Seminar 3 problem Sheet

1. Given the following task set:

Process	CPU	Period
A	1	5
B	2	7
C	1	4

   a. What is the total utilisation for the set?
   b. Is the task set schedulable?
   c. Identify the highest and lowest priority processes using rate monotonic priorities.
   d. Assuming the processes are assigned rate monotonic priorities draw the timeline for the processes.
   e. Add one unit of time to the execution time for B. Calculate the total utilisation for the set. Is it schedulable? Draw the new timeline.

2. Assess the schedulability of the following processes:

Process	CPU	Period
A	1	5
B	3	6
C	3	14

3. Consider the following processes:

Process	CPU	Period
A	10	100
B	20	50
C	20	150
D	25	80

   a) List them in rate monotonic order, highest priority first, (assume 4 is high).
   b) Based on the above priority ordering are the processes schedulable? If not why not?
   c) Change the problem as follows: assume that process C executes as an interrupt instead of its rate monotonic priority, (i.e. it gets top priority). Use the Completion Time Theorem to show whether the 4 processes are schedulable. If not which processes miss deadlines?
   d) Draw time lines showing the execution patterns for the original problem and the modified problem.
   e) Based on the modified problem from part c make the following changes: assume that C involves 10 units of interrupt processing and 10 units of application processing. Use the following model to determine if the process set is schedulable:

      cpu + interference + blocking

      where blocking is the time due to C running at top priority. For the rest of the time C runs at its rate monotonic priority.

f) Returning to the original set up: assume that the processes have the following deadlines: (A:20), (B:50), (C:120), (D:80). Is the set now schedulable using the rate monotonic priority assignment?

4. Rework the problem using deadline monotonic priorities

5. Consider each of the following sets of processes. For each

a) Using the rate monotonic algorithm allocate priorities to each process
b) Calculate the utilisation for each process
c) Is this set of processes schedulable using the Utilisation Bound Theorem?
d) If the Utilisation Bound test fails use the Completion Time Theorem.
e) Identify the “scheduling points” for each set.
f) Draw a timing diagram showing how the set of processes would be scheduled.

Process	**C**	**T**
A	6	12
B	3	18
C	4	24
D	6	30

Process	**C**	**T**
A	20	100
B	30	150
C	30	210
D	70	400

Process	**C**	**T**
A	6	2000
B	20	200
C	40	100
D	10	114
E	2	66
F	2	14

We will now introduce process deadlines such that each deadline is less than or equal to the process period, i.e $D_i \le T_i$.
Reconsider each example and check to see if

a) The processes are schedulable under Rate Monotonic Priorities
b) The processes are schedulable under Deadline Monotimic Priorities.
c)

Process	C	T	D
A	6	12	12
B	3	18	18
C	4	24	16
D	6	30	10

Process	C	T	D
A	20	100	100
B	30	150	75
C	30	210	210
D	70	400	200

Process	C	T	D
A	6	2000	40
B	20	200	200
C	40	100	100
D	10	114	20
E	2	66	66
F	2	14	14

6. Below is a table which shows a process set of six processes:

Process	Period	Deadline	CPU
A	1000	20	3
B	100	100	10
C	50	50	20
D	57	10	5
E	33	33	1
F	7	7	1

a) What is the utilisation of this set ?
b) What is the priority ordering if *rate monotonic* is used?
c) What are the worst-case response times of the process set in rate monotonic ordering?
d) Are all deadlines met?

An alternative to rate monotonic is a scheme known as *deadline monotonic*. In this scheme the deadline value of a process is used to determine its priority. The shorter the deadline the higher the priority.

e) What is the priority ordering of the above set if deadline monotonic ordering is used?
f) What are the worst case response times of the process set using deadline monotonic ordering?
g) Are all deadlines met?
h) Add a new task, called G, to the above with a period of 30, a deadline of 5 and a cpu requirement of 2. Can the deadlines still be met?