Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent Institution of MAHE, Manipal)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
END SEMESTER EXAMINATIONS, DECEMBER 2018
SUBJECT: REAL TIME SYSTEMS [ELE 4004]
REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 01, December 2018** **Max. Marks: 50**

Instructions to Candidates:
- Answer **ALL** the questions. Graph sheet will be provided.
- Missing data may be suitably assumed. All values representing time is in milliseconds

1A. Identify the timing constraints and construct three Extended Finite State Machine model of a telephone system whose partial behavior is described as:

"After lifting the receiver headset, the dial tone should appear within 2 seconds. If a dial tone cannot be given within 2 seconds, then an idle tone is produced. After the dial tone appears, the first digit should be dialed within 30 seconds and the subsequent five digits within 5 seconds of each other. If the dialing of any of the digit is delayed, then an idle tone is produced. The idle tone continues until the receiver handset is replaced." ***(03)***

1B. A cyclic real-time scheduler is to be used to schedule three periodic tasks with the characteristics shown in **Table 1B**. Suggest a suitable frame size that can be used. Show all the intermediate steps in your calculations. ***(03)***

1C. Check for feasibility of a pre-emptive Rate Monotonic (RMA) scheduler used for task set shown in **Table 1C** using graphical method for time demand analysis. ***(04)***

2A. Rate monotonic (RMA) is used to schedule a set of periodic hard real-time tasks in a system. Is it possible in this system that a higher priority task misses its deadline, whereas a lower priority task meets its deadlines? If your answer is negative, prove your assertion. If your answer is affirmative, give an example involving three tasks scheduled using RMA where the lower priority task meets all its deadlines whereas the higher priority task misses its deadline. ***(03)***

2B. Consider a real-time system task set shown in **Table 2B,** using Deadline Monotonic (DM) Algorithm schedule the tasks in the time interval [0 to 250ms]. Verify the feasibility of scheduler with analytical method. Assume only Task 1 has a phase of 50ms and remaining tasks have zero phase and deadline is relative to the phase. ***(03)***

2C. Consider a real time system periodic task set given in **Table 2C** with the restrictions throughout its operation as: uni-processor, preemptive tasks, period and deadline are relative to arrival time, if priorities of tasks are equal then task with lower index has the highest priority. Schedule task set in RMA and Earliest Deadline First (EDF) for timeline [0 to 100ms] and verify its feasibility ***(04)***

3A. State the modifications to be made to the task parameters of an EDF scheduler to handle the task dependency. For the task set, parameter and dependencies shown in **Figure 3A**, make suitable modifications to the task parameters for it to be schedulable. Show all the calculations and assume task parameter is given as (release time, execution time, deadline) respectively. ***(03)***

3B. Schedule the task set shown in **Table 3B** using Least Slack Time (LST) Scheduling method. Show the time-line [0 to 23ms] of the schedule. Show all the intermediate steps in your calculations for schedule. ***(03)***

3C. A real-time system runs with task set shown in **Table 3C**, scheduled with the pre-emptive RM scheduler. Consider three Aperiodic job arrives as shown in Table 3C. Schedule the task set in the timeline if a simple sporadic-server with period of 5ms and execution budget of 1.5ms is used. Schedule the task set in the timeline and draw the server budget consumption graph for a duration of 0 to 25ms. ***(04)***

4A. Explain three types of Priority Inversions in the Priority Ceiling Protocol (PCP). What are the advantages of PCP over other priority protocols? ***(03)***

4B. Write a pseudo code to show the working procedure of distributed clock synchronization. Explain the problems of byzantine clocks in distributed clock synchronization. If a distributed system has 10 clocks, and it is required to restrict the maximum drift to 1ms and maximum drift of clocks per unit time is $5 * 10^{-6}$. Determine the required synchronization interval. ***(03)***

4C. A system has tasks T_1, T_2, T_3, T_4, T_5, and T_6 with priority order given as: $T_1 > T_2 > T_3 > T_4 > T_5 > T_6$. The resource and computing requirements of these tasks are shown in **Figure 4C**. Compute different type of inversion that each task might undergo in the worst-case condition. Clearly state the reason for each such computation. ***(04)***

5A. Explain the working principle of any three static task assignment algorithms for RMA or EDF task schedulers in a distributed multi-processor real time system. ***(03)***

5B. Explain the working of IEEE 802.4 protocol used to provide real-time guarantees in a system. If a network designed using IEEE 802.4 protocol has three nodes: N1, N2, N3 which needs to transmit 2 MB, 2.4MB, 4MB of data every 600msec, 1000msec, 400msec. Select suitable Target Token Rotation Time and determine the synchronous bandwidth of the nodes. ***(03)***

5C. Give an overview of POSIX standard. Mention the requirements for an operating system to be real-time POSIX standard compliant. ***(04)***

Table 1B			
Task	Period	Execution	Deadline
T1	4	1	4
T2	5	2	5
T3	20	5	20

Table 1C			
Task	Period	Execution	Deadline
T1	80	10	80
T2	50	10	50
T3	40	10	40
T4	100	10	100
T5	30	10	30

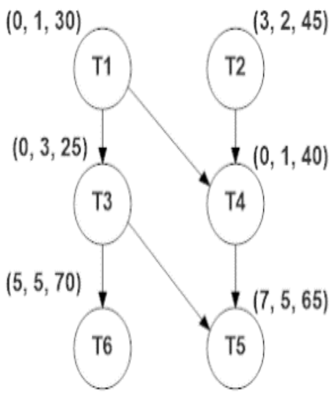

Figure 3A

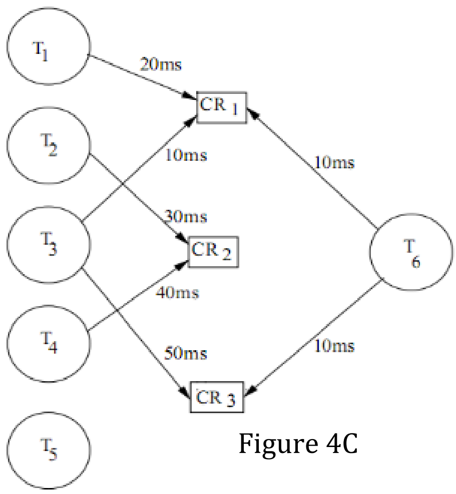

Figure 4C

Table 2B			
Task	Period	Execution	Deadline
T1	50	25	100
T2	62.5	10	20
T3	125	25	50

Table 2C				
Task	Arrival	Period	Execution	Deadline
T1	25	30	10	20
T2	40	40	7	40
T3	60	60	10	50
T4	20	150	25	100

Table 3B			
Task	Arrival	Execution	Deadline
T1	0	10	33
T2	4	3	28
T3	5	10	29

Table 3C					
Periodic	Period	Execution	Aperiodic	Arrival	Execution
T1	3	0.5	A1	3	1
T2	4	1	A2	7	2
T3	19	4.5	A3	15.5	3