Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/ME (CSE)/M.Tech (SE/IT)/SEM-1/PGCSE-102/PGIT-105/PGSE-102/2009-10

2010

DISTRIBUTED REAL TIME OPERATING SYSTEM / REAL TIME OPERATING SYSTEM / ADVANCED OPERATING SYSTEMS

Time Allotted : 3 Hours Full Marks : 70

The figures in the margin indicate full marks.

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

GROUP – A

1. Answer any *five* of the following : 5 × 2 = 10

   i) What do you mean by "tardiness" of job ?

   ii) Give an example (with proper reasoning) of a Real-Time Application that should not be modelled using the Periodic Task Model.

   iii) Name two temporal parameters, functional parameters and resource parameters of jobs/tasks modelled according to the Periodic Task Model.

iv) Name and briefly describe two performance metrics used to measure the performance of schedulers used for scheduling jobs in Real-Time System.

v) What do you mean by the term "lateness of a job" ? How does it differ from "tardiness" ?

vi) How does release time and execution time jitter of jobs affect the performance of the Periodic Task Model ?

GROUP – B

Answer any *two* of the following. 2 × 15 = 30

2. a) Define 'Hyperperiod' of a set of periodic tasks. What is the usefulness of hyperperiod in the Periodic Task Model of a Real-Time (RT) System ? What is the upper bound of total processor utilization for a set of tasks for which is feasible schedule is available ? In a mostly cyclic RT system, how are aperiodic tasks generally accomodated by the scheduler ? What do you understand by the term 'feasible interval' of a job J in a deterministic work load model of a RT system ?

1 + 2 + 1 + 2 + 1

b) What is a feasible schedule ? What is an optimal scheduler ? What are aperiodic tasks and how do they differ from sporadic tasks ? What do you understand by the statement "The interarrival times of the jobs in an aperiodic task are generally given by an identically distributed random variable X with some probability distribution $A(X)$" ? 2 + 2 + 2 + 2

3. a) Using an example of your choice, discuss why weighted round robin algorithm is not suitable for scheduling precedence constrained jobs in a RT system. 5

b) From a RT system perspective, what is a dynamic system and what is a static system ? Which would you prefer for implementing a mostly hard RT system ? Why ? 2 + 1 + 1

c) Under what conditions is the EDF scheduling algorithm optimal ? Prove the optimality of the EDF algorithm under your stated conditions. 2 + 4

4. a) Prove that fixed priority based scheduling algorithms cannot be optimal. 4

b) What do you mean by Maximum Schedulable Utilization (MSU) of a scheduling algorithm ? What is the MSU of the RMS algorithm for a system with 9 periodic tasks ? 1 + 1

c) State the conditions under which the RMS algorithm is optimal. Prove that optimality of RMS algorithm under those conditions. 2 + 4

d) Compare the behaviour of RMS *vs* EDF algorithm during system overload using an example of your choice. 3

GROUP – C

Answer any *two* of the following. 2 × 15 = 30

5. Consider a system that has five independent, preemptable periodic tasks *A*, *B*, *C*, *D* and *E* and three processors *P*1, *P*2 and *P*3. The periods of *A*, *B* and *C* are 2 and their execution times are equal to 1. The periods of *D* and *E* are 8 and their execution times are 6. The phase of every task is 0.

a) Show that if the tasks are scheduled dynamically on three processors according to the LST algorithm, some jobs in the system cannot meet their deadlines. 5

b) Find a feasible schedule of the five tasks on three processsors. 4

c) Show the schedule of the five tasks on three processors using the LRT algorithm. Is the schedule feasible ? 6

6. Consider a structured cyclic schedule :

a) Discuss the consequences of using a frame size that

i) is too large

ii) is too small

iii) does not divide the hyperperiod of the set of tasks to be scheduled. 2 + 2 + 2

b) State and prove the constraint to be imposed on the frame size so that it becomes possible for the scheduler to determine whether every job completes by its deadline. 5

c) Choose an appropriate frame size for the following tasks to be scheduled according to a cyclic schedule :

$T1 = (4, 0{\cdot}5)$, $T2 = (5{\cdot}6, 1)$, $T3 = (6, 2)$ 4

7. a) State the conditions under which deadlocks can occur. Explain how priority ceiling protocol prevents deadlocks by preventing the occurrence of one or more of those conditions. Use an example of your own to illustrate your explanation. What is the biggest disadvantage of the priority ceiling protocol compared to the priority inheritance protocol ? 2 + 5 + 4 + 1

b) A system contains five jobs. There are three resources X, Y and Z. The resource requirements of the jobs are as follows :

$J1$: [X; 2], $J2$: none, $J3$: [X; 4] [Z; 1], $J4$: [Y; 1], $J5$ [Y; 3] [Z; 2]. The priority of Ji is higher than the priority of Jj for $i > j$. What are the maximum blocking times of the jobs under the NPCS protocol ? 3