2022

1st Semester Examination

COMPUTER SCIENCE

Paper : COS 104

Full Marks : 40 Time : Two Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

1. Answer any ***four*** questions from the following : 2×4=8

   (a) What do you understand by behavioral and performance timing constraint?

   (b) What is "fail-safe" state of a system?

   (c) What do you understand by *unbounded priority inversion*?

   (d) What is POSIX?

   (e) Give and explain an example of stimulus response deadline.

   (f) What is bin-packing scheme?

   (g) "A cyclic schedular is more proficient than a pure time-driven schedular for scheduling a set of hard real-time tasks" — Justify or falsify the statement.

P.T.O.

(h) What do you understand by edge computing real-time application?

2. Answer any ***four*** questions from the following : 4×4=16

(a) Consider the following set of three periodic real-time tasks : T1 = (20,30), T2 = (15,60), T3=(20, 120) to be run on a uniprocessor. Determine whether the task set is schedulable under RMA.

(b) Why fault tolerance is essential to achieve high reliability? Briefly discuss the hardware fault tolerance techniques. 2+2

(c) Assume that the drift rate between any two clocks is restricted to $\rho = 5 \times 10^{-7}$. Suppose we want to implement a synchronized set of six distributed clocks using the central synchronized scheme so that the maximum drift between any two clocks is restricted to ϵ 2ms at any time, determine the period with which the clock need to be resyncronized.

(d) Explain using an appropriate example as to why a critical resource can get corrupted if the task using it is preempted, and then another task is granted use of the resource.

(e) Suppose a network designed using IEEE 802.4 protocol has three nodes. Node N1 needs to transmit 1 MB of data every 300ms. Node N2 needs to transmit 1.2 MB of data every 500ms. Node N3 needs to transmit 1.2 MB of data every 500ms. Select a suitable TTRT for the network and compute the token holding time for each node.

(f) Discuss the deficiencies of Windows as Real-Time OS.

(g) Real-time tasks are normally classified into periodic aperiodic and sporadic real-time tasks. What are the basic criteria based on which a real-time task can be determined to belong to one of the three categories? Give one example of each category. 2+2

(h) Consider the following set of four independent real-time periodic tasks :

Task	Start time (nSec)	Processing time (nSec)	Period (nSec)
T1	20	25	150
T2	40	10	50
T3	20	15	50
T4	60	50	200

Assume that task T3 is more critical than task T2. Check whether the task set can be feasibly scheduled using RMA.

3. Answer any *two* questions from the following : 8×2=16

(a) Explain the operations of priority ceiling protocol (PCP) in sharing critical resources among real-time tasks. Explain how PCP is able to avoid deadlock, unbounded priority inversion and chain blockings. 2+2+2+2

P.T.O.

(b) Discuss briefly various features of the Real-Time operating system.

(c) Identify key difference among hard, soft and firm real-time system. Give one example of real-time tasks corresponding to each of these three categories. Identify timing constraints in your tasks and justify why the tasks should be categorized into the categories that you have indicated.

(d) A set of hard real-time periodic tasks need to be scheduled on a uniprocessor using RMA. The following table contains the details of these periodic tasks and their use of three non-preemptive shared resources. Can the tasks T2 and T3 meet their respective deadlines when priority ceiling protocol (PCP) is used for resources scheduling?

Task	$\mathbf{p}_i$	$\mathbf{e}_i$	$\mathbf{R}_1$	$\mathbf{R}_2$	$\mathbf{R}_3$
T1	400	30	15	20	–
T2	200	25	–	20	10
T3	300	40	–	–	–
T4	250	35	10	10	10
T5	450	50	–	–	5

p_i indicates the period of the task T_i and e_i indicates its computation time. The period of each task is the same as its deadline. The entries in the R_i columns indicate the time duration for which a task needs the named resource in non-preemptive mode. Assume that after a task releases a resource, it does not acquire the same or any other resource.
