

GUJARAT TECHNOLOGICAL UNIVERSITY
MECHATRONICS ENGINEERING (20)
SUBJECT NAME: MICROCONTROLLERS AND EMBEDDED SYSTEMS
SUBJECT CODE: 2172001
B.E. 7th SEMESTER

Type of course: Engineering Science

Prerequisite: Knowledge of microprocessor and microcontroller.

Rationale: This subject focuses on the study of advanced microcontroller along with various applications using microcontrollers. It also briefs the students about interfacing of memory and various I/O devices like A to D converter, D to A converter LED, LCD to advanced microcontrollers. The students learn the Programming language (Embedded C) used for microcontrollers. They will be able to use the advanced fast microcontroller.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		PA (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	2	5	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning;

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Overview: Basics of embedded System design, Microcontroller based systems, Historical perspective, von Neumann versus Harvard Architecture and CISC versus RISC Processors.	4	9
2	8051 Programming in C: 8051 C programming basics and time delay in 8051 C, I/O programming in 8051 C, Logic operations in 8051 C, Data conversion programs in 8051 C, Accessing code ROM space in 8051 C.	4	9
3	Interfacing real world devices with 8051 microcontroller: Analog to Digital converters (ADC) & Digital to Analog Converter (DAC) basics. ADC, DAC and Temperature Sensor interfacing with 8051 microcontroller. LCD and Matrix Keyboard interfacing with 8051 microcontroller.	5	12

4	Motor Control: Relay, PWM, DC and Stepper Motors: Relays and Opt-isolators, Stepper motor interfacing, DC motor interfacing and PWM using 8051.	4	9
5	8051 Timer, Serial port, interrupt Programming in C: Programming 8051 timers/Counter in C. Basics of serial communication, 8051 connection to RS232, 8051 serial port programming in C. 8051 interrupts programming in C: Timer interrupts, external hardware interrupts and serial communication interrupt.	5	12
6	Microcontroller Architecture – PIC18F Family: Block diagram, Memory Organization.	3	8
7	PIC 18F Programming Model and Its Instruction Set: PIC18F Family Programming model , Introduction to PIC18F Family instruction Set	4	9
8	Data transfer, Arithmetic and Branch Instructions - PIC18F Family: Data copy operations, Arithmetic operations, branching operations, Stack and Subroutines and Illustrative Programs.	4	9
9	Logic, Bit manipulation and Multiply/Divide operations - PIC18F Family: Logic operations, Bit operations, Multiply/divide operations and Illustrative Programs.	4	9
10	I/O ports, Interrupts and Timers - PIC18F Family: Basics concepts of Input/output ports and Interfacing input/output Peripherals, PIC18F Interrupts, PIC18F Timers, Illustration programs.	6	14

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
Remembrance	Understanding	Application	Analyze	Evaluate
R Level	U Level	A Level	N Level	E Level
20	30	20	20	10

Legends: R: Remembrance; U = Understanding; A = Application and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

Reference Books:

1. The 8051 Microcontroller and Embedded Systems Using Assembly and C, by Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay (Second Edition, Pearson Education).
2. Fundamentals of Microcontrollers and Applications in Embedded Systems (with the PIC18 Microcontroller Family), by Ramesh Gaonkar, Penram.
3. The 8051 Microcontroller & Embedded Systems using Assembly and C by K. J. Ayala, D. V. Gadre (Cengage Learning, India Edition).
4. 8051 Microcontroller: Internals, Instructions, Programming and Interfacing by Subrata Ghoshal, Pearson Education.
5. The 8051 Microcontrollers: Architecture, Programming and Applications by K Uma Rao, Andhe Pallavi, Pearson Education.
6. Embedded systems architecture, programming and design, second edition by Raj Kamal, TMH publishing company limited

Course Outcome:

After learning the course the students should be able to:

1. Understand how microcontroller and its peripherals function and interface to external peripherals
2. Program an embedded system in assembly and C language
3. Design, implement and test a single-processor embedded systems for real-time applications in engineering automation
4. Optimize embedded software for speed and size for industrial applications

List of Experiments:

1. Interfacing ADC and DAC with 8051 microcontroller.
2. Interfacing Matrix Keyboard with 8051 microcontroller.
3. Interfacing LED and LCD Displays with 8051 microcontroller.
4. Interfacing Stepper Motor with 8051 microcontroller.
5. Controlling DC motor using PWM with 8051 microcontroller.
6. Introduction to MPLAB IDE and Basic programming for PIC18F microcontroller.
7. Simulate programs based on data transfer and arithmetic operations in PIC18F Microcontroller.
8. Simulate programs based on logical operations in PIC18F microcontroller.
9. Programming based on stack and subroutines in PIC18F microcontroller.
10. Interfacing Input/output Peripherals with PIC18F microcontroller.
11. Programming based on Interrupts in PIC18F microcontroller.
12. Programming based on timers in PIC18F microcontroller.

Design based Problems (DP)/Open Ended Problem:

Implementation of embedded system for industrial application (e.g. instrumentation, control, automation but not limited to these) using any of the 16-bit or 32-bit microcontroller available in the market, in guidance of course instructor

Major Equipment:

Kit for advanced 8051 controller and μ VISION2/3/4 IDE, kit for PIC 18F series microcontroller and MPLAB IDE.

List of Open Source Software/learning website:

The website of NPTEL may be utilized for additional learning.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.