The Open University of Sri Lanka
B.Sc. Degree Programme- Level 05
Final Examination 2014/2015
PYU 3161- Practical Physics

Duration: Two (02) hours

Date: 16.10.2015 **Time: 1.30 P.m. – 3.30 P.m.**

ANSWER FOUR QUESTIONS ONLY.

1. (a) Show that when both the inputs are at logic one state the output state is ambiguous in a S-R Flip-Flop. Explain your answer by drawing a truth table for different input states considering the previous output states of the S-R Flip-Flop.

(b) If you are provided with a 7400 IC given in figure 1. How do you construct a S-R Flip-Flop on a bread board? Draw the pin connections you made using wires and the power connection to the IC in your diagram.

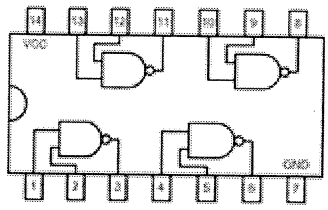

Figure 1

(c) Would you be able to construct a J-k Flip-Flop using a single 7400 IC? Justify your answer by drawing a circuit diagram of the J-K Flip-Flop constructed using NAND gates. Also draw the truth table and explain how the ambiguity in S-R Flip-Flop is avoided in the J-k Flip-Flop.

(d) How do you construct a four bit counter using J-K Flip-Flops having clock inputs? Explain your answer by drawing the relevant circuit diagram.

(e) Sometimes counters are used as frequency dividers. Explain how this is done by drawing the output waveform of each J-K Flip-Flop of the four bit counter in a time diagram. What is the division factor?

2. (a) Many numerical operations in the Arithmetic Logic Unit (ALU) of processors are done with the help of binary adders.
   (i) Draw the truth table of a half adder circuit.
   (ii) If you are provided with NAND gates, how do you construct a half adder circuit to function according to your truth table?

(b) How do you construct a half adder circuit taking into account the truth table of EXOR gate? What are the additional gates that you need in this circuit? Explain your answer by drawing the truth table of EXOR gate and the circuit diagram of half adder with EXOR gate.

(c) What is the difference that you noticed between the half adder and the full adder circuits? Construct a full adder circuit using two half adders you constructed in (b) and using any other necessary gates.

(d) Using the full adder circuit symbolized in figure 2, how do you connect four of them to construct four bit full adder circuit?

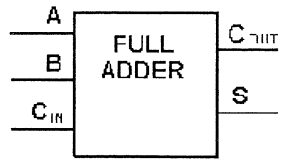

Figure 2

3. (a) Write down three differences between Harvard and Von-Neumann architecture of computers. How does these two types of computer architectures are used to design microcontrollers and microprocessors?

(b) Following diagram (Figure 3) shows pin description of PIC16F84 microcontroller. Write down the function/s of each pin.

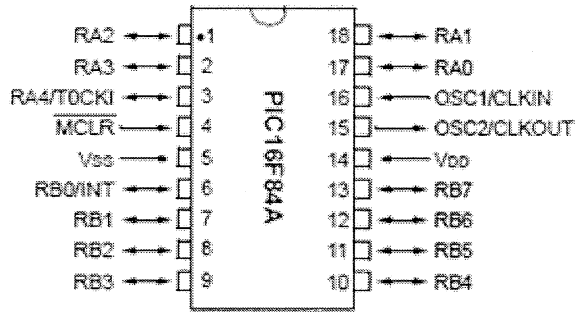

Figure 3

(d) What are the frequently used two types of oscillators in microcontrollers? How does the microcontroller designate according to the type of the oscillator use with it?

(e) How do you connect these two types of oscillators to a microcontroller? Explain your answer by drawing necessary circuit diagrams with necessary components.

(e) Briefly discuss the advantages and disadvantages of those two types of oscillators.

4. (a) PIC16F84 microcontroller has two memory blocks. What are they? Give a short account on them explaining what is meant by EEROM, GPR, SFR, RAM, FLASH when possible and how these terms relate to the memory organization in each block.

(b) STATUS register is a SFR that contains status of ALU and RESET. It also used to select Bank 0 and Bank 1of the data memory. Briefly explain how this is done by the STATUS register. The designation of the eight bits of the STATUS register is given below.

IRP	RP1	RP0	$\overline{TO}$	$\overline{PD}$	Z	DC	C

(f) How do you configure Port A or Port B as input or output selecting the two banks?

(g) Why is the port A or Port B set always as outputs after a reset?

(h) Write a programme in Assembly language to configure all the pins in port B as outputs.

5. (a) What is meant by an interrupt in a programme of a microcontroller?

(b) Write down two interrupt mechanisms that occur in a microcontroller.

(c) Name the SFR that handles the interrupts?

(d) What is the involvement of the Stack of a microcontroller when an interrupt occurs?

(e) When the following programme written in Assembly language is executed in a microcontroller, a LED connected to RB7 light up when the main programme is executed and LED connected to RB 6 light up when interrupt occurs by grounding RB0 pin. Write down what happens after execution of each instruction/s of the programme in front of the respective line/s.

```
#include "p16f84A.inc"

cblock 0x0C
        x
        y
        temp

                ORG 0X00
                GOTO INT
                ORG 0X04

MOVWF TEMP
        CALL DELAY
        BSF PORTB, 7
```

```
                BCF INTCON, 1
                MOVF TEMP, 0
                CALL DELAY
                CALL DELAY
                RETFIE

INT     BSF STATUS, 5
        MOWLW B'00000001' ;
        MOVWF TRISB
        BCF STATUS, 5

        BSF INTCON, 7;
        BSF INTCON, 4;

MAIN    BSF PORTB, 6
        CALL DELAY
       BCF PORTB, 7
        GOTO MAIN

DELAY   DECFSZ X,1
        GOTO DELAY
        DECFSZ Y,1
        GOTO DELAY
        RETURN
        END
```

6. (a) Briefly explain (i) direct addressing and (ii) indirect addressing of the memory of a microcontroller.

   (b) How does the STATUS register of microcontroller involve in (i) direct addressing and (ii) indirect addressing? Explain the states of IRP, RP1 and RP0 bits of STATUS register in the two processes.

   (c) Write down the steps that follow in a microcontroller at the indirect addressing of memory. What is the role of FSR and INDF registers in this process.

   (d) With the help of an example, explain how does the indirect addressing is used to manipulate data arrays in General Purpose Registers?

   (e) Write a programme in Assembly language to read the data in GPR address 0Ch from Port B by indirect addressing.