Uka Tarsadia University

B. Tech.

Semester VI

EMBEDDED SYSTEMS

XXXXXX

EFFECTIVE FROM July-2021

Syllabus version: 1.00

Subject Code	Subject Title	Teaching Scheme (Hours)			
		Theory	Practical	Credits	
				Theory	Practical
XXXXXX	Embedded Systems	3	2	3	1

Subject Code	Subject Title	Theory Examination Marks		Practical Examination Marks	Total Marks
		Internal	External	CIE	
XXXXXX	Embedded Systems	40	60	50	150

Objectives of the course:

- To provide effective knowledge of building up the system for a real time world.
- To develop knowledge of real time operating system and communication protocols.
- To apply knowledge of assembly and 'C' language programming for the development of the application.

Course outcomes:

Upon completion of the course, the student shall be able to

CO1: Understand the process of Embedded System development.
CO2: Anlayze switching of process, thread and Task.
CO3: Understand the RTOS and different scheduling techniques.
CO4: Describe the ARM processor.
CO5: Develop the assembly language program of ARM processor.
CO6: Apply knowledge of 'C' language program for ARM processor interfacing.

Sr. No.	Topic	Hours
	Unit – I	
1	**Introduction to Embedded Systems:** Embedded system, Processor embedded into a system, Embedded hardware units and devices in a system, Embedded system design, Embedded system architecture, Classification of embedded system, Examples of the embedded system, Design process in embedded system, Design challenges in Embedded system, Design process & design examples, Skill required for an embedded system designer.	7
	Unit – II	
2	**Inter process Communication and Synchronization of processes, Thread and Task:** Multiple process and thread in application, Task, Task states, Thread, Task and data, Distinction between function, ISR, IST and Task, Concept of semaphores, Shared data problem, Inter-process communication and synchronization, Disabling and enabling function.	7
	Unit – III	

3	**Real Time Operating System:** Operating System services, Process management, Memory management, Device, file and I/O subsystems management, Real Time Operating System (RTOS), Basic design using RTOS, RTOS task scheduling models, OS security issue. Case Study: RTOS mCOS-II, RTOS VxWorks, ACVM using Mucos RTOS, Digital camera, Cell phone, Alarm clock.	9
Unit – IV		
4	**The ARM Architecture:** Basic Embedded Processor: RISC and CISC, The Acorn RISC machine, Architectural inheritance, The ARM Programmer's model, ARM7TDMI, 3-stage pipeline ARM organization, 5-stage pipeline ARM organization, The ARM coprocessor interface.	6
Unit – V		
5	**ARM Assembly Language Programming:** Data processing instructions, Data transfer instructions, Control flow instructions, Data types, Exceptions, Conditional execution, Software interrupt, Swap memory and register instructions, Program status register instructions, The Thumb Instruction set, Assembly language programming.	7
Unit – VI		
6	**Embedded 'C' programming and ARM interfacing:** Overview of C compiler, Basic 'C' compiler, Basic C data types, C Looping structures, Variable and Constants, Register allocations, Function calls, Pointers and arrays, Structure arrangement, bitfields, Interrupt service routines, Pointers to function, Control statements, LED interfacing, 7-segment LED interfacing, Switch interfacing, LCD interfacing, ADC, DAC, Sensor interfacing.	9

Sr. No.	Embedded Systems (Practical)	Hours
1	Introduction: 1. Microcontroller Vs Microprocessor 2. RISC Vs CISC 3. An Introduction to ARM7 Development board LPC2148. 4. List features of LPC2148 ARM7 development board. 5. List any 5 companies which make ARM7 based processor.	2
2	Write an ALP to perform following tasks: 1. Transfer data from one register to another. 2. Store two numbers in registers and perform addition operation. 3. Store two numbers in registers and perform subtraction operation.	4

