



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3150306

Semester – V

Microcontroller Programming & Interfacing

Type of course: Professional core course

Prerequisite: Digital Logic Design, basics of C programming.

Rationale: This course introduces the architecture, assembly language and C language programming of different microcontrollers. The course objective is to introduce the basic concepts of small and medium scale embedded system design using microcontroller and to develop assembly and C language programming skills for real time applications of Microcontroller. It gives hands-on training of interfacing external sensors and actuators with microcontroller.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction to 8051 Microcontroller Fundamentals of Microprocessors, Block diagram approach for Microprocessor and Microcontroller, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers, definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems, RISC and CISC programmer's model, Criteria for selecting microcontroller Overview of the 8051 family: 8051 architecture, address, data and control bus, working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles	12
2	8051 ASSEMBLY LANGUAGE PROGRAMMING: Instruction Set and Assembly Language Programming: Instruction syntax, assembler directives, Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, bit inherent and bit direct addressing, 8051 Instruction set - Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions, Assembly language Programs, Memory Interfacing	12



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3	Introduction to AVR microcontroller Overview of AVR family, AVR Microcontroller architecture, status register, RAM, ROM & EEPROM space, On-Chip peripherals, ATmega 32 pin configuration & function of each pin, Fuse bits of AVR.	8
4	AVR programming in C AVR Data types, AVR I/O port programming, Logic Programming, Data conversion, Timer programming, Input capture and Wave Generator, Interrupt programming, Serial Port Programming using USART, PWM programming and DC Motor Controlling	12
5	Peripheral interfacing programming in C LCD and Keyboard Interfacing, ADC&DAC Interfacing, Stepper motor, relay, optoisolator Interfacing	12

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	20%	30%	20%	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 the above table.

Reference Books:

1. 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)
2. The 8051 Microcontroller & Embedded Systems using Assembly and C By K. J. Ayala, D. V. Gadre (Cengage Learning, India Edition).
3. The AVR Microcontroller and Embedded Systems Using Assembly and C, By Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi, Pearson Education.
4. Programming and Customizing the AVR Microcontroller, By Dhananjay Gadre, McGraw Hill Education



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Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the role of computer organization to differentiate between microprocessors and microcontrollers based on architecture.	15%
CO-2	Apply the concepts of instruction sets to program in assembly language for problem solving.	20%
CO-3	Understand the architecture and features of ATmega32 AVR Microcontroller	15%
CO-4	Implement various operation like Timer, Interrupt, ADC, DAC and Serial Communication on ATmega32 AVR Microcontroller.	25%
CO-5	Interface I/O peripheral devices to create applications using Microcontroller-based systems	25%

List of Experiments:

1. To study about introduction of the 8051 microcontroller and its architecture.
2. Write and simulate different assembly programs to study 8051 data transfer instructions using Keil compiler and 8051 kit.
3. Write and simulate different assembly programs to study 8051 Arithmetic, Logical and Boolean instructions.
4. Write and simulate different assembly programs to study 8051 branching instructions.
5. To study the introduction of the ATMEGA32 microcontroller and its architecture.
6. Write and simulate different C language programs to study about LED and switch interfacing with ATMEGA32 using ATMEL studio compiler.
7. Write and simulate different C language programs to study about Keypad and LCD interfacing with ATMEGA32 using ATMEL studio compiler.
8. Write and simulate different C language programs to study about different Timers of ATMEGA32.
9. Design a circuit to read analog signal using an ATMEGA32 microcontroller and display it on LCD.
10. Design a circuit to interface Serial Communication with ATMEGA32 microcontroller.
11. Design a circuit to interface a Stepper motor using ATMEGA32 microcontroller.
12. Design a circuit to interface a DC motor using ATMEGA32 microcontroller.
13. Write and simulate different C language programs to study about interfacing of Relay and Optoisolator using ATMEGA32 microcontroller.

Major Equipment:

1. 8051 microcontroller trainer kit with peripheral devices
2. AVR ATmega32 microcontroller trainer kit with peripheral devices



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3. Programmer/Loader
4. Computer System for Atmel Studio

List of Open Source Software/learning website:

1. <https://nptel.ac.in/courses/108105102/>
2. https://swayam.gov.in/nd1_noc20_ee42/preview
3. Open source Atmel studio simulator.
4. www.microchip.com/