COURSE TITLE	**ADVANCED MICROPROCESSOR**
COURSE CODE	**01CT1507**
COURSE CREDITS	**4**

Objective:

1 This course introduces the ARMv7 and ARMv7 Cortex M architecture, Instruction set, assembly language and C language programming of ARMv7 Cortex M 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 Cortex M based microcontroller and to develop assembly and C language programming skills for real time applications of ARMv7 Cortex M based microcontroller.

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

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Introduction** Hardware Components of Embedded System, Instruction Set Architecture	8

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Contents : Unit	Topics	Contact Hours
2	**RISC Processors and ARM** 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** Instruction Set:Tables with all categories of instructions with descriptions, Load/Store instructions with addressing modes,, Thumb instruction set, CMSIS	8
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	8
5	**Serial communication protocols** UART protocol, I2C protocol, SPI protocol, Serial Port Programming, I2C Programming, SPI Programming	6
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment 1** Installation of CCS and familiarization of ARMv7 Development Board	2
2	**Experiment 2** Hands-on experimentation of GPIO programming in C on ARMv7 development board.	2
3	**Experiment 3** Hands-on experimentation of Timer to generate accurate delay in C on ARMv7 development board.	2
4	**Experiment 4** Hands-on experimentation of Hibernation and Wakeup by RTC programming in C on ARMv7 development board.	2
5	**Experiment 5** Hands-on experimentation of ADC programming in C on ARMv7 development board.	2
6	**Experiment 6** Hands-on experimentation of PWM programming in C on ARMv7 development board.	2
7	**Experiment 7** Hands-on experimentation of UART Transmit programming in C on ARMv7 development board.	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
8	**Experiment 8** Hands-on experimentation of UART Receive programming in C on ARMv7 development board.	2
9	**Experiment 9** Hands-on experimentation of UART Transmit and Receive programming in C on ARMv7 development board.	2
10	**Experiment 10** Hands-on experimentation of interfacing 16x2 LCD and programming in C with ARMv7 development board.	2
11	**Experiment 11** Hands-on experimentation of interfacing SIM800L GSM/GPRS and programming in C withARMv7 development board.	2
12	**Experiment 12** Hands-on experimentation of interfacing HC-05 Serial Bluetooth and programming in C withARMv7 development board.	2
13	**Experiment 13** Hands-on experimentation of MPU6050 Accelerometer & Gyroscope Interfacing in C usingI2C protocol with ARMv7 development board.	2
14	**Experiment 14** Hands-on experimentation of MAX7219 LED matrix driver interfacing in C using SPI protocol with ARMv7 development board.	2
15	**Experiment 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.	2
Total Hours		**30**

Textbook :

1 TI ARM Peripherals Programming and Interfacing Using C Language, Muhammad Ali Mazidi,, Pearson Education, 2014

2 Microprocessors and Interfacing: Programming and Hardware, Douglas, McGraw-Hill, 1986

References:

1 Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers,, Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers,, Jonathan W. Valvano, Texas Instruments, 2017

Suggested Theory Distribution:

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

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
20.00	20.00	30.00	15.00	10.00	5.00

Instructional Method:

1 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

2 Practical examination will be conducted at the end of the semester for evaluation of performance of students in laboratory.

3 Students may use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory, etc.

4 The course delivery method will depend upon the requirement of content and need of the students. The teacher in addition to conventional teaching method (Chalk and Talk) may use any of the tools such as demonstration, role play, Quiz, brainstorming, Flipped class, Project based learning, Collaborative learning, MOOCs etc. for effective teaching.

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

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