Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B. Tech

PECS 5403

Seventh Semester Examination – 2011

REAL-TIME SYSTEMS

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

(a) When a system is said to be "real time system" ?

(b) What is a safety critical system ?

(c) What is a clock-driven scheduler and how it is different from the event-driven scheduler ?

(d) What are the shortcomings of the EDF real time task scheduling algorithm ?

(e) Under what circumstances the unbounded priority inversion occur ?

(f) What are the two most important problems of Priority Inheritance Protocol (PIP) ?

(g) Is the 2PL-WP protocol used in concurrency control in real-time databases, free from deadlocks ?

(h) In a logical ring, is it necessary that the order of nodes in the ring must be the same as their order in the physical network ?

(i) Specify the names of 5 contemporary real-time operating systems

(j) Can a task undergo Chain Blocking in Highest Locker Protocol (HLP) ?

2. (a) Draw the block diagram of the basic model of a real-time system, showing its important hardware components and their interactions. Explain the role of the different components. 5

(b) Identify the key differences between hard real-time, soft real-time and firm real-time systems. Give atleast one example of real-time tasks corresponding to these three categories. Identify the timing constraints in your tasks and justify why the tasks shouldbe categorized in to the categories you have indicated ? 5

P.T.O.

3. (a) What do you understand by **scheduling point** of a task scheduling algorithm ? How are the Scheduling points determined in (i) clock-driven, (ii) event-driven, and (iii) hybrid schedulers ? How will your definition of **scheduling points** for the clock-driven scheduler change when **self-suspension** of tasks are taken in to account ? 5

b) Consider a real-time system which consists of three tasks T_1, T_2, and T_3 which have been characterized in the table below :

Task	Phase (mSec)	Execution Time (mSec)	Relative Deadline (mSec)	Period (mSec)
T_1	20	10	20	20
T_2	40	10	50	50
T_3	70	20	80	80

If the tasks are to be scheduled using a table-driven scheduler, what is the length of time for which the scheduler have to be stored in the pre-computed schedule table of the scheduler ? 5

4. (a) Briefly explain while scheduling a set of hard real-time periodic tasks, why RMA can not achieve 100% processor utilization without missing task deadlines? 5

(b) Determine whether the following set of periodic real-time tasks is schedulable on a uniprocessor using RMA. Show the intermediate steps in your computation. Is RMA optimal when the task deadlines differ from task periods? 5

Task	Start-Time (mSec)	Processing-Time (mSec)	Period (mSec)	Deadline (mSec)
T_1	20	25	150	100
T_2	40	7	40	40
T_3	60	10	60	50
T_4	25	10	30	20

5. (a) Explain the operation 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 ? 5

(b) A set of hard real-time periodic tasks need to be scheduled on a uniprocessor using RMA. The following contains the details of these periodic tasks and their use of three non-preemptable shared resources. Can the tasks T_2 and T_3 meet their respective deadlines,when priority ceiling protocol (PCP) is used for resource scheduling ?

Task	p_i	e_i	R_1	R_2	R_3
T_1	400	30	15	20	
T_2	200	25	-	20	10
T_3	300	40	-	-	-
T_4	250	35	10	10	10
T_5	450	50	-	-	5

p_i indicates the the period of task T_i and e_i indicates its computation time. The entries in the R_1, R_2, and R_3 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. 5

6. (a) Explain why algorithms that can be satisfactorily used to schedule real-time tasks on multi-Processors often are not satisfactory to schedule real-time tasks on distributed systems, and vice versa ? 5

(b) Describe the focused addressing and bidding and the buddy schemes for running a set of real-time tasks in a distributed environment ? Compare these two schemes with respect to communication overhead and scheduling proficiency. 5

7. (a) Explain how a real-time database differs from a conventional database. Illustrate a few practical applications requiring the use of a real-time database. 5

(b) Why the traditional 2 phase locking (2PL) based concurrency control protocol may not be suitable for use in real-time databases ? Explain how the traditional 2PL protocol can be extended to make it suitable for use in real-time database applications. 5

8. (a) What do you understand by the term "hard real-time communication support by a network" ? Give two example applications where hard real-time communication support from the underlying communication network is required. Give an overview of how hard real-time communication can be supported by a network. 5

(b) Explain the features of any commercial real-time operating system you have studied. 5