

University of Ruhuna

Bachelor of Science General Degree Level III (Semester II) Examination

January 2018

Subject: Physics
Course Unit: PHY3282

TWO HOURS

PART B – 01 hour & 15 minutes

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

All symbols have their usual meaning

Use given data sheets to answer question

You are given a PIC16F877A microcontroller, a push button, a 4 MHz crystal and a MAX232 integrated circuit (IC) to construct an embedded system which can maintain a communication with a computer under the asynchronous serial communication with a baud rate of 9600 bps. The system has to convert an analog voltage, which is available on the AN0, to its corresponding digital value and send the right justified ADC results (ADRESH and ADRESL) to the computer using the serial communication when the push button is pressed or character "A" is received from the serial port of the computer.[Hint: Use interrupts and set BRGH=1]

- i Assign suitable input and output pins for hardware interfaces. [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 flow charts for the main and other sub routings (including the interrupt program) 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 each of the following functions using a PIC16F84A microcontroller.

- i To write a given 8 bit value on a given file register change bank 1 [04 Marks]
- ii To set a given pin of a given port as an output [04 Marks]
- iii To reverse the currently available output logic state of each bits of a given port [04 Marks]
- iv To jump a particular label if the value of given a register at the bank zero is greater than 3. [04 Marks]

Write down a subprogram in C language in order to initialize a LMB162ABC Liquid Crystal Display (LCD) using a PIC16F84A microcontroller with following specifications (Refer the relevant data sheet).

Parameter	Value
L1	1
N	1
F	0
S	0
I/D	1
D	1
C	1
B	0

[16 Marks]

4. Write a sub-program in C language by including the assembly codes in order to write an 8 bit value at a given location of the Electrically Erasable Programmable Read Only Memory (EEPROM) in a PIC16F84A microcontroller. [16 Marks]

5. Rewrite the following assembly program using the 14-bit machine codes [16 Marks]

```
#INCLUDE "P16F84A.INC"
CBLOCK EQU 0X0C
COUNT1
COUNT2
ENDC

MAIN      MOVLW      0x0A
          MOVWF     TMRO
          CALL      DELAY
          GOTO     MAIN

DELAY     DECFSZ    COUNT2, 1
          GOTO     DELAY
          RETURN

END
```

5. A PIC16F877A microcontroller is used to conduct an Analog to Digital Conversion (ADC) with the following voltage settings. (Assume that, value of the ADCON1 register is maintained at 0B11001101 throughout this conversion.)

Voltage	Value
Voltage on AN2	2 V
Voltage on A4	4 V

Answer the followings questions regarding this ADC

- i Find the voltage values for V_{REF+} and V_{REF-} . [04 Marks]
- ii Calculate the sample size [04 Marks]
- iii Find the values on ADRESH and ADRESL after the conversion of a 3.2 V analog voltage. [04 Marks]
- iv If this system is used to conduct an analog data acquisition during a period of 5 minutes under the data rate of 0.5 ksp/s (kilo samples per second), calculate the amount of memory (in kilobytes) required to store the data. [04 Marks]

Following table illustrates the values of the registers of a PIC16F877A microcontroller, which is configured in order to maintain an asynchronous serial communication with a computer. (assume that the microcontroller works at its maximum speed)

Register Name	Value (in Hexadecimal)
TXSTA	0x26
RCSTA	0x90
SPBRG	0x40

Answer the following questions regarding the above communication.

- i Find the baud rate in bps. **[04 Marks]**

- ii Calculate the bit time rate. **[04 Marks]**

- iii Assume that character "5" is transmitted from this microcontroller to the computer under the above configuration. Sketch the complete data packet corresponding to this communication. (The ASCII value of the letter 5 in decimal is 53). **[04 Marks]**

- iv Calculate the maximum number of characters that can be sent to the computer during the period of 10 seconds. **[04 Marks]**