | | |
| **Course Outcomes** | 1. To understand Arduino Uno, NODE MCU 8266 and Raspberry PI along with critical protocols and its communication to cloud.<br>2. To apply commonly used IOT protocols such as REST API, MQTT through IOT based demonstration.<br>3. To solve analog sensor and digital sensor Interfacing with IOT devices.<br>4. Program ESP devices for IoT applications, including setting up wireless connectivity.<br>5. Use Raspberry Pi as an IoT gateway and implement data processing tasks.<br>6. Successfully integrate sensors and actuators with the chosen platforms to achieve specific IoT functionalities. | | | | |

## Course Outcome and Program Outcome Mapping

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | | 2 | 2 | | | | | | | | | 3 | 3 |
| CO 2 | 3 | | | 2 | | | | | | | | | 3 | |
| CO 3 | 3 | | 2 | | | | | | | | | | | 2 |
| CO 4 | | | 3 | | | | | | | | | | | 2 |
| CO 5 | | | 3 | | 3 | | | | | | | | | |
| CO 6 | | | | | 3 | | | | | | | | 3 | 3 |

Level of Mapping as: Low 1, Moderate 2, High 3

| Unit No. | Course Content | Hours |
|---|---|---|
| 1 | **IoT- introduction and its components**<br>IoT building blocks, Sensors and Actuators, IoT Devices, IoT boards (Arduino Uno, ESP 8266-12E Node MCU, and Raspberry Pi 3). | 06 |
| 2 | **Arduino Uno – getting started with the Uno boards**<br>blink program, connection of sensors to the Uno board, reading values of sensors from the Uno board, interrupts. Case study: Temperature/Humidity Control; Case Study: Sending values Temperature/Humidity values to the Internet via GSM module | 06 |
| 3 | **ESP 8266-12E Node MCU – getting started with the ESP board**<br>Micropython and Esplorer IDE, Flushing the ESP8266 board with micropython, connecting sensors to the ESP board, Connecting ESP board to WiFi, Interfacing ESP with the Cloud (REST API-GET, POST, MQTT), interrupts, comparison of ESP 32 board with the ESP 8266 board. Case Study: Switching light on /off remotely. Case Study: Voice-based Home Automation for switching lights on/off (Android phone – Google Assistant (Assistant <-> IFTTT), MQTT (ESP <-> IFTTT), ESP 8266 <-> Lights). | 06 |
| 4 | **Raspberry Pi 3 - Rpi3 introduction and installing the Raspbian Stretch OS**<br>Headless - Computer and Rpi3 configuration to connect through SSH via Ethernet, Headless - connecting Rpi3 remotely without Ethernet cable via SSH, IP address, Rpi 3 - Testing the GPIO pins through Scripts. | 06 |
| 5 | **Raspberry pi3 interfacing with Sensor**<br>DHT11, Raspberry pi3 python library install and reading sensor feed, 'Plug and play ' type cloud platform overview for integration to IOT devices, 'Plug and play' cloud platform for integration to IOT device - actuator (LED), Plug and play platform - Custom widget (DHT11-Sensor) integration through Python. New - Raspeberry Pi 4 Vs Raspberry Pi3 Mobel B Comparison, LoRawan /LPWAN – Overview. | 06 |
| 6 | **IoT Case Studies:** Introduction to Cloud Storage Models, Communication API. | 06 |

| Sr. No. | Reference Books |
|---|---|
| 1 | Rao, M. (2018). Internet of Things with Raspberry Pi 3: Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects. Packt Publishing Ltd |
| 2 | Baichtal, J. (2013). Arduino for beginners: essential skills every maker needs. Pearson Education. |
| 3 | Schwartz, M. (2016). Internet of Things with ESP8266. Packt Publishing Ltd. |
| 4 | Richardson, M., & Wallace, S. (2012). Getting started with raspberry PI. " O'Reilly Publisher Media, Inc." |
| **Sr. No.** | **Important web links** |
| 1 | https://www.coursera.org/learn/iot |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year, Program, Semester** | Multidisciplinary Minor II, 4th Semester onwards | | | | | | |
| **Course Code** | MDM 3.4 | | | | | | |
| **Course Category** | Minor Program Core | | | | | | |
| **Course title** | **Internship** | | | | | | |
| **Teaching Scheme and Credits** | **L** | **T** | **P** | **Total Contact Hours** | | | **Total Credits** |
| | One Month | | | | | | 03 |
| **Evaluation Scheme** | **ISE** | **ESE** | **IOE** | **IPE** | **EOE** | **EPE** | **Total** |
| | 00 | 00 | 50 | - | 50 | - | 100 |
| **Pre-requisites (if any)** | Prerequisites for this course typically include a solid background in digital electronics, microcontrollers | | | | | | |
| **Course Rationale** | The course provides a comprehensive introduction to the core principles and concepts IoT. It aims to equip students with the foundational knowledge and skills necessary to program and design the IoT systems. | | | | | | |
| **Course Objectives** | The students will learn<br>1. To expose students to real working environment and get acquainted with the organization structure, business operations and administrative functions<br>2. To have hands on experience in the related field to get exposure with the industrial trend<br>3. To promote cooperation and to develop synergetic collaboration between industry and the university<br>4. To set the step for future recruitment<br>5. Get familiarity with professional skills<br>6. Understand the information required for entrepreneurship | | | | | | |
| **Course Outcomes** | The students will be able to<br>1. Know the industrial working environment<br>2. Utilize the technical resources<br>3. Write technical documents and appear for interview / power point presentations/ technical discussions<br>4. Develop attitude of a team player and ability of life-long learning<br>5. Adapt and develop professional skills required for employability<br>6. Motivation for entrepreneurship | | | | | | |

