GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS AND COMMUNICATION ENGINEERING (11)
ADVANCED MICROPROCESSOR
SUBJECT CODE: 2161102
B.E. 6thSEMESTER

Type of course: Advanced Microprocessor Architecture and Programming

Prerequisite: Knowledge of basic Microprocessor Architecture and Programming

Rationale: This course will provide an opportunity to the students to become familiar with ARM microprocessor architecture, instruction set and programming.

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)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction:** Need of advance microprocessors, Difference between RISC and CISC, RISC Design philosophy, ARM Design Philosophy, History of ARM microprocessor, ARM processor family, Development of ARM architecture	6	10
2	**The ARM Architecture and Programmers Model :** The Acorn RISC Machine, ARM Core data flow model, Architectural inheritance, The ARM7TDMI programmer's model: General purpose registers, CPSR, SPSR, ARM memory map, data format, load and store architecture, Core extensions, Architecture revisions, ARM development tools	10	20
3	**ARM Instruction set:** Data processing instructions**,** Arithmetic and logical instructions**,** Rotate and barrel shifter**,** Branch instructions, Load and store instructions, Software interrupt instructions, Program status register instructions, Conditional execution, Multiple register load and store instructions, Stack instructions, Thumb instruction set, advantage of thumb instructions, Assembler rules and directives, Assembly language programs for shifting of data, factorial calculation, swapping register contents, moving values between integer and floating point registers	10	20
4	**C Programming for ARM:** Overview of C compiler and optimization, Basic C data types, C Looping structures, Register allocations, function calls, pointer aliasing, structure arrangement, bit-fields, unaligned data and Endianness, Division, floating point, Inline functions and inline assembly, Portability issues. C programs for	10	20

	General purpose I/O, general purpose timer, PWM Modulator, UART, I2C Interface, SPI Interface, ADC, DAC		
5	**Memory management units:** Moving from memory protection unit (MPU) to memory management unit (MMU), Working of virtual memory, Multitasking, Memory organization in virtual memory system, Page tables, Translation look aside buffer, Caches and write buffer, Fast context switch extension,	8	15
6	Advanced Microprocessor Bus Architecture (AMBA) Bus System, User peripherals, Exception handling in ARM, ARM optimization techniques	8	15
Total		52	100

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**15**	**20**	**10**	**10**	**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 above table.

Reference Books:

[1] ARM Assembly Language Programming & Architecture By. Muhammad Ali Mazidi, Kindle edition
[2] Arm Assembly Language, Fundamentals and Techniques, 2nd edition, William Hohl, Christppher Hinds, CRC Press.
[3] Arm System Developer's Guide, Designing and Optimizing Software, Andrew N. Sloss, Dominic Symes, Chris Wwight, Elsevier
[4] Arm System-on-chip Architecture, 2nd Edition, Steve Furber, Pearson publication
[5] Embedded Systems By. Lyla Das, Pearson publication

Course Outcomes:

After learning the course the students should be able to:

[1] Become familiar with importance and applications of advance microprocessor
[2] Understand architecture of ARM processor
[3] Understand instruction set of ARM processor
[4] Be able to write hybrid (assembly & C) program for ARM microprocessor
[5] Analyze given program to find out program output
[6] Be able to interface input/output devices like Keyboard, LED, LCD, sensors with ARM7TDMI

List of Experiments:

1. To write and simulate ARM assembly language programs for data transfer, arithmetic and logical operations.
2. To write and simulate C Programs for ARM microprocessor in KEIL
3. To interface LED with ARM microprocessor and write program to blink LED at the interval of 1 second
4. To interface switch with ARM microprocessor and write program in C language to read status of the switch
5. To interface LCD with ARM microprocessor. Write and execute programs in C language for displaying text messages and numbers on LCD.
6. To interface DC motor with ARM microprocessor. Write program to rotate DC motor in clockwise and anticlockwise direction with different speed
7. To interface Stepper motor with ARM microprocessor. Write program to rotate motor in half step and full step mode
8. To write programs for ARM microprocessor using optimization techniques and compare execution time
9. To implement convolution of two sequences on ARM microprocessor using assembly or C language
10. To write and execute programs using ARM free mbed online developer tool using cloud computing https://developer.mbed.org/
11. Interfacing of temperature sensor with ARM freedom board (or any other ARM microprocessor board) and display temperature on LCD
12. To write programs for serial communication between PC and ARM microprocessor
13. Student mini project based on ARM microprocessor

Design based Problems (DP)/Open Ended Problem:

- To design ARM based wireless sensor network for temperature measurement
- To monitor and control industrial parameters with help of ARM processor
- To design ARM cortex based automatic number plate recognition system
- To design ARM based power saving system

Major Equipment/software:

[1] Freescale freedom development boards for ARM

[2] Add on Sensor board for ARM

[3] Open source ARM Mbed Development plateform

[4] KEIL IDE and Proteus for simulation

List of Open Source Software/learning website:

[1] GNU tool chain

[2] NPTEL Video lecturers : http://nptel.ac.in/syllabus/117106111/

Website:

[1] https://developer.mbed.org

[2] http://www.freescale.com/tools/software-and-tools/hardware-development-tools/freedom-development-boards:FREDEVPLA

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.