COEN 418 : Real-Time Systems Design
Midterm Examination (March 5th, 2001)
Instructor: Dr. Purnendu Sinha

1. Consider the following fragment of **C** code which deals with *TIMER*:

```
struct timespec start_time, cur_time, est_time; /* places to hold time */
clock_gettime(CLOCK_REALTIME, &start_time); /* get the time */

myfoo(); /* Some arbitrary function */

clock_gettime(CLOCK_REALTIME, &cur_time); /* get the time again */
/* estimate the time of myfoo() */
est_time.tv_sec = cur_time.tv_sec - start_time.tv_sec;
est_time.tv_nsec = cur_time.tv_nsec - start_time.tv_nsec;
```

Suppose we plan to use the value *est_time* computed above as the execution time e_i of a job that executes function *myfoo*(), for the purpose of schedulability analysis. Explain *at least* **three** serious sources of error you can think of. Be very specific in your answer!! **[3 points]**

2. The following is the entire set of code words in some scheme.

A: 1000001000
B: 1111110000
C: 1111110100

Hd = 7 ?

What is the **hamming distance,** H_d for this code? Between which two words does it occur? How many bit errors can be corrected and detected with this set of code words. **[3 points]**

3. Draw the subsystem configuration for a system with four subsystems and an overall reliability function given by

$$r_1(t)r_4(t) + r_1(t)r_2(t)r_3(t) - r_1(t)r_2(t)r_3(t)r_4(t) \qquad \textbf{[4points]}$$

4. The following system of periodic tasks is scheduled and executed according to a cyclic schedule. Calculate an appropriate frame size for this task set: **(Show all the steps!)** **[7 points]**

τ_i	e_i	p_i	D_i
τ_1	1	4	4
τ_2	2	6	6
τ_3	5	16	16

5. Consider three tasks P, Q and S. P has a period of 25 milliseconds in which it requires 9 milliseconds of processing, represented as (25,9). The corresponding values (in milliseconds) for Q and S are (15,5) and (10,2), respectively. All tasks are periodic, independent, and have no precedence constraints. Deadline is being equal to task's period.

(a) Assume that P is the most important task in the system, followed by S and then Q. Illustrate the behavior of the scheduler if priority was based on importance. Show (using time-line) which task(s) would fail to meet its deadline.
(b) What is the processor utilization of P, Q and S?
(c) What are the possible ways to schedule the given task set so that all deadlines are met? Illustrate one of the schemes that will allow these tasks to be scheduled. Draw the time-line. **[8 points]**

~ MIDTERM ~

COEN 320 : Introduction to Real-Time Systems
Midterm Exam (October 25, 2000)
Instructor: Dr. Purnendu Sinha
Value: 35% of Final Grade

1. Consider any high-level programming language that you are familiar with. Which features of it prohibit the construction of schedulability analyzer? What can be done in order to make the language analyzable? *Please be specific. No credits will be given for irrelevant discussions.* **[5 pt.]**

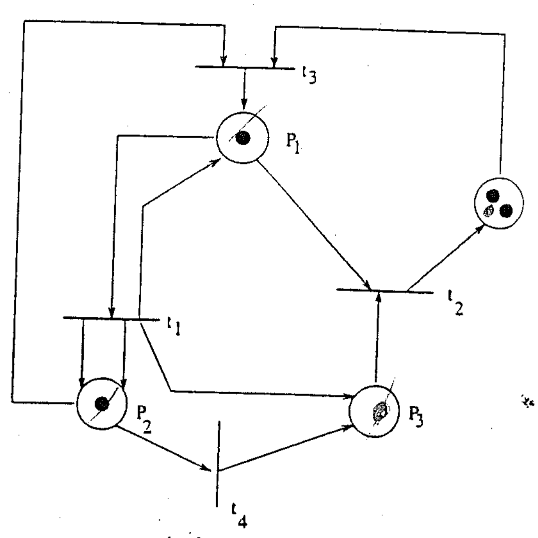
2. A system consists of three periodic tasks:

τ_i	e_i	p_i
τ_1	1	3
τ_2	2	5
τ_3	3	8

   - What is the total utilization?
   - Construct an earliest-deadline-first (EDF) schedule of this system in the interval (0,32). Label any missed deadlines.
   - Construct a rate-monotonic schedule for this system in the interval (0,32). Label any missed deadlines.
   - Suppose we want to reduce the execution time of the task with period 3 in order to make the task system schedulable according to the EDF algorithm. What is the minimum amount of reduction necessary for the system to be schedulable by the EDF algorithm? **[20 pt.]**
   - **[Bonus 5 pt.]** Verify the schedulability of the given task set under RMA using the response time analysis discussed in the class.

3. Consider the following Petri net (See Fig. 1). After Petri net fires twice, find a state where all transitions are *dead*, i.e., **no** further stage changes are possible. Identify the firing sequences for these transitions to result in a deadlock. **[10 pt.]**

when P4 & P3 have all the tokens we will get deadlock. So fire t4, t2 will get P4(3) and deadlock.



$t_4 \rightarrow t_2$.

Figure 1: Petri Net

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