

Real Time Operating System  
(INFO 5102) 17

Time Allotted : 3 hrs

Full Marks : 70

*Figures out of the right margin indicate full marks.*

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

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

Group - A

(Multiple Choice Type Questions)

10 x 1=10

1. Choose the correct alternatives for the following:

- (i) ..... is a Hard real time task.  
(a) Robot (b) Video Conferencing  
(c) Satellite tracking system (d) None of these.
- (ii) In..... protocol every resource is assigned ceiling priority value.  
(a) PIP (b) HLP  
(c) PCP (d) PDP
- (iii) In a ..... task the minimum separation between two consecutive instance of the task is the relative deadline.  
(a) periodic (b) sporadic  
(c) none of these (d) aperiodic
- (iv) ..... protocol follows greedy approach.  
(a) HLP (b) PLP  
(c) PIP (d) PCP.
- (v) ..... is a dynamic real time task allocation algorithm.  
(a) Balancing algorithm (b) Next Fit algorithm  
(c) Buddy algorithm (d) Both (a) and (b) .
- (vi) Streaming compressed video transmission is an example of \_\_\_\_\_ traffic.  
(a) VBR (b) CBR  
(c) real-time VBR (d) real time CBR.
- (vii) Real-time computer communication is essentially communication with  
(a) high data rates (b) high reliability  
(c) low data rates (d) low delay.

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(viii) The virtual time protocol is an example of \_\_\_\_\_ scheduling in a multiple access network.

- (a) bounded access type                      (b) global priority based  
(c) calender based                              (d) window based.

(ix) In real-time Linux (RTLinux), real time processes are scheduled at priorities \_\_\_\_\_ than the kernel processes.

- (a) higher    (b) lower  
(c) same    (d) none of the above.

(x) 2PL-WP protocol in real-time databases is free from

- (a) deadlock    (b) starvation  
(c) both (a) and (b)                                      (d) none of These.

**Group - B**

2.(a) What is Real Time system? Discuss different types of Timing Constraints.

(b) State the concept of cyclic scheduler. Differentiate between relative deadline and absolute deadline.

(c) Consider the following set of three periodic real time tasks: T1= (40,150), T2= (15, 50) and T3= (50, 200) to be run on a uniprocessor. Determine whether the task set is schedulable under RMA.

$$(1+3) + (2+2) + 4 = 12$$

3.(a) Discuss different types of Real Time tasks based on their recurrence over a period of time. State the concept of EDF scheduling.

(b) A cyclic scheduler is used to run the following set of periodic task on a uniprocessor. T1 (e1=20, p1=100) T2= (e2=20, p2=80) T3= (e3=30, p3=150). Select an appropriate frame size.

(c) Discuss Rate Monotonic Algorithm in detail.

$$(3+2) + 4 + 3 = 12$$

**Group - C**

4.(a) What is unbounded priority inversion? Discuss PIP (Priority Inheritance Protocol) in detail.

(b) Explain Focussed Addressing, Bidding algorithm and Buddy algorithm in detail.

$$(1+5) + 6 = 12$$

- 5.(a) Discuss Centralized and Distributed clock synchronization algorithm in detail.  
(b) Discuss HLP (Highest Locker Protocol) in detail.

6 + 6 = 12

**Group - D**

- 6.(a) Identify the factors which contribute to delay jitter in real time communications in packet-switched networks. Assume that a certain real-time application receives data at the rate of 10mbps. The QoS guarantee to the application permits a delay jitter of 20 ms. Compute the buffer requirement.  
(b) Explain the differences between traffic shaping and policing. Name a traffic shaping and policing protocol and briefly describe its operation.  
(c) "A higher priority packet might undergo inversion for at most  $2 \times \max(F, \theta)$  time units"  
- Prove it. (F is the frame transmission time and  $\theta$  is the propagation time)

(2+2)+(1+1+3) +3 = 12

- 7.(a) Consider the use of timed token protocol (IEEE 802.4) in the following situation. The real time requirement is that the node  $N_i$  be able to transmit up to  $b_i$  bits over each period of duration  $P_i$  ms, where  $b_i$  and  $P_i$  are given below:

Node	$B_i$ in kilobytes	$P_i$ in milliseconds
$N_1$	4	10
$N_2$	10	50
$N_3$	10	90
$N_4$	20	100

Choose suitable Target Token Rotation Time (TTRT) and obtain suitable values of  $f_i$  (total number of bits that can be transmitted by the node  $N_i$  over every cycle). Assume the propagation time is negligible compared to TTRT and that the system bandwidth is 1mbps.

- (b) Briefly describe a heuristic algorithm for generating Delay- and Delay Variation-Bounded Multicast Tree (DVBMT) problem.

6 + 6 = 12

**Group - E**

- 8.(a) What is an open system? Compared to a close system what is its advantage?  
(b) Traditional 2 phase locking (2PL) based concurrency control protocol may not be suitable for use in real-time databases. Why? Explain how traditional 2PL protocol can be extended for make it suitable for use in real-time database applications.

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- (c) Briefly explain why the traditional Unix kernel is not suitable to be used in a multiprocessor environment. Explain a spin lock and discuss its use in realizing a preemptive kernel.

**(1+2)+(2+2)+(3+2) = 12**

- 9.(a) Suppose, temporal data are denoted using triplets of the form {value, avi, timestamp} and that the different components of the temporal data have their usual meanings. Assume that the relative consistency set  $R = \{\text{position, velocity, acceleration}\}$  and  $R_{vi} = 100\text{ms}$ . Suppose the position, velocity and acceleration samples taken at given time instant are given by : Position = (25m, 2500ms, 200ms), Velocity = (300m/s, 2550ms, 300ms), Acceleration = (20m/s<sup>2</sup>, 2425ms, 200ms) . At the time instant 2600ms, determine whether the given data samples are i) absolutely consistent ii) relatively consistent.

- (b) Briefly indicate how Unix dynamically recomputes task priority values. What are the implications of such priority recomputations on real time application development?

- (d) What do you understand by temporal data?

**5+(3+2)+2= 12**