Faculty of Computers & Information
Fourth Year, CS department
Embedded Systems
Instructor: **Dr. Anas Youssef**

Midterm Exam
Time: **1 hour**
Number of Pages: **4**
Total marks: **20**

Student Name	
Student Section No.	

Question 1:

[10 Marks]

(a) Briefly describe the role of each of the following components in an embedded system. *(2 Marks)*

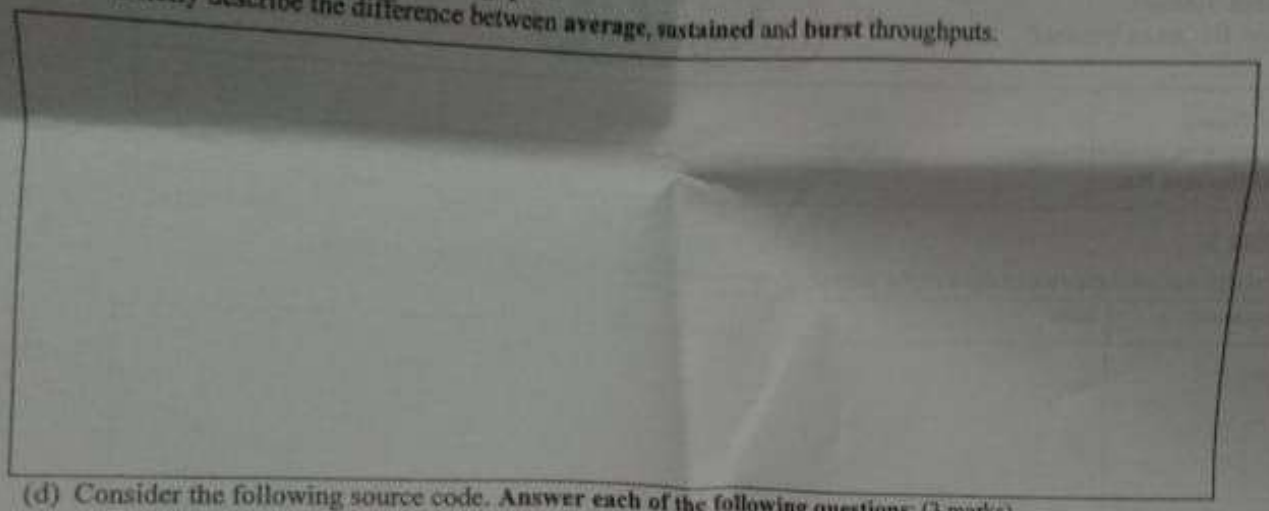
Component	Role
Sensor	
Actuator	
Firmware	
Diagnostic Software	

(b) Draw a **diagram** that shows an example of an embedded system that controls flow of water in a pipe. (2 Marks)

(c) When designing an embedded system, the designer might be concerned with optimizing some design criteria like enforcing an average, sustained, and burst throughput. **Answer each of the following questions**: (3 marks)

1- What is meant by **system throughput**?

2- Briefly describe the difference between **average, sustained** and **burst** throughputs.



