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

COURSE CONTENT

EMBEDDED REAL TIME OPERATING SYSTEM

I Semester: ES

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BESE03	**Elective**	3	-	-	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Embedded systems.								

I. COURSE OVERVIEW:
This course is to introduce students with the basic concepts and approaches in the design and analysis of real-time operating systems. It covers design considerations of real time operating systems, task scheduling, threads, multitasking, task communication and synchronization. Applications of the course include real time operating systems in image processing, fault tolerant applications and control systems.

II. COURSES OBJECTIVES:
The students will try to learn

I.   The concepts of operating systems and principles of real time operating system, implementation aspects of real time concepts in embedded systems.
II. The design of real time operating system by using the concepts of Timers, I/O subsystem and Memory management units.
III. Software development process and tools like Vxworks and mu COS for real time operating system applications.

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

CO1   Recall real time operating system to provide resource management and synchronization for communication systems.

CO2   Compare soft real-time operating system and hard real-time operating systems for the priority-based task scheduling.

CO3   Outline the components of real time operating systems for the design of reliable embedded system.

CO4   Analyze finite state machine for the task scheduling and execution in kernel models.

CO5   Develop a semaphore token for the execution of one or more threads in mutual exclusion.

CO6   Interpret message queue in asynchronous communications protocol for send and receive messages simultaneously.

IV. COURSE CONTENT:

MODULE - I: REAL TIME OPERATING SYSTEM PRINCIPLES (9)
History of operating systems, defining RTOS, classification of real-time systems, The scheduler, objects,

services and key characteristics of RTOS, Tasks: Defining a task, task states and scheduling, typical task operations, typical task structure.

MODULE –II: REAL TIME KERNEL OBJECTS (9)

Semaphores: Defining semaphores, typical semaphore operations, typical semaphore use; Message Queues: Defining Message queues, message queue states, message queue content, message queue storage, typical message queue

Operations; Typical message queue use other kernel objects: Pipes, event registers, signals, condition variables.

MODULE –III: RTOS DESIGN CONSIDERATIONS (9)

Timer and Timer Services: Real-time clocks and system clocks programmable interval timers, timer interrupt service routines, model for implementing the soft-timer handling facility, timing wheels.

Characteristics of RTOS, Defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use

MODULE –IV: TASKS COMMUNICATION AND SYNCHRONIZATION (9)

Synchronization and Communication: Synchronization, communication, resource synchronization methods, common practical design patterns; common design problems: Resource classification, deadlocks, priority inversion.

Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

MODULE –V: RTOS APPLICATION DOMAINS (9)

Comparison and study of RTOS: Vx works and COS, Case studies: RTOS for image processing, embedded RTOS for voice over IP, RTOS for fault tolerant applications, RTOS for control systems.

V. TEXT BOOKS:

1. Andrew Troelsen,"Pro C and the .NET 4 Platform, Springer (India) Private Limited, New Delhi, India, 5th
   Edition,2010.
2. David Chappell, "Understanding .NET – A Tutorial and Analysis", Addison Wesley, 2nd Edition, 2002.
3. Thamarai Selvi, R. Murugesan, A Textbook on C, Pearson Education, 1st Edition, 2003.

VI. REFERENCE BOOKS:

1. Raymond J.A.Bhur, Donald L.Bailey, "An Introduction to Real Time Systems", PHI, 1st Edition, 1999.
2. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Kindle
   Publishers, 2nd Edition, 2005.
3. Tanenbaum, "Modern Operating Systems", Pearson Edition, 3rd Edition, 2007.

VI. WEB REFERENCES:

1. https://www.jntumaterials.co.in
2. http://www.inf.ed.ac.uk/teaching/courses/es/PDFs/RTOS.pdf
3. https://nptel.ac.in/courses/106108101/pdf/Lecture_Notes/Mod%208_LN.pdf
4. http://wwww.iare.ac.in

VII. E-TEXT BOOKS:

1. http://www.bookzz.org/
2. http://www.jntubook.com

3. http://www.4shared.com/web/preview/pdf/BhrrT3m0
4. http://www.archive.org

IX. 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 presentation
8. Early Lecture Readiness Videos