INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

ARM CORTEX ARCHITECTURE AND PROGRAMMING								
II Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESE14	**Core**	3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: **Embedded system Design.**								

I. COURSE OVERVIEW:
This course focuses on the fundamental concepts and practical aspects of ARM Cortex-M-based microprocessor, incorporates architecture, programming and interfacing aspects. ARM Cortex-M processor-based microcontroller, TM4C123, Cortex-M programming, the basics of Cortex-M assembly programming, interfacing different real- life hardware devices to the ARM Cortex-M controller. the workings of general-purpose input-output (GPIO) pins, their features, possible alternate functionalities, and interfacing of Output (LED, LCD displays) as well as input (switches and keypads) devices.

II. COURSES OBJECTIVES:
The students will try to learn

I. Architectural features of ARM cortex-M Processor.
II. Programming of ARM using assembly language.
III. TM4C123 Microcontroller architecture and interfacing.
IV. Configuration of TM4C123 microcontroller communication interfaces.

III. COURSE OUTCOMES:
At the end of the course students should be able to:

CO 1 Describe the features of ARM Cortex-M processors for signal description and architecture.
CO 2 Illustrate the programmer ‘s model of ARM processor and test.
CO 3 programming model using high level and low-level languages.
CO 4 Demonstrate the internal architecture and TM4C123 Microcontroller various modes of operation of the devices used for interfacing memory and I/O devices with ARM processor.
CO 5 Apply the memory management architecture for allocating the MMU.
CO 6 Analyze floating point processor architecture and its architectural.

IV. COURSE CONTENT:

MODULE - I: ARM CORTEX-M ARCHITECTURE: (10)
ARM instruction, set architecture, register set, Operating modes, Processor reset sequence, Pipelined architecture and data path, Memory address map, Bus system and bus matrix, Memory and peripherals, Bit banding, System stack architecture, Debug system, Exceptions and interrupts.

MODULE –II: ASSEMBLY LANGUAGE PROGRAMMING (09)

Software development process, ARM cortex –M assembly language, addressing modes, Instruction set: Data processing instructions, Memory access instructions, Branch and control instructions. Embedded hardware platforms Introduction and specifications of hardware SBC platforms for AI and ML applications: Raspberry Pi 4, Jetson Nano, Jetson Xavier NX, Jetson AGX Xavier, Google Coral, Rock Pi, Beagle Bone AI and PYNQ boards.

MODULE –III:TM4C123 MICROCONTROLLER (10)

TM4C123 Microcontroller Block Diagram, The hardware development board for TM4C123, Microcontroller peripherals,

Configuring microcontroller pins as GPIOs, Input – output interfacing for LED and Switch, Methods for input-output synchronization.

MODULE –IV: INTERFACING WITH TM4C123 (09)

Configuration of interrupts and exceptions, UART configuration, I2C configuration, SPI configuration, CAN configuration, ADC configuration.

MODULE –V: SERIAL PERIPHERAL INTERFACE (10)

SPI Modes of Operation, SPI Signal Timing, SPI Details on TM4C123 Microcontroller, CAN Details on TM4C123 Microcontroller, GPIO Configuration for CAN Alternate Function.

V. TEXT BOOKS:

1. Muhammad Tahir and Kashif Javed, ARM Microprocessor Systems – Cortex-M Architecture, programming and Interfacing, Florida: CRC Press, 2017.
2. https://toaz.info/doc-view-2: ARM® Microprocessor Systems by M. Tahir and Kashif Javed Platform PDF Viewer to download ARM® Microprocessor Systems by M. Tahir and Kashif Javed.

VI. REFERENCE BOOKS:

1. Jonathan W Valvano, Embedded Systems: Real time interfacing to ARM Cortex-M Microcontrollers, 5th edition. Self- Published, 2017.
2. Joseph Yiu, The Definitive Guide to the ARM Cortex-M3 2nd edition. USA: Newness Publishers, 2010.
3. Andrew N Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide -Designing and Optimizing System Software, San Francisco: Morgan Kaufmann Publishers, 2014.

VII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations
8. Early Lecture Readiness Videos