



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Minor/Hons. Program

Level: UG

Branch: Minor/Hons. Electrical and Computer

Subject Code: BE050AK011

Subject Name: Advanced Controller Based System Design

w. e. f. Academic Year:	2026-2027
Semester:	5
Category of the Course:	Core Courses

Prerequisite:	Microprocessor and Microcontroller
Rationale:	The modern day technology works on the real time system, which should be precisely designed and developed. It includes software and hardware-based utilization for solving the real time problems through the advanced microcontrollers.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	To understand the basics and requirement of embedded system and review of 8-bit microcontrollers.	10%
CO-2	To introduce the architecture of PIC microcontroller.	30%
CO-3	To educate on the architecture of ARM processors.	20%
CO-4	To learn the processors based system design.	20%
CO-5	Incorporate I/O hardware interface of a processor based application with peripherals.	20%

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	TH		Theory		Tutorial / Practical			
						ESE (E)	PA (M)	PA (I)	PBL (I)	ESE (V)	
60	00	30	60	150	5	70	0	0	30	50	150

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

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, PA = Progressive Assessment, ESE = End-Semester Examination



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Content:

Sr. No.	Content	Total Hrs
1	REVIEW OF 8051: Introduction to Embedded System. Architecture, 8051- CPU Block diagram, Memory Organization, Program memory, Data Memory, Interrupts Peripherals: Timers, Serial Port, I/O Port Programming: Addressing Modes, Instruction Set, Programming Timing Analysis Case study with reference to 8-bit 8051 Microcontroller.	10
2	PIC MICROCONTROLLER Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–IC16cxx– Pipelining - Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – Simple Operations.	10
3	INTERRUPTS AND TIMER: PIC micro controller Interrupts- External Interrupts-Interrupt Programming–Loop time subroutine Timers-Timer Programming– Front panel I/O-Soft Keys– State machines and key switches– Display of Constant and Variability strings.	15
4	PERIPHERALS AND INTERFACING: I2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM— Analog to Digital Converter– UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.	15
5	ARM PROCESSOR: Architecture –ARM programmer’s model –ARM Development tools- Memory Hierarchy – ARM Assembly Language Programming–Simple Examples–Architectural Support for Operating systems, ARM Implementation.	10
TOTAL		60

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	25	30	15	5	5

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



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Reference Books:

1. Ayala, Kenneth J “8051 Microcontroller - Architecture, Programming & Applications”, 1st Edition, Penram International Publishing
2. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ‘PIC Microcontroller and Embedded Systems using Assembly and C for PIC18’, Pearson Education 2008.
3. Peatman, J.B., “Design with PIC Micro Controllers”PearsonEducation, 3rd Edition, 2004.
4. William Hohl, ‘ ARM Asseby Language’ Fundamentals and Techniques,2009
5. Steve Furber, ‘ARM system on chip architecture’, Addison Wesley,2010.
6. Rajkamal, Microcontrollers Architecture, Programming, Interfacing, & System Design, Pearson, 2012.

Suggestive List of Experiments:

1. Read Push-button switch and display its status on LED.
2. Write program for blinking LED
3. Write a program to generate a delay using timer.
4. Interfacing 7-Segment LED Display with controller.
5. Interfacing of 16x2 LCD with controller and display message on it.
6. Interface 4x4 matrix keyboard with microcontroller. Display value of pressed switch on LCD.
7. Read analogue voltage using controller board and display its equivalent digital value on LCD.
8. Interfacing Buzzer with controller Board.
9. Interface temperature sensor and display temperature on LCD

List of Software/learning website:

- MATLAB
- KEIL
- ARDUINO
- NPTEL: <https://nptel.ac.in/courses/108/105/108105102/>
<https://nptel.ac.in/courses/106/105/106105193/>



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• **List of suggested activities for Problem Based Learning**

Sr. No	Name of the activity	No. of hours	Evaluation Criteria	Targeted COs
1	To study the architecture and Pin of 8051 Microcontroller, PIC-IC16cxx, and STM32F407 32 bit controller.	Discussion and report preparation = 08 Hours	Preparation of Report and Viva Examination	CO1 – CO3
2	To study various IDEs.	Discussion -02 Hours, Preparing a report -02 Hours, Total = 04 Hours	Preparation of Report and Viva Examination	CO1
3	Hands on various IDEs for microcontroller programming.	Utilization of IDEs in generating the source file = 06 Hours	Software based utilization	CO1 – CO5
4	To learn and understand assembly and embedded C language programming for microcontrollers.	Discussion -02 Hours, Preparing a report -02 Hours, Total = 04 Hours	Preparation of Report and Viva Examination	CO4-CO5
5	Programming of GPIOs, Timers, ADC and DAC, Serial Communication, LCD and Keyboard using 8051 and PIC based microcontrollers.	Discussion – 10 Hours, Programming using IDEs – 10 Hours, Total = 20 Hours	Software based utilization	CO4 – CO5
6	Hardware Based Design using Programming of GPIOs, Timers, ADC and DAC, Serial Communication, LCD and Keyboard using 8051 and PIC based microcontrollers.	Programming using IDEs and hardware components = 10 Hours	Software and Hardware based utilization	CO4 – CO5
7	To study basic programming of STM32F407 32 bit microcontrollers using Keil IDE, MATLAB and Waijung Blockset.	Programming using IDEs and hardware components = 08 Hours	Software and Hardware based utilization	CO4 – CO5



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- All the suggested activities should be related to the subject.
- Min 3 activities must be carried out as per the availability of faculties and students.
- The number of hours is suggestive.
- Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.
- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record keeping and to ensure transparency in the evaluation and assessment of Problem based learning activities.
