REAL TIME CONCEPTS OF EMBEDDED SYSTEMS

Course Code: 15EE2203

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Pre requisites: Microcontrollers, Operating system basics

Course Outcomes: The student will be able to

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.

UNIT-I (10-Lectures)

INTRODUCTION TO REAL TIME SYSTEM:

Introduction to Real time Embedded System, Types of Real Time systems, Real Time Applications and features, Issues in real time computing, Performance measures of Real Time System, real-time requirement specifications, modeling /verifying design tools (real-time UML, state charts, etc.,).

UNIT-II (10-Lectures)

EMBEDDED HARDWARE FOR REAL TIME SYSTEM:

Selection criteria for Real time system - Hardware and Software perspective, need for partitioning, criteria for partitioning, System Considerations, Basic development environment-Host vs Target Concept, CPU features – Architecture, On-Chip peripherals, Real time implementation considerations, Pipeline, bus architecture, Interrupts, Case study of real time applications using C2000 microcontroller – Motor Control, Digital Power, Power Line Communication.

UNIT-III (10-Lectures)

EMBEDDED HARDWARE – ON CHIP PERIPHERALS AND COMMUNICATION PROTOCOLS

Role of peripherals for Real Time systems, On-Chip peripherals & hardware accelerators, Peripherals, Need of real time Communication, Communication Requirements, Timeliness, Dependability, Real time Communication Peripherals – I2C, SPI & UART Case study - Illustration of Configuring and Interfacing the peripherals and Real time communication protocols for C2000 platforms

UNIT-IV (10-Lectures)

EMBEDDED SOFTWARE AND RTOS

Software Architecture of real time System, Introduction to RTOS, role of RTOS, Real time kernel, qualities of good RTOS, Functionalities of RTOS – Task Management, I/O management, Memory management, Task, Task control block, Context Switching, Interrupts handling, Multiprocessing and multitasking Case study examples for demonstrating task management using TI RTOS on C2000 platforms understanding user API and programming.

UNIT-V (10-Lectures)

SCHEDULING, SYNCHRONIZATION AND INTER TASK COMMUNICATION IN REAL TIME SYSTEMS

Principles, Semaphores and Queues, Hard Real-Time Scheduling Considerations, definitions, Overview of Scheduling policies (Rate monotonic Analysis (RMA), Earliest Deadline First (EDF) and etc.,) 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.

TEXT BOOKS:

1. Real-Time Systems by Jane W. S. Liu,1st edition, 2000, Prentice Hall
2. Krishna C. M. Kang G.Shin “Real Time Systems”, Tata McGraw-Hill Edition 2010.

REFERENCES:

1. Hamid A. Toliyat and Steven G. Campbell, "DSP based Electromechanical Motion Control" CRC Press, 2003, ISBN 9780849319181.
2. Jean J Labrosse, "Embedded System Design blocks", CMP books, Second Edition, ISBN 0-87930-604-1.
3. TMS320C28x CPU and Instruction Set Reference Guide, TI Literature Number: SPRU 430E, Revised January 2009.
4. TMS320x28xx, 28xxx DSP Peripheral Reference Guide, TI Literature Number: SPRU566J, Revised April 2011.
5. C2000 Teaching CD ROM from Texas Instruments.
6. Introduction to the TI-RTOS Kernel Workshop Lab Manual, by Texas Instruments, Rev 2.3– December 2014.