# 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** |
| **BESD14** | **Core** | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **Contact Classes: 48** | **Tutorial Classes: Nil** | **Practical Classes: Nil** | | | | **Total Classes: 48** | | |
| **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: INTRODUCTION TO EMBEDDED SYSTEMS (10)**
Overview of microcontrollers and microprocessors architecture, memory organization, and I/O operations, selection criteria for choosing microcontrollers, definition and characteristics of embedded systems, embedded system applications and real- world examples, challenges and constraints in embedded system design.

**MODULE –II: TYPICAL EMBEDDED SYSTEM (09)**
Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), memory: ROM, RAM, memory according to the type of interface, memory shadowing, memory selection for embedded systems, sensors and actuators, communication interface: Onboard and external communication Interfaces.

**MODULE –III: EMBEDDED SYSTEM SOFTWARE (10)**
Embedded software development process, embedded programming languages (C, Assembly), real-time operating systems (RTOS) and scheduling.

Hardware/Software Co-design: Hardware-software partitioning, communication between hardware and software components, trade-offs and optimization techniques.

**MODULE –IV: RTOS BASED EMBEDDED SYSTEM DESIGN (09)**
Operating System Basics, types of Operating Systems, Tasks, process and Threads, multiprocessing and Multitasking, task scheduling.

**MODULE –V: EMBEDDED NETWORKING AND COMMUNICATION (10)**
Network protocols (TCP/IP, MQTT, etc.), wireless communication (Wi-Fi, Bluetooth, etc.), IoT (Internet of Things) concepts.

## V. TEXT BOOKS:

1. Frank Vahid, Tony Givargis, "Embedded System Design", John Wiley Publications, 3rd edition, 2006.

## VI. REFERENCE BOOKS:

1. Raj Kamal, "Embedded Systems", TMH, 2nd edition, 2008.
2. Shibu K.V, "Introduction to Embedded Systems", McGraw Hill, 3rd edition, 2012.
3. Lyla, "Embedded Systems", Pearson Education 2nd edition, 2013.

## 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