CE7-R3: REAL TIME SYSTEMS

NOTE:

1. **Answer question 1 and any FOUR from questions 2 to 7.**
2. **Parts of the same question should be answered together and in the same sequence.**

Time: 3 Hours **Total Marks: 100**

1.

a) How does a real time scheduling algorithm try to meet the deadlines of all tasks?

b) Why should a real time computer be much more reliable than its individual hardware and software components?

c) Why should static priority task scheduling algorithms incur less run time overhead compared to the dynamic priority task scheduling algorithms?

d) Explain difference between fault latency and error latency.

e) What is expected from high level language for real time system?

f) What is performability? How is it used in real time system?

g) Why should real time databases use in-memory databases during system operator for predictable performance?

(7x4)

2.

a) Explain the main techniques available to achieve hardware fault tolerance.

b) What are the main techniques available to achieve software fault-tolerance? Briefly explain these techniques. What are the shortcomings of these techniques?

c) Name any two important sensor devices and two actuator devices used in real-time applications and explain the physical principles behind their working.

(6+6+6)

3.

a) What do you understand by temporal data? Give some examples of temporal data. Can any database containing temporal data be called a real-time database? Discuss.

b) Why is selection of an appropriate concurrency control protocol important to meet the timeliness requirements for transactions? Explain the different categories of concurrency control protocols that can be used in real-time databases.

c) Identify the key differences between hard real-time, soft real-time, and firm real-time systems. Give at least one example of real-time tasks corresponding to these three categories. Identify the timing constraints in your tasks and justify why the tasks should be categorized into the categories you have indicated.

(6+6+6)

4.

a) Why is debugging and testing real-time software difficult? Explain how real-time software can be efficiently debugged and tested.

b) Consider a 10Mbps token ring network. The walk time is 1 mSec. The shortest deadline among different messages is 10mSec. The frame size is 512 bytes. Determine the maximum time for which a message may undergo priority inversion under IEEE 802.4 and IEEE 802.5 protocols.

c) What problems would you experience if you used a contention-based protocol such as Ethernet for real-time task communications? Describe a contention-based real-time communication protocol and explain how it overcomes the problems that Ethernet suffers from.

(6+6+6)

5.

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.

b) Determine whether the following set of periodic tasks is schedulable on a uniprocessor using RMA ignoring context switch overhead.

Task	Processing-time (mSec)	Period (mSec)
T1	25	100
T2	70	200
T3	60	300

c) Define the terms priority inversion and unbounded priority inversion as used in real-time operating systems. Explain the situations in which these arise using suitable examples. Explain how the priority inversion problem is addressed in practical real-time systems.

(6+6+6)

6.

a) Discuss the important performance measures of real-time operating systems. Identify the important factors that determine the performance of a real-time operating system.

b) Explain the additional features that real-time UML provides for modelling real-time applications.

c) What do you understand by a microkernel-based operating system? Explain the advantages of a microkernel-based real-time operating system over a monolithic operating system in supporting real-time applications.

(6+6+6)

7.

a) Explain how clock synchronization can be achieved in a distributed real-time system. Why does presence of Byzantine faults makes clock synchronization problem difficult? What is the minimum number of clocks necessary to ensure proper synchronization in the presence of m Byzantine faults?

b) Explain how a real-time operating system differs from a traditional operating system. Name a few real-time operating systems that are commercially available.

c) What do you understand by the term "delay jitter" in a real-time communication application? Identify at least two factors which contribute to delay jitter in real-time communications and explain how they cause jitter.

(6+6+6)