MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL (A constituent unit of MAHE, Manipal)

## SIXTH SEMESTER B.TECH. (E & C) DEGREE END SEMESTER EXAMINATION JUNE 2019

## SUBJECT: REAL TIME SYSTEMS (ECE - 4004)

## **TIME: 3 HOURS**

MAX. MARKS: 50

## Instructions to candidates

- Answer ALL questions.Missing data may be suitably assumed.
- 1A. With a neat diagram explain the structure of a real time system. Illustrate with suitable example.
- 1B. Write whether the following statements are TRUE or FALSE. Justify your answer.
  - a) A good algorithm for scheduling of hard real time tasks tries to complete each task in the shortest possible time.
  - b) Scheduling decisions are made only at the arrival and completion of tasks in a nonpreemptive event-driven task scheduler.
  - c) A basic problem with clock driven scheduling strategies is their inability to handle a large number of tasks.
- 1C. Explain the important differences between hard, firm and soft realtime systems.

(4+3+3)

- 2A. Define semaphore and their types. Discuss the typical uses of semaphore.
- 2B. Draw the finite state machine for task execution and explain all the states.
- 2C. Answer the following:
  - a) Suppose that the sampling period of a furnace to read the temperature and to determine the flow rate of a fuel, air and coolant is 100 msec. And the system begins its first law of computation at time 20msec. What is the release time of J3 among J0, J1, J2----- Jn where n=0, 1, 2 etc.
  - b) Consider a command generated by a system to stop the train is within 1msec and the actuator functions after 5 msec. What is the tardiness of the job? Is the timing constraint being deterministic or probabilistic? Give reason.
  - c) The job that executed to accomplish the task of changing autopilot system resulted in a change from cruise mode to standby mode. Can you call this an aperiodic or sporadic task? Give reason

(4+3+3)

3A. The system has four jobs and their parameters are as given below. The jobs are scheduled on two identical processors in a priority driven manner. The priority order is J1 having highest and J4 the least. The system is dynamic meaning jobs may be pre-empted but not migrated. Show the feasible schedule. Is there be any anomalous behaviour of the system due to the jitter in execution? Give your answer.

	$r_i$	$d_i$	$[e_i^{-}, e_i^{+}]$
$J_1$	0	10	5
$J_2$	0	10	[2, 6]
$J_3$	4	15	8
$J_4$	0	20	10

- 3B. Give the advantages and disadvantages of EDF algorithm. What is Domino's effect? Explain the Domino effect with the diagram for four tasks T1, T2, T3 and T4 with execution time equal to 2 and periods 5, 6, 7, 8 respectively.
- 3C. Using a cyclic real time scheduler suggest a suitable frame size that can be used to schedule the three periodic tasks T1, T2 and T3 with the following characteristics:

Tasks	Phase	Execution time (ms)	Relative deadline (ms)	Period(ms)
T1	0	20	100	100
T2	0	20	80	80
T3	0	30	150	150
				(4

4A. Consider a system that has five periodic tasks, A, B, C, D, and E, and three processors P1, P2, P3. 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 and the relative deadline of every task is equal to its period.

- 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.
- b) Find a feasible schedule of the five tasks on three processors.
- c) Parts (a) and (b) allow us to conclude that the LST algorithm is not optimal for scheduling on more than one processor. However, when all the jobs have the same release time or when they have the same deadline, the LST algorithm is optimal. Prove this statement.
- 4B. Draw a network flow graph that we can find a pre-emptive cyclic schedule of the periodic tasks T1=(3,1,7), T2=(4,1), T3=(6,2.4,8).
- 4C. A system consists of three periodic tasks: (3, 1), (5, 2), and (8, 3).
  - a) What is the total utilization?
  - b) Construct an EDF schedule of this system in the interval (0,32). Label any missed deadlines.
  - c) Construct a RM schedule for this system in the interval (0,32). Label any missed deadlines

(4+3+3)

- 5A. Elaborate the real time communication model with relevant diagram.
- 5B. Differentiate the priority inheritance protocol and priority ceiling protocol. Where they are used ?
- 5C. Discuss briefly the traditional performance measures in real time systems.

(4+3+3)