INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	EMBEDDED REAL TIME OPERATING SYSTEMS				
Course Code	BESB22				
Programme	M. Tech				
Semester	III				
Course Type	Professional Elective				
Regulation	IARE-R18				
Course Structure	Theory			Practical	
	Lectures	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Faculty	Dr. P Munaswamy, Professor Ms. M Sugana Sri , Assistant Professor				

I. COURSE OVERVIEW:

This course starts by introducing some basic ideas of real time systems design paradigms. Subsequently the course covers important concepts like scheduling in real time and challenges, both with respect to software and hardware. In later units analysis of a system and programming tools and languages, to understand how the real time system design and fault tolerance techniques.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEC524	VI	Wireless Communication and Networks	3

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Wireless LANs and PANs	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	LCD / PPT	✔	Seminars	✔	Videos	✔	MOOCs
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

Theory Course: The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations.

Semester End Examination (SEE):

The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
30 %	To test the analytical skill of the concept.
20 %	To test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Technical Seminar and Term Paper.

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	**CIE Exam**	**Technical Seminar and Term Paper**	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 9th and 17th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration, consisting of 5 one mark compulsory questions in part-A and 4 questions in part-B. The student has to answer any 4 questions out of five questions, each carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Technical Seminar and Term Paper:

Two seminar presentations and the term paper with overview of topic are conducted during II semester. The evaluation of technical seminar and term paper is for maximum of 5 marks. Marks are awarded by taking average of marks scored in two Seminar Evaluations.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	Apply advanced level knowledge, techniques, skills and modern tools in the field of Embedded Systems and sub areas IoT, Processor technology, and Storage technology.	2	Seminar and Term paper
PO 2	Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team.	2	Seminar and Term paper
PO 3	Respond to global policy initiatives and meet the emerging challenges with sustainable technological solutions in the field of electronic product designing	3	Seminar
PO 4	Demonstrate the importance of embedded technologies and design new innovative products for solving society relevant problems	3	Seminar and Term paper
PO 6	Independently carry out research / investigation and development work to solve practical problems.	2	Seminar and Term paper

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES:

The course should enable the students to:

I	Understand different WLAN topologies and transmission techniques.
II	Interpret Bluetooth and Zigbee technologies.
III	Enhance the understanding of 3G systems and 4G networks.

VIII. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understand the concepts of various operating systems for embedded systems and describe the basic commands to perform operations on files.	CLO 1	Understand the basic UNIX/LINUX programming.
		CLO 2	Understand the overview of commands, file I/O process control.
		CLO 3	Understand the history of OS, RTOS, characteristics of RTOS
CO 2	Explore the structures, task services, states and other basic operations of the real time operating systems.	CLO 4	Understand the defining a task, task states, scheduling and synchronization.
		CLO 5	Understand the various components of the RTOS.
CO 3	Demonstrate the objects, services, I/Os and other building blocks of the real time operating systems.	CLO 6	Analyze the objects and services of the RTOS.
		CLO 7	Evaluate the Pipes, event registers, other building blocks, and component configuration.
		CLO 8	Understand the device I/O management, Exceptions, interrupts and event handling.

CO 4	Explore exceptions, timers interrupts, service routines and other operations of the RTOS	CLO 9	Analyze the real time clocks, Programmable timers, timer interrupt service routines.
		CLO 10	Understand the basic concepts of RT Linux, Micro C/OS-II
CO 5	Develop knowledge and practical skills through case studies of various RTOS.	CLO 11	Understand the basic concepts of Vx works, embedded Linux, tiny OS
		CLO 12	Understand the basic concepts of android OS.

IX. COURSE LEARNING OUTCOMES(CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to	PO's Mapped	Strength of Mapping
BESB03.01	CLO 1	Understand and Analyze First and Second Generation Cellular Systems.	PO 1	2
BESB03.02	CLO 2	Analyze Cellular Communications from 1G to 3G.	PO 1, PO 2	2
BESB03.03	CLO 3	Explain Wireless 4G systems, The Wireless Spectrum.	PO 1, PO 3	1
BESB03.04	CLO 4	Describe Carrier Sense Multiple Access (CSMA), Carrier Sense Multiple Access with Collision Detection (CSMA/CD), Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA).	PO 2, PO 3	3
BESB03.05	CLO 5	Explain WLAN Topologies and Analyze Transmission Techniques	PO 1	3
BESB03.06	CLO 6	Distinguish Random Access Methods.	PO 1	3
BESB03.07	CLO 7	Describe importance of Wireless Local Area Networks.	PO 3	3
BESB03.08	CLO 8	Explain Network Architecture and Analyze MAC Layer issues.	PO 1, PO 3	2
BESB03.09	CLO 9	Describe importance of Wireless Private Area Networks.	PO 3, PO 6	2
BESB03.10	CLO10	Explain Bluetooth technology and Bluetooth specifications.	PO 1, PO 6	3
BESB03.11	CLO 11	Analyze Enhancements to Bluetooth technology and applications	PO 2	2
BESB03.12	CLO 12	Describe IEEE 802.15.3, The IEEE 802.15.4	PO 2, PO 6	3
BESB03.13	CLO 13	Understand ZigBee components and network topologies.	PO 2	2
BESB03.14	CLO 14	Analyze Device architecture and network topologies	PO 3, PO 6	3

3 = High; 2 = Medium; 1 = Low2

X. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes (COs)	Program Outcomes (PO)				
	PO1	PO2	PO3	PO4	PO6
CO 1	3	3	2		1
CO 2	2	2			1
CO 3	3		3	3	
CO 4		2		2	2
CO 5	2		2		

