00232

THE OPEN UNIVERSITY OF SRI LANKA

Faculty of Engineering Technology
Department of Electrical & Computer Engineering
Bachelor of Technology Honours in Engineering

FINAL EXAMINATION – (2014/2015)

ECX4236 – Microprocessors and Interfacing

Time Allowed: **3 hours**

Date: 10th September 2015 **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.

3. State your assumptions (if any) clearly.

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SECTION A:

Answer ALL questions. [70 Marks]

Colour Object Separating Machine (COSM)

The following description is about a *Coulour Object Seperating Machine (COSM)* which is used for separating the yellow colour objects (Ex. Pepper, grains, etc.). You are to analyze and design the requirements of the ***COSM*** (Figure 1) given below according to the 8051 microcontroller specifications.

(Image source: http://www.anzai.co.jp/english/products/img/anima_GDM_E.gif)

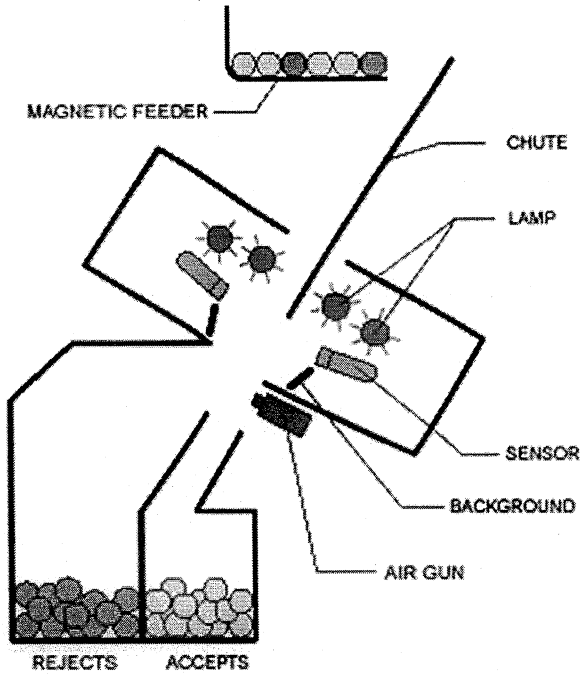

Figure 1: Typical view of COSM

Figure 1 shows the major components of the COSM. The COSM consists of a Magnetic feeder, Chute (a channel down, which guides the falling objects), Lamps, Sensors, an Air gun and two bins. The magnetic feeder has sensors to detect the existence of the objects. The Chute has a motor (M1) to vibrate the falling objects. There are lamps and sensors inside the covered area at the end of the chute to detect the colour of the objects. The front control panel of the COSM has two seven-segment displays to display the count of the accepted objects, a start button to start the system, a stop button to stop the system, and an alarm to indicate the existance of the objects in the magnetic feeder.

When the COSM starts, the motor M1 runs at 20% duty cycle to provide smooth flow of the objects. The Air gun has an electronic valve (V1) to release the compressed air to separate the yellow colour objects. When the sensors (shown in the Figure 1) detect the yellow colour object, the system will accept the object and increase the count of the accepted objects, otherwise the system rejects the object and operate the Air gun for 100ms to move the object to the reject bin.

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

[Q1]

(i) State a suitable sensor which can detect the existence of the objects in the Magnetic feeder. [03 Marks]

(ii) State a suitable sensor which can capture the colour of the object in the system (Figure 1) and draw a diagram to describe the interfacing mechanism with input/output values of the sensor. [09 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] The COSM perform the following tasks.

a. Check the existence of the object when the system starts and activate the alarm if the objects are not present in the Magnetic feeder else vibrate the Chute. (ie. operate the M1 with 20% duty cycle),

b. Detect the colour of the objects if the objects are available in the Magnetic feeder and separate the objects using Air gun (ie. operate the V1 for 100ms),

c. Increase the count of the yellow colour objects and display the results in the two seven-segment display unit.

Draw flowcharts to represent the algorithm of each above task. (ie. a, b and c). Clearly show the port mapping of the 8051 microcontroller. (ie. show the pin connection of each sensor and actuators used in each task).

[21 Marks]

[Q4]

Write assembly language programs (ALP) to perform the each above task. (ie. Q3 a, b and c). Clearly show the assembly language routines with comments and relation with the flowcharts drawn in above Q3.

[21 Marks]

SECTION B:

Answer any TWO questions. [30 Marks]

[Q5] The 12-bit R/2R digital-to-analog converter (DAC) has a reference of 2.048 Volts.

(i) Find the analog output for the input value 1(one). [07 Marks]

(ii) Find the digital input value for the output 615 mV. [08 Marks]

[Q6]

(i) In a serial communication experiment of 8051 microcontroller, a student set the crystal frequency as 11.0592 MHz and the variable baud rate is 19.2K. Find the timer values of the 8051 microcontroller for the experiment. [05 Marks]

(ii) Write an assembly language program to send the string "***MOVE SBUF***" to a device through serial communication of the 8051 microcontroller using serial interrupts. Use 9600bps, 8 data bits, 1 start bit, 1 stop bit and no parity bits for the communication. (Assume that the device will receive data without any error) [10 Marks]

[Q7]

(i) The Intel hex file of a particular program of the 8051 microcontroller is shown in the Figure 2. Draw a two column table to show the address of each memory location and its respective code of the given hex file. [05 Marks]

```
:0A0165007430B4250280031480F802
:00000001FF
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Figure 2: Intel hex file

(ii) Convert the machine code given in the Figure 2 to the 8051 assembly language program (ASM file). [10 Marks]