



# UNIVERSITY OF RUHUNA

## Faculty of Engineering

End-Semester 6

Examination in Engineering: November 2016

Module Number: EE6304

Module Name: Embedded System Design

[Three Hours]

[Answer all questions]

- Q1 a) Compare the differences in between 16F84A and 16F877A microcontrollers [2 Marks]
- b) Briefly explain in few words the purpose of the address 0x0004 in the program memory of the PIC 16 series microcontrollers. [2 Marks]
- c) What is meant by the statement; PIC 16 series microcontrollers are 8-bit microcontrollers. [2 Marks]
- d) In the PIC16 series, explain why there is no single instruction that can perform addition between two memory locations in one step. [2 Marks]
- d) For the circuit in figure Q1, what is the purpose of RC circuit that is connected to the RESET input of the microcontroller?

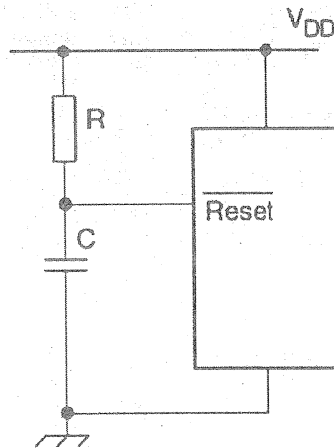


Figure Q1.

[2 Marks]

- Q2 a) Describe the advantages of in-circuit programming and debugging over the corresponding conventional development process. [2 Marks]
- b) State the advantages of flash ROM, compared with other memory types [1 Mark]
- c) State the function of the EQU directive. [1 Mark]
- d) State three PIC chip options, which are determined by the configuration cod [1 Mark]

Q3 A matrix key pad consists of matrix switches (one switch for each key) as shown in figure Q3 (a). In order to scan the keypad, each column is pulled to logic one in turn whilst each row is read in turn. Figure Q3 (b) demonstrate the flow chart of the scanning process. Once the key is identified it should be displayed on a 7 segment LED which is connected to a Microcontroller. It is the task of the program is to produce software which will scan the keypad and determine which key is pressed. Refer the table Q3 for coding.

- a) Draw a complete flow chart to demonstrate the overall operation of the key pad. [3 Marks]
- b) Write a algorithm to demonstrate the scanning and identification process. [3 Marks]
- c) Draw a complete circuit diagram with Microcontroller. [4 Marks]
- d) Write a program in assembly language to execute the given task. [5 Marks]

- Q4.
- a) Outline the process of installing a program in the PIC MCU. [2 Marks]
  - b) State the three main elements in any microprocessor system. [1 Mark]
  - c) State the difference between a microprocessor and a microcontroller. [2 Marks]
  - d) Describe briefly the process of fetching an instruction. [2 Marks]
  - d) Explain why serial data communication is generally slower than parallel data communication. [2 Marks]
  - e) State why Ports A and E in the PIC 16F877 cannot be used for digital input without initialization. [1 Mark]

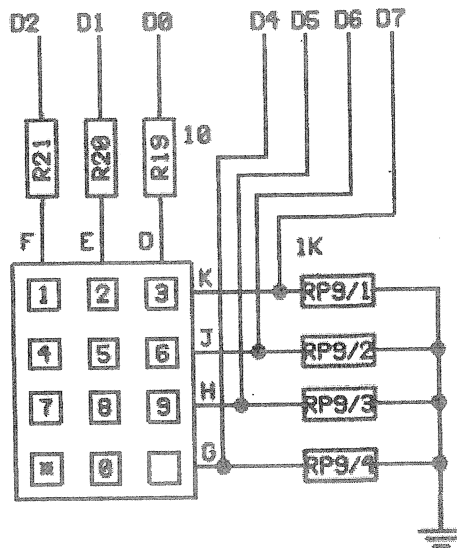


Figure Q3.(a)

