

# GUJARAT TECHNOLOGICAL UNIVERSITY

## ELECTRICAL ENGINEERING MICROPROCESSOR AND MICROCONTROLLER INTERFACING SUBJECT CODE: 2150907 B.E. 5<sup>th</sup> SEMESTER

**Type of course:** Engineering

**Prerequisite:** Analog and Digital Electronics

**Rationale:** This subject focuses on the study of microprocessor and microcontroller along with the basics of Digital Circuits. It also briefs the students about interfacing of memory and I/O devices like A to D converter, D to A converter LED, LCD etc. The students learn the Programming language (Both assembly and Embedded C) used for microcontrollers. They learn the basics of Microprocessor and design of Microcontroller based systems. They will be able to use the same in electrical engineering related fields like Power system protection, instrumentation, power electronics, Electrical Drives and control of Electrical Equipments.

### Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
4	0	2	6	70	20	ALA 10	ESE 20	OEP 10		20

### Content:

Sr. No.	Content	Total Hrs	% Weightage
1	<b>Review of logic devices and memories:</b> Latches, Flip flops, Buffers, Controller buffer registers, Decoders Memory Cell, Internal organization of Memory Chips, Types of Memories Ram Rom PROM EPROM EEPROM, Flash Memory.	03	5
2	<b>Microprocessor Based Systems:</b> Digital Computer, Microprocessor, Microcomputer, Microcontroller, Van Neumann and Harvard Architecture, CISC and RISC Processors	02	5
3	<b>8085 Microprocessor:</b> Architectural Block Diagram, Schematic and Pin diagrams, Pin functions, Bus Organization, Internal operations and registers, Externally initiated operations, Serial interrupt and I/O Control, Brief Introduction of Instruction and assembly language Program, (Complete 8085 instruction set and Programming of assembly language 8085 should not be covered & asked in the exam) Timing and Control Unit ,Microprocessor communication, Multiplexing of address/data bus, Generation of control signals, 8085 machine cycles, Fetch and execution of only MOV, STA, and OUT instructions with timing diagram.	08	15
4	<b>8051 Microcontroller architecture:</b> Introduction to MCS -51 Family microcontrollers, Architectural block Diagram, Pin diagram and Pin	07	15

	Functions General Purpose and Special Function Registers, , Oscillator and clock circuit, Reset circuit, I/O Port circuits, Memory organization, Internal program and data memory.		
5	<b>Introduction to Program Development Tools (IDE):</b> Concept of IDE, Editor, Assembler, Compiler, Linker, Simulator, Debugger and assembler directives.	02	20
6	<b>8051 Assembly language programming:</b> Programming model of 8051, Addressing modes, data transfer instructions, I/O Port programming, Arithmetic and Logical instructions, Bit level instructions, Branching instructions (Jump and loop Jump and call), Concept of stack, subroutine and related instructions, writing programs (like time delay using loop, data conversions HEX to ASCII, BCD to ASCII, use of look up table etc) in assembly language 8051 and testing the same using IDE.	08	
7	<b>8051 Programming in C:</b> Data types in 8051 C, programming for time delay, I/O programming in 8051 C, Logic operations in 8051 C, Control statements and loops in embedded C, Functions and Arrays in embedded C, Data conversion programs in 8051 C, , Accessing code ROM space using 8051 C, Data serialization using 8051 C.	05	10
8	<b>External Memory Interfacing:</b> Memory address decoding, interfacing 8031/8051 with ROM/EPROM and Data ROM	02	20
9	<b>8051 Timer/Counter and Programming:</b> Use of counter as timer, Timer/Counters and associated registers, Various modes of timer/counter operations, Time delay programs in Assembly language/ Embedded C	03	
10	<b>8051 Serial Port and Programming:</b> Basics of serial communication, RS232 standards, 8051 connection to RS232, Serial data input/output and associated registers, Various modes of serial data communication, serial data communication programs in Assembly language/ Embedded C	03	
11	<b>8051 Interrupts:</b> Concept of Interrupt, interrupt versus polling, Types of interrupts in 8051, Reset, interrupt control and associated registers, interrupt vectors, Interrupt execution, RETI instruction, software generated interrupt, interrupt handler subroutine for timer/counter and serial data transmission/reception in Assembly language/ Embedded C ,	04	
12	<b>Applications and design of microcontroller based systems:</b> Interfacing of LEDs, 7 Segment display device, LCD display, DIP Switches, Push Button switches, Key denounce techniques, Keyboard connections load per key and matrix form, Interfacing A/D converter, D/A converter, Relay, opto isolator stepper motor and DC motor.	09	15

**Suggested Specification table with Marks (Theory):**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	30	10	10	10

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create 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. Microprocessor Architecture, Programming, and Applications with the 8085, By Romesh Gaonkar, Penram International Publishing (India) LTD.
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, 2/e by Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay ( Second Edition , Pearson Education)
3. The 8051 Microcontroller & Embedded Systems using Assembly and C By K. J. Ayala, D. V. Gadre (Cengage Learning , India Edition).
4. Using the MCS-51 Microcontrollers By Han Way Huang Oxford Uni Press
5. Programming and Customizing the 8051 Microcontroller by Myke Predko Tata Mcgraw Hill.

## Course Outcome:

After learning the course the students should be able to:

1. Apply the concept of buses, microprocessor architecture and interrupts.
2. Interface memory and I/O devices with 8 bit microprocessor/microcontroller
3. Describe 8 bit microcontroller architecture-of MCS -51 family
4. Program assembly language programming/ C programming of 8051
5. Design microcontroller based small system

## Suggested List of Experiments:

1. Introduction to IDE and Assembler directives.
2. 8051 Assembly language programming for addition, subtraction, multiplication and division of two 8-bit numbers .
3. 8051 Assembly language programming for block data transfer between internal and external memory including overlapping blocks.
4. 8051 Assembly language programming using Arithmetic instructions
5. 8051 Assembly language programming using Logical Instructions
6. 8051 Assembly language programming for code conversions
7. 8051 Assembly language programming for Timers in different modes.
8. I/O port programming in embedded C.
9. Timers and Counters programming in embedded C for time delay and frequency measurement using ISRs.
10. Digital clock programming using 7- segment display in embedded C.
11. Programming of LCD in embedded C.
12. Programming of keyboard in embedded C.
13. Serial communication and UART programming in Embedded C.
14. Programming of parallel ADC and DAC in embedded C.
15. Interfacing Stepper Motor.
16. Speed Control of DC motor using PWM Technique and Microcontroller
17. Designing of SCR firing Circuit for D. C. Converter using Microcontroller
18. Interfacing Relay and opto isolators using Microcontroller

## Design based Problems (DP)/Open Ended Problem:

1. Frequency and Pulse with measurement using microcontroller 8051
2. Temperature Measurement and control using microcontroller 8051
3. Measurement of Electrical Quantity using microcontroller 8051
4. Communication between microcontroller 8051 and Computer
5. Triac triggering using microcontroller 8051

**Major Equipment: Kit for Microcontroller 8051,  $\mu$ VISION2/3/4 IDE,**

**List of Open Source Software/learning website: NPTEL, [www.infineon.com](http://www.infineon.com), [www.silabs.com](http://www.silabs.com)**

**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.