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

COURSE CONTENT

EMBEDDED REAL TIME OPERATING SYSTEM								
VII Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AECD50	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: --								

I. COURSE OVERVIEW:
The objective of this course is to develop the typically involve a combination of lectures, practical exercises, programming assignments, and possibly a final project where students apply their knowledge to develop a real-time embedded system using an RTOS.

II. COURSES OBJECTIVES:
The students will try to learn

I. Familiarize students with the basic concepts, components, and characteristics of embedded systems, providing a foundation for understanding RTOS integration.
II. Develop a deep understanding of real-time operating systems, including their types, features, and requirements, distinguishing between hard and soft real-time systems
III. Analyze the architecture of RTOS, including kernel components, task scheduling algorithms, and memory management mechanisms, highlighting their roles in real-time system operation.

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

CO1 Understand how to create, prioritize, and synchronize tasks within an RTOS environment, ensuring efficient coordination and communication between concurrent tasks.
CO2 Realize timekeeping mechanisms, scheduling policies, and timer services crucial for managing time-sensitive tasks in real-time embedded systems.
CO3 Investigate memory allocation strategies and memory protection mechanisms within RTOS, addressing issues such as fragmentation and optimizing resource utilization.
CO4 Derive the mathematical relationships that determine the operational characteristics of advanced bipolar and CMOS device architectures that make possible modern nanoscale integrated circuits;
CO5 Use their understanding of the processing steps used in real time operating system to produce integrated manufacturing procedures that will enable the production of advanced Real time operations
CO6 Envisage novel interrupt handling mechanisms and their impact on real-time responsiveness, including techniques for minimizing interrupt latency and efficient device driver integration.

IV. COURSE CONTENT:

MODULE - I: Introduction to Embedded Systems (10)
Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

MODULE –II: Typical Embedded System MULTISTAGE (10)
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 Firmware (10)
Embeddedfirmware concepts and development process; firmware architecture and designapproaches; super-loop, interrupt-driven and event-driven programming models;embedded C programming principles; data types, bitwise operations, pointers,structures and memory handling. Dev

ice driversand hardware abstraction layers; interfacing with GPIO, timers, counters, ADC,DAC, PWM and watchdog timers; interrupt handling and interrupt serviceroutines; polling versus interrupt-based control; firmware debugging, testingand validation; bootloaders, firmware updating and basic real-time firmwareimplementation.

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: Task Communication (09)
Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

V. TEXT BOOKS:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill
2. "Embedded Systems" by Raj Kamal

VI. REFERENCE BOOKS:

1. Sedra, AS., and K.C.Smith, “Microelectronic Circuits” , New York, NY: Oxford University Press, 4th Edition, 1998.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.

VII. ELECTRONICS RESOURCES:

1. NPTEL :: Electrical , Electronics and Communication: ERTOS
2. https://ocw.mit.edu/courses/6-012-microelectronic-devices-and-circuits-fall-2009/pages /
3. https://archive.nptel.ac.in/content/storage2/courses/103106075/Courses/Lecture18.html

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Tech-talk topics
5. Assignments
6. Model question paper - I
7. Model question paper - II

8. Lecture notes
9. Early learning readiness videos (ELRV)
10. Power point presentations