00189

# The Open University of Sri Lanka
# Faculty of Engineering Technology
# Department of Electrical & Computer Engineering

| | |
|---|---|
| Study Programme | : Bachelor of Technology Honours in Engineering |
| Name of the Examination | : Final Examination |
| **Course Code** | **: EEX4436/EEX4536/ECX4236** |
| **Title** | **: Microprocessors and Interfacing** |
| Academic Year | : 2019/20 |
| Date | : 08th October 2020 |
| Time | : 0930-1230hrs |

**General Instructions**

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Four (4)** question in **SECTION A** and **three (3)** questions in **SECTION B** in **Four (4)** pages.
3. Answer **ALL FOUR (4)** questions in **SECTION A** [70 Marks] and Answer **any TWO** questions from **SECTION B** [30 Marks]
4. The answer to each question should commence from a new page.
5. Relevant charts/ codes are provided.
6. This is a Closed Book Test (CBT).
7. Answers should be in clear handwriting.
8. Do not use Red colour pens.

**Special Instructions**

- When you write any Assembly Language Program (ALP), you need to provide appropriate comments where necessary. **Full marks will only be given to correct programs with comments**.
- Refer **datasheet of the 8051 microcontrollers (given separately)**, when you answer the questions in this paper. **Do not attach it with the answer script.**
- State your assumptions (if any) clearly.

# Section A

**Answer all questions. [70 Marks]**

## Electronic Hand Sanitizer (EHS)

The following description is about a part of an *Electronic Hand Sanitizer (EHS),* which is used for cleaning human hands with liquid soap and water owing to the COVID-19 pandemic (epidemic).

You are required to analyse and design the ***EHS*** (Figure 1) according to the given requirements.

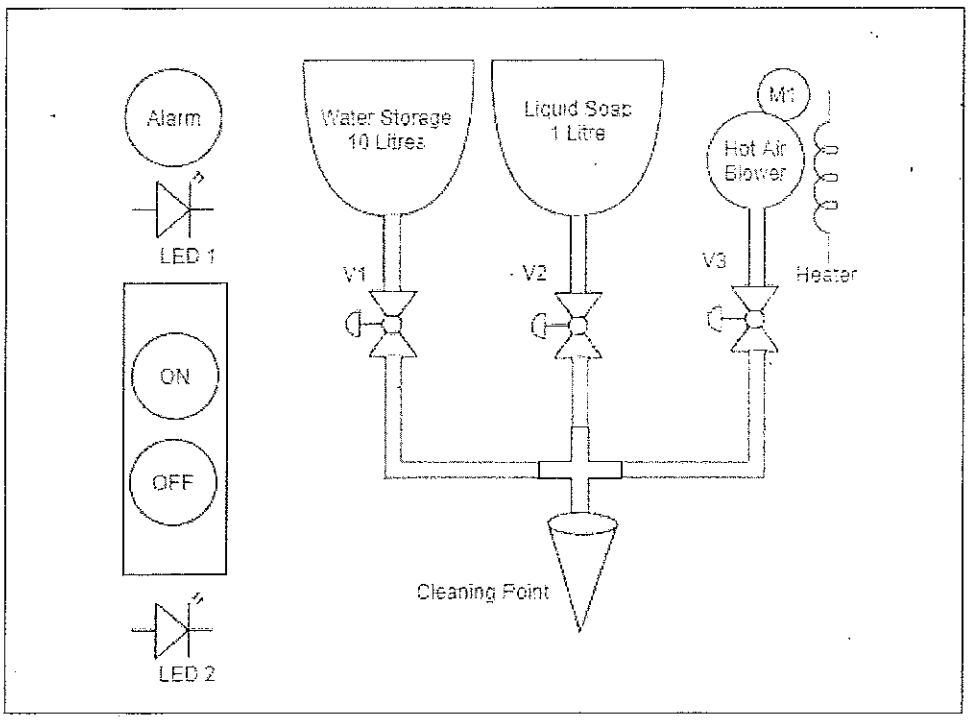


**Figure 1: Typical View of the EHS**

Figure 1 shows the major components of the EHS. The EHS consists of two liquid storage containers to store water and liquid soap, and a hot air blower to produce hot air to dry hands after washing. Three electro-mechanical valves V1, V2 and V3, control the liquids and hot airflow. Hot air blower is driven by the DC motor M1 and heater provides the necessary temperature to outflow air. There is a switch to ON and OFF the EHS and alarm to indicate emptiness of two containers. LED 1 and LED 2 indicate whether the water storage and liquid soap are empty, respectively.

