GUJARAT TECHNOLOGICAL UNIVERSITY

Minor Degree: Electrical and Computer

Subject Code: N115AK01 (w.e.f. AY 2025-26)

Subject Name: Advanced Controller Based System Design

Type of course: Minor Degree Course

Prerequisite: Microprocessor and Microcontroller

Objective:

On successful completion of this course, all students will have developed knowledge and understanding on the system requirements specifications, architectural and detailed design, and implementation, focusing on real-time applications. Learning the concepts will be enforced by laboratory work to design and develop an embedded system based on a single-chip microcontroller.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	0	30	0	100

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.	**06**
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.	**10**
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.	**08**

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.	**08**

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**

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 the above table.

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,3rdEdition, 2004.
4. William Hohl, ' ARM Assebly Language' Fundamentals and Techniques,2009
5. Steve Furber, 'ARM system on chip architecture', Addision Wesley,2010.
6. Rajkamal,"Microcontrollers Architecture, Programming, Interfacing,& System Design,Pearson,2012

Course Outcomes:

S. No	**CO STATEMENT**	**Bloom's taxonomy level**	**Marks % weightage**
CO1	To understand the basics and requirement of embedded system and review of 8-bit microcontrollers	**Remember L1 , Understand L2, Evaluate L5,**	**10%**
CO2	To introduce the architecture of PIC microcontroller	**Remember L1 , Understand L2, Evaluate L5,**	**30%**
CO3	To educate on the architecture of ARM processors	**Remember L1 , Understand L2, Evaluate L5**	**20%**

CO4	To learn the processors based system design.	**Remember L1 , Understand L2, Evaluate L5 Create L6**	**20%**
CO5	Incorporate I/O hardware interface of a processor based application with peripherals	**Remember L1 , Understand L2, Evaluate L5 Create L6**	**20%**

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CO' s	Program Outcomes (PO's)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	1			1			1	1
CO2	3	1	3	2	2	1						2
CO3	1	3	3	2							1	
CO4	2	2	1	1							1	1
CO5	1	2	2	1							1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) : None

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/