THE OPEN UNIVERSITY OF SRI LANKA

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

FINAL EXAMINATION – (2008/2009)

ECX4236 – Microprocessors and Interfacing

Time Allowed: **3 hours**

Date: **1st April 2009**

Time: **09.30 – 12.30 hours**

INSTRUCTIONS TO CANDIDATES

1. This question paper contains one question in **SECTION A** and three questions in **SECTION B** on 4 pages.
2. Answer **ALL** questions in the **SECTION A**.
3. Answer any **TWO** questions from **SECTION B**.
4. This is a **CLOSE BOOK** examination.

NOTE:

1. When you have to write any Assembly Language Program for your answer, you need to provide appropriate comments where necessary. **Full marks will be given to correct programs, with comments**.
2. Refer **attached data sheet of the 8051 microcontroller**, when you answer the questions in this paper.

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SECTION A:
Answer ALL questions

Question 01

Automated Wheelchair

The following description is about an *Automated Wheelchair* and you are supposed to analyze the requirements according to the 8051 microcontroller specifications. A typical view of wheelchair is given in Figure 1.1.

The automated wheelchair consists of four wheel base, joy stick and keypad. Automated wheelchair is operated by two 12V motors that drive two major wheels. Small two wheels used to turn the wheelchair to either left side or right side. Joy stick controls the moving direction of the wheelchair (i.e. move forwards or backwards and turn left or right).

Maximum carrying weight of automated wheelchair is 100kg. Once the weight limit is reached, alarm should be activated and blink a red bulb. Path should be recorded and store in memory.

Figure 1.1: Typical Wheelchair

There should be a method to recall the path information and come back to the started location. There should be means to stop the wheelchair whenever an emergency situation is occurred. Wheelchair should stop if there are any obstacles. Speed of the motors can be controlled by varying the duty cycle of the PWM (Pulse Width Modulation) signals.

Clearly state if any assumptions that you made to answer the questions.   [01 Marks]

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

(ii)   Identify the sub units/sub modules of the system and draw the interconnected block diagram of the system by using central controller.   [10 Marks]

(iii)   Draw a flowchart to represent the operation of the system.   [15 Marks]

(iv)   Write an Assembly Language Program to implement the system.   [20 Marks]

(v)   Write an entity declaration of the system in HDL (Hardware Description Language) or pseudo-code/Structured-English.   [08 Marks]

SECTION B:
Answer any TWO questions

Question 02

Figure 2.1 depicts the block diagram of the simple pulse counter. There are two seven segment display units connected to the port 0 and port 1 of the 8051 microcontroller. Input pulse connected to the counter 0 pin (T0) of the 8051 microcontroller. Each and every 35ms intervals, the counted value should be display in the display units. Table 2.1 depicts the truth table of the seven segment display unit. (Assume 0 <= counter value <=99)
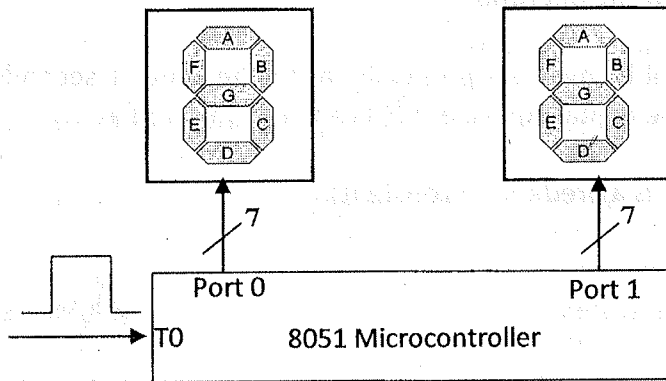

Figure 2.1: Pulse Counter

#	A	B	C	D	E	F	G
0	On	On	On	On	On	On	Off
1	Off	On	On	Off	Off	Off	Off
2	On	On	Off	On	On	Off	On
3	On	On	On	On	Off	Off	On
4	Off	On	On	Off	Off	On	On
5	On	Off	On	On	Off	On	On
6	Off	Off	On	On	On	On	On
7	On	On	On	Off	Off	Off	Off
8	On	On	On	On	On	On	On
9	On	On	Off	Off	On	On	On

Table 2.1: Truth Table

(i)   Draw the counter configuration with specific counter setting of the TMOD register.   [02 Marks]

(ii)   Write an Assembly Language Program (ALP) to generate 35ms intervals using timer interrupt.   [06 Marks]

(iii)   Write an ALP to send the counter value in to seven segment displays using the lookup table.   [10 Marks]

Question 03

(i)   Briefly explain the *"Baud Rate"* in serial data communication.   [02 Marks]

(ii)   In a certain experiment, a student sets the timer to 250. In order to get the variable baud rate 4800 find the suitable crystal frequency.   [06 Marks]

(iii)   Write an Assembly Language Program to send external RAM (XRAM) data from location 4000h - 4100h to a PC through serial communication using above (Q3, ii) settings. Use **serial interrupt** facility available in the 8051 microcontroller. (Assume that the PC will receive data without any error)
                                                                            [10 Marks]

Question 04

In a laboratory experiment, a simple analogue to digital converter (SADC) is interfaced to an 8051 microcontroller unit (MCU) to measure analogue signals. SADC operates as follows.

When the microcontroller unit (MCU) sets the SOC (Start of Conversion) signal then SADC read the input analogue signal (V_s, $0V <= V_s <= 2V$) and start the conversion.

After conversion completed, SADC sets the interrupt signal EOC (End of Conversion) which will be sent to MCU to indicate the end of the operation.

Digital equivalent of the analogue signal is inversely proportional to the time (T seconds) between SOC and EOC signals. Hence, the digital equivalent (D) can be computed as

$$D = 2K/T \qquad \text{(where "K" is a predefined constant).}$$

(i)   Draw the block diagram of the system   [04 Marks]

(ii)   Draw the timing diagram of the I/O signals   [04 Marks]

(iii)   Write an Assembly Language Program to obtain the digital equivalent of the input analogue signal and store it in the external RAM location 1200H (Assume the value "K" is stored in R0 register)   [10 Marks]

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