Marwadi University
Faculty of Technology
Department of Information and Communication Technology

Subject Code: 01CT1507

Subject Name: Advanced Microprocessor

B. Tech. Year – III (Semester V)

Objectives:

This course introduces the ARMv7 and ARMv7 CortexM architecture, Instruction set, assembly language and C language programming of ARMv7 CortexM core-based Microcontroller. It gives a hands-on training of evaluate various on chip peripherals and interfacing external sensors and actuators with Cortex-M based microcontroller. The course objective is to introduce the basic concepts medium scale embedded system design using ARMv7 CortexM based microcontroller and to develop assembly and C language programming skills for real time applications of ARMv7 CortexM based microcontroller.

Credits Earned: 04 Credits

Course Outcomes: After completion of this course, student will be able to:

1. Understand evolution of RISC based microprocessors and their comparative analysis
2. Develop real time software and hardware for embedded systems using Cortex M Microcontroller (Create).
3. Write and debug C programs for Cortex-M Microcontroller (Apply).
4. Effectively utilize on chip peripherals such as timers, serial communications, analog-to-digital converters & pulse width modulation for low power applications (Apply).
5. Implement advance communication protocol like I2C and SPI on Cortex-M Microcontroller (Apply).
6. Effectively utilize ARMv7 and ARMv7 Cortex M based microcontroller to solve real world problems (Apply).

Pre-requisite of course: Basics of Digital Logic Design, Microprocessor architecture, and basics of C programming

Teaching and Examination Scheme:

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial / Practical Marks		Total Marks
				E	I		V	T	
Theory	Tutorial	Practical		ESE	IA	CSE	Viva	Term Work	
3	0	2	4	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**Introduction** Introduction to Microprocessors, RISC & CISC Microprocessors, Scalar & super scalar processors , Vector & array processors, Chronology of Intel processors : 8086, Pentium ,Pentium Pro , Pentium II ,Pentium III , Pentium IV , Itanium , Latest Intel processors :Atom, I3 , I5 , I7 ,AMD processors , MIPS processors ,SUN's Sparc processor , Mobile/Tablet processors, Comparative analysis of characteristics of various microprocessors, Concepts of Memory management units	8
2	**RISC Processors and ARM:** The RISC revolution – Characteristics of RISC Architecture , Basic architecture of the ARM7core, Registers, Current Program Status Register (CPSR), Operating States, Operating Modes, Programming Model, Interrupt and Exception Handling, ARM Instruction Set, Migration to Cortex Series, ARM 12 architecture v7 profile, ARMv7-Marchitecture, Operating States and Operating Modes, Programming Model.	12
3	**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, bitfields, unaligned data and Endianness, Division, floating point, Inline functions and inline assembly, Portability issues.	08
4	**Peripheral Programming in C for Cortex M based Microcontroller** C programs for General purpose I/O, General Purpose Timers, WDT Programming, Interrupt Programming, LPM programming, ADC, DAC, PWM and DMA programming	08
5	**Serial communication protocols** UART protocol, I2C protocol, SPI protocol and their programming	06
	Total Hours	**42**

Suggested Text books / Reference books:

1. Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi, TI ARM Peripherals Programming and Interfacing Using C Language, Pearson Education.
2. Jonathan W. Valvano, Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers, 5th edition, ISBN: 978-1477508992.
3. Embedded System Design Using TIVA, TI University Program, Learning Material.
4. Microprocessors and Interfacing: Programming and Hardware, Douglas V.Hall, McGraw-Hill/Glencoe, ISBN: 9780070257429

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process.

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
20%	20%	30%	15%	10%	5%

Suggested List of Experiments:
Minimum 14 experiments to be performed during the semester

1. Installation of CCS and familiarization of ARMv7 Development Board.
2. Hands-on experimentation of GPIO programming in C on ARMv7 development board.
3. Hands-on experimentation of Timer to generate accurate delay in C on ARMv7 development board.
4. Hands-on experimentation of Hibernation and Wakeup by RTC programming in C on ARMv7 development board.
5. Hands-on experimentation of ADC programming in C on ARMv7 development board.
6. Hands-on experimentation of PWM programming in C on ARMv7 development board.
7. Hands-on experimentation of UART Transmit programming in C on ARMv7 development board.
8. Hands-on experimentation of UART Receive programming in C on ARMv7 development board.
9. Hands-on experimentation of UART Transmit and Receive programming in C on ARMv7 development board.
10. Hands-on experimentation of interfacing 16x2 LCD and programming in C with ARMv7 development board.
11. Hands-on experimentation of interfacing SIM800L GSM/GPRS and programming in C withARMv7 development board.
12. Hands-on experimentation of interfacing HC-05 Serial Bluetooth and programming in C withARMv7 development board.
13. Hands-on experimentation of MPU6050 Accelerometer & Gyroscope Interfacing in C usingI2C protocol with ARMv7 development board.
14. Hands-on experimentation of MAX7219 LED matrix driver interfacing in C using SPI protocol with ARMv7 development board.
15. Design Mini project based on Cortex M based Microcontroller utilizing minimum 3 on-chip peripherals and minimum 2 external sensors/actuators to solve a real-world problem.

Supplementary Resources:

1. https://www.ti.com/seclit/ml/ssqu015/ssqu015.pdf
2. https://university.ti.com/en/faculty/teaching-materials-and-classroom-resources/embedded-learning-material