MID TERM EXAM – IV Year EVEN SEM (2017-2018)

MM: 25 Sub: Real-Time Systems (RTS) Time: 1.5 Hrs

1. State whether the following statements are TRUE or FALSE. Justify your answer. (4 marks)
   a) A good algorithm for scheduling of hard real-time tasks tries to complete each task in the shortest possible time.
   b) Soft real-time tasks do not have any associated time bounds.
   c) With EDF a higher utilization is possible than with RMS.
   d) The LL-bound ($LL(n)=n(2^{1/n}-1)$) and HB-bound ($HB(n): \prod(U_i+1)\leq 2$) are examples of sufficient conditions for fixed-priority preemptive scheduling (FPPS). Give at least three assumptions on which these bounds are based.
2. Draw the full scheduling tree for the following set of non-premptive tasks and mark the branches that are pruned by the Bratley's algorithm. (3 marks)

| | J1 | J2 | J3 | J4 |
|---|---|---|---|---|
| $a_i$ | 0 | 4 | 2 | 6 |
| $C_i$ | 6 | 2 | 4 | 2 |
| $D_i$ | 18 | 4 | 7 | 4 |

3. Consider the following taskset. (5 marks)

| Name | Priority | Computation Time | Resources |
|---|---|---|---|
| $\tau_1$ | 1 | $C_1$ | *Ra, Rb* |
| $\tau_2$ | 2 | $C_2$ | *none* |
| $\tau_3$ | 3 | $C_3$ | *Ra* |
| $\tau_4$ | 4 | $C_4$ | *Rb* |

The priorities are fixed with lower numbers representing higher priorities. The tasks need resources that they reserve through a regular locking mechanism. For example, task $\tau_1$ needs resources *Ra* and *Rb* for its operations and acquires them in that order.
   a) Discuss two scenarios for priority inversion.
   b) Assume that we use the priority inheritance protocol to resolve this. What is the maximum blocking time for $\tau_1$ expressed in the given computation times? And what is this value if the priority ceiling protocol is used?
4. How can the following taskset be optimally scheduled (using fixed priority scheduling)? Is this task set schedulable? (6 marks)

| | Time Period | Computation Time | Relative Deadline |
|---|---|---|---|
| $\tau_1$ | 8 | 4 | 8 |
| $\tau_2$ | 10 | 2 | 7 |
| $\tau_3$ | 30 | 5 | 30 |

Now we include the Maximum Blocking time also for each task as shown below.

| | Time Period | Computation Time | Blocking Time | Relative Deadline |
|---|---|---|---|---|
| $\tau_1$ | 8 | 4 | 2 | 8 |
| $\tau_2$ | 10 | 2 | 2 | 7 |
| $\tau_3$ | 30 | 5 | 0 | 30 |

Is the task set schedulable? If not, what change in deadline parameter will make it schedulable.
5. Consider two jobs J1 (r1, C1, d1) and J2 (r2, C2, d2) where J1 precedes J2 (i.e., J1 -> J2), but J2 arrives before J1 and has an earlier deadline. How can the two taskes be scheduled so that the timing and precedence constraints are met. The tasks are preemptable. Assume that C1+C2 < d2. (3 marks)
6. Formulate processor demand function for 'n' preemptive periodic tasks with deadlines less than periods. (4 marks)