Subject: Physics
Course Unit: PHY3282

TWO HOURS

PART B – 01 hour & 15 minutes

Answer question No.1 and any 04 of the other questions only

All symbols have their usual meaning

Use given data sheets to answer question

You are given a PIC16F877A microcontroller, a Seven Segment Display (common cathode type) and a MAX232 integrated circuit (IC) to construct an embedded system, which could communicate with a computer under the asynchronous serial communication. The system has to toggle the output logic state on the RA0 each 500 ms and in addition to that, the system should be able to increase the current value of the SSD when character "A" is received via the serial port of the computer. You have to reset the SSD to zero when it reaches the maximum decimal value it can display.

  i Assign suitable input and output pins for serial interface and the SSD. **[08 Marks]**

  ii Draw the complete hardware diagram for the system including other essential components which are necessary to operate the system properly. **[10 Marks]**

  iii Draw appropriate main and interrupt flow charts in order to operate the above system.
[08 Marks]

  iv Write down a complete C program to execute the above system. **[10 Marks]**

Write down suitable macros in assembly language in order to operate the following functions through a PIC16F84A microcontroller **[04 Marks]**

  i To change bank1 **[04 Marks]**

  ii To set a given pin of a given port as an output **[04 Marks]**

  iii To toggle 0th bit of a given port.

  iv To jump a particular label if the value of given register at the bank zero equals to 5
[04 Marks]

Write down a C program in order to display ten numbers from 0 to 9 on the 1st row of an LMB162ABC Liquid Display (LCD) module as shown in the following figure by using a PIC16F84A microcontroller.
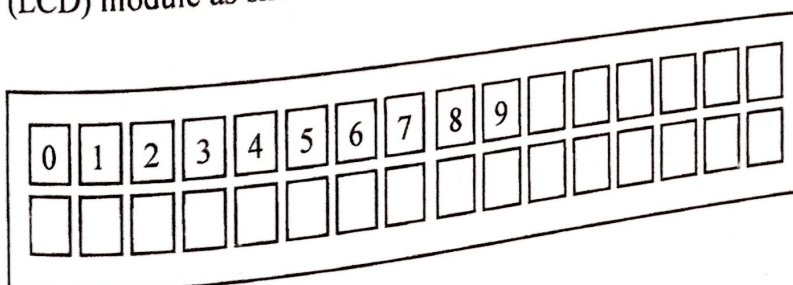
[16 Marks]

4. Write down an assembly language program in order to write the last four digits of your index number at the first four addresses of the PIC16F84A microcontroller respectively.

[16 Marks]

5. Rewrite the following assembly program using 14 bit machine codes

[16 Marks]

```
#INCLUDE "P16F84A.INC"

X EQU 0X0C

INIT        BSF         STATUS,5
            CLRF        TRISA
            BCF         STATUS,5


MAIN        MOVLW       .1
            XORWF       PORTA, 1
            GOTO        MAIN


            END
```

6. An Analog to Digital Converter (ADC) has following specifications.
   - Positive reference voltage (V ref+) = 5 V
   - Negative reference voltage (V ref-) = 0 V
   - Resolution = 8 bit
   - Maximum sampling rate= 10 ksps

   Answer the followings regarding the given ADC
   - i   Sample size (Voltage resolution)

   [04 Marks]

   - ii   What would be the corresponding digital result after the conversion of a 2.5 V analog voltage?

   [04 Marks]

   - iii   What would be the corresponding analog input voltage if related ADC results is 0x1F?

   [04 Marks]

   - iv   If the data acquisition is conducted for 2 minutes at the maximum sampling rate using this ADC, what would be the size of the memory in megabytes (MB) required to store the data collected?

   [04 Marks]

2

You have to maintain an asynchronous serial communication between two PIC16F877A microcontrollers with following specifications,

Baud rate	19200
Number of data bits	8
Number of stop bits	1
BRGH	1

Answer the following questions regarding this communication.

i   What would be the frequency of the crystal to generate this baud rate more accurately?

[04 Marks]

ii   Assign the suitable binary values for TXSTA, RCSTA and SPBRG registers in order to maintain this communication.

[04 Marks]

iii   Assume that if a character "7" is transmitted from one microcontroller to another draw a complete data packet for this communication (the ASCII valve of the letter 6 in decimal is 50)   [04 Marks]

iv   How much time will be taken by one data packet?   [04 Marks]