Assignment 1: Scheduling

Note: Response-Time Analysis formula should not be used for this assignment.

Question 1 part 1:
Briefly explain the following concepts related to scheduling and schedulability analysis:

    a) Sufficient and necessary schedulability test
    b) Feasible schedule
    c) Task and task instance
    d) Task and processor utilization factor
    e) Static and dynamic priority scheduling
    f) Critical instant

Question 1 part 2:
Briefly explain the following terms in the context of offline scheduling:

    a) Schedulability
    b) Predictability
    c) Flexibility
    d) Communication and synchronization
    e) Jitter
    f) Heuristic

Question 2:
Assume the following set of periodic tasks that are to be scheduled by Rate Monotonic (RM) scheduling (all times are given in milliseconds):

Task	Period = Deadline	Execution time
A	3	1
B	5	2
C	2	0.5

    a) Determine if the task set above is schedulable by RM by applying appropriate schedulability analysis test.

    b) Draw the execution schedule for the task set assuming RM and that all tasks are released simultaneously. Draw the schedule for the full hyperperiod (LCM), or the first deadline miss, whichever occurs first.

Question 3:
Assume the following set of periodic tasks (all times are given in milliseconds):

Task	Period	Execution time
A	4	C_A=?
B	12	4
C	20	9

Find maximum C_A (not using trial and error) such that the task set is schedulable by Rate Monotonic.

Question 4:
Assume the following periodic task set (with values given in system clock ticks):

Task	Period = deadline	Execution time
A	10	3
B	14	3
C	13	2
D	8	2

Draw a scheduling trace showing how tasks execute during the time interval 0 – 30 clock ticks, assuming that scheduling is done according *to Earliest Deadline First (EDF)* principle.

Question 5:
Propose a task set with three periodic tasks A,B,C, such that the set is schedulable by Earliest Deadline First but not by Rate Monotonic. In other words, you should set periods, deadlines and the execution times of the task in such way that at least one of the tasks will miss its deadline if RM is used, but all tasks will make it if EDF is used. Motivate your answer!

Question 6:
Assume an online scheduled real-time system consisting of two tasks:

- task L, which has the lowest priority and it is time-triggered, and
- task H, high priority, event-triggered

Task L regulates the rotation speed of a motor and it has the period of 50 ms and the execution time of 10, while task H reacts on the changes (events) from user (e.g., increase/decrease speed), and it has the execution time of 3 ms.

How frequently (i.e. find the minimum inter-arrival time) can two events that H handles occur, such that the system is still schedulable?

Question 7:
   a) What is the main difference between Polling Server and Deferrable Server?

   b) Does Deferrable Server used together with Rate monotonic increases or decreases the Rate Monotonic schedulability bound?

   c) What is the main difference between Total Bandwidth Server and Constant Bandwidth Server?

Question 8:
Assume the following periodic task set:

Task	Period	Deadline	Execution time
A	6	6	1
B	8	8	2
C	12	12	3

   a) Specify the Polling Server for this task set. Maximize server utilization, i.e., do the best server you can. Motivate your answer e.g. by a schedulability analysis.

   b) The same question as above, but for Total Bandwidth Server.

c) Now assume two soft aperiodic tasks enter the system:

- First, A1 arrives at t=4, with an execution time of 2
- Second, A2 arrives at t=6, with an execution time of 2

Show an execution trace.