When the switch is ON, the EHS initialised the system itself and getting ready for its sanitising operations. The hand sanitising process starts when there is enough water in the water storage and liquid soap in the cylinder. If there is no water or liquids soap (empty), then the alarm should be activated. The DC Motor M1 is running at 80% duty cycle, and the heater is maintaining $50^0$C temperature to produce hot air. When a human hand reach to the cleaning point, then the electro-mechanical valves are operated according to the following sequence (i.e. 1 to 7).

1. V1 opens for 1 second and closing it.
2. V2 opens for 1 second and closing it.

3. Wait for 20 seconds.
4. V1 opens for 20 seconds and close it.
5. V3 opens for 10 seconds while M1 is running and heater, providing the expected temperature at the same time.
6. V3 closes.
7. When the process is completed, beep the alarm for 2 Seconds. Then the system goes to the initial state.

State all the assumptions clearly (if any) when answering questions.

**[Q1]** For the proposed mechanism, identify suitable sensors and actuators to detect the followings and draw simple diagrams for each to explain your methodology.

(i) To identify the status of water storage and liquid soap containers (Empty or not) [04 Marks]

(ii) To identify the presence of a human hand at the cleaning point. [04 Marks]

(iii)To measure and maintain $50^0$C temperature. [07 Marks]

**[Q2]**

(i) Analysis the given specifications/parameters related to the operations/processes of the EHS and then prepare a Table of resources/feature and conditions/constraints required to design the EHS. (Table should contain, Processes, Sub-Operations, Parameters, Conditions, Resources, Features required of 8051 microcontrollers, and Comments). [08 Marks]

(ii) Draw the external view of the system, i.e., a diagram that shows the inputs/sensors and the outputs/actuators of the system. [07 Marks]

(iii)Identify the subunits/sub-modules of the system and draw the interconnected block diagram of the system using the central controller and other required interfacing devices. [08 Marks]

(iv)Draw an interfacing diagram to show the 8051 port connections. [08 Marks]

**[Q3]** Draw flowchart(s) to represent the algorithm of the EHS operations. [12 Marks]

**[Q4]** Write assembly language programs (ALP) to perform the above task. (i.e., Q3). Clearly, show the assembly language routines with comments and relation with the flowcharts drawn in above Q3. [12 Marks]

# Section B

**Answer any two (2) questions. [30 Marks]**

**[Q5]**

(a) Assuming clock frequency is **12MHz**, write an Assembly Language Programme(ALP) create five(5) second delay. [6 Marks]

(b) Modify your code to expand the delay time to twenty-five (25) seconds. [3 Marks]

(c) It is required to rotate a DC motor at 80% duty cycle, PWM signal(50kHz) continuously. Write an ALP to generate the PWM signal using timers. [6 Marks]

**[Q6]**

In an industrial application, it is required to measure the temperature of a heating element and maintain the temperature in the 55-65°C range. Specification of available two temperature sensors is shown in Table 1.

Table 1 : Sensor specification

| Parameter | Temp. Sensor 1 | Temp. Sensor 2 |
|---|---|---|
| Sensor accuracy (Max) (+/-°C) | 4 | 0.5 |
| Operating temperature range (°C) | 0-100 | -50- 150 |
| Output voltages (V) | 0-1 | 1V -+8 |
| Interface type | Analog | Analog |
| Supply voltage (Min) (V) | 2 | 5 |
| Supply voltage (Max) (V) | 6 | 18 |

Assume supply voltage is 5V for sensor 1 and 12V for sensor 2.

(a) Draw a block diagram showing the interface of a temperature sensor, ADC, DAC (if required) and with 8051 Microcontroller(MC). Clearly, show interfacing between ADC and MC. [6 Marks]

(b) Select a suitable sensor form Table 1 for this application. Justify your answer. [3 Marks]

(c) If ADC is 4bit, Find the ADC value of sensor output when the temperature at 62.5°C. Select suitable reference voltage for ADC. [6 Marks]

**[Q7]**

(a) Write the steps to enable serial interrupts in 8051 [4 Marks]

(b) If the clock frequency is 11.0592MHz and the variable baud rate is set to 4800, Find the value for timer TH register in 8051 MC. [4 Marks]

(c) Write an assembly language program to send a string "Invalid input" to a PC through serial communication of the 8051 microcontroller. Use 4800bps, 8 data bits, one start bit, one stop bit and no parity bits for the communication. (Assume that the PC will receive data without any error.) [7 Marks]