GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3141008
Semester – IV
Subject Name: Microprocessor and Microcontroller

Type of course: Professional Core Course

Prerequisite: Digital System Design

Rationale:
The knowledge of microcontroller is very essential for a UG student of Electronics and Communication Engineering as the world is migrating towards automation rapidly in each and every fields. The students studying the subject are supposed to learn the architecture and programming of typical microcontroller. Students will be taught the basic use of an assembly as well as embedded C programming environment to control peripheral devices. Students will also understand the interfacing of various peripheral elements with microcontroller to design an automated system. The course will cover introduction to basic 8085 microprocessor as well as AVR, 8-bit Microcontroller in detail with sufficient exposure to design an embedded system.

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	**Fundamentals of Microprocessors:** History of microprocessor and microcontrollers, Difference between microprocessors and microcontrollers and Applications of microcontrollers, Architectural of 8-bit 8085 microprocessor, Pin details and functional operation of 8085, Memory and I/O interfacing. Role of microcontrollers in embedded Systems. Overview of the AVR family	8	15%
2	**Architecture and instruction set of 8-bit AVR Microcontroller:** AVR Microcontroller architecture: Registers, AVR status register, Memory Space, ATmega32 pin-configuration & function of each pin, Addressing mode and instruction set of AVR microcontroller, Data transfer, Arithmetic, Logic and Compare, Rotate and Shift, Branch and Call instructions, Bit manipulation instructions	6	15%
3	**AVR Assembly and C Programming:** . AVR data types and assembler directives, AVR assembly language programs,	14	25%

	AVR I/O Port Programming, Time delay loop, BCD, ASCII conversion Program, Look-up table, Bit addressability, MACROs, Pros and cons of C and assembly language programming, Data types, Intex Hex file format, Simple C programs for general purpose I/O and bit addssablity.		
4	**AVR on-chip peripherals and its programming:** General purpose I/O Ports, Timers, Interrupts, serial port, Serial port Interfacing protocols, SPI, I2C, UART. Assembly and C Language programming for peripherals.	12	20%
5	**Device interfacing and its programming:** LCD and GLCD interfacing, Keyboard Interfacing, TFT interfacing, ADC, DAC and sensor interfacing, Relay, Opto-isolator and Stepper Motor Interfacing, Industrial servo interfacing, Input capture and Wave Generator, PWM programming and DC motor control, SPI protocol and Display interfacing, I2C Protocol and RTC interfacing. Assembly and C Programming	12	25%

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**25**	**15**	**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. Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi,"*The AVR Microcontroller and Embedded Systems", Using Assembly and C*, Pearson Education, 1st Edition, 2012.
2. Dhananjay Gadre, *"Programming and Customizing the AVR Microcontroller*", TMH, 1st Edition, 2001.
3. R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Explain the architecture of 8085 microprocessor and AVR 8-bit	15

	Microcontroller	
CO-2	Differentiate microprocessor and microcontroller and Describe the importance and function of each pin of AVR ATmega32 Microcontroller	15
CO-3	Learn and analyze assembly language programs for AVR Microcontroller	25
CO-4	Develop embedded C language programs for AVR Microcontroller	25
CO-5	Interface I/O peripheral devices with AVR microcontroller to develop embedded system	20

List of Experiments:

Understand Arduino open source hardware and programming environment and write program to blink LED using Arduino instructions, C language & Assembly language.

2. Interface Digital/Analog input output interfacing module with Arduino board and write programs related to I/O module

3. Generate PWM waveform and change intensity of LED connected with Arduino board.

4. Write and execute Arduino program for serial communication. Transmit temperature value through serial communication and store it in spreadsheet or text file

5. Write and execute Arduino program to display message and numbers on LCD, GLCD and TFT.

6. Write and execute Arduino program to read analog value. Sense temperature using LM35 sensor and display temperature value on LCD

7. Write assembly language programs for ATMega32 Microcontroller and simulate using ATMEL Studio

8. Understand hardware of ATMega32 Kit. Write program to flash LEDs, Read status of switches, Display count values on seven segment display. Upload programs in the kit one by one and execute.

9. Write program to read switch status and display it on LCD. Write program in Assembly as well as C language.

10. Write program to rotate stepper motor in half step and full step mode in Assembly as well as C language. Simulate program using PROTEUS software

11. Write program to rotate DC motor in clockwise and anti-clockwise direction in Assembly as well as C language. Simulate program using PROTEUS software.

12. Observe waveforms of I2C and SPI communication and understand I2C and SPI protocol

13. Write Arduino program to receive IR Signal from IR remote and operate Electrical device based on switch pressed.

14. Report of Student Mini Project based on microcontroller (Student will select mini project based on real life challenge identified through Shodh-Yatra)

Major Equipment/software:

- Arduino UNO or Nano board
- ATMega32 Kit
- Proteus or equivalent microcontroller simulation software
- ATMEL Studio 7.0

List of Open Source Software/learning website:

- NPTEL Video lecture on AVR microcontroller**:** **https://nptel.ac.in/courses/108105102/52**
- Arduino software