# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**
**Subject Code: 3151707**
**Semester – V**
**Subject Name:** MICROCONTROLLER AND INTERFACING

**Type of course:** Professional Core

**Prerequisite:** Programming, Basics Electronics

**Rationale:** Every electrical and electronics project designed to develop electronic gadgets that can used in domestics as well industry utilizes microcontrollers with appropriate interfacing devices. There are different types of applications that are designed using microcontroller based projects. In maximum number of applications, the microcontroller is connected with some external devices like keyboard, display, timer etc. called as interfacing devices for performing some specific tasks.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | |
| L | T | P | C | 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 & architecture of 8051 Micro controller**<br>Definition of Micro controller, Difference between Microprocessor and Microcontroller, Block diagram of 8051 Microcontroller, over view of 8051 family<br><br>**8051 Microcontroller Architecture** Architecture of 8051 Microcontroller, The program counter and ROM space in the 8051, 8051 flag bits and the PSW register, 8051 register banks, stack and RAM Space. | **2** |
| 2 | **8051 Assembly Language Programming:**<br>Introduction to 8051 assembly programming, Structure of Assembly language, Assembling and running an 8051 program, 8051 data types and directives **Jump, Loop, And Call Instructions:** Loop and jump instructions, Call instructions time delay for various 8051 chips | **4** |
| 3 | **8051 Addressing Modes:**<br>Immediate and register addressing modes, Accessing memory using various Addressing modes, Bit addresses for I/O and RAM, Extra 128-byte on-chip RAM in 8052. | **4** |

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| 4 | **Arithmetic and Logic Instructions and Programs:**<br>Arithmetic instructions, Signed number concepts and arithmetic operations, Logic and compare instructions, Rotate instruction and data serialization, BCD, ASCII, and other application programs. | **4** |
| 5 | **I/O Port Programming and Seven Segment Display:**<br>8051 I/O programming, I/O bit manipulation programming.<br>Internal Structure of ports<br>• Introduction to seven segment display, common cathode and common anode seven segment display<br>• Interfacing of seven segment display with 8051 and programming to display from 0 to 9 at every second using loop.<br>• Interfacing of push button and SPST switch with 8051 ports. Introduction to key bouncing and de-bouncing techniques.<br>• Write a program to interface 8 SPST switch and one seven segment display with 8051 and display the number of switch whichever is presses at a time on seven segment display<br>• Generation of square wave on port pin with different duty cycle using loop. | **6** |
| 6 | **8051 Programming in C:**<br>Data types 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, Data serialization using 8051 C. | **2** |
| 7 | **8051 Hardware Connection and Intel Hex File:**<br>Pin description of the 8051, Design and test of 8051 Minimum Module, Explaining the Intel hex file. | **2** |
| 8 | **8051 Timer Programming in Assembly and C:**<br>Programming 8051 timers, Counter programming, Programming timers 0 and 1 in 8051 C.<br>**8051 Serial Port Programming in Assembly and C:**<br>Basics of serial communication, 8051 connection to RS232, 8051 serial port programming in Assembly, Programming the second serial port, Serial port programming in C.<br>**Interrupts Programming in Assembly and C:**<br>8051 interrupts programming, Timer interrupts, Programming external hardware interrupts, Programming the serial communication interrupt, Interrupt priority in the 8051/52, Interrupt programming in C. | **8** |
| 9 | **LCD and Keyboard Interfacing:**<br>LCD interfacing in Assembly and C.<br>Keyboard interfacing in Assembly and C. | **6** |
| 10 | **ADC and DAC interfacing**<br>Types of ADC and DAC.<br>Parallel ADC 0804 and 0808 interfacing with 8051<br>Parallel DAC 0808 interfacing with 8051, converting $I_{out}$ to voltage in DAC0808, Generation of sine wave using DAC0808. | **4** |

| | | |
|---|---|---|
| 10 | **8051 Interfacing to External Memory:**<br>Memory address decoding, 8031/51 interfacing with external ROM, Flash RAM, 8051 data memory space, Accessing external data memory in 8051 C.<br><br>**8051 interfacing with 8255**<br>Programming the 8255, 8255 interfacing, 8051 C programming for 8255 | **4** |
| 11 | **Motor Control: PWM, DC and Stepper Motors:**<br>Generation of PWM signal using timer in Assembly or C language<br>Interfacing of DC motor with 8051 and control it's speed and direction using PWM Interfacing of Stepper motor with 8051 | **4** |

