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Total Number of Pages: 02

Course: B.Tech
Sub_Code: RCS6D001

6th Semester Regular / Back Examination: 2022-23

Real-Time System

BRANCH(S): CSE

Time: 3 Hour

Max Marks: 100

Q.Code : M323

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right-hand margin indicate marks.

Part-I

Q1 Answer the following questions:

(2 × 10)

- What does the term "real" in a real-time system signify? Explain what you mean by a real-time system.
- Explain why safety and reliability are not independent issues in safety-critical hard real-time systems.
- What do you mean by jitter associated with a periodic task? How are these jitters caused?
- Can the following set of real-time tasks be schedulable using EDF algorithm? Justify your answer for the real-time tasks such as $T1 = (10, 20)$, $T2 = (5, 50)$ and $T3 = (10, 35)$.
- What is code sharing? Explain serially reusable and reentrant code.
- What is chain blocking? How is unbounded priority inversion avoided in PCP?
- What do you mean by priority inversion?
- What are the shortcomings of Windows NT?
- What are the different types of timing constraints that can occur in a system? Give examples of each.
- What is the difference between synchronous I/O and asynchronous I/O?

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)

(6 × 8)

- Describe mutual exclusion using binary semaphore.
- Define "Fail-safe" state of a system. Justify your answer "safety-critical real-time systems do not have a fail-safe state."
- Briefly explain while scheduling a set of hard real-time periodic tasks, why RMA cannot achieve 100% processor utilization without missing task deadlines?
- Explain the operation of priority ceiling protocol (PCP) in sharing critical resources among real-time tasks. Explain how PCP can avoid deadlock and chain blockings.
- List the necessary constraints required to select a suitable frame size for a set of real-time tasks in the cyclic scheduler.

- f) Would it be advisable to use an Ethernet LAN in a hard real-time application such as factory automation? Justify your answer. Evaluate the pros and cons of using an Ethernet-based protocol in such an application.
- g) Describe the focused addressing and bidding and buddy algorithm for running a set of real-time tasks in a distributed environment.
- h) Define Byzantine clock. What is the maximum number of Byzantine clocks that are permissible in a system with n clocks for synchronization?
- i) What is a safety-critical system? Give a few practical examples of safety critical hard real-time systems. Are all hard real-time systems safety-critical? If not, give at least one example of a hard real-time system that is not safety critical.
- j) What do you mean by QoS routing? Explain the different types of QoS routing algorithms.
- k) What do you understand by the fail-safe state of a system? Safety-critical real-time systems do not have a fail-safe state. What is the implication of this? Explain the key differences between the characteristics of a soft real-time task and a non-real-time task.
- l) Define real-time system. With a neat block diagram show the important hardware components of a real-time system and their interactions. Explain the roles of those components.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** a) Prove that a set of periodic real-time tasks in RMA schedulable under any task phasing, if all the tasks meet their respective first deadlines under zero phasing. (8)
- b) Briefly indicate how Unix dynamically recomputes task priority values. Why is such re computation of task priorities required? What are the implications of such priority re computations on real-time application development? (8)
- Q4** a) When EDF is used for task scheduling in a real-time application, explain a scheme by which sharing of critical resources among tasks can be supported. Give an algorithm in pseudo-code notation to describe the steps to handle resource grant and release. (8)
- b) Three hard real-time periodic tasks such as $T_1 = (50\text{ms}, 100\text{ms}, 100\text{ms})$, $T_2 = (70\text{ms}, 200\text{ms}, 200\text{ms})$ and $T_3 = (60\text{ms}, 400\text{ms}, 400\text{ms})$ are to be scheduled on a uniprocessor using RMA. Can the task set be feasibly scheduled? (Show all the intermediate calculations.) (8)
- Q5** a) Define the terms priority inversion and unbounded priority inversion used in real-time system. Why is Priority Inheritance Protocol (PIP) required? Explain its basic operation with suitable example. (8)
- b) Discuss the different types of Priority Inversion occurs under PCP with example. (8)
- Q6** a) Why is it necessary to synchronize the clocks in a distributed real-time system? Discuss the relative advantages and disadvantages of the centralized and distributed clock synchronization schemes. (8)
- b) Explain why 2PL-WP protocol is not free from deadlocks. (8)