Test 3 – Take home

Name: _____

- Test is open books and notes.

- Calculator is allowed.

- Students are NOT ALLOWED to collaborate on the exam. Each student must submit his/her own work.

- The total points is 100 points. Points for each problem are indicated at the beginning of the problem.

- Problem statements are intended to be unambiguous, but if you are unsure what one means, *you can contact me for clarification* or you may *clearly state your interpretation of the problem*.

- The due date to submit your answers is 11th Monday, June 14th, 2021, at 11:20 a.m.

- Submit your answers via Blackboard.

1. 20 points – Soft Timers

   Draw the data structure indicated in each part below for the given set of task delays. Assume that the data structures are empty initially, that the task calls occur in the order listed, and all occur in a single clock tick.

   Task A: 63 ms; Task B: 7 ms; Task C: 745 ms; Task D: 63 ms; Task E: 158 ms

   a. Non-sorted linked list

   b. Hierarchical timing wheels using a 10 element wheel of 1 ms slots, a 10 element wheel of 10 ms slots, and a 10 element wheel of 100 ms slots. Assume the clock dials are at 6 ms, 60 ms, and 600 ms respectively.

2. 25 points – Hyperperiod and utilization

For the sets of threads below, calculate:

a) The **hyperperiod**,
b) The **utilization per thread**,
c) The **total utilization**,
d) The **total number of jobs per hyperperiod**, and
e) The **maximum number of clock cycles allowable per context switch** so that the system still meets its deadlines.

Assume an 40 MHz CPU instruction clock, and that relative deadlines are equal to the thread periods. Also assume that the execution time is for the complete set of jobs, not the execution time per job.

Thread	p_i	e_i	j_i
1	6 ms	2 ms	8 jobs
2	10 ms	3 ms	12 jobs
3	15 ms	3 ms	15 jobs

3. 25 points – Cyclic Scheduler

For the periodic task set given below, calculate:

a) The **Hyperperiod (H),** and
b) **All valid values for the frame length**.

Show your work. Each thread is described by period, execution time, and the relative deadline. (6, 1, 6), (12, 3, 10), (9, 2, 12)

Thread	p_i	e_i	D_i
1	6 ms	1 ms	6 ms
2	12 ms	3 ms	10 ms
3	9 ms	2 ms	12 ms

4. 30 points – EDF, LST, and RR Scheduling

For the thread set below, generate the following schedules:
a) *Least Slack-Time First (LST)*
b) *Earliest Deadline First (EDF)*
c) *Round Robin (RR)*

Assume a preemptive system with one processor, no resource contention, and scheduling decisions are made during events (creation or termination of a thread). In the case of a tie, schedule the thread with the lowest ID number. For Round Robin, assume the time quanta is 1ms and new threads are added at the tail of the list. The columns r_i, e_i, and d_i represent absolute release times, execution times, and absolute deadlines respectively.

Thread	r_i	e_i	d_i
1	0 ms	5 ms	12 ms
2	0 ms	3 ms	13 ms
3	2 ms	4 ms	8 ms

Please create your schedule in a neat handwriting, or create it electronically in table or spreadsheet form, and include it in this document or attach it as a separate file.