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

| **Distribution of Theory Marks** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **14** | **21** | **14** | **14** | **7** | **-** |

**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.

**Text Books:**

1. Microprocessor Architecture, Programming and Applications with the 8085 by Ramesh Gaonkar(Fifth Edition).
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, 2/e by Muhammad Ali Mazidi, Janice GillispieMazidi and RolinMcKinlay( 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. 8051 Microcontrollers: MCS51 family and its variants by Satish Shah, Oxford University Press.
5. 8051 Microcontroller: Internals, Instructions, Programming and Interfacing by SubrataGhoshal, Pearson Education.
6. The 8051 Microcontrollers: Architecture, Programming and Applications by K Uma Rao, AndhePallavi, Pearson Education.

**Reference Books:**

1. INTEL Manual: MCS-51 Architecture.

2. Philips Data Handbook, "I2C Peripherals".

3. IEEE Standards, "Low Rate Wireless Personal Area Networks", 2003.

**Course Outcomes:**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Able to understand and explain microprocessor and microcomputer architectures, microcontroller family, addressing modes, data types in Embedded C, basics of serial communication, timer-counter configuration and interrupt handling. | 25 |
| CO-2 | Able to write, debug and analyze the code in assembly as well as Embedded C language. | 20 |
| CO-3 | Able to apply digital logic design and programming principles to interface and access external memories and Input-Output devices like keyboard, Seven segment LED and LCD displays, ADC, DAC etc. with micro controller. | 25 |
| CO-4 | Able to calculate instruction execution time, delay, baud rate, and write assembly and C Code, identify the timer mode, serial communication mode and interrupt priorities | 15 |
| CO-5 | Able to work as an individual and as a team-member to design, formulate and implement automation project using microcontroller | 15 |

**List of Experiments and Design based Problems (DP)/Open Ended Problem:**

**Assembly and C language programming for the 8051 Microcontroller**

1) a) Write a program to add and subtract two 8-bit numbers stored in registers or internal/External memory locations.
   b) Write a program to multiply and divide two 8-bit numbers stored in registers or memory locations.
   c) Write a program to perform 16-bit addition and multiplication.

2) a) Write a program to add block of data stored in internal/external memory locations.
   b) Write a program to transfer block of data from internal memory locations to external memory locations.

3) a) Write a program to find maximum and minimum number from given data series
   b) Write a program to sort block of data in ascending or descending order.
4) Write a program to count the number of even numbers, odd numbers and zeroes from given data series 5) Write a program to generate Fibonacci series and store them to internal memory location
   6) Write a program to compare a password (two data string ).
7) a) Write a program to perform the following.
   1. Keep monitoring P1.2 until it becomes high.
   2. When P1.2 becomes high write value 45H on P0.
   3. Sent a high to low pulse to P2.3
   b) A switch is connected to P1.7. Write a program to check the status of switch and perform the following.
   1. if switch = 0, send letter
   "N" to P2 2. if switch = 1,
   send letter "Y" to P2.

8) a) Write a program to generate 5 KHz pulse waveform of 50% duty cycle on pin 1.0 using timer 1 in mode
   2.

   b) Write a program to generate 1 KHz pulse waveform of 70% duty cycle on pin 1.0 using timer.

9) a) Write a program for the 8051 to transfer letter "A" serially, continuously.
   b) Write a program to transfer the message "YES" serially. Do this continuously.
   c) Program the 8051 to receive bytes of data serially, and put them in P1.

**Microcontroller Interfacing**

10) Interfacing ADC and DAC.
11) Interfacing Matrix Keyboard.
12) Interfacing LED and LCD Displays.
13) Interfacing Stepper Motor.
14) Controlling DC motor using PWM.

**Miniproject based on 8051 family microcontroller in a group of 2 to 3 students is mandatory**.
**Practical number 1 to 5 is programmed in assembly language as well as in embedded C**.

**Major Equipment:**

Microcontroller kits, IC programmer, IC tester, Bread board trainer, Power Supply, Function generator, DSO, Special purpose ICs.