THE OPEN UNIVERSITY OF SRI LANKA

Faculty of Engineering Technology
Department of Electrical & Computer Engineering
Diploma in Technology – Level 04

FINAL EXAMINATION – (2013/2014)

ECX4236 – Microprocessors and Interfacing

Time Allowed: **3 hours**

Date: 28th August 2014 **Time: 0930 – 1230 hours**

INSTRUCTIONS TO CANDIDATES

1. This question paper contains three questions in **SECTION A** and three questions in **SECTION B** on 4 pages.
2. Answer **ALL** 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]

Electronic Diameter Measuring System (EDMS)

The following description is about an *Electronic Diameter Measuring System (EDMS)* which is used to measure the diameter of a metal ball. You are to analyze and design the requirements for the ***EDMS*** (Figure 1) according to the 8051 microcontroller specifications.

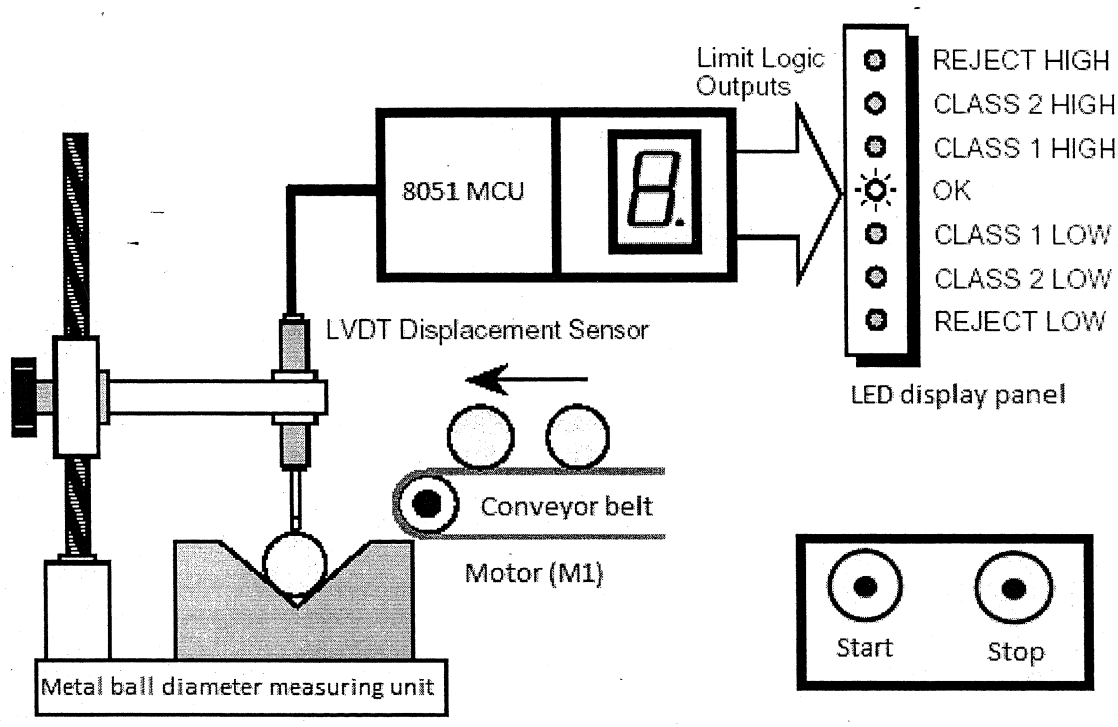

Figure 1: Typical view of EDMS

The EDMS consists of a Diameter measuring unit, a Conveyor unit, a LED display panel, a Start/Stop button panel and a 8051 microcontroller unit (8051 MCU) with a seven segment display. The Conveyor unit which has only one motor (M1) rotating in one direction moves the metal balls on to the diameter measuring unit. The Diameter measuring unit has a Linear Variable Differential Transformer (LVDT) displacement sensor attached to the measuring bed. The LED display panel has seven LEDs to show the classification of the metal ball (Table 1). The 8051 MCU is used to connect all the modules in the system. In addition to that, the seven segment display shows the diameter of each metal ball in millimeters and the Start/Stop buttons are used for switching the system on or off.

When the EDMS starts, the motor M1 runs at 50% duty cycle to move the metal balls on to the diameter measuring unit.

Assume that the EDMS is automatically started by measuring the diameter of the metal ball when it comes to the measuring bed and release the result to the 8051 MCU before the next metal ball arrives to the measuring bed.

The EDMS will classify the metal balls according to the metal ball diameter. Assume that acceptable diameter range of a metal ball is between 2mm and 6mm and the metal ball diameter is a single digit integer (1 to 7). The classification values and LVDT output voltages are shown in the Table 1 below.

Table 1: Classification of the ball diameter and LVDT output

Classification	**Ball Diameter (mm)**	**LVDT Output Voltage (mV)**
REJECT LOW	1	80
CLASS 2 LOW	2	160
CLASS 1 LOW	3	240
OK	4	320
CLASS 1 HIGH	5	400
CLASS 2 HIGH	6	480
REJECT HIGH	7	560

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

[Q1]

(i) Find the resolution and the reference voltage (V_{ref}) of the Analog to Digital Converter (ADC) which interfaces the LVDT and the 8051 MCU. [05 Marks]

(ii) Calculate the equivalent digital values for the LVDT sensor. [10 Marks]

[Q2]

(i) Draw the external view of the system, i.e. a diagram that shows the inputs and the outputs of the system. [10 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. [10 Marks]

[Q3]

(i) Draw a flowchart to represent the algorithm for the operations of the system. [20 Marks]

(ii) Write an assembly language program to classify a ball diameter and indicate the class on the LED display panel according the LVDT values. (Clearly show the assembly language routines with comments) [15 Marks]

SECTION B:

Answer any TWO questions. [30 Marks]

[Q4] The 8-bit R/2R digital-to-analog converter (DAC) has a reference of 10 volts.

(i) Find the analog output for the input code 00000001. [07 Marks]

(ii) Find the digital input value for the output 3.125 V. [08 Marks]

[Q5]

(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 9600. Find the timer values of the 8051 microcontroller for the experiment. [05 Marks]

(ii) Write an assembly language program to send the string "***ROTATE 60 DEG***" 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]

[Q6]

(i) Draw a block diagram to represent the 2 channel De-multiplexer. [05 Marks]

(ii) Write an assembly language program (ALP) to represent the behaviour of the 2 channel De-multiplexer. [10 Marks]