GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (EMBEDDED SYSTEM) (54)

ARM PROCESSOR ARCHITECTURE AND SYSTEM DESIGN

SUBJECT CODE: 2715401

SEMESTER: I

Type of course: Advanced Microcontrollers architecture and programming

Prerequisite: Fundamental knowledge of microprocessor architecture and programming

Rationale: Microprocessors available in market for personal computer design are x86 family processors which are not suitable for embedded application development. An ARM processor designed based on RISC technology is having advantages in terms of speed and power consumption. The fundamentals of this CPU in terms of its architecture and programming are essential to know for efficient embedded system design.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Contents	Total Hrs.	% Weightage
1	ARM Architecture: The Acorn RISC machine, Architectural inheritance, ARM programmer's model, Control flow instructions, Conditional execution, 3-stage pipeline, ARM organization, 5-stage pipeline, ARM organization, Understanding of ARM instruction execution, Exceptions in ARM	8	20
2	ARM instruction set: Addressing modes, Data processing instructions, Data transfer instructions, ARM Condition codes, Branches, Software interrupt (SWI), Multiply instructions	8	15
3	Programming: Writing simple assembly language programs for ARM, Thumb programmer's model and instruction set, ARM development tools	6	15
4	LPC2148: System Peripherals: Bus Structure, Memory Map, Register Programming, Memory Accelerator Module, FLASH Memory Programming, External Bus Interface, Booting process, Phase Locked Loop, Power Control and LPC2000 Interrupt System	10	20
5	User peripherals: General Purpose I/O, General Purpose Timers, PWM Modulator, Real Time Clock, Watchdog Timer, Analog To Digital Converter, Digital To Analog Converter, UART Interface, I^2C Interface, SPI	10	30

	Interface, CAN Controller		

Text Books:

1. ARM System on Chip Architecture, Second Edition, Author: Steve Furber, Pearson Education
2. Computer as Components: Principles of Embedded Computing System Design, Third Edition, Author: Wayne Wolf, Morgan Kaufmann Publication
3. ARM Assembly Language, Second Edition, Author: J R Gibson, Cengage Learning
4. The Insider's Guide To The Philips ARM7-Based Microcontrollers Author: Trevor Martin, Hitex Publisher

Course Outcome:

1. To study Accorn RISC Machine 7 (ARM 7) architecture with instruction set.
2. To study basics of Assembly language programming for ARM 7 CPUs.
3. To understand system peripherals for compact engineering system design.
4. To study serial bus protocols for system design with communication support.

List of Experiments:

1. Introduction to ARM Assembly Language Programming with KEIL and Assembler Directives.
2. Write assembly language program for converting a nibbles into its equivalent ASCII number.
3. Write assembly language program to sort a given array into ascending order.
4. Write assembly language program to convert
   BCD to HEX
   HEX to BCD
5. Write assembly language program to add two arrays into THUMB mode programming.
6. Write an Assembly language program to ON and OFF the LED connected on MCB2140 module.
7. Write a C program to generate 1 Hz signal from port 0 and the same performed on MCB2140.
8. Write a C program to read potentiometer given on MCB2140 module through ADC0 which is available on LPC2148.
9. Write a C Program To Verify SPI Interface with Variable Clock Frequency And Data Transfer.
10. Write a C program to verify UART serial communication and verify that same on MCB2140 and also with hyperterminal of a computer.

Open Ended Problems

1. Write an assembly language program to calculate factorial of a number using stack operations.
2. It is desired to generate two PWM outputs; one with Timer 0 and another with Timer 1 so that these outputs are generated on pins MAT0.0 and MAT1.1. Keep duty cycle as 40% for MAT0.0 and 65% for MAT1.1 with 10 KHz frequency in both the cases. Write a 'C' language program with proper initialization of Special Function Registers for this task. Verify the result with MCB2140 kit available in laboratory.
3. Generate digit drive signal for multiplexed display with the help of configuring timer appropriately and 'C' program. Define PLL and Timer settings appropriately in the program to take care for the timings of following waveforms. Verify the result with MCB2140 kit available in laboratory.
4. An analog signal in the range of 0 to 10 mVolts needs to be amplified and given to the LPC2148 for digitization. After digitization it is required to generate a PWM wave whose average value is proportional to the analog input in the ADC. Configure Timer and ADC appropriately for this activity. Write a 'C' language program with proper initialization of Special Function Registers for this task.
5. Write a 'C' program to interface 8 keys such that when any key is pressed a signal in the form of interrupt is given to EINT0 pin of LPC2148. Interface these 8 keys with port pins and write a 'C' program along with an Interrupt service routine to identify the key being pressed.

Major Equipment:

i. KEIL MCB2140 Experimental Kit
ii. Personal Computer
iii. Function Generator
iv. Oscilloscope
v. Digital Multi-meter
vi. DC Power Supply (0-30 V)

List of Software:

KEIL for ARM processor

Learning website:

www.nptel.ac.in

www.nxp.com