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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	**: EEX4536/ ECX4236**
Title	**: Microprocessors and Interfacing**
Academic Year	: 2017/18
Date	: 10th February 2019
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 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]

Liquid Filling Machine (LFM)

The following description is about part of a *Liquid Filling Machine (LFM)* which is used for filling liquids (Ex. Fruit drinks, Water, etc.).

You are required to analyse and design the ***LFM*** (Figure 1) according to the given requirements and 8051 microcontroller specifications.

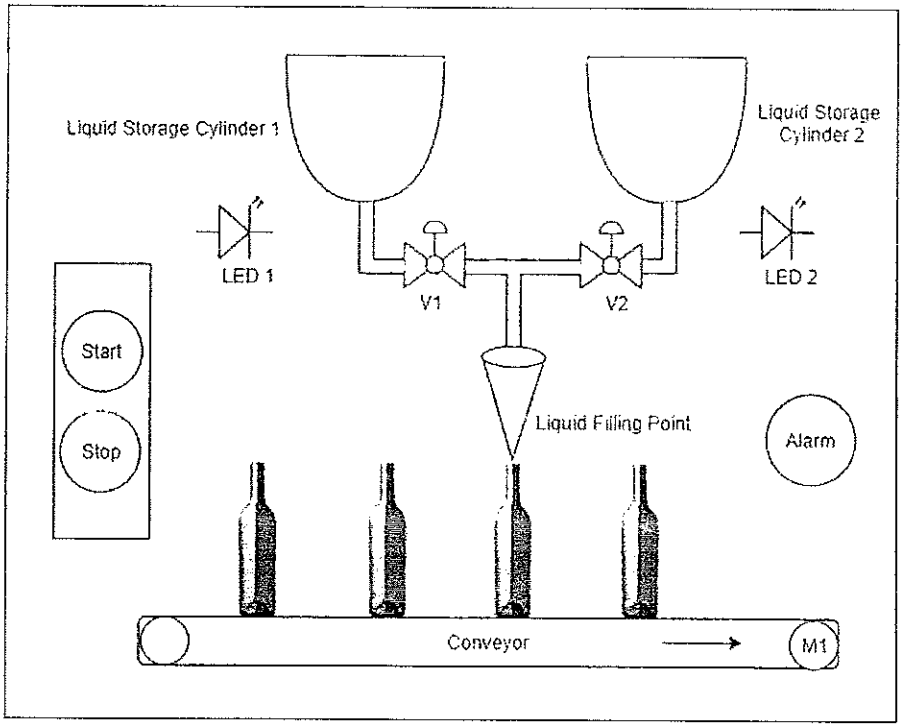

Figure 1: Typical View of the LFM

Figure 1 shows the major components of the LFM. The LFM consists of two liquid storage cylinders to store liquids. Two electro-mechanical valves V1 and V2 control the liquid flow. Bottles are driven forward on the conveyor and it is driven by the DC motor M1. There are Start and Stop buttons and the Alarm. The LED 1 and the LED 2 indicate that the storage cylinders 1 and 2 are empty of liquid respectively.

When the Start button is pressed, the LFM starts the liquid filling process and it will stop whenever the user pressed the Stop button. The liquid filling process starts when there are enough liquids in the liquid storage cylinders. If there are no liquids (empty) in both liquid storage cylinders, then the Alarm should be activated. The DC Motor M1 is running 50% duty cycle to move bottles to forward. When an empty bottle reaches to the filling point, the Motor M1 should be stopped until the bottle is filled by the LFM. The electro-mechanical valves V1 and V2 control the liquid flow after opening the valves for 250ms and closed immediately to fill an empty bottle. At first LFM checks for liquids from cylinder 1 and if it is empty then checks the cylinder 2.

Section B

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

[Q5] In a simple microcontroller-based application, the subroutine of the programme has the following steps.

- Monitor port 1 pin 1(P1.1) until it becomes high
- When P1.1 become high, write value 45H to Port 0(P0)
- Read the value of Port3(P3) and save the value in the External RAM location 60H
- End

(a) Draw a flowchart to demonstrate sequential process using the above steps. [7 Marks]

(b) Write an assembly language program (ALP) for the above process in Q5 (a). [8 Marks]

[Q6]

(a) The step angle of a stepper motor is 1.8^0. It is required to rotate it two full rotations in the clockwise direction and wait for 2second and continue the process. Assume full stepping mode. Step sequence is given in Table 1.

Table 1: The 4-step sequence

Step	Winding1	Winding2	Winding3	Winding4
1	1	0	0	1
2	1	1	0	0
3	0	1	1	0
4	0	0	1	1

(i) Draw the interfacing diagram of the stepper motor with port 1 of the 8051 microcontroller. [5 Marks]

(ii) Write an ALP for the above process in Q6 (a) (i). [5 Marks]

(b) A student is expected to generate a PWM signal to control a DC motor. The duty cycle of the PWM signal is may vary 25% or 45% or 50% or 65%. Assume that the frequency of the PWM signal is 50kHz. If the student wants to rotate the motor $\frac{1}{4}$ th of its maximum speed, what is the duty cycle to be selected? Write an ALP to generate the required PWM signal using **Timers**. [5 Marks]

[Q7]

(a) The n-bit R/2R digital-to-analog converter (DAC) has a reference of 16 V and the analog output for the input code 1 is 15.625 mV. Find the digital input value for the output 9.140625 V. [7 Marks]

(b) Write an assembly language program to send a string "Critical Alarm" to a PC through serial communication of the 8051 microcontrollers. 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.) [8 Marks]

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 a simple diagram to explain your methodology.

(i) To identify the status of liquid storage cylinders (Empty or not) [05 Marks]

(ii) To identify the presence of an empty bottle in the liquid filling point. [05 Marks]

(iii)To check the opening of the bottle is free or already capped. [05 Marks]

[Q2]

(i) 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]

(ii) 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]

(iii)Draw an Interfacing diagram to show the 8051 port connections. [10 Marks]

[Q3] Draw flowchart(s) to represent the algorithm of the LFM operations. [15 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. [15 Marks]