

# GUJARAT TECHNOLOGICAL UNIVERSITY

## INSTRUMENTATION & CONTROL ENGINEERING (17)

### MICROCONTROLLER & INTERFACING (IC)

**SUBJECT CODE:** 2151707

B.E. 5<sup>th</sup> SEMESTER

**Type of course:** Core Engineering

**Prerequisite:**

1. Fundamental of Digital Logic Design, Register array, flip-flops, counter..
2. Decoder, Logic Gates, Number systems, etc.

**Rationale:** This subject deals with how to control any external electronic device using programming and control it automatically and make it suitable for next stage of any measurement system.

**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)		
				PA	ALA	ESE	OEP			
4	0	2	6	70	20	10	20	10	20	150

**Contents:**

S.N.	Content	Total Hrs	% Weightage
1	<b>Introduction to 8085 Micro processor</b> <b>Basic ideas about:-</b> Micro processor definition, Machine language, Assembly language, Lower level languages, Higher level languages, Interpreter, Compiler, Example and basic block diagram of computer with the micro processor as CPU(ALU+CU).	2	4
2	<b>8085 Microprocessor Architecture and Memory interfacing</b> <b>Microprocessor Bus organization:-</b> The 8085 Bus structure block diagram, Explanation of Address bus, Data bus, Control bus, RD, WR, MEM,I/O signals. <b>Memory:-</b> Definition of memory, Explanation about Program memory (code memory/ ROM), Read/write memory (RAM). <b>Latches as a storage element:</b> Diagram of four latches as a 4-bit register, Explanation how 4 nit register store data using RD, WR and enable signal. Diagram of 4X8 Bit register, How address and command signal is given to 4X8 bit register memory <b>Memory and Instruction Fetch:-</b> 2.3.1. Instruction fetch Diagram, Explain Program Counter register, Stack Pointer, Register array bank, Control Unit, ALU. 2.3.2 Explanation of steps to perform instruction fetching operation from memory to Microprocessor, working of control signal, data bus, address bus, internal data bus, instruction decoder and ALU. 2.3.3. Introduction to Microcomputer system block diagram	4	8

3	<p><b>Microprocessor Memory interfacing and Timing Cycles</b>  <b>8085 Microprocessor Pin out and signal diagram</b>  Higher address bus, Lower address and data bus, ALE, RD, WR, IO/M, VCC, VSS, X1,X2 pins, Clock frequency of 8085  De-multiplexing of the Address and data Bus AD7 - AD0, Role of ALE.  Generation of control signals MEMR, MEMW, IORD, and IOWR.  <u><b>Timing cycles:-</b></u>  Definition of T-state, Machine cycle, Instruction cycle  Timing cycle to transfer of byte(ex. mov C,A) from memory to MPU, Role of ALE, Role of IO/M , RD and WR.  Timing Cycle of any two byte data transfer instruction(Ex. MVI A, 32H)  <u><b>Memory Interfacing with 8085:-</b></u>  Basic concept of Memory interfacing, concept of Chip select pin, Address decoding techniques (Ex. Using NAND gate, Decoder etc.), Memory address selection according to size of memory chip,  Example of interfacing different size of ROM, EPROM with 8085 Microprocessor.  Example of interfacing different size of RAM with 8085 Microprocessor.</p>	4	8
4	<p><b>Introduction &amp; architecture of 8051 Micro controller</b>  Definition of Micro controller, Difference between Microprocessor and Microcontroller, Block diagram of 8051 Microcontroller, over view of 8051 family</p> <p><b>8051 Microcontroller Architecture</b>  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.</p>	2	4
5	<p><b>8051 Assembly Language Programming:</b>  Introduction to 8051 assembly programming, Structure of Assembly language, Assembling and running an 8051 program, 8051 data types and directives  <b>Jump, Loop, And Call Instructions:</b>  Loop and jump instructions, Call instructions time delay for various 8051 chips</p>	3	6
6	<p><b>8051 Addressing Modes:</b>  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.</p>	3	6
7	<p><b>Arithmetic and Logic Instructions and Programs:</b>  Arithmetic instructions, Signed number concepts and arithmetic operations, Logic and compare instructions, Rotate instruction and data serialization, BCD, ASCII, and other application programs.</p>	2	4
8	<p><b>I/O Port Programming and Seven Segment Display:</b>  8051 I/O programming, I/O bit manipulation programming.  Internal Structure of ports  Introduction to seven segment display, common cathode and common anode seven segment display  Interfacing of seven segment display with 8051 and programming to display from 0 to 9 at every second using loop.  Interfacing of push button and SPST switch with 8051 ports. Introduction to key bouncing and de-bouncing techniques. 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  Generation of square wave on port pin with different duty cycle using loop.</p>	5	10

9	<b>8051 Programming in C:</b> 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	4
10	<b>8051 Hardware Connection and Intel Hex File:</b> Pin description of the 8051, Design and test of 8051 Minimum Module, Explaining the Intel hex file.	2	4
11	<b>8051 Timer Programming in Assembly and C:</b> Programming 8051 timers, Counter programming, Programming timers 0 and 1 in 8051 C. <b>8051 Serial Port Programming in Assembly and C:</b> Basics of serial communication, 8051 connection to RS232, 8051 serial port programming in Assembly, Programming the second serial port, Serial port programming in C. <b>Interrupts Programming in Assembly and C:</b> 8051 interrupts programming, Timer interrupts, Programming external hardware interrupts, Programming the serial communication interrupt, Interrupt priority in the 8051/52, Interrupt programming in C.	9	16
12	<b>LCD and Keyboard Interfacing:</b> LCD interfacing in Assembly and C. Keyboard interfacing in Assembly and C.  <b>ADC, DAC</b> Parallel ADC 0804 and 0808 interfacing with 8051 Parallel DAC 0808 interfacing with 8051, converting $I_{out}$ to voltage in DAC0808, Generation of sine wave using DAC0808.	6	10
13	<b>8051 Interfacing to External Memory:</b> Memory address decoding, 8031/51 interfacing with external ROM, Flash RAM, 8051 data memory space, Accessing external data memory in 8051 C.  <b>8051 interfacing with 8255</b> Programming the 8255, 8255 interfacing, 8051 C programming for 8255	4	8
14	<b>Motor Control: PWM, DC and Stepper Motors:</b> Generation of PWM signal using timer in Assembly or C language Interfacing of DC motor with 8051 and control it's speed and direction using PWM Interfacing of Stepper motor with 8051	4	8

**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 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. 8051 Microcontrollers: MCS51 family and its variants by Satish Shah, Oxford University Press.
5. 8051 Microcontroller: Internals, Instructions, Programming and Interfacing by Subrata Ghoshal, Pearson Education.
6. The 8051 Microcontrollers: Architecture, Programming and Applications by K Uma Rao, Andhe Pallavi, 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 Outcome:**

1. After learning the course the students should be able to design a mini computer system.
2. Students should be able to do programming for general purpose automation.
3. Students should be able to make different displays, control dc motor speed control, interfacing memory with micro controller.
4. Student can make their own automation projects which may be useful in day to day life and helps to make human life better.

**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 P2.3b) 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.

#### **List of Open Source Software/learning website:**

[http://www.onlinevideolecture.com/electrical-engineering/nptel-iit-kharagpur/industrial-instrumentation/?course\\_id=514](http://www.onlinevideolecture.com/electrical-engineering/nptel-iit-kharagpur/industrial-instrumentation/?course_id=514)

<https://www.8051.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.