Marwadi University
Faculty of Diploma studies
Information and Communication Technology

Subject Code: 09CT0603
Subject Name: Embedded Systems

Diploma Year – III (Semester VI)

Objective: The objective of the subject is to introduce the concepts of embedded systems and AVR microcontroller architecture, programming and various applications based on it.

Credits Earned: 4

Course Outcomes: After learning this course, students should be able to,

1. Learn the concepts of embedded system
2. Understand the features of AVR microcontroller
3. Apply programming skill to interface necessary hardware with microcontroller
4. Develop AVR microcontroller based systems

Pre-requisite of course: Digital Electronics, Microprocessor

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA (M)	CSE (I)	Viva (V)	Term work (TW)	
3	0	2	4	50	30	20	25	25	150

Contents:

Unit No	Course content	Total Hrs.
1	**Introduction to Embedded Systems** Embedded Systems, Processor Embedded into a System, Embedded Hardware Units and Devices In a System, Embedded Software in a system, Examples of Embedded Systems, Embedded System-on-chip (SOC) and Use of VLSI Circuit Design Technology, Complex Systems Design and Processors, Design Process in Embedded System, Formulization of System Design, Design Process and Design Examples, Classification of Embedded Systems, Skills Required for an Embedded System Designer	**06**
2	**AVR microcontroller-History and Features** Microcontrollers and embedded processors, Criteria for choosing a microcontroller, Simplified view of AVR microcontroller, ATMega32 block diagram, Overview of AVR family	**04**

3	**AVR Microcontroller Architecture and assembly language programming:** General Purpose registers in AVR, The AVR data memory, AVR status register, AVR data formats and assembler directives, Assembly Language Programming, Program Counter and program ROM space in AVR, RISC architecture in AVR, Branch Instructions, CALL instruction and Stack, Pipelining, Time delay loop , AVR I/O port programming, Arithmetic and Logic instructions, AVR advanced assembly language programming, Bit addressability, MACROs, Intel HEX file, AVR Hardware pin connections	**12**
4	**AVR programming in C :** Data types and time delay in C, I/O port programming in C, Logic operations in C, Data conversion programs in C, Data serialization in C, Memory allocation in C, AVR Timer programming in C, AVR interrupt programming in C, AVR serial port programming in C	**10**
5	**AVR Interfacing :** LCD and Keyboard Interfacing, Relay and optoisolator interfacing, Stepper and DC Motor control, ADC,DAC and sensor interfacing, SPI Protocol and MAX7221 display interfacing, I2C Protocol and DS1307 RTC Interfacing	**10**
	Total	**42 hrs.**

Suggested List of Experiments:

1. Introduction to simulation tool Atmel Studio for AVR microcontroller programming.
2. Introduction to ATMega32 AVR microcontroller development board.
3. Write AVR assembly language instructions for simple operations like ADD and load and access internal RAM in AVR microcontroller.
4. Write AVR assembly language instructions to create loops.
5. Write AVR assembly language instructions for conditional and unconditional branching.
6. Write AVR assembly language instructions to demonstrate CALL instruction, time delay and subroutine.
7. Write AVR assembly language instructions to use the ports for input or output.
8. Write AVR assembly language instructions for arithmetic and logical operation.
9. Write C programs for time delay and I/O operations.
10. Write C programs for arithmetic and logical operations.
11. Write C programs for data conversions.
12. Write C programs for data serialization.
13. Write C programs for AVR timers.
14. Interface LCD with AVR microcontroller and write C program.
15. Interface 4x4 key board with AVR microcontroller and write C program.

16. Interface LM 35 temperature sensor with AVR microcontroller. Program the AVR's ADC in C language. Write a C program to read the temperature and display on port.
17. Interface stepper motor with AVR microcontroller. Write a program in C to operate the stepper motor.
18. Interface DC motor with AVR microcontroller. Write a program in C to control the speed of the motor.

References:

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

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

R Level	U Level	A Level	N Level	E Level	C Level
30	**30**	**20**	**10**	**10**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)