Embedded Information Systems: 1st Mid-Term Exam retake 12.12.2023

1. Assume there is no blocking and give the schedule of the following task set using the Rate-Monotonic algorithm (max. 2 points)! Give the worst-case response times of the tasks if blocking is unavoidable (max. 3 points))!

Task	$T[ms]$	$C[ms]$	$B[ms]$
1	10	4	5
2	15	3	3
3	20	2	0

   Assuming the application of the Dual Priority Scheduling method, determine the promotion time for task 2 for the case of simultaneous start of the tasks (max. 2 points)!

2. Within a communication system the maximum of the message forwarding time is $8\ ms$, while its jitter is $6\ ms$. Determine the value of the action delay (1) if the global time is available (max. 1 point); (2) if the global time is not available (max. 1 point)! What can we do if the temporal accuracy of the transmitted value is $12\ ms$ (max. 1 points)?

3. Using the Deadline Monotonic Analysis (DMA) method, calculate the worst-case response time of Task4, if the time difference between two occurrence of a single failure during task execution is minimum $T_F = 50ms$, and the error handling requires at maximum $C_F = 3ms$. (max. 4 points):

Task	$T[ms]$	$C[ms]$	$D[ms]$
1	100	5	10
2	10	2	10
3	100	25	50
4	100	30	100

4. We must schedule two hard real-time tasks. The requests are simultaneous: at the beginning both tasks are ready to run.

	$C[ms]$	$T[ms]$
τ_1	25	50
τ_2	80	200

   In addition to the two tasks a server task is also scheduled to provide processor capacity for aperiodic requests. The server period is $T_S = 100ms$, and the server capacity is $C_S = 10ms$. Show how the three tasks are scheduled with the RM algorithm (max. 2 points)! Firstly, apply the Polling Server (PS) algorithm, and after it use the Deferrable Server (DS)! Show how an aperiodic request at $18ms$ asking for processor time of $5ms$, and another aperiodic request at $90ms$ asking for processor time of $10ms$ is scheduled using PS and DS (max. 4 points)? Determine the response time of the aperiodic requests (max. 1 point)! How will the response time change if EDF together with a Total Bandwidth Server is applied (max. 3 points)?

5. Under what condition will be schedulable a periodic hard real-time task-set if $D_i < T_i$? Consider both static and dynamic priority assignment strategies (max. 3 points)!

6. Please verify that the following task-set can be scheduled using the EDF algorithm (max. 4 points)!

Task	$T[ms]$	$C[ms]$	$D[ms]$
1	30	10	25
2	40	10	20
3	60	20	40

7. Consider the following set of periodic tasks:

	$C[ms]$	$T[ms]$
τ_1	4	10
τ_2	4	12

After defining two Total Bandwidth Servers, TB_1 and TB_2, with utilization factors $\mu_1 = 1/10$ and $\mu_2 = 1/6$, construct the EDF schedule in the case in which an aperiodic request with $r_1 = 2\,ms$ and $C_1 = 1\,ms$ is served by TB_1, and an aperiodic request with $r_2 = 6\,ms$ and $C_2 = 1\,ms$ is served by TB_2 (max. 3 points)! Construct the schedule also for the case when a single Total Bandwidth Server is used with $\mu_s = 4/15$ and the aperiodic requests are the same (max. 3 points)!

8. We know the arrival time, the execution time, and the deadline of 5 hard real-time tasks (time is measured in ms):

	τ_1	τ_2	τ_3	τ_4	τ_5
a_i	0	4	0	16	26
C_i	6	2	12	4	6
d_i	32	14	16	22	36

Give the schedule using the Earliest Deadline First (EDF) algorithm (max. 3 points)!

To pass this Mid-Term minimum 16 points are required. Good luck!