First & Last Name: ____________________  Legi-Number: ____________________

Instructions:

- Put your Legi-Card on the Table.
- Write your Name and your Legi-Number on top of this page.
- Accurately read each question before solving it.
- There is at least one correct solution.
- You will get points only for correct and complete answers.
- Supporting Materials: Printouts, handwritten notes, and calculators are allowed. Devices that can be used for communication (laptops, phones, tablets, mp3 players, etc.) are NOT allowed.
- After test duration, leave your filled test and Legi-Card on the table infront of you. Do Not collect/aggregate tests in your row.
- Test duration: 10 minutes. Good luck!

Task 1: Periodic Tasks

(a) (3 Points) Consider a task-set consisting of three periodic tasks, A, B and C as listed in the table below.

<table>
<thead>
<tr>
<th>Task-set Γ</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Execution Time</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Relative Deadline</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Period</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

Select all the correct statements, assuming a Rate Monotonic (RM) scheduling policy:

- The worst case interference suffered by task A is 1.
- All tasks can always meet their deadlines.
- The worst case interference suffered by task B is 1.
- The worst case response time of task C is 5.

Task 2: Threads in BTnut

(a) (2 Points) You are given the following excerpt of a BTnut program:

```
13: int main(void)
14: btn_hw_init();
15: btn_led_init(0); // Switch off all LEDs
16: for(;;){
17: btn_led_set(LED_BLUE);
18: NutThreadYield();
19: NutThreadCreate("Blue", blue_thread, 0, 192);
20: btn_led_clear(LED_BLUE);
21: }
```

When this program is executed on the BTnode, which LEDs will be on?

- LED_RED and LED_BLUE
- Only LED_RED
- Only LED_BLUE
- None
(b) (1 Point) Select all statements that are a disadvantage of cooperative multi-threading:

- Simultaneous memory access by two threads leads to data corruption
- Poorly designed threads may bring the entire system to halt
- The operating system’s scheduler is responsible for thread priority assignment

Task 3: Microcontroller Programming

(a) (2 Points) The following assembler program for a BTnode starts executing at line 1:

```
1: ldi r10, 0x07
2: label:
3: ldi r11, 0x01
5: ldi r12, 0x0F
6: subi r11, 0x01
7: brne label
8: subi r10, 0x02
```

Select all correct statements:

- After program execution, the value of `r10` is 4.
- After program execution, the value of `r12` is 15.
- After program execution, the value of `r11` is 0.
- The program remains in an infinite loop.

Task 4: BTnode Schematic

(a) (2 Points) The figure below illustrates a modified version of the BTnode schematics, detailing how the four LEDs are interfaced to the microcontroller (not shown in the figure) using an external memory address bus. As in the original schematics, PC<0...7> is connected to the upper part (bits 8 to 15) of the microcontroller’s external memory address bus.

Which of the following lines of assembler code turns on the red and the blue LED?

- lds r24, 0x0008
- lds r24, 0x0700
- lds r24, 0x0007
- lds r24, 0x3333