MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL (A constituent unit of MAHE, Manipal)

SIXTH SEMESTER B.TECH. (E & C) DEGREE END SEMESTER EXAMINATION APRIL/MAY 2019 SUBJECT: REAL TIME SYSTEMS (ECE - 4004)

TIME: 3 HOURS

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.
- 1A. What is the basic difference between Embedded systems and Real time systems? Discuss the characteristics of real time systems.
- 1B. Describe how the applications of real time systems are divided according to their timing attributes. Give suitable example for each class.
- 1C. What are the distinguishing characteristics of periodic, aperiodic and sporadic real-time tasks?

(4+3+3)

MAX. MARKS: 50

- 2A. Explain the following kernel objects with help of state diagram:a) Semaphore b) Mutex c) Message queues
- 2B. Define the following: i) Effective release time ii) relative deadline iii) tardiness iv) laxity type v) feasible schedule vi) hyper period
- 2C. Give reason for the followings:
 - a) Consider a computer control aircraft. Its tasks include maintaining stability and keeping the cabin temperature within acceptable limits. Suppose the aircraft encounters turbulence that makes it momentarily unstable. Whether round robin scheduling is useful? If not what is the alternate solution?
 - b) An autopilot system is required to respond to a pilot's command to disengage the autopilot and take over the control manually within a specific time. Whether you call this aperiodic or sporadic task?
 - c) Binary semaphore may encounter a problem in sharing the common resource among two tasks. What is the solution?

(4+3+3)

- 3A. A system contains nine jobs named Ji, for i = 1, 2, ..., 9. Their execution times are 3, 2, 2, 2, 4, 4, 4, 4, and 6 units respectively, their release times are equal to 0, and their deadlines are 12. J1 is the immediate predecessor of J9, and J4 is the immediate predecessor of J5, J6, J7, and J8. There is no other precedence constraints. For all the jobs, Ji has a higher priority than Jk if i < k.
 - a) Draw the precedence graph of the jobs.
 - b) Can the jobs meet their deadlines if they are scheduled on three processors non preemptively?

- c) Can the jobs meet their deadlines if we make them pre-emptible but without migration on three processors? Show the schedule. Explain your answer.
- d) Can the jobs meet their deadlines if they are scheduled non pre-emptively on four processors? Explain your answer.
- 3B. The uniprocessor system has three independent jobs J1, J2 and J3 with release times are 0, 2 and 4 respectively. Their execution times are 3, 6 and 4; and their deadlines are 10, 14 and 12 respectively.

a) Show the feasible schedule if the jobs are non-pre-emptible.

b) Schedule the given jobs using LST algorithm. Compute the slack time of each job.

3C Determine whether the following set of periodic real time tasks are schedulable on an uniprocessor using RMA. Apply the schedulable test constraints before scheduling.

Task	Phase (ms)	Processing Time(ms)	Period (ms)	Deadline (ms)
T1	10	5	20	50
T2	20	10	40	40
T3	30	15	60	60
T4	40	15	30	20

(4+3+3)

- 4A. A system contains the following periodic tasks: T1=(5,1), T2=(10,1,9), T3=(10,3) and T4=(30,5)
 - a) What is the possible frame size? b) Draw the network flow graph of the system.
 - c) Find a cyclic schedule by solving the network flow graph in part (b) or show that the system can be feasibly scheduled according to the frame size chosen. NOTE: Preemption are allowed but number of pre-emption should be kept small.
- 4B. In the task graph shown below, the number next to the name of each job is its execution time. J4 is released at 4 and all other jobs are released at time 0. Given that J_i has higher priority than J_k if i<k. Schedule these jobs with priority driven pre-emptive and non-pre-emptive scheduling on two processor system using a) dynamic scheduling b) static scheduling by assigning J₁-J₄ for processor 1 and J₅-J₈ on processor 2. (Note: jobs can be migrated)



4C. Explain the bounded and unbounded priority inversion with suitable example diagram.

(4+3+3)

- 5A. What is the critical section? Explain the Priority –Inheritance protocol by giving a suitable example.
- 5B. With the help of a real time communication model, give the architectural overview of real time communication

(5+5)