	4. Store two numbers in registers and perform multiplication operation. 5. Store two numbers in registers and perform logical operation like AND, XOR, OR. 6. Take 3 numbers and perform multiply and accumulate. 7. Square a number. Use instruction of ARM7.	
3	Write an ALP to perform following task: 1. Addition of data in a single array. 2. Addition of 5 (32 bit) data stored in two arrays and stores the result in third array. Use instruction of ARM7.	2
4	Write an ALP to perform following task: 1. Compare the data from the given array and store the smallest number in the register. 2. To transfer data from one location to another location. Use instruction of ARM7.	2
5	Write an ALP to arrange given numbers in Ascending and Descending order. Use instruction of ARM7.	2
6	Write an ALP to illustrate the use of IMPORT and EXPORT subroutines.	2
7	Write an embedded 'C' program to blink 4 LED's connected on LPC2148 board on pin P1.16. to P1.19	4
8	4 switches (SW1 to SW4) are connected with LPC2148 board on pin P0.12, P0.13, P0.14 and P0.15 and 4 LEDs are connected on LPC2148 board on pin P1.16. to P1.19. Write an embedded 'C' program for following: 1. Turn on LED1 if SW1 is pressed. 2. Turn on LED2 if SW2 is pressed. 3. Turn on LED3 if SW3 is pressed. 4. Turn on LED4 if SW4 is pressed. Turn off LEDs after some delay.	2
9	Write an embedded 'C' program to display 0 to 9 on 7-segment LED connected on LPC2148 board on pin P0.0 to P0.6 in common anode configuration.	4
10	Assume that bit P0.0 is an input and represents the condition of an oven. If it goes high, it means that the oven is hot. Write an embedded 'C' program to monitor the bit continuously. Whenever it goes high, send a high-to-low pulse to port P1.16 to turn on a buzzer.	2
11	Write an embedded 'C' program to display "CGPIT" on LCD connected to ARM processor.	4

Text books:

1. Rajkamal – "Embedded System: Architecture, Programming and Design", TMH.
2. Steve Furber – "ARM System on Chip Architecture", Pearson Education.

Reference books:

1. Muhammad Ali Mazidi – "ARM Assembly Language Programming & Architecture", Kindle edition.
2. Wayne Wolf - "Computer as Components: Principles of Embedded Computing System Design", Morgan Kaufmann Publication.
3. K.V.K.K Prasad - "Embedded/Real time systems: concepts, design and programming", Dreamtech press.

Course objectives and Course outcomes mapping:

- To provide effective knowledge of building up the system for a real time world: CO1
- To develop knowledge of Real time operating system and communication protocol: CO2, CO3
- To apply knowledge of assembly and 'C' language programming for the development of the application: CO4, CO5, CO6

Course units and Course outcome mapping:

Unit No.	Unit Name	Course Outcomes					
		CO1	CO2	CO3	CO4	CO5	CO6
1	Introduction to Embedded Systems	✓					
2	Inter process Communication and Synchronization of Processes, Thread and Task		✓				
3	Real Time Operating System			✓			
4	The ARM Architecture				✓		
5	ARM Assembly Language Programming					✓	
6	Embedded 'C' Programming						✓

Programme outcomes:

PO 1: Engineering knowledge: An ability to apply knowledge of mathematics, science, and engineering.

PO 2: Problem analysis: An ability to identify, formulates, and solves engineering problems.

PO 3: Design/development of solutions: An ability to design a system, component, or process to meet desired needs within realistic constraints

PO 4: Conduct investigations of complex problems: An ability to use the techniques, skills, and modern engineering tools necessary for solving engineering problems.

PO 5: Modern tool usage: The broad education and understanding of new

engineering techniques necessary to solve engineering problems.

PO 6: The engineer and society: Achieve professional success with an understanding and appreciation of ethical behaviour, social responsibility, and diversity, both as individuals and in team environments.

PO 7: Environment and sustainability: Articulate a comprehensive world view that integrates diverse approaches to sustainability.

PO 8: Ethics: Identify and demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work.

PO 9: Individual and team work: An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give/receive clear instructions.

PO 11: Project management and finance: An ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: A recognition of the need for, and an ability to engage in life-long learning.

Programme outcomes and Course outcomes mapping:

Programme Outcomes	Course Outcomes					
	CO1	CO2	CO3	CO4	CO5	CO6
PO1	✓	✓	✓	✓	✓	✓
PO2					✓	✓
PO3	✓	✓	✓			
PO4	✓	✓	✓			
PO5					✓	✓
PO6				✓	✓	✓
PO7						
PO8					✓	✓
PO9					✓	✓
PO10	✓	✓	✓		✓	✓
PO11	✓	✓	✓	✓	✓	✓
PO12	✓	✓	✓	✓	✓	✓