First Exam, First Semester 2010/2011

Course Title: Embedded Systems Design	**Date:**	24/11/2010
Course No: 0630470	**Time Allowed:**	1 hour
Instructor: Prof. Kasim Al-Aubidy	**No. of Pages:**	3

Question 1: [40%]

Objectives: Basic concepts of Embedded Systems.

[A]. Answer **TWO** of the following:
1. With the help of block diagram, list different components of an embedded system?

2. Explain interrupt structure of PIC 16F84 microcontroller?

3. Show TWO main differences between conventional von Neumann structure and Harvard structure?

[B]. An embedded system is to be designed to run from battery power. The system must remain powered, but will have short periods of activity, separated by long periods of inactivity.
1. Explain the impact of clock frequency on power consumption?

2. Give a feature of the 16F84 microcontroller that can be used to minimize power consumption?

3. What other techniques of circuit design can be applied to minimize power consumption?
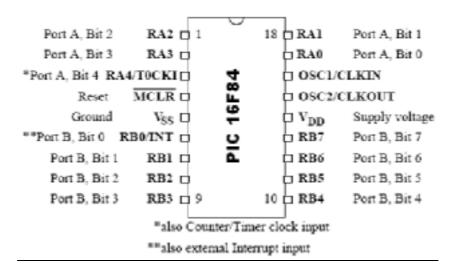
Question 2: [60%]
Objectives: Microcontroller Interfacing & Programming.

[A]. It is required to read inputs from **TWO** switches and display received data on **TWO** LEDs. The microcontroller oscillator clock is **8 MHz,** I_o= 10 mA, I_L= 1µA, V_{IH}=2.4 V and V_D= 1.8 V.
  1. Give the hardware design of the required interface circuit?
  2. Calculate the values of each parameter in the circuit?

[B]. It is required to generate a delay subroutine in an embedded system based on 16F84 microcontroller with 8MHz oscillator clock.
  1. Write 250 µsec delay subroutine using minimum number of instructions?
  2. Modify your subroutine to generate 10 msec delay? Give a flowchart only?

Mnemonic, Operands		Description	Cycles	14-Bit Opcode MSb			LSb	Status Affected	Notes
BYTE-ORIENTED FILE REGISTER OPERATIONS									
ADDWF	f, d	Add W and f	1	00	0111	dfff	ffff	C,DC,Z	1,2
ANDWF	f, d	AND W with f	1	00	0101	dfff	ffff	Z	1,2
CLRF	f	Clear f	1	00	0001	1fff	ffff	Z	2
CLRW	-	Clear W	1	00	0001	0xxx	xxxx	Z	
COMF	f, d	Complement f	1	00	1001	dfff	ffff	Z	1,2
DECF	f, d	Decrement f	1	00	0011	dfff	ffff	Z	1,2
DECFSZ	f, d	Decrement f, Skip if 0	1 (2)	00	1011	dfff	ffff		1,2,3
INCF	f, d	Increment f	1	00	1010	dfff	ffff	Z	1,2
INCFSZ	f, d	Increment f, Skip if 0	1 (2)	00	1111	dfff	ffff		1,2,3
IORWF	f, d	Inclusive OR W with f	1	00	0100	dfff	ffff	Z	1,2
MOVF	f, d	Move f	1	00	1000	dfff	ffff	Z	1,2
MOVWF	f	Move W to f	1	00	0000	1fff	ffff		
NOP	-	No Operation	1	00	0000	0xx0	0000		
RLF	f, d	Rotate Left f through Carry	1	00	1101	dfff	ffff	C	1,2
RRF	f, d	Rotate Right f through Carry	1	00	1100	dfff	ffff	C	1,2
SUBWF	f, d	Subtract W from f	1	00	0010	dfff	ffff	C,DC,Z	1,2
SWAPF	f, d	Swap nibbles in f	1	00	1110	dfff	ffff		1,2
XORWF	f, d	Exclusive OR W with f	1	00	0110	dfff	ffff	Z	1,2
BIT-ORIENTED FILE REGISTER OPERATIONS									
BCF	f, b	Bit Clear f	1	01	00bb	bfff	ffff		1,2
BSF	f, b	Bit Set f	1	01	01bb	bfff	ffff		1,2
BTFSC	f, b	Bit Test f, Skip if Clear	1 (2)	01	10bb	bfff	ffff		3
BTFSS	f, b	Bit Test f, Skip if Set	1 (2)	01	11bb	bfff	ffff		3
LITERAL AND CONTROL OPERATIONS									
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	0kkk	kkkk	kkkk		
CLRWDT	-	Clear Watchdog Timer	1	00	0000	0110	0100	TO,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	TO,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	

Port A, Bit 2   RA2 □ 1   18 □ RA1   Port A, Bit 1
Port A, Bit 3   RA3 □   □ RA0   Port A, Bit 0
*Port A, Bit 4 RA4/T0CKI □   □ OSC1/CLKIN
Reset   MCLR □   □ OSC2/CLKOUT
Ground   Vss □   PIC 16F84   □ VDD   Supply voltage
**Port B, Bit 0   RB0/INT □   □ RB7   Port B, Bit 7
Port B, Bit 1   RB1 □   □ RB6   Port B, Bit 6
Port B, Bit 2   RB2 □   □ RB5   Port B, Bit 5
Port B, Bit 3   RB3 □ 9   10 □ RB4   Port B, Bit 4

*also Counter/Timer clock input

**also external Interrupt input