

MSE1025 REAL TIME SYSTEMS

Module 1

Basic Real-Time Concepts: Terminology, Systems Concepts, Real-Time Definitions, Events and Determinism, CPU Utilization, Real-Time System Design Issues, Common Misconceptions, Brief History, Theoretical Advances, Early Systems, Hardware Developments, Early Software, Commercial Operating System Support

Module 2

Hardware Considerations for Real Time Systems: Basic Architecture, Hardware Interfacing, Latching, Edge versus Level Triggered, Tristate Logic, Wait States, Systems Interfaces and Buses, Central Processing Unit, Fetch and Execute Cycle, Microcontrollers, Instruction Forms, Core Instructions, Addressing Modes, RISC versus CISC, Memory, Memory Access, Memory Technologies, Memory Hierarchy, Memory Organization, Input/Output, Programmed Input/Output, Direct Memory Access, Memory-Mapped Input/Output, Interrupts, Enhancing Performance Locality of Reference, Cache, Pipelining Coprocessors, Other Special Devices, Applications-Specific Integrated Circuits, Programmable Array Logic/Programmable Logic, Array, Field-Programmable Gate Arrays, Transducers, Analog/Digital Converters, Digital/Analog Converters, Non-von-Neumann Architectures, Parallel Systems, Flynn's Taxonomy for Parallelism

Module 3

Real-Time Operating Systems: Real-Time Kernels, Pseudokernels, Interrupt-Driven Systems, Preemptive-Priority Systems, Hybrid Systems, The Task-Control Block Model, Theoretical Foundations of Real-Time Operating Systems, Process Scheduling, Round-Robin Scheduling, Cyclic Executives, Fixed-Priority Scheduling–Rate-Monotonic Approach, Dynamic-Priority Scheduling: Earliest-Deadline–First Approach, Intertask Communication and Synchronization, Buffering Data, Time-Relative Buffering, Ring Buffers, Mailboxes, Queues, Critical Regions, Semaphores

Module 4

Memory Management: Process Stack Management, Run-Time Ring Buffer, Maximum Stack Size, Multiple-Stack Arrangements, Memory Management in the Task-Control-Block Model, Swapping, Overlays, Block or Page Management, Replacement Algorithms, Memory Locking, Working Sets, Real-Time Garbage Collection, Contiguous File Systems, Building versus Buying Real-Time Operating, Selecting Real-Time Kernels

Module 5

Performance Analysis And Optimization: Theoretical Preliminaries, NP-Completeness, Challenges in Analyzing Real-Time Systems, The Halting Problem, Amdahl's Law, Gustafson's Law, Performance Analysis, Code Execution Time Estimation, Analysis of Polled Loops, Analysis of Coroutines, Analysis of Round-Robin Systems, Response-Time Analysis for Fixed-Period Systems, Response-Time Analysis: RMA Example, The M/M/1 Queue, Service and Production Rates, Some Buffer-Size Calculations, Response-Time Modeling, Little's Law, Erlang's Formula.

Module 6

I/O Performance Basic: Buffer-Size Calculation, Variable Buffer-Size Calculation, Performance Optimization, Compute at Slowest Cycle, Scaled Numbers, Binary Angular Measure, Look-Up Tables, Imprecise Computation, Optimizing Memory Usage

Module 7

Advanced Performance Optimization: Postintegration Software Optimization, Results from Compiler Optimization, Use of Arithmetic Identifiers, Reduction in Strength, Common Subexpression Elimination, Intrinsic Functions, Constant Folding, Loop Invariant Optimization, Loop Induction Elimination, Use of Registers and Caches, Removal of Dead or Unreachable Code, Flow-of-Control Optimization, Constant Propagation, Dead-Store Elimination, Dead-Variable Elimination, Short-Circuiting Boolean Code, Loop Unrolling, Loop Jamming, More Optimization Techniques, Combination Effects, Speculative Execution, Analysis of Memory Requirements, Reducing Memory Utilization, Variable Selection, Memory

Fragmentation

Text Book:

Lapante P. A. , Real Time Systems Design and Analysis, 3rd Edition, Prentice Hall India, New Delhi

Reference Books:

1. Jane W. S. Liu, Real-Time Systems, 1st Edition, Pearson Education, New York.
2. Stallings W. , Operating Systems, Internals and Design Principles, 5th Edition, New Delhi.