GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (Part Time)

Subject Code: 2950901

MICROPROCESSORS AND MICROCONTROLLERS

Semester V

Type of course: Engineering

Prerequisite: Analog and Digital Electronics

Rationale: Microprocessor and microcontrollers are the most useful electronic chips which are used to design and develop processor and computer based automatic smart electronics systems for home and industry application. This subject is devoted to the study of microprocessor and microcontroller interfacing of memory and I/O devices like A to D converter, D to A converter LED, LCD etc. The students learn Programming language (Both assembly and Embedded C) used for microcontrollers. They learn the basics of Microprocessor and designs of Microcontroller based systems and also get a brief idea of advanced microcontrollers used in industries. 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	Examination Marks				Total Marks
L	T	P	C	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	% Weightage
1	**Microprocessor Based Systems:** Digital Computer, Microprocessor, Microcomputer, Microcontroller, Van Neumann and Harvard Architecture, CISC and RISC Processors	**02**	5
2	**8085 Microprocessor:** Architectural Block Diagram, Schematic and Pin diagrams, Pin functions, Bus Organization, Internal operations and registers, Externally initiated operations, Serial interrupt and I/O Control, Timing and Control Unit ,Microprocessor communication, Multiplexing of address/data bus, Generation of control signals, 8085 machine cycles, Fetch and execution of only MOV, MVI, and OUT instructions with timing diagram. (Other 8085 instructions and Programming of assembly language using 8085 should not be covered & asked in the exam)	**06**	10
3	**8051 Microcontroller architecture**: Introduction to MCS -51 Family Micro-controllers, Architectural block Diagram, Pin diagram and Pin Functions, General Purpose and Special Function Registers, Oscillator and clock circuit, Reset circuit, I/O Port circuits, Memory organization, Internal program and data memory.	**08**	10

4	**8051 Assembly language programming:** Programming model of 8051, Addressing modes, programming of 8051 based on data transfer, arithmetic and logical group, branching instructions, bit manipulation instructions and I/O Port programming. Concept of stack, subroutine and related instructions, writing programs for generating time delay, code conversions in assembly language of 8051 and testing the same using IDE.	**08**	15
5	**8051 Programming in C:**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**	20
6	**8051 Timer/Counter and Programming:** Use of counter as timer, Timer/Counters and associated registers, Various modes of timer/counter operations, Time delay programs in Assembly language/ Embedded C	**04**	
7	**8051 Serial Port and Programming:** 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	**04**	10
8	**8051 Interrupts:** 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**	30
9	**External Memory Interfacing:** Memory address decoding, interfacing 8031/8051 with ROM/EPROM and Data ROM	**02**	
10	**Applications and design of microcontroller based systems:** 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**	
11	**ARM Processor Fundamentals:** Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts and Vector Table, Core Extensions, Architecture Revisions, Arm Processor Families	**04**	

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. ARM System Developer's Guide, Designing & Optimizing System Software, by Andrew Sloss, Dominic Symes, Chris Wright, Elsevier Publications.

Course Outcomes:

At the end of this course, students will have the ability to

Sr. No.	CO statement	Marks % weightage
CO-1	Describe 8085 microprocessor and microcontroller architecture of MCS-51 family.	
CO-2	Develop assembly language/ embedded C- language code for a given problem	
CO-3	Configure a given microcontroller/ microprocessor based system for timer-counter/serial communication/interrupt operation in assembly/embedded C	
CO-4	Interface appropriate peripheral devices, memory with microcontroller for given application/problem	

Suggested List of Experiments:

1. Introduction to IDE, assembler, compiler, linker, simulator, debugger and assembler directives.
2. 8051 Assembly language programming based on data transfer, arithmetic and logical group instructions.
3. 8051 Assembly language programming using bit manipulation instructions.
4. 8051 Assembly language programming using branching group instructions
5. 8051 Timer/counter programming using assembly language and C
6. 8051 Serial programming using assembly and embedded C.
7. I/O port programming in embedded C.
8. Programming of LCD in assembly & embedded C.
9. Programming of matrix keyboard in assembly & embedded C.
10. Programming of parallel ADC and DAC in embedded C.
11. Interfacing Stepper Motor.
12. Speed Control of DC motor using PWM Technique and Microcontroller
13. Designing of SCR firing Circuit for D. C. Converter using Microcontroller
14. Interfacing Relay and opto isolators using Microcontroller

Additional experiments using ARM boards are suggested as they would be beneficial to students for project development in final year (Refer NPTEL course based on 'Embedded system design using ARM' Link:https://nptel.ac.in/courses/106/105/106105193/)

1. Interfacing of LM35 temperature sensor with STM32F401 Nucleo board
2. Interfacing of electric bulb with STM32 through SRD-05DC-SL-C relay
3. Speed control of DC motor using STM32
4. Interface relay, speaker, LDR, LM35 to the STM32 board.
5. Interfacing of SIM900A GSM module with STM32
6. Design of home automation system using STM32
7. Design of simple alarm system using touch sensor with STM32

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, µVISION2/3/4 IDE, STM32F401 Nucelo Development Board

List of Open Source Software/learning website: NPTEL, www.infineon.com, www.silabs.com