GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS AND COMMUNICATION (11)
MICROCONTROLLER AND INTERFACING (EC)
SUBJECT CODE: 2151001
B.E. 5th SEMESTER

Type of course: Microcontroller Architecture and Programming

Prerequisite: Students should have in depth knowledge of Digital Logic Design, Microprocessor architecture as well as logical ability and programming skills to develop the code

Rationale: The knowledge of microcontroller is very essential for a student of BE in 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 AVR, 8-bit Microcontroller in detail with sufficient exposure to design an automated system.

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

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction To 8-bit Microcontroller :** Microcontrollers and Embedded processors, Overview of AVR family, AVR Microcontroller architecture, Register, AVR status register, ROM space and other hardware modules, ATmega32 pin configuration & function of each pin.	8	15
2	**AVR Assembly Language Programming:** Addressing modes of AVR, Data transfer, Arithmetic, Logic and Compare, Rotate and Shift, Branch and Call instructions. AVR data types and assembler directives, AVR assembly language programs, AVR I/O Port Programming, Time delay loop, BCD, ASCII conversion Program, Look-up table, Bit addressability, MACROs.	15	25
3	**AVR Programming in C :** Data types, I/O programming, logic operations, Intel HEX file, Timer programming in assembly and C, Interrupt programming in assembly and C, Serial Port programming in assembly and C	15	30
4	**Peripheral Interfacing :** LCD and Keyboard Interfacing, ADC, DAC and sensor interfacing,	18	30

	Relay, Opto-isolator and Stepper Motor Interfacing, Input capture and Wave Generator, PWM programming and DC motor control, SPI protocol and Display interfacing, I2C Protocol and RTC interfacing		

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**25**	**25**	**20**	**15**	**-**

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. The AVR Microcontroller and Embedded Systems Using Assembly and C, By Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi, Pearson Education.
2. Programming and Customizing the AVR Microcontroller, By Dhananjay Gadre, McGraw Hill Education
3. AVR ATmega32 data sheet

Course Outcome:

After learning the course the students should be able to:

1. Understand the architecture of AVR 8-bit Microcontroller.
2. Describe the importance and function of each pin of AVR ATmega32 Microcontroller.
3. Write, debug and simulate assembly as well as embedded C language programs.
4. Understand Timer operation, Interrupt environment and Serial Communication.
5. Interface I/O peripheral devices with microcontroller.
6. Summarize the functionality of I2C and SPI protocol.

List of Experiments:

1. Familiarization with AVR simulator and trainer kit.
2. Write and simulate minimum of 15 programs (Assembly as well as Embedded C) to be written making effective use of all the instructions and on-chip peripheral.
3. Installation of Arduino software and write program for blinking LED.
4. Read Push-button switch and display its status on LED.
5. Interfacing Buzzer with AVR Board.
6. Interfacing 7-Segment LED Display with AVR Board.
7. Interfacing of 16x2 LCD with Arduino board and display message on it.
8. Interface 4x4 matrix keyboard with AVR microcontroller. Display value of pressed switch on LCD.
9. Read analogue voltage using Arduino board and display its equivalent digital value on LCD.
10. Interface temperature sensor LM35 with Arduino board and display temperature on LCD.

11. Interface Stepper motor with AVR Microcontroller and Write program to rotate stepper motor in clockwise and anticlockwise direction.
12. Interface DC Motor with AVR Microcontroller and write program to rotate DC motor in clockwise and anticlockwise direction.
13. Generate PWM using AVR and use it for speed control of DC motor

Design based Problems (DP)/Open Ended Problem:

1. Connect infrared sensor with AVR microcontroller. Control electrical device with help of IR remote control.
2. Read 100 temperature readings using LM35 and Arduino board, take average of it and send it to PC using serial communication.
3. Interface LDR with Arduino board. Display light intensity on LCD. If light intensity is less than certain threshold value, switch ON lamp connected with Arduino board with help of driver circuit.

Major Equipments:

1. AVR ATmega32 microcontroller trainer kit with peripheral devices.
2. Programmer/Loader
3. Arduino Board
4. Computer system.
5. CRO, Power supply

List of Open Source Software/learning website:

1. Open source AVR simulator.
2. www.atmel.com
3. http://www.arduino.cc/

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.