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)

Explain in detail the difference in the working of polling versus interrupts.

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. Ci denotes execution times and Ti denotes periods. The periods are equal to the deadlines. Draw the Earliest Deadline First (EDF) schedule for the 3 tasks.
(3 points)

	Ci	Ti
Task 1	1	5
Task 2	2	4
Task 3	3	20

(b) Discuss the difference between EDF and Rate Monotonic schedule with respect to assignment of priorities. **(3 points)**

Question 9.

A Mealy Finite State Machine produces an output of 1 if in the input sequence it detects either a 110 or 101 patterns. Overlapping sequences should be detected.

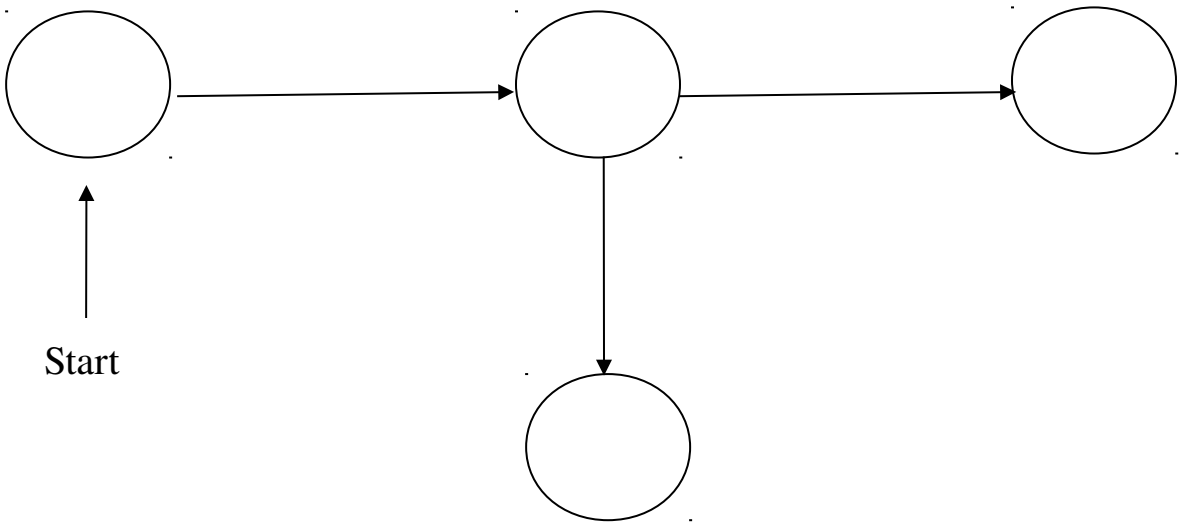
An example sequence is given below.

Input	0	1	1	0	0	1	0	1	1	0	0
Output	0	0	0	1	0	0	0	1	0	1	0

A partial Mealy 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.

a. Draw all the transitions and label them with the proper inputs. **(3 points)**

b. Are outputs associated with states or with transitions in a Mealy State Machine? Write the output at the appropriate place for this machine. **(3 points)**



Question 10. (3 points)

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
```

Question 11. (5 points)

Write a function called *isPowerOfTwo(int)* that takes an integer argument to determine the number of bits required to convert integer A to integer B. You need to write pseudocode and not syntactically correct C code.

Consider 4 as input to *isPowerOfTwo(int)*. In this case, the output should be 1 because 4 is a power of 2. Consider 6 as input to *isPowerOfTwo(int).* In this case, the output should be 0 because 6 is not a power of 2.

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