

Question 1. (2 points)

Let us consider a simple system with two devices – a push button and an LED bulb. The LED illuminates when the button is pushed. Is this an embedded system. Why?

Question 2. (2 points)

What is context switching?

Question 3. (4 points)

What is an interrupt?

What is the difference between vectored interrupt and fixed interrupt?

Mention one advantage and disadvantage of vectored interrupt.

Question 4. (2 points)

When we develop software for general-purpose systems, it is often enough to make sure that the software is functionally correct. However, embedded systems must also satisfy non-functional properties. Give four examples of non-functional properties.

Question 5. (4 points)

Assume that size of char is 1 byte, size of int is 2 bytes, and size of float is 4 bytes. What will be the size of the type Data when defined as follows?

```
union Data
{
    int i;
    float f;
    char str[20];
} data;
```

Question 6. (4 points)

What do the nodes and edges represent in a dataflow model?
What does it mean when we say that a node may “fire” in a dataflow model?

Question 7. (2 points)

What is the difference between an embedded system and a real-time system?

Question 8.

- (a) A task set contains 3 tasks. Their execution times and periods are given as follows. C_i denotes execution times and T_i denotes periods. The periods are equal to the deadlines. Draw the Earliest Deadline First (EDF) schedule for the 3 tasks.

(3 points)

	C_i	T_i
Task 1	1	5
Task 2	2	4
Task 3	3	20

- (b) What is the criteria that is used to assign priorities in Rate Monotonic schedule? **(3 points)**

Question 9.

An electronic lock controlling entry to a door is one example of an embedded system. You may have seen similar locks, in black boxes next to restricted-entry doors at our university, with keys labeled 0 to 9. We're going to take a simpler keypad comprising just two keys, "0" and "1". The binary keypad provides inputs S to the Finite State Machine which must decide whether the correct input sequence of 0s and 1s has been entered. You are told that the entry code is the 4-bit sequence "0110". If this sequence has been correctly input to the FSM, then the FSM moves into its end-state where it outputs a "1" (i.e., the "open" command) to the release mechanism. Any incorrect sequence outputs a "0" which means "do not open".

A partial Moore Finite State Machine is shown in the figure below. It shows all the states but only some of the transitions. You should complete the FSM.

- Draw all the transitions and label them with the proper inputs. **(2 points)**
- Mark the initial and the final states. **(2 points)**
- Write the output in each state. **(2 points)**



Question 10.

In the following there are three macros that are supposed to calculate the power of a number, the area of a circle and the area of a rectangle. Are the definitions error free? If not, what may become wrong with the definitions?

```
#define POW(x) x*x
```

```
#define CIRCLE_AREA( x ) PI * x * x
```

```
#define RECTANGLE_AREA( x, y ) x * y
```

(3 points)

Question 11. (5 points)

Write a function that swaps odd and even bits in a given integer. (e.g., bit 0 and bit 1 are swapped, bit 2 and bit 3 are swapped etc.). You need to write pseudo-code, not syntactically correct C language.

It is mandatory to explain your approach to solve the problem. Correctness, efficiency of your algorithm and readability are important criteria to get full points.