

COURSE TITLE	MICROCONTROLLERS AND EMBEDDED SYSTEM LABORATORY
COURSE CODE	01MR0402
COURSE CREDITS	2

Objective:

- 1 To develop fundamental Embedded skills, control theory, implement hardware and software related algorithms for efficient problem-solving, and apply programming to address engineering challenges.

Course Outcomes: After completion of this course, student will be able to:

- 1 Apply embedded C programming techniques to program microcontrollers for real-time mechanical, robotic, and automation applications.
- 2 Apply sensor and actuator interfacing methods to acquire data and execute control actions in automation and robotic systems.
- 3 Implement motor control strategies using microcontrollers for speed, direction, and position control of DC, stepper, and servo motors.
- 4 Apply and Integrale timers, interrupts, and serial communication protocols to develop time-critical and event-driven embedded applications.
- 5 Design, Implement and Demonstrate a complete microcontroller-based embedded system that solves a practical problem in robotics or automation.

Pre-requisite of course:Nil

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
0	0	4	0	0	0	50	50

Contents : Unit	Topics	Contact Hours
Total Hours		

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Study of Microcontroller Development Board and Embedded System Hardware. Arduino / STM32 / ESP32 Architecture, Pin configuration, memory organization, datasheet interpretation	4

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
2	Embedded C Programming and Digital I/O Control Development Environment Setup IDE installation, board configuration , Program uploading & debugging, LED and switch interfacing	4
3	Delay and Timing Control Using Software Loops LED sequencing , Software-based timing analysis	4
4	Timer Programming for Periodic Event Generation Timer Programming for Periodic Event Generation	4
5	Interrupt Programming for Event-Driven Applications Interrupt Programming for Event-Driven Applications	4
6	Analog-to-Digital Converter (ADC) Interfacing with Sensors Analog Sensor Interfacing using ADC , Signal scaling and calibration	4
7	Temperature / Proximity Sensor Interfacing and Data Acquisition Temperature sensor Interfacing and Proximity / IR Sensor Interfacing , Ultrasonic Sensor Interfacing	4
8	Relay and Solenoid Control for Automation Applications Industrial automation application	4
9	DC Motor Interfacing and Direction Control DC Motor Interfacing using Driver Circuit , Direction and speed control	4
10	PWM-Based Speed Control of DC Motor PWM-Based DC Motor Speed Control , Mechanical load variation study	4
11	Stepper Motor Control for Positioning Applications Stepper Motor Control Positioning and indexing	4
12	Servo Motor Control for Robotic Joint Applications Robotic joint actuation	4
13	Serial Communication Using UART Encoder Interfacing Speed and position feedback and Basic feedback control implementation , Interrupt-Based Event Handling Emergency stop / sensor-triggered action and Timer-Based Real-Time Control Precise timing applications	4
14	Mini Project Design, implement, and demonstrate a microcontroller-based embedded system relevant to robotics or automation.	4
Total Hours		56

Textbook :

- 1 Microcontroller and Embedded Systems: Using Assembly and C, Mazidi, M. A., Mazidi, J. G., and McKinlay, R. D., Pearson Education, 2023
- 2 Embedded Systems: Architecture, Programming and Design, Kamal, Raj, McGraw-Hill Education, 2020

References:

- 1 Design with Microcontrollers , Design with Microcontrollers , Peatman, J. B, McGraw-Hill Education, 2009
- 2 Embedded C , Embedded C , Pont, Michael J. , Pearson Education , 2015
- 3 Programming Arduino: Getting Started with Sketches, Programming Arduino: Getting Started with Sketches, Simon Monk, McGraw-Hill Education, 2016
- 4 Embedded Systems Design, Embedded Systems Design, Heath, Steve, Newnes / Elsevier, 2002
- 5 Microprocessor Architecture: Programming and Applications with the 8085, Microprocessor Architecture: Programming and Applications with the 8085, R. S. Gaonkar, Penram International Publishing, 1996

Suggested Theory Distribution:

The suggested theory distribution as per Bloom’s taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
		30.00	30.00	10.00	30.00

Instructional Method:

- 1 Demonstration-Based Laboratory Learning
- 2 Hands-on Experimental Learning
- 3 Problem-Based Learning (PBL)
- 4 Simulation-Assisted Learning

Supplementary Resources:

- 1 <https://nptel.ac.in/courses/106105193> - Embedded System Design with ARM, IIT Kharagpur
- 2 <https://randomnerdtutorials.com/esp32-firebase-realtime-database/> - ESP32: Getting Started with Firebase (Realtime Database)