THE OPEN UNIVERSITY OF SRI LANKA

Faculty of Engineering Technology
Department of Electrical & Computer Engineering
Diploma in Technology – Level 04
FINAL EXAMINATION – (2011/2012)

ECX4236 – Microprocessors and Interfacing

CLOSED BOOK EXAM

Time Allowed: **3 hours**

Date: 15th March 2012   **Time: 1400 – 1700 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** parts in **SECTION A**.
3. Answer any **TWO** questions from **SECTION B**.

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.

SECTION A:
Answer ALL questions

Question 01

Electronic Toll Collection System (ETCS)

The following description is about the *Electronic Toll Collection System (ETCS)* and you are to analyze and design the requirements for the *ETCS* according to the 8051 microcontroller specifications.
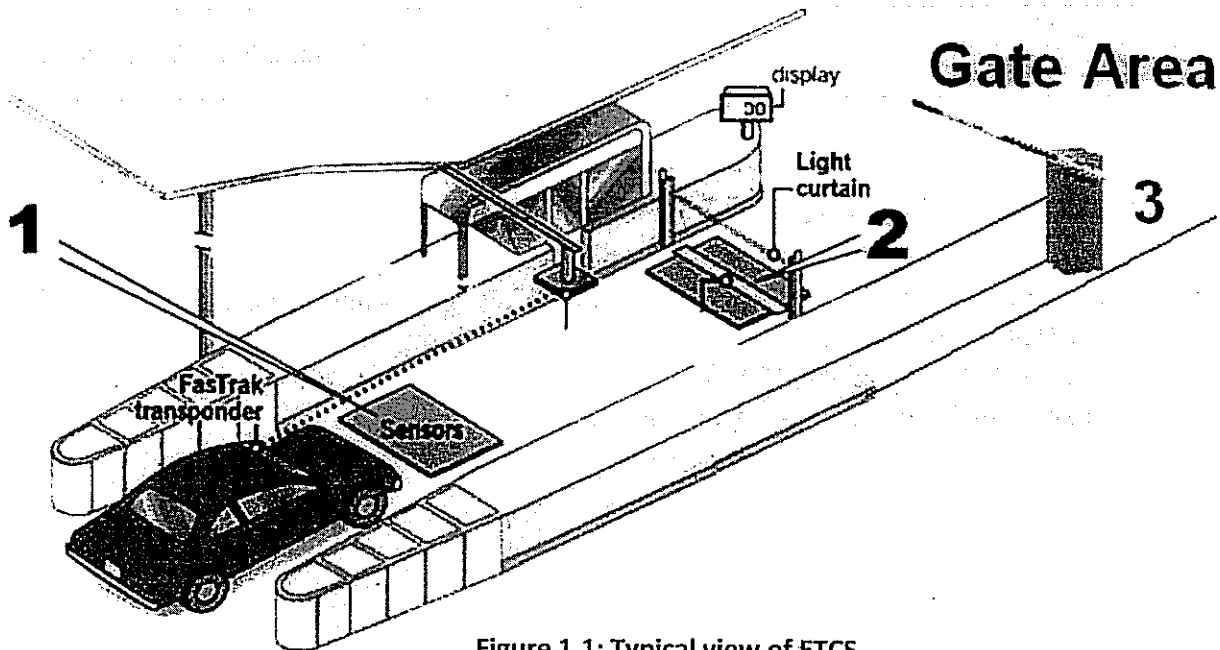

Figure 1.1: Typical view of ETCS
(Image source: http://www.mindfully.org)

The electronic toll collection system (ETCS) allows drivers to pass through toll gates without stopping for toll payment. A typical view of the toll booth in *ETCS* is shown in Figure 1.1.

"One of the biggest complaints of motorists using toll roads is the congestion and delay caused by stopping to pay at the tollbooths. Many toll authorities have searched for ways to improve the toll collection process"

You are required to analyze and design the toll booth operation as depicts in the Figure 1.1. As a vehicle approaches the toll booth, sensors alert the electronic toll collection system of its presence (refer no **1** in the typical view).

The vehicle next passes through a light curtain, which records when a car has entered and exited the system (refer no **2** in the typical view).

When the vehicle reached to the gate area then the gate will be opened 90^0 degrees upward (refer no **3** in the typical view).

Design Guidelines

1. Design **only** for operate the gates and **need not** for calculates or designs the toll collection or payment.
2. Two seven segment displays are used in **ETCS** for display current vehicle count (i.e. *current vehicle count = total arrived vehicles − total leaving vehicles*).
3. Assume that this toll gates are operating only one direction of the highway.
4. There are two identical toll booths available at the Entry point and Exit point and they are interconnected with each other.
5. These two toll booths operate via a single 8051 microcontroller unit.
6. Distance from the entry point to exit point is 100km.
7. When the vehicle reaches the light curtain the gate should be opened, and stay open for 90 seconds.
8. At both gates, *current vehicle count* should be displayed.
9. *No vehicles are allowed* in the entrance, if the *current vehicle count* reaches 90 and that gate should not be opened.
10. You can use external memory of the microcontroller to store the *current vehicle count, total arrived vehicles* and *total leaving vehicles.*
11. Crystal frequency of the 8051 microcontroller is 12MHz.

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

(i)   Identify the sensors and the actuators required in each phase that shown in the Figure 1.1 (no 1, 2, and 3).   [10 Marks]

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

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

(iv)   Draw a flowchart to represent the algorithm for operations of the system.

[20 Marks]

(v)   Write an Assembly Language Program for the system.   [20 Marks]
(Clearly show assembly routines with comments)

SECTION B:

Answer any TWO questions

Question 02

A student wishes to construct a 8051 microcontroller interface which controls a bipolar stepper motor using three push button switches, where one push button switch is used to rotate the bipolar stepper motor in the clockwise direction and another push button switch is used to rotate the bipolar stepper motor in the anticlockwise direction. The remaining push button switch is used to stop the system.
He has written the following functions in 8051 Assembly Language Program (ALP) subroutines.

stepper_clockwise   :   to rotate stepper motor clockwise direction
stepper_anticlockwise   :   to rotate stepper motor anticlockwise direction.

    (i)   Clearly draw a simple circuit diagram to show the connection of three push button switches with an external interrupt pin (either INT0 or INT1) of the 8051 microcontroller by using logic circuits. [07 Marks]

    (ii)   Write an assembly language program for operations of the push button switches using interrupt. Use pre-written functions *stepper_clockwise* and *stepper_anticlockwise*. [08 Marks]

Question 03

    (i)   In a serial communication experiment of 8051 microcontroller, a student set the crystal frequency as 11.0592MHz and the variable baud rate is 9600. Find out the timer values of the 8051 microcontroller for the experiment. [05 Marks]

    (ii)   Write an Assembly Language Program to send a string *@RMOV 01 -5000* to a PC through serial communication of the 8051 microcontroller. Use 9600bps, 8 data bits, 1 start bit, 1 stop bit and no parity bits for the communication. (Assume that the PC will receive data without any error) [10 Marks]

Question 04

    (i)   Draw a block diagram to represent the 2 to 4 line Decoder. [05 Marks]

    (ii)   Write an Assembly Language Program (ALP) to represent the behavior of 2 to 4 line Decoder. [10 Marks]

— The End —