SCHEME OF COURSE WORK

Course Title	REAL TIME CONCEPTS OF EMBEDDED SYSTEMS		
Course Code	15EE2203	L P C	3 0 3
Program	M.Tech		
Specialization	POWER SYSTEM AND CONTROL AUTOMATION		
Semester	I		
Prerequisites	Microcontroller, Operating Systems Basics		
Course to which it is prerequisite	To all advanced Electrical Courses		

Course Outcomes

CO1: Understand Real-Time System.
CO2: Analyze how embedded hardware is used for Real-Time System.
CO3: Identify the role of peripherals for Real-Time Systems.
CO4: Understand the definition of Real-Time Operating System.
CO5: Explain the principles of Scheduling.

Program Outcomes (POs):

A graduate of M.Tech (Power System and Control Automation) will be able to

1	Acquire in depth knowledge in the area of power system control and automation.
2	Attain the ability to prepare models with respect to any kind of problem on hand and try to solve related to power system control and automation.
3	Obtain the capability of problem solving and original thinking to arrive at feasible and optimal solutions considering societal and environmental factors.
4	Have sufficient knowledge base, sufficient to apply the techniques and tools to solve power system problems.
5	Use the state-of-the-art tools for modeling, simulation and analysis of problems related to power systems.
6	Attain the capability to contribute positively to collaborative and multidisciplinary research to achieve common goals.
7	Demonstrate knowledge and understanding of power system engineering and management principles and apply the same for efficiently carrying out projects with due consideration to economical and financial factors.
8	Communicate confidently, make effective presentations and write good reports to engineering community and society.
9	Recognize the need for life-long learning and have the ability to do it independently.
10	Become socially responsible and follow ethical practices to contribute to the community for sustainable development of society.
11	Independently observe and examine critically the outcomes of his actions and reflect on to make corrective measures and move forward positively.

Course Outcome versus Program Outcomes:

PO / CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO-1	M	M	M	S	S	S	S	M	M	S	M
CO-2	S	S	S	S	S	S	S	M	M	S	M
CO-3	S	S	S	S	S	S	S	M	M	S	M
CO-4	S	S	S	S	S	S	S	M	M	S	M
CO-5	S	S	S	S	S	S	S	M	M	S	M

S - Strongly correlated, M - Moderately correlated, Blank - No correlation

Assessment Methods	Assignment / Quiz / Seminar / Case Study / Mid-Test / End Exam

Teaching-Learning and Evaluation

Week	TOPIC / CONTENTS	Course Outcomes	Sample question	Teaching-learning strategy	Assessment Method & Schedule
1.	Introduction to Real time Embedded System, Types of Real Time systems, Real Time Applications and features, Issues in real time computing,	CO-1	a) What is a Real Time Embedded System? Explain the various issues of Real Time Systems/Computing?	▪ Lecture ▪ State-of-the-art examples	Assignment (Week 6) Quiz (Week 8) Mid-Test 1 (Week 9)
2.	Performance measures of Real Time System, real-time requirement specifications, modeling /verifying design tools (real-time UML, state charts, etc.,)	CO-1	a) Explain three different UML diagrams with examples.	▪ Lecture	Assignment (Week 5) Quiz (Week 6) Mid-Test 1 (Week 9)
3.	Selection criteria for Real time system - Hardware and Software	CO-2	a) What is a heterogeneous embedded system? Define hardware-software partitioning and need for	▪ Lecture ▪ PowerPoint	Assignment (Week 5) Quiz (Week 6) Mid-Test 1

	perspective, need for partitioning, criteria for partitioning, System Considerations		partitioning.		(Week 9)
4.	Basic development environment-Host vs Target Concept, CPU features – Architecture, On-Chip peripherals	CO-2	a) What is cross-platform development? Explain the host system in an embedded system in detail.	▪ Lecture ▪ Datasheet	Assignment (Week 6) Quiz (Week 8) Mid-Test 1 (Week 9)
5.	Real time implementation considerations, Pipeline, bus architecture, Interrupts, Case study of real time applications using C2000 microcontroller	CO-2	a) Explain the role of peripherals in real-time communication.	▪ Lecture ▪ Datasheet	Assignment (Week 6) Quiz (Week 8) Mid-Test 1 (Week 9)
6.	Role of peripherals for Real Time systems, On-Chip peripherals & hardware accelerators, Peripherals, Need of real time Communication	CO-3	a) Explain the role of hardware accelerators with a neat block diagram	▪ Lecture ▪ PowerPoint	Assignment (Week 6) Quiz (Week 8) Mid-Test 1 (Week 9)
7.	**MID TEST – 1**				
8.	Communication Requirements, Timeliness, Dependability, Real time Communication Peripherals – I2C, SPI & UART	CO-3	a) Explain I2C Protocol in detail.	▪ Powerpoint ▪ Lecture	Assignment -2 (Week 14) Quiz-2 (Week 14) Mid-Test 2 (Week 15)
9.	Case study - Illustration of Configuring and Interfacing the peripherals and	CO-3	a) Explain configuration for SPI communication in a C2000 processor	▪ Lecture ▪ Datasheet	Assignment -2 (Week 14) Quiz-2 (Week 14)

	Real time communication protocols for C2000 platforms				Mid-Test 2 (Week 15)
10.	Software Architecture of real time System, Introduction to RTOS, role of RTOS, Real time kernel, qualities of good RTOS, Functionalities of RTOS	CO-4	a) What is the role of RTOS in embedded systems?	▪ Lecture ▪ PowerPoint	Assignment -2 (Week 14) Quiz-2 (Week 14) Mid-Test 2 (Week 15)
11.	Task Management, I/O management, Memory management, Task, Task control block, Context Switching, Interrupts handling	CO-4	a) Explain function queue scheduling. Compare its characteristics with RTOS software architecture	▪ Lecture	Assignment -2 (Week 14) Quiz-2 (Week 14) Mid-Test 2 (Week 15)
12.	Multiprocessing and multitasking Case study examples for demonstrating task management using TI RTOS on C2000 platforms understanding user API and programming.	CO-4	a) Explain with an example, task management using TI-RTOS.	▪ Lecture ▪ Datasheet	Assignment -2 (Week 14) Quiz-2 (Week 14) Mid-Test 2 (Week 15)
13.	Principles, Semaphores and Queues, Hard Real-Time Scheduling Considerations, definitions, Overview of Scheduling policies (Rate monotonic Analysis (RMA), Earliest Deadline	CO-5	a) Explain with examples, what are the problems associated with shared data.	▪ Lecture	Assignment -2 (Week 14) Quiz-2 (Week 14) Mid-Test 2 (Week 15)

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14.	Task Synchronization, shared data problems and its ways of handling, Inter task communication – Need of communication, Message Mailbox and Message Queues, RTOS problems - Priority inversion phenomenon, Deadlock phenomenon and steps to handle them.	CO-5	a) Define priority inversion. Explain with examples, bounded and unbounded priority inversions.	▪ Lecture	Assignment -2 (Week 14) Quiz-2 (Week 14) Mid-Test 2 (Week 15)
15.	**MID TEST – 2**				
16.	**SEMESTER END EXAM**				