THE OPEN UNIVERSITY OF SRI LANKA

Faculty of Engineering Technology
Department of Electrical & Computer Engineering
Bachelor of Technology Honours in Engineering
FINAL EXAMINATION – (2015/2016)

ECX4236 – Microprocessors and Interfacing

Time Allowed: **3 hours**

Date: 9 December 2016   **Time: 0930 – 1230 hours**

INSTRUCTIONS TO CANDIDATES

1. This question paper contains four questions in **SECTION A** and three questions in **SECTION B** on 4 pages.
2. Answer **ALL FOUR** questions in **SECTION A**. [70 Marks]
3. Answer any **TWO** questions from **SECTION B**. [30 Marks]

NOTE:

1. When you have to write any Assembly Language Program (ALP) for your answer, you need to provide appropriate comments where necessary. **Full marks will only be given to correct programs with comments**.

2. Refer **data sheet of the 8051 microcontroller (given separately)**, when you answer the questions in this paper. Do not attach it with the answer script.

3. State your assumptions (if any) clearly.

SECTION A:

Answer ALL questions. [70 Marks]

Electronic Packaging System (EPS)

The following description is about an *Electronic Packaging System (EPS)* which is used for packaging the goods (Ex. Books, Magazines etc.). You are required to analyze and design the requirements of the *EPS* (Figure 1) given below according to the 8051 microcontroller specifications.

(Image source: http://tensionautomation.com/fulfillment-packaging-automation/cold-fusion-autopacker/sp600-3d)
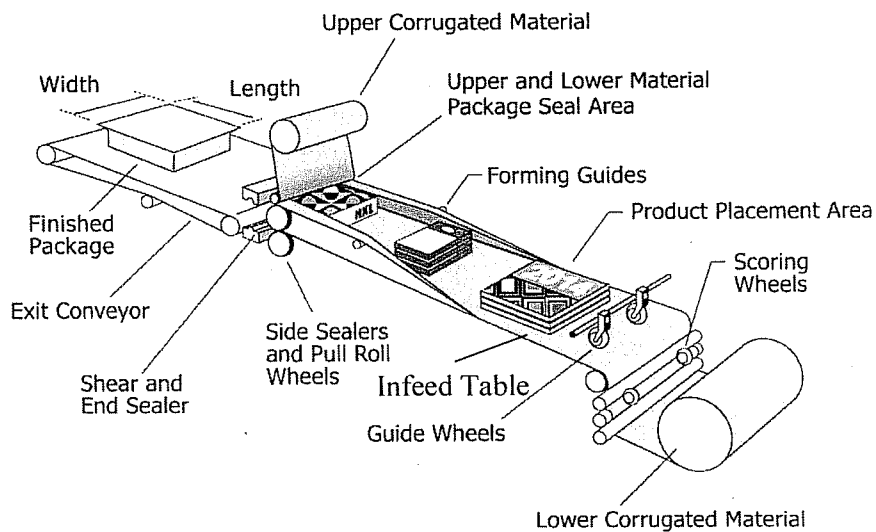
Figure 1: Typical view of EPS

Figure 1 shows the major components of the EPS. The EPS uses two rolls of cold seal material (upper and *Lower Corrugated Material*, Ex. Cardboard) to make a protective covering (packaging) to the goods. The *Lower Corrugated Material* run over the *Infeed Table* and carries the product into the sealing section. This is where the section joins the *Upper and Lower Corrugated Material* to form a protective packaging. The end seals and length cutoff are done simultaneously in the sealing head of the system (*Shear and End Sealer*). The EPS uses a pre-set length counter to regulate the package size. The EPS Start/Stop operation and setup pre- set length is done through the touch screen panel. This allows the operator to make adjustments quickly and easily.

When the EPS starts, a DC motor (M1) runs at 50% duty cycle to provide smooth flow of the objects into the sealing section. The *Shear and End Sealer* can be activated using electronic solenoid valve (V1) based on the preset value of the length counter. This preset value can be changed by using the keypad available in the touch panel and it stored in the external RAM location 1001H of the 8051 microcontroller. The *Exit Conveyor* operates from a DC motor (M2) which is running at same duty cycle as M1. The EPS system has three seven-segment displays to show the number of parcels and a labelling unit to stick a predefined label on top of the parcel in the *Exit Conveyor*. The labelling unit can be operated using electronic solenoid valve (V2).

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

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[Q1]

    (i)   Draw a diagram and show, how to count the total parcels using suitable sensor(s) and/or actuator(s) in the *Exit Conveyor*.

[05Marks]

    (ii)   Suggest a simple method which could remove empty parcels from the *Exit Conveyor*. Clearly show how you are going to implement this task using diagrams.

[05 Marks]

    (iii)   List four (4) features required in a microcontroller for this kind of application and provide proper justification for each.   [04 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.

[08 Marks]

    (ii)   Identify the sub units/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]

[Q3]   Draw flowcharts to represent the algorithm of the operation EPS. Clearly show the port mapping of the 8051 microcontroller. (ie. Show the pin connection of each sensor and actuators used in the EPS).

[20 Marks]

[Q4]   Write assembly language programs (ALP) to perform the above task. (ie. Q3). Clearly show the assembly language routines with comments and relation with the flowcharts drawn in above Q3.

[20 Marks]

SECTION B:

Answer any TWO questions. [30 Marks]

[Q5]

    (i)   By using examples for each, explain five addressing modes used in 8051.

        [03 Marks]

    (ii)   If the clock frequency of 8051 is 8 MHz, find the time taken to execute the following program:

                MOV R2, #10
                MOV R1, #25
                WAIT: DJNZ R2, WAIT

        [04 Marks]

    (iii)   It is required to interface a push button with 8051 microcontroller based systems. Explain how you are going to eliminate the switch bounce effect using software and hardware techniques. Write an Assembly Language Program for the software technique.

        [08 Marks]

[Q6]

    (i)   Briefly explain the "***Baud Rate***" in serial data communication.

        [02 Marks]

    (ii)   In a certain experiment, the timer value is set to 0FEh and variable baud rate to 9200. Calculate and select a suitable crystal frequency for this experiment.

        [05 Marks]

    (iii)   Write an assembly language program to transfer serially 'ECX 4236' to a computer continuously with baud rate 9600 using the 8051 microcontroller. Assume, PC will receive data without any error.

        [08 Marks]

[Q7]   In an automation design, it is required to interface bipolar stepper motor with 8051 based microcontroller system. It is needed to design the system as follows. When the push button(A) is pressed, stepper motor rotates four (4) steps clockwise and then six (6) steps anticlockwise direction. The push button (B) will stop the motor rotation immediately whenever it is pressed.

    (i)   Draw a circuit diagram to show the connection with the 8051 Microcontroller. Note: you have to clearly show the pin connection with the 8051 microcontroller and any additional electronic components required.

        [07 Marks]

    (ii)   Write an assembly language program for the design.

        [08 Marks]