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**
Title	**: Microprocessors and Interfacing**
Academic Year	: 2020/21
Date	: 20th February 2022
Time	: 0930-1230hrs

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Four (4)** questions in **SECTION A** [70 Marks] and **two (2)** questions [30 Marks] in **SECTION B** in **Four (4)** pages.
3. Answer **ALL Questions.**
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 Dumbwaiter Lift (EDL)

The following description is about a part of an *Electronic Dumbwaiter Lift (EDL),* which is used for transporting foods and beverages between floors up and down from the hotel's kitchen.

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

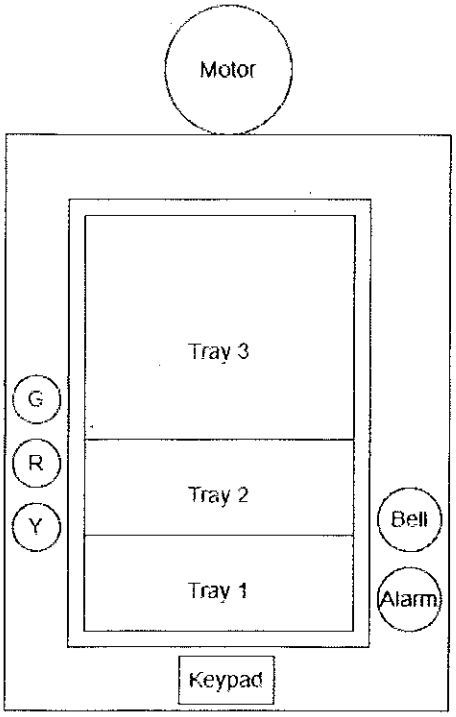


Figure 1: Typical View of the EDL

Figure 1 shows the major components of the EDL. The EDL consists of a Keypad, a Bell, an Alarm, three indicator lights (G-Green, R-Red, and Y-Yellow), and a Motor. There are three trays to store food. The motor is fixed on the top floor.

The hotel owner initially plans to install the lift for three stories (ground floor, first floor, and second floor). The default location of the lift is the first floor where the kitchen is located. Ground and second floor have restaurants. The maximum carrying capacity of the entire lift is 250kg. The person who sends food selects the required floor using the keypad. Subsequently, the EDL moves to that floor and stops there until the person who receives the food presses the return button. After closing the door and pressing the return button, the EDL returns to the default location. With each successful move, the bell should run for 1 second. Otherwise, the alarm should be on for 5 seconds. The green indicator is on when the EDL is idling. The yellow indicator is on when the EDL is operating. The red indicator should be on when there is any failure. The motor needs to operate at constant velocity with 50% PWM for each move.

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

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

(i) To identify the status of EDL reached each floor. [04 Marks]

(ii) To identify the status of the lift's door (whether it is closed or not) [04 Marks]

(iii) To measure and maintain a 250kg carrying load. [04 Marks]

[Q2]

(i) Analyse the given specifications/parameters related to the operations/processes of the EDL and then prepare a Table of resources/features and conditions/constraints required to design the EDL. (Table should contain, Processes, Sub-Operations, Parameters, Conditions, Resources, Feature Required of 8051 microcontrollers, and Comments). [04 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. [10 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 EDL operations. [14 Marks]

[Q4] Write assembly language programs (ALP) to perform the above task (i.e., Q3). Clearly show the assembly language routines with comments related to the flowcharts drawn in the above Q3. [14 Marks]

Section B

Answer all questions [30 Marks]

[Q5] An 8-bit A/D converter device is to be interfaced with an 8051 microcontroller, as shown in Figure 2. When the SOC (Start of Conversion) signal is high, the conversion process starts. The EOC (End of Conversion) line goes low when the conversion data is available. Reference voltage of ADC fed by a 4-bit digital-to-analogue converter (DAC) has a reference of 12V. Data captured from ADC is stored in an external data memory (2K x 8).

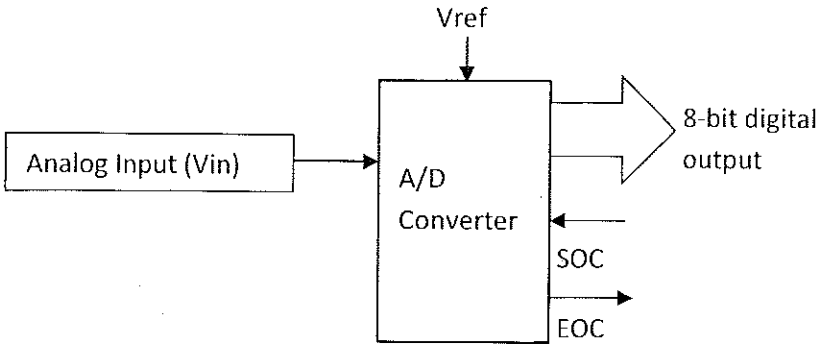


Figure 2

1) With the aid of a block diagram, show how input device, ADC, DAC and External ROM can be interfaced to the 8051 (You can use additional ICs if needed). Clearly show the ports, pins of 8051 and data/address/control lines with other voltage values. [07 Marks]
2) Draw a flowchart to capture 200 data samples from the A/D converter and store this data in the External Data memory. [08Marks]

[Q6]

1) A student plans to build a security system using the 8051 microcontroller. It has 4 zones, and each zone has one sensor. Inputs are connected to 8051 I/O ports. A bell will ring for 1 minute if any of these inputs are triggered. Further, the associated zone LED or LEDs will be illuminated.
   i. With the aid of a diagram, describe the hardware circuit/ block diagram for this alarm device. [02 Marks]
   ii. Write ALP to implement the required functionality for this system. [05 Marks]

2) Write an interrupt-driven ALP (Serial interrupt- Vector address is 0023h), which sends the ASCII 'X' character (ASCII value of X is 88) continuously to a PC through serial communication of the 8051 microcontroller. Use 4800bps, 8-bit data bits, 1 start bit, and 1 stop bit, and ignore the parity bit. [08 Marks]