GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Subject Code: BE04000061
Subject Name: Microcontroller

WEF Academic Year:	2025-26
Semester:	4
Category of the Course:	PCC-05

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.

Course Outcome :

After Completion of the Course, Student will able to :

No	Course Outcomes	RBT Level*
01	Explain the architecture of AVR 8-bit Microcontroller	RM and UN
02	Differentiate microprocessor and microcontroller and Describe the importance and function of each pin of AVR ATmega32 Microcontroller	UN
03	Learn and analyze assembly language programs for AVR Microcontroller	AN
04	Develop embedded C language programs for AVR Microcontroller	AP
05	Interface I/O peripheral devices with AVR microcontroller to develop embedded system	AP

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	Total no of hours per semester		ESE (E)	PA / CA (M)	PA/ CA (I)	TW/SL (I)	ESE (V)	
45	0	30	45	120	4	70	30	20	30	50	200

*** Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.**

Course Content:

Sr. No.	Course Content	Total Hrs	% Weightage
1	Fundamentals of Microprocessors: Overview of 8085 microprocessor, Overview of 8086 microprocessor Difference between microprocessors and microcontrollers and Applications of microcontrollers 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, 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.	14	25
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

Reference Book :

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

Suggested Course Practical List :

1. 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)

List of Open Source Software/learning website:

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

List of Laboratory/Learning Resources Required:

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

Activities suggested under Self-learning/Team Work:

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numericals based assignment is preferable.	5 assignments of 2h each. Total = 10h	Based on the assignment submitted.
4.	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB, MS-EXCEL or any other relevant software	5 small coding based assignment of 2h each. Total = 10h	Based on the coding solution submitted.
5.	Self learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Complex problem solving	Maximum 2 problem. Study of the problem and solution finding, Total = 10h	Based on the depth of the solution submitted.
7	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h	Based on quiz/report submitted

		Total = 10h	
8	Discussion on research paper based on relevant subject	5 research paper = 20 h	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 h	Based on poster/chart preparation and presentation skills
10	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration = 10 h	Depending on the complexity of the Application/Software

Note:
1. All the suggested activity should be related to the subject.
2. The number of hours are suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
3. Rubrics for the evaluation can be prepared by the faculty.

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