COURSE TITLE	**MICROCONTROLLER AND INTERFACING**
COURSE CODE	**01CT0403**
COURSE CREDITS	**4**

Objective:

1 This course introduces the architecture, assembly language and C language programming of ATmega32
AVR family microcontroller. It gives a hands-on training of interfacing external sensors and actuators
with microcontroller. The course objective is to introduce the basic concepts of small and medium scale
embedded system design using microcontroller and to develop assembly and C language programming
skills for real time applications of Microcontroller.

2 This course introduces the architecture, assembly language and C language programming of ATmega32 AVR family microcontroller. It gives a hands-on training of interfacing external sensors and actuators with microcontroller. The course objective is to introduce the basic concepts of small and medium scale embedded system design using microcontroller and to develop assembly and C language programming skills for real time applications of Microcontroller.

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programming skills for real time applications of Microcontroller.

4 This course introduces the architecture, assembly language and C language programming of ATmega32 AVR family microcontroller. It gives a hands-on training of interfacing external sensors andactuators with microcontroller. The course objective is to introduce the basic concepts of small and medium scale embedded system design using microcontroller and to develop assembly and C language programming skills for real time applications of Microcontroller.

Course Outcomes: After completion of this course, student will be able to:

1 Acquire basic knowledge of microcontroller and utilize real time software and hardware for embedded systems using AVR Atmega-32 microcontroller.

2 Understand architecture of Atmega-32, its pin configuration, data-types, instruction set, addressing modes and advance communication protocols like SPI, I2C etc.

3 Develop assembly and C language programs for ADC, EEPROM, PWM and Timer by applying various instructions like data transfer, ALU, Branch, subroutine etc.

4 Analyse I/O peripherals like LCD, Keyboard, Relay, Sensor, Motor etc. by interfacing it with AVR microcontroller.

5 Evaluate minor microcontroller based projects that solves real world problems.

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Pre-requisite of course: Basics of Digital Logic Design, Microprocessor architecture and basics of C programming

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Introduction to microcontroller** Microprocessor and Microcontroller difference, RISC and CISC programmer's model, Criterial for selecting microcontroller	4
2	**Introduction to AVR microcontroller** Overview of AVR family, AVR Microcontroller architecture, status register, Special function registers, RAM, ROM & EEPROM space, On-Chip peripherals, ATmega32 pin configuration & function of each pin, Fuse bits of AVR.	7
3	**AVR assembly language programming** AVR data types and assembler directives, Addressing modes of AVR, Data transfer, Arithmetic, Logic and Compare,, Rotate and Shift, Branch and Call instructions, AVR studio setup for assembly language programming, AVR I/O Port Programming, Time delay loop,, Look-up table, Bit addressability, MACROs, Intel HEX file.	8
4	**AVR programming in C** AVR Data types, AVR I/O port programming, Timer programming, Input capture and Wave Generator,, PWM programming External Interrupt programming, ADC programming, EEPROM programming	8
5	**Serial communication protocols** UART protocol,, I2C protocol, SPI protocol, Serial Port programming using polling and interrupt,, I2C Programming, SPI Programming	7
6	**Peripheral interfacing** LCD and Keyboard Interfacing,, Relay interfacing, Stepper and DC Motor control,, DS1307 RTC Interfacing, LM35 Temperature sensor interfacing, MAX7219 display controller interfacing	8
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Installation of AVR STUDIO and familiarization of ATMega32 AVR Development Board** Installation of AVR Studio, Overview of ATMega32 AVR development board	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
2	**Hands-on experimentation of ATMega32 GPIO programming in Assembly and C.** LED Blinking and pattern	2
3	**Hands-on experimentation of ATMega32 Timer to generate accurate delay using polling in Assembly and C.** Timer Generate using delay	2
4	**Hands-on experimentation of ATMega32 Timer to generate accurate delay using Interrupt in Assembly and C.** Timer using intterupt	2
5	**Hands-on experimentation of ATMega32 Timer to generate waveforms in Assembly and C** Generate Waveform	2
6	**Hands-on experimentation of Seven Segment Display interfacing with ATMega32 in Assembly and C.** Display date and time on 7 segment display	2
7	**Hands-on experimentation of 16x2 LCD interfacing with ATMega32 in Assembly and C.** Display message on LCD display	2
8	**Hands-on experimentation of ATMega32 UART programming in Assembly and C.** Basic message display on UART	2
9	**Hands-on experimentation of 4x4 matrix keyboard interfacing with ATMega32 in Assembly and C** Display data from keyboard matrix	2
10	**Hands-on experimentation of ATMega32 on-chip ADC for interfacing analog sensors in C.** Take data from sensor using ADC and convert to digital data	2
11	**Hands-on experimentation of DC motor interfacing and speed/direction control with ATMega32 in C.** DC motor speed control	2
12	**Hands-on experimentation of Stepper motor interfacing with ATMega32 in C.** Stepper motor drive using ATMega32	2
13	**Hands-on experimentation of DS1307 RTC Interfacing with ATMega32 in C using I2C protocol.** Interface the controller with RTC module	2
14	**Hands-on experimentation of MAX7219 LED matrix driver Interfacing with ATMega32 in C using SPI protocol** SPI protocol by LED matrix	2
15	**Design Frequency Counter which displays frequency of unknown pulse on 16x2 LCD using ATMega32 on-chip Timer.** Design Frequency Counter which displays frequency of unknown pulse on 16x2 LCD using ATMega32 on-chip Timer.	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
16	**Design Pulse period meter which displays ON-time of unknown pulse on 16x2 LCD using ATMega32 on-chip Timer** Design Pulse period meter which displays ON-time of unknown pulse on 16x2 LCD using ATMega32 on-chip Timer	2
17	**Design Bluetooth controlled 2-ch variable frequency square wave generator using ATMega32 UART and on-chip Timer.** Design Bluetooth controlled 2-ch variable frequency square wave generator using ATMega32 UART and on-chip Timer.	2
18	**Design 4 Channel Data Logger which measures Voltage between 0-5V on 4 ADC Channels of ATMega32 and transmit it to Host PC at every 1 second where it stored in excel sheet with timestamp for future analysis.** Design 4 Channel Data Logger which measures Voltage between 0-5V on 4 ADC Channels of ATMega32 and transmit it to Host PC at every 1 second where it stored in excel sheet with timestamp for future analysis.	2
Total Hours		**36**

Textbook :

1 Programming and Customizing the AVR Microcontroller, By Dhananjay Gadre, , McGraw Hill Education , 2000

References:

1 The AVR Microcontroller and Embedded Systems Using Assembly and C, , The AVR Microcontroller and Embedded Systems Using Assembly and C, , By Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi,, Pearson Education, 2015

2 AVR ATmega32 data sheet, AVR ATmega32 data sheet, Microchip, Microchip, 2018

Suggested Theory Distribution:

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

Distribution of Theory for course delivery

Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
25.00	20.00	30.00	5.00	5.00	15.00

Instructional Method:

1 The course delivery method will depend upon the requirement of content and need of the students. The teacher in addition to conventional teaching method (Chalk and Talk) may use any of the tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc. for effective teaching.

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Instructional Method:

2 Practical examination will be conducted at the end of the semester for evaluation of performance of students in laboratory.

3 Students may use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory, etc.

4 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

Supplementary Resources:

1 http://nptel.ac.in/courses/106108100/7

2 http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/micro/ui/TOC.htm

3 https://swayam.gov.in/course/4446-microprocessors-and-microcontrollers

4 https://www.coursera.org/courses?languages=en&query=microcontroller

5 http://www.study-hub.com/avr-microcontroller-programming.html

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