REAL TIME SYSTEMS
(INFO 4133)

Time Allotted: 3 hrs   **Full Marks: 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) _____ converts physical characteristics of environment into electrical signals.
   (a) Actuator   (b) Sensor
   (c) Both (a) and (b)   (d) None of the above

   (ii) When a system enters fail-safe state,_____ would result.
   (a) No damage   (b) Full damage
   (c) Partial damage   (d) None of the above

   (iii) Video conferencing is an example of _____
   (a) Hard Real time task   (b) Soft Real time task
   (c) Firm Real time task   (d) None of the above

   (iv) In _____ task, the minimum separation between two consecutive instances of the task cannot be zero.
   (a) Periodic   (b) Aperiodic
   (c) Sporadic   (d) Both (a) and (c)

   (v) Liu and Layland's condition is verified in_____
   (a) EDF scheduling   (b) Cyclic Scheduling
   (c) Rate Monotonic Algorithm   (d) None of the above

   (vi) Inheritance related inversion is possible in_____
   (a) Priority Inheritance Protocol   (b) Highest Locker Protocol
   (c) Priority Ceiling Protocol   (d) None of the above

   (vii) Data transmission rate varies with time in_____ traffic.
   (a) CBR   (b) VBR
   (c) Sporadic   (d) None of the above

   (viii) _____ algorithm is applicable in dynamic allocation of tasks.
   (a) Buddy   (b) Rate Monotonic
   (c) Both (a) and (b)   (d) None of the above

(ix) _____ is defined as time delay between occurrence of an interrupt and running of corresponding Interrupt Service Routine.
(a) Interrupt latency   (b) ISR latency
(c) Non-Interrupt latency   (d) None of the above

(x) _____ is suitable for small applications.
(a) Priority Ceiling Protocol   (b) Priority Inheritance Protocol
(c) Both (a) and (b)   (d) None of the above.

Group- B

2. (a) Explain the model of a Real Time System with neat diagram.
[(CO1) (Understand/LOCQ)]

(b) Discuss any five characteristics of Real time Systems.
[(CO1) (Understand/LOCQ)]

(c) Define fail-safe state of a system with an example.[(CO1) (Remember/LOCQ)]
5 + 5 + 2 = 12

3. (a) Explain four different types of deadline constraints in real time system with appropriate example in each category. [(CO2) (Understand /LOCQ)]

(b) Construct the EFSM model of a telephone system whose partial behaviour is described below:
After lifting the receiver handset, the dial tone should appear within 20 sec. If the dial tone fails to appear within 20 sec, then an ideal tone is produced. After the dial tone appears, the first digit should be dialled within 10 sec and the subsequent three digits within 5 sec of each other. If the dialling of any of the digit is delayed, then an idle tone is produced.   [(CO2) (Create/HOCQ)]

(c) Differentiate between Delay Constraint and Deadline Constraint.
[(CO2) (Analyze/IOCQ)]
4 + 4 + 4 = 12

Group - C

4. (a) Differentiate between Proficient scheduler, Optimal scheduler and Preemptive scheduler.   [(CO3) (Analyze/IOCQ)]

(b) Explain the shortcomings of Earliest Deadline first scheduling.
[(CO3) (Understand/LOCQ)]

(c) Explain Rate Monotonic algorithm in detail, stating its Necessary condition and sufficient condition.   [(CO3)(Understand/LOCQ)]
6 + 3 + 3 = 12

5. (a) Consider the execution of three tasks in a Real Time System having the following parameters:
T1 (e1=10 msec, p1=20 msec), T2 (e2=15 msec, p2=30 msec), T3 (e3=20 msec, p3=60 msec). Solve and calculate the appropriate Frame size. (Show all the steps while calculating the Frame size). [(CO3) (Analyze/IOCQ)]

(b) Consider the following set of three periodic real time tasks: T1 (e1=20 msec, p1=100 msec), T2 (e2=15 msec, p2=30 msec) and T3 (e3=60 msec, p3=360 msec) to be run on a uniprocessor. Justify whether the task set can be scheduled under RMA. [(CO3) (Evaluate/HOCQ)

6 + 6 = 12

Group - D

6. (a) Differentiate between Priority Inversion and Unbounded Priority Inversion.
[(CO4) (Analyze/IOCQ)]

(b) Explain the working of Priority Inheritance protocol with appropriate diagram. While drawing the diagram, assume there are two tasks, First task (T1) with priority=10, Second task(T2) with priority=20 and a critical resource(CR).
[(CO4) (Understand/LOCQ)]

(c) Justify the statement "Highest Locker protocol removes chain blocking" with appropriate explanation.　　[(CO4) (Evaluate/HOCQ)]

3 + 6 + 3 = 12

7. (a) Explain the 'Resource Grant rule' and 'Resource Release rule' of Priority Ceiling protocol.　　[(CO4) (Understand/LOCQ)]

(b) Differentiate between Inheritance-related inversion and Avoidance-related inversion.　　[(CO4) (Analyze/IOCQ)]

(c) Discuss Focussed Addressing and Bidding algorithm in detail.
[(CO5) (Understand/LOCQ)]

5 + 3 + 4 = 12

Group - E

8. (a) In a distributed system, six clocks needs to be synchronized to a maximum difference of 15 msec between any two clocks. Assume that the individual clocks have a maximum drift rate of $2*10^{-6}$. Calculate the clock synchronization interval using (i) Centralized clock synchronization and (ii) Distributed clock synchronization. [(CO5) (Apply/IOCQ)]

(b) Explain Centralized clock synchronization and Distributed clock synchronization.　[(CO5) (Understand/LOCQ)]

(3 + 3) + 6 = 12

9. (a) Discuss the three categories of traffic relevant in real time communication.
[(CO6) (Understand/LOCQ)]

(b) Explain different types of Quality of Service (QoS) parameters that determines service quality from the underlying network.　　[(CO6) (Understand/LOCQ)]

(c) Explain Fixed-Rate Traffic Smoothing algorithm in detail.
[(CO6) (Understand/LOCQ)]
3 + 5 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	54.20%	32.30%	13.50%

Course Outcome:

After the completion of the course students will be able to:
1. Define the concept of Real time system. Sketch the model of a Real time system. Explain the characteristics of Real time system.
2. Classify different types of Timing constraints. Discuss different types of Real time tasks. Construct different types of Timing constraints
3. Compare between the types of Real time tasks. Solve numerical based on scheduling techniques.
4. Differentiate between different resource sharing protocols in real time systems.
5. Explain different Dynamic task allocation algorithms. Differentiate between types of Clock synchronization.
6. Classify different types of network and traffic in real time communication. Explain Quality of Service.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission Link
IT	https://classroom.google.com/c/NDA0OTExMTk5Nzgy/a/NDYzODUwNzQ0MjQ0/details