XI. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (PO)				
	PO1	PO2	PO3	PO4	PO6
CLO 1	3				
CLO 2	2				
CLO 3	2	2			
CLO 4		2			
CLO 5		2			
CLO 6		3	3		
CLO 7			3		
CLO 8		2	2		
CLO 9				2	
CLO 10				2	2
CLO 11				2	
CLO 12					2

3 = High; 2 = Medium; 1 = Low

XII. ASSESSMENT METHODOLOGIES –DIRECT:

CIE Exams	PO 1, P0 2 PO 3, PO 6	SEE Exams	PO 1, P0 2 PO 3, PO 6	Seminar and Term Paper	PO 3
Viva	-	Mini Project	-	Laboratory Practices	-

XIII. ASSESSMENT METHODOLOGIES –INDIRECT:

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIV. SYLLABUS:

Unit-I	**INTRODUCTION:**
Introduction to UNIX/LINUX, overview of commands, file I/O (open, create, close, lseek, read, write), process control (fork, vfork, exit, wait, waitpid, exec).	
Unit-II	**REAL TIME OPERATING SYSTEM:**
Brief history of OS, defining RTOS, Scheduler, objects, services, characteristics of RTOS, defining a task, task states and scheduling, task operations, structure, synchronization, communication and concurrency, defining semaphores, operations and use, defining message queue, states, content, storage, operations and use.	
Unit-III	**OBJECTS, SERVICES AND INPUT OUTPUTS:**
Pipes, event registers, signals, other building blocks, component configuration. Basic I/O concepts, I/O subsystem.	
Unit-IV	**EXCEPTIONS , INTERUPTS AND TIMERS:**
Exceptions, interrupts, applications, processing of exceptions and spurious interrupts, real time clocks, programmable timers, timer interrupt service routines, soft timers, operations.	
Unit-V	**CASE STUDIES OF RTOS:**
RT Linux, Micro C/OS-II, Vx works, embedded linux, tiny OS and basic concepts of android OS.	
TEXT BOOKS:	
1. Quing Li, "Real Time Concepts for Embedded Systems",Elsevier,1st Edition,2011	
REFERENCES:	
1. Rajkamal,"Embedded systems, Architecture, programming and Design" 'Tata Mc Graw Hill,2nd Edition 2003.	
2. Richard steven,"Advanced UNIX Programming", Addision – Wesely professional,3rd Edition 2013.	
3. Dr.Craig Hollabaugh ,"Embedded Linux :Hardwar0e,software and Interfacing",Addision Wesely,1st Edition,2002	

XV. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No	Topic Outcomes	Topics to be covered	Reference
1-3	Understand the basic concepts of operating system.	Introduction to real time system, issues task class performances	T1:1
4-5	Implement basic scheduling algorithms of operating systems.	Real time application examples basics in algorithms	T1:1, 5
6-7	Describe the task scheduling of the specific application.	Application specific scheduling of independent task Internal process design Applications of each tasks	T1:1, 5
8-9	Understand the history of the operating system.	Introduction to real time operating system history of OS,	T2:4
10-12	Implementing the concepts of task schedulers, services.	Defining RTOS, Scheduler, objects, services, characteristics of RTOS	T2: 7, 8
11-14	Understand the concepts of concurrency, various states of the task.	RTO defining a task states and scheduling, communication and concurrency,	T2: 2, 3

Lecture No	Topic Outcomes	Topics to be covered	Reference
15-16	Understand the concepts of structure, synchronization of the task and communication.	task operations structure, synchronization	T2: 5
17-18	Describe the managing of shared resources and task synchronization using semaphores.	Defining semaphores, operations and use	T1: 5, T2: 3
19-21	Defining message queues, States, Content and typical message queue operations.	Defining message queue, states, content, storage, operations and use.	T2: 10
22-24	Understand the unstructured data exchange and facilitate synchronization among tasks using objects, event registers, pipes and other blocks of the real time embedded system.	Understanding the objects, service and I/O Pipes, event registers, signals, other building blocks	T2:11
25-26	Describing the I/O concepts to interact with the outside world by moving data into and out of the system.	Component configuration. Basic I/O concepts, I/O subsystem.	T2:11
27-28	Defining exception handling and interrupts information for managing software and hardware events that occur, to avoid the failures, and improves the robustness of the software.	Exceptions, interrupts and timers applications, processing of exceptions	T1,T2:96-97
29-30	Describing the RTC and timers to generate a periodic interrupt like timer tick, provide a baud rate clock to a UART. Implement real-time clock (RTC) functions in embedded systems with minimal design time, component count, and power	Spurious interrupts, real time clocks, timers	T2:170-86
31-32	Understand the portions of the ISR program that handle the interrupt requests, when an Interrupt is triggered (either a hardware /software interrupt),	Timer interrupts service routines, soft timers, operations.	T2:1
33-34	Analysis the characteristics of various embedded real time operating systems	Case studies of ERTOS, RT linux, Micro C/OS-II.	T3:2
35-37	Understand the customizable real-time operating system (RTOS).,VxWorks designed for distributed computing on most central processing units.	Vx works, embedded linux	T3:5,6
38-40	Defining a component-based operating system and platform for low-power wireless devices, such as those used in wireless sensor networks	Tiny OS and basic concepts of android OS	T3:164

XVI. GAPS IN THE SYLLABUS-TO MEET INDUSTRY /PROFESSIONAL REQUIREMENTS:

S No	Description	Proposed Actions	Relevance with POs
1	Real Time Databases	Seminars / Guest Lectures / NPTEL	PO 4, PO 6,
2	Fault Tolerance Techniques	Work Shops/ Guest Lectures / NPTEL	PO 4, PO 6

Prepared By:

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