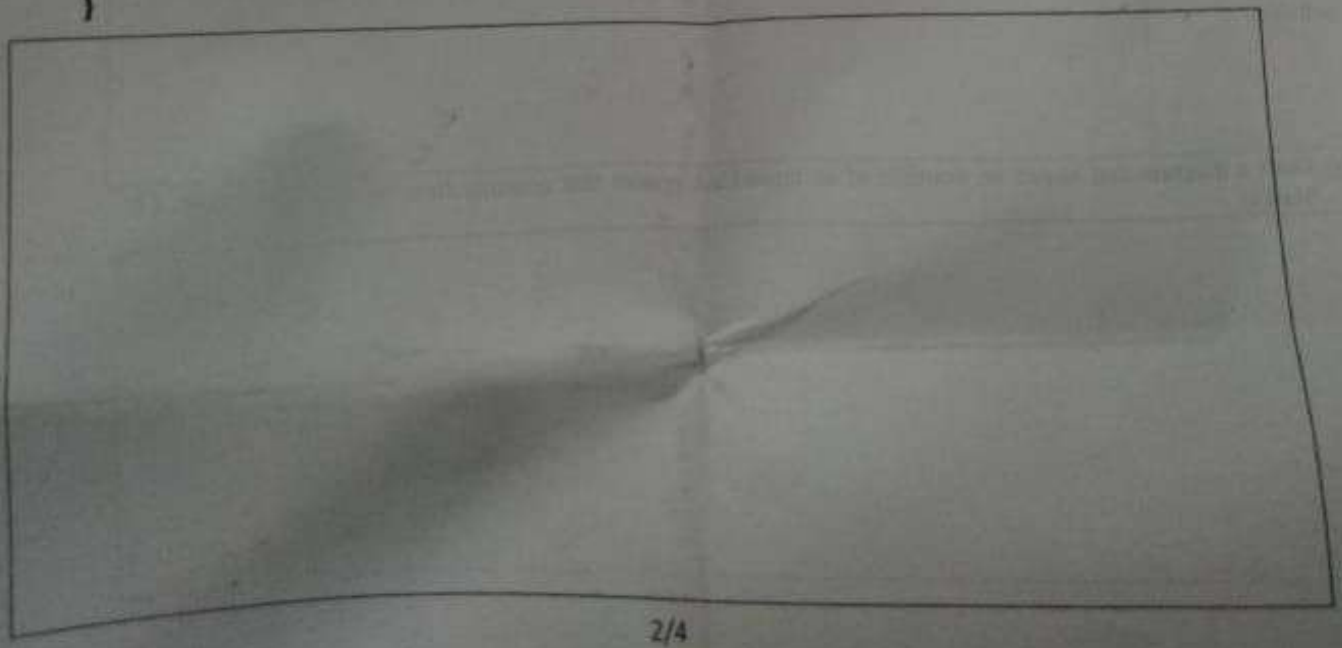
(d) Consider the following source code. **Answer each of the following questions**: (3 marks).

1- What is the purpose of this code?

2- What is the importance of using the variable "**delta**" in this code?

```
/* Monitor Room_Temperature */
do forever {
        measure temperature;
        if (temperature < temperature_setting)
                start furnace_heater;
        else if (temperature > temperature_setting + delta)
                stop furnace_heater;

}
```



Question 2:

(a) What does a **HAL** stand for in an embedded system? List the different HALs that form an embedded system. (2 marks) ***[10 marks]***

(b) Suppose you want to design an embedded system that controls a motor and displays information about the motor **without directly** accessing its hardware. There is an intermediate agent that enables both the motor controller and the motor display client to access the motor hardware. Mention one embedded system design pattern that can be used in your design. **Justify your answer showing how to map the mentioned design pattern to the case study under question.** (3 marks)

(c) Consider the following set of periodic real-time tasks with the following execution profiles: **Task T1** execution time is **50 ms** and execution period is **100 ms**, and **Task T2** execution time is **100 ms** and execution period is **200 ms.** (3 marks)

(i) Can the two tasks be successfully scheduled using **perfect scheduling**? **Why**?

(ii) Suppose that the first instance of each of the **two** tasks arrives at time $t = 0$. Assume that the **deadline** for each task **is less than its corresponding execution period by 10%**. Draw a timing diagram that uses **rate monotonic scheduling** to show the steps of task scheduling over time. Will **all** the tasks' deadlines be met or not? **Why**?

(d) When designing an event-driven embedded system for an air conditioning (AC) system, it is required to implement an interrupt service routine (ISR) for updating the temperature value. One of two design choices can be applied which are follows: (1) include all logic of setting the new temperature value and updating the LCD inside the ISR or (2) only using the ISR code to set a bit in an event array. Which of the two options guarantees that the AC system performs better? **Give reasons.** (2 marks)