Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, DECEMBER 2020

REAL TIME SYSTEMS [ELE 4004]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 30 December 2020** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed. Representation of time is in mili-seconds.
- Nomenclature: Period(P); Execution time(E); Deadline(D); Arrival (A); Aperiodic (AP); Task (T)

1A. What is a 'real-time system'? Explain how the concept of real-time is different from the traditional notion of time? What are the three types of real-time tasks classified based on the consequences of a task missing its deadline? Explain each of the types with the help of an example. Compare semaphore and Mutex for a real time operating system with suitable example. ***(04)***

1B. 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)***

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

2A. Check for feasibility of a pre-emptive Rate Monotonic (RM) scheduler used for task set shown in **Table 2A** using analytical calculations for time demand analysis and verify the same with graphical method. ***(04)***

2B. Schedule the task set shown in **Table 2B** 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)***

2C. Generate an example to show that if the utilization U>1, then it doesn't imply non-feasibility for Earliest Deadline First (EDF) Scheduler. Check by scheduling taskset in timeline. ***(03)***

3A. A real-time system runs on pre-emptive RM scheduler with three periodic task (T) set and three Aperiodic (AP) job arrives at instances (A) as shown in **Table 3A**. 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)***

3B. Schedule in timeline and compare preemptive and non-preemptive scheduling for the following jobs to be run on a dual-processor system. The precedence graph is given in **Figure 3B.** J1(E1=3), J2(E2=4), J3(E3=1), J4(E4=2), J5(E5=11). All the jobs are released at zero except for J2 which is released at 4ms. Assume Priority is higher for jobs with lower index. ***(03)***

3C. A real-time system runs with task set shown in **Table 3C**, scheduled with the pre-emptive RM scheduler. Consider an Aperiodic job arrives at time t=0.1ms and has an execution time of e=0.8ms. Schedule the task set in the timeline and calculate the response time of Aperiodic job. For the same task set if a poller server with period of 2.5ms and execution budget of 0.5ms is used Schedule the task set in the timeline and calculate response time of Aperiodic job. ***(03)***

4A. Design a deferable server for the task set shown in **Table 4A**. Assume an aperiodic task with execution time 1.5ms arrives quite at random in every 8ms. Use pre-emptive RM scheduler for the system. Check for the system feasibility with server using analytical time demand approach. ***(04)***

4B. 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 4B**. Compute different type of inversion under PCP that each task might undergo in the worst-case condition. State the reason for each such computation. ***(03)***

4C. Write an Algorithm/Flowchart to show the working of Priority Ceiling Protocol (PCP) considering all the clauses/rules. Support the explanation by generating suitable example/s using set of tasks and resources for all the clauses/rules. ***(03)***

5A. Explain in detail the modifications made to RM and EDF algorithms to handle task dependencies or precedence constraints. ***(04)***

5B. What are the important requirements for an operating system to be called as real-time operating system? ***(03)***

5C. Explain the working of count-down protocol used in real time communication for LAN. With the help of an example explain how high priority message is determined in Count-down protocol. ***(03)***

Table 1C			
T	P	E	D
T1	8	3	8
T2	7	2	7
T3	5	1	5

Table 3A					
T	P	E	AP	A	E
T1	3	0.5	A1	3	1
T2	4	1	A2	7	2
T3	19	4.5	A3	15.5	2

Table 3C			
T	P	E	D
T1	3	1	3
T2	10	4	10

Table 2A			
T	P	E	D
T1	3	1	3
T2	5	1.5	5
T3	7	1.25	7

Table 4A			
T	P	E	D
T1	3	0.5	3
T2	20	5	20
T3	60	10	60

Table 2B			
T	A	E	D
T1	0	10	33
T2	4	3	28
T3	5	10	29

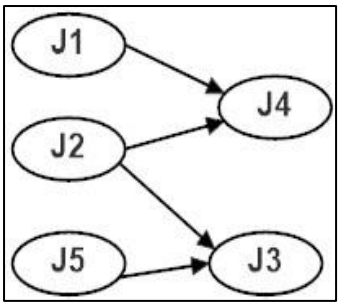

Figure 3B

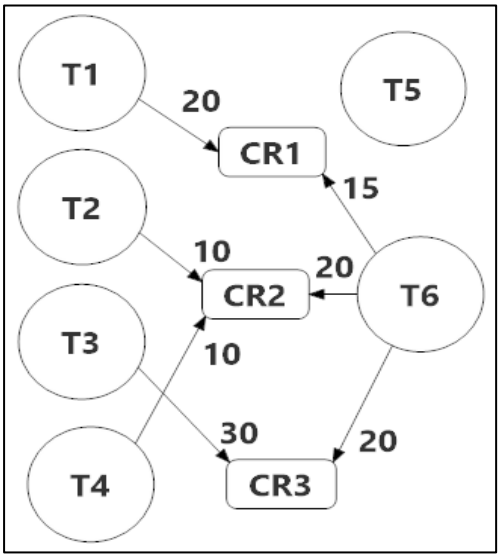

Figure 4B