## Course Outcome and Program Outcome Mapping

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 1 | 1 | 1 | | | | | | | 3 | |
| CO 2 | 3 | 2 | 3 | 3 | | | | | | | 3 | |
| CO 3 | 3 | 2 | 3 | 3 | 3 | | | | | | 3 | |
| CO 4 | 3 | 1 | 3 | 3 | | | | | | | 3 | |
| CO 5 | 3 | 3 | | 1 | | | | | | | 3 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 6 | 3 | 2 | 3 | 3 | 3 | | | | | | 3 | 3 |
| PSO1 | 3 | 3 | 3 | 3 | 2 | | | | | | 1 | |
| PSO2 | 2 | 3 | 1 | 3 | 2 | | | | | | 2 | |

Level of Mapping as: Low 1, Moderate 2, High 3

| **Unit No.** | **Course Content** | **Duration** |
|---|---|---|
| **1** | Four-week industrial training in a reputed industry from stand point view of IoT - electronics engineering is mandatory. Students should learn and understand the concepts of IoT system design, industrial organization and management. They should get familiarity with different departments like R & D, production, quality, purchase, sales & marketing and other. Students should submit detail report in the given format to the department / program in which all details of internship must be included. Panel of faculty members appointed by the program coordinator will assess the individual student. | **4 week** |
| | | |
| **Sr. No.** | **Reference Books** | |
| 1 | Articles from reputed journals, magazines, websites, real world problems, case studies, Survey reports | |
| 2 | Institute's Laboratory Course Manual and equipment wise Standard Operating Procedure to follow. | |
| **Sr. No.** | **Important web links** | |
| 1 | As per requirement | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Year, Program, Semester | Multidisciplinary Minor III, 4th Semester onwards | | | | | | |
| Course Code | MDM 3.5 | | | | | | |
| Course Category | Project Based Learning | | | | | | |
| Course Title | **Mini Project** | | | | | | |
| Teaching Scheme and Credits | **L** | **T** | **P** | **Total Contact Hours** | | **Total Credits** | |
| | - | - | - | - | | 02 | |
| Evaluation Scheme | **ISE** | **ESE** | **IOE** | **IPE** | **EOE** | **EPE** | **Total** |
| | 00 | 00 | 50 | - | 50 | - | 100 |
| Pre-requisites(if any) | Basics of unit processes and unit operations. | | | | | | |
| Course Rationale | This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this field project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena. | | | | | | |
| Course Objectives | The course teacher will<br>1. Facilitate application of theoretical knowledge.<br>2. Guide the students about enhancement of practical skills.<br>3. Explain about development of industry-relevant competencies. | | | | | | |
| Course Outcomes | Upon completion of this course, student should be able to<br>1. Demonstrate application of theoretical concepts with instructor guidance.<br>2. Collaborate effectively in instructor-led team-based projects.<br>3. Communicate findings and insights professionally under instructor supervision. | | | | | | |

## Course Outcome and Program Outcome Mapping

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | - | - | 2 | - | - | - | 2 | - | - | - |
| CO 2 | - | - | 3 | - | - | - | - | - | 3 | - | 2 | 1 |
| CO 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |

Level of Mapping as: Low 1, Moderate 2, High 3

## Course Content

Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets with respect to application of piping design basics.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

## Course Assessment Process

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:

Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:
• Rubric-based assessment for the project work and its report.
• Peer evaluation for project.
• Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
• Overall course grading based on a weighted average of individual assessments and participation.
The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.