THE OPEN UNIVERSITY OF SRI LANKA

Faculty of Engineering Technology
Department of Electrical & Computer Engineering
Bachelor of Technology Honours in Engineering
FINAL EXAMINATION – (2016/2017)

ECX4236 – Microprocessors and Interfacing

Time Allowed: **3 hours**

Date: 02 December 2017   **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)**. Do not attach it with the answer script.

3. State your assumptions (if any) clearly.

SECTION A:

Answer ALL questions. [70 Marks]

Electronic Product Code Reader (EPR)

The following description is about an *Electronic Product Code Reader (EPR)* which is used for reading the passive RFID tags and show the Electronic Product Code (EPC) values.
You are required to analyse and design the requirements of the *EPR* (Figure 1) given below according to the 8051 microcontroller specifications.
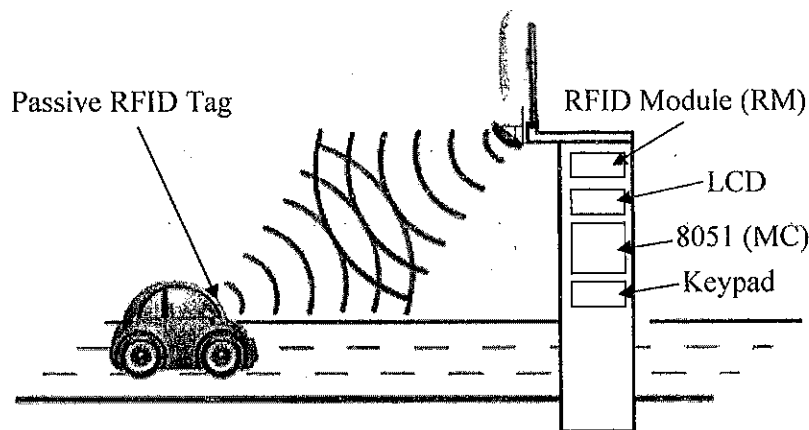

Figure 1: Typical view of EPR

Figure 1 shows the major components of the EPR. The EPR consists of a RFID module (RM) which is connected to the RFID antenna, a LCD, a Keypad and a 8051 microcontroller (MC). The RM has a Start Of Reading signal (SOR), End of Reading (EOR) signal, and DATA buffer (char (24)). MC needs to give low to high pulse to SOR in order to activate reading the RFID tag of the vehicle. Once the SOR signal has been sent, MC needs to wait until EOR signal is available to read the tag data (EPC). EOR signal will change high to low after RM reads the RFID tag of the vehicle and ready to send the tag data (EPC). After EOR signal becomes available, MC can read the RFID tag data from the DATA buffer of the RM via serial communication. A passive RFID tag includes EPC memory bank, which holds the char (24) EPC code (3575BCD15BC614E000000001).

MC needs to show the EPC value on the LCD display. The keypad can be used to start/stop the system and other operation where necessary. There should be a mechanism to detect the vehicles before it enters to readable area and automatically activate the tag reading process.

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

[Q1]

(i) For the proposed mechanism, identify suitable sensors and actuators to detect a vehicle prior to arriving at readable area. [05Marks]

(ii) Draw a diagram to show, how to detect arrival of a vehicle at the readable area. [05 Marks]

(iii) List four (4) features required in a microcontroller for this 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) Draw a diagram and show how to interface RM with MC. [03 Marks]

(iii) 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. [05 Marks]

[Q3] Draw flowchart(s) to represent the algorithm of the EPR operation. Clearly show the port mapping of the 8051 microcontroller. (i.e. mark the pin connection of each sensor and actuators used in the EPR). [20 Marks]

[Q4] Write assembly language programs (ALP) to perform the above task. (i.e. 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)   Explain uses of the DPTR Register of the 8051 Microcontroller.

                [02 Marks]

    (ii)   Name five interrupts which supported by the 8051 Microcontroller.

                [03 Marks]

    (iii)   Write an Assembly Language Program (ALP) to transfer 8bytes of data stored in external memory locations starting address from 2000H to internal memory location starting address from 30H.   [04 Marks]

    (iv)   In a 8051 Microcontroller based system, it is required to generate 50Hz square wave at an output pin. Write an ALP considering 16bit timer and the timer is to be interrupt driven.   [06 Marks]

[Q6]

    (i)   Explain why the crystal oscillator frequency in the 8051 Microcontroller is chosen as 11.0592Mhz.   [02 Marks]

    (ii)   Briefly explain the function of the SBUF register in serial communication by giving example.   [03 Marks]

    (iii)   Write an assembly language program to send the string *"TURN ON SW1"* 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]   In a certain experiment, you are required to interface an analog-to-digital (ADC) converter to the 8051 microcontroller using a DAC for setting the reference voltage 625 mV of the ADC.

    (i)   Draw a block diagram to show your configuration.   [03 Marks]

    (ii)   Draw a flowchart to measure analog value using an ADC with the help of the DAC.   [04 Marks]

    (iii)   Write an ALP for the above setup.   [08 Marks]