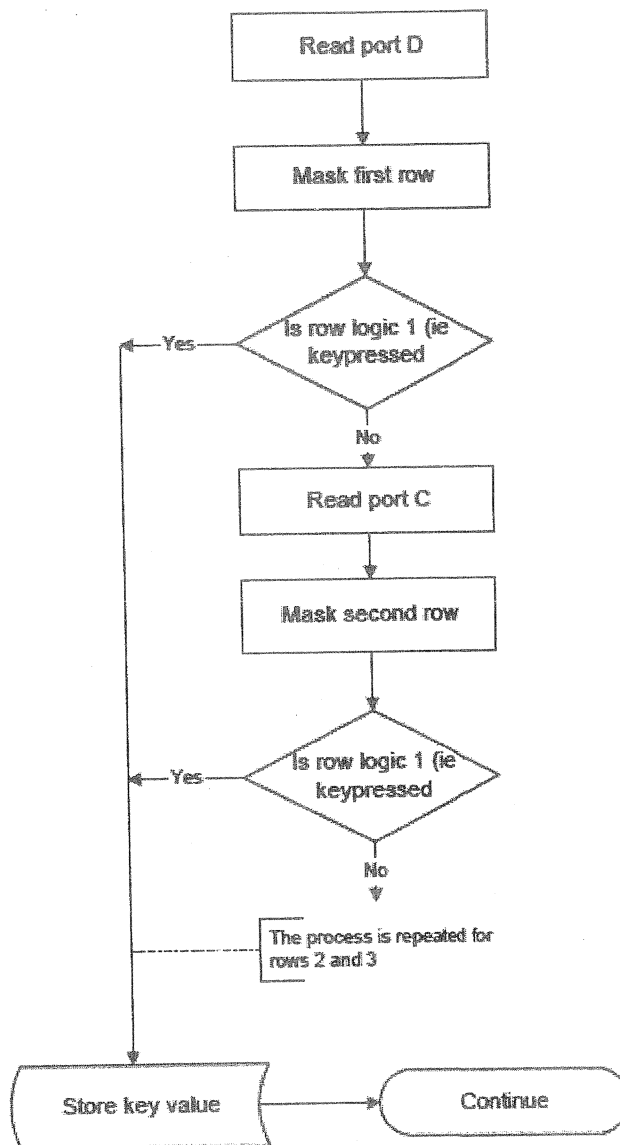


Figure Q3.(b)

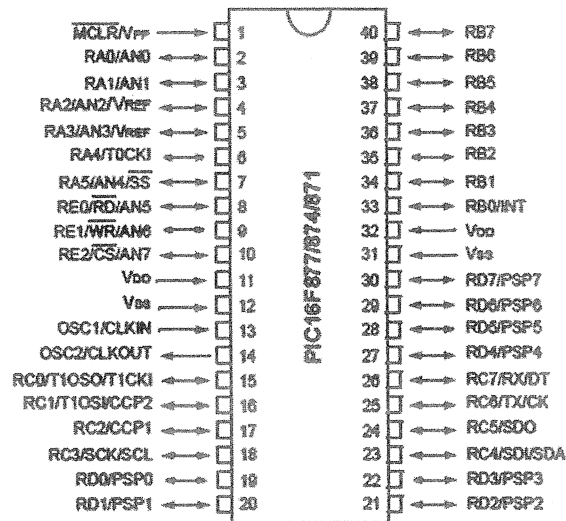


Figure Q3 (c): Pin diagram of 16F8XX.

Table Q3: Instruction set

Mnemonic, Operands	Description	Cycles	14-Bit Opcode		Status Affected	Notes
			MSb	LSb		
<b>BYTE-ORIENTED FILE REGISTER OPERATIONS</b>						
ADDWF	f, d Add W and f	1	00	0111 dfff efff	C,DC,Z	1,2
ANDWF	f, d AND W with f	1	00	0101 dfff efff	Z	1,2
CLRF	f Clear f	1	00	0001 1fff efff	Z	2
CLRWF	- Clear W	1	00	0001 0xxx xxxx	Z	
COMF	f, d Complement f	1	00	1001 dfff efff	Z	1,2
DECf	f, d Decrement f	1	00	0011 dfff efff	Z	1,2
DECFSZ	f, d Decrement f, Skip if 0	1(2)	00	1011 dfff efff		1,2,3
INCF	f, d Increment f	1	00	1010 dfff efff	Z	1,2
INCFSZ	f, d Increment f, Skip if 0	1(2)	00	1111 dfff efff		1,2,3
IORWF	f, d Inclusive OR W with f	1	00	0100 dfff efff	Z	1,2
MOVF	f, d Move f	1	00	1000 dfff efff	Z	1,2
MOVWF	f Move W to f	1	00	0000 1fff efff		
NOP	- No Operation	1	00	0000 0xxx 0000		
RLF	f, d Rotate Left f through Carry	1	00	1101 dfff efff	C	1,2
RRF	f, d Rotate Right f through Carry	1	00	1100 dfff efff	C	1,2
SUBWF	f, d Subtract W from f	1	00	0010 dfff efff	C,DC,Z	1,2
SWAPF	f, d Swap nibbles in f	1	00	1110 dfff efff		1,2
XORWF	f, d Exclusive OR W with f	1	00	0110 dfff efff	Z	1,2
<b>BIT-ORIENTED FILE REGISTER OPERATIONS</b>						
BCF	f, b Bit Clear f	1	01	00bb bfff efff		1,2
BSF	f, b Bit Set f	1	01	01bb bfff efff		1,2
BTFSC	f, b Bit Test f, Skip if Clear	1 (2)	01	10bb bfff efff		3
BTFSS	f, b Bit Test f, Skip if Set	1 (2)	01	11bb bfff efff		3
<b>LITERAL AND CONTROL OPERATIONS</b>						
ADDLW	k Add literal and W	1	11	111x kkkk kkkk	C,DC,Z	
ANDLW	k AND literal with W	1	11	1001 kkkk kkkk	Z	
CALL	k Call subroutine	2	10	01kk kkkk kkkk		
CLRWDT	- Clear Watchdog Timer	1	00	0000 0110 0100	$\overline{TO}, \overline{PD}$	
GOTO	k Go to address	2	10	1kkk kkkk kkkk		
IORLW	k Inclusive OR literal with W	1	11	1000 kkkk kkkk	Z	
MOVLW	k Move literal to W	1	11	00xx kkkk kkkk		
RETfIE	- Return from interrupt	2	00	0000 0000 1001		
RETLW	k Return with literal in W	2	11	01xx kkkk kkkk		
RETURN	- Return from Subroutine	2	00	0000 0000 1000		
SLEEP	- Go into standby mode	1	00	0000 0110 0011	$\overline{TO}, \overline{PD}$	
SUBLW	k Subtract W from literal	1	11	110x kkkk kkkk	C,DC,Z	
XORLW	k Exclusive OR literal with W	1	11	1010 kkkk kkkk	Z	