

## Final Exam, First Semester 2007/2008

<b>Course Title:</b> Embedded Systems Design	<b>Date:</b> 29/1/2008
<b>Course No:</b> 630470	<b>Time Allowed:</b> 2 hours
<b>Instructor:</b> Dr. Kasim Al-Aubidy	<b>No. of Pages:</b> 2

### Question 1: [20%]

*Objectives: Basic concepts of Embedded Systems.*

Choose the correct answer:

1. A serial port adaptor that receives and transmits serial data is called;  
(a). UART            (b). USART.            (c). I<sup>2</sup>C.            (d). SPI.
2. The baud rate is;  
(a). the total number of bits that can be transmitted. (b). the bandwidth of the serial interface.  
(c). the total number of bits per unit time that can be transmitted. (d). non of the above.
3. Flash memory is an economical compromise between EEPROM and EPROM. A high voltage is applied to;  
(a). selectively erase portions of flash memory.            (b). erase the entire block.  
(c). selectively erase and rewrite portions of flash memory. (d). erase and rewrite the entire block.
4. Assembler directives can be used to;  
(a). improve the hardware design of an embedded system.            (b). modify the system reliability.  
(c). improve the efficiency and flexibility of code production. (d). minimize the size of programs.
5. The alphanumeric LCD needs command codes for control operations. It is an;  
(a) input device receives HEX codes.            (b) input device receives ASCII codes.  
(c). output device receives HEX codes.            (d) output device receives ASCII codes.
6. After the execution of these instructions "movlw 5A" "andlw A8", the content of WREG is;  
(a). 02.            (b). 24.            (c). 08.            (d). AA.
7. In the PIC16F84 microcontroller, the instruction fetching and execution are done at;  
(a). the same time.            (b). two clock periods.            (c). four clock periods.            (d). eight clock periods.
8. RISC processors normally have;  
(a) a large number of general-purpose registers.            (b). variable instruction length.  
(c). instructions of variable sizes.            (d). many addressing modes.
9. The percentage accuracy per bit of a 10-bit ADC at full scale is;  
(a). 0.24%.            (b). 0.096%.            (c). 0.96%.            (d). 0.024%.
10. The PIC 16F84 microcontroller has a stack memory with;  
(a). a single-stack level.            (b). 2-stack level.            (c). 4-stack level.            (d). 8-stack level.

### Question 2: [30%]

*Objectives: Embedded Systems Architecture.*

- [A]. What is a microcontroller? What are the major differences between microprocessors and microcontrollers?
- [B]. Draw the embedded system design and development model? List **FIVE** features of the Microcontroller-Based Embedded Systems?
- [C]. The Harvard memory structure gives some clear advantages over conventional von Neumann structure. Can you think of any disadvantages? Show that with the help of diagrams?

**Question 3:**

**[20%]**

*Objectives: Embedded System Programming.*

An embedded system has a PIC 16F84 microcontroller with a crystal frequency of 4.0 MHz.

- [A]. Determine the function of the following set of instructions;
- [B]. Write a 100 msec delay subroutine?
- [C]. The hardware counter/timer (TMRO) of the microcontroller can be used to generate a repetitive interrupts. Explain that and calculate the minimum and maximum interrupt frequency?

<i>adr1:</i>	<i>movlw</i>	<i>value</i>
	<i>movwf</i>	<i>register</i>
<i>adr2:</i>	<i>decfsz</i>	<i>register</i>
	<i>goto</i>	<i>adr2</i>
	<i>return</i>	

**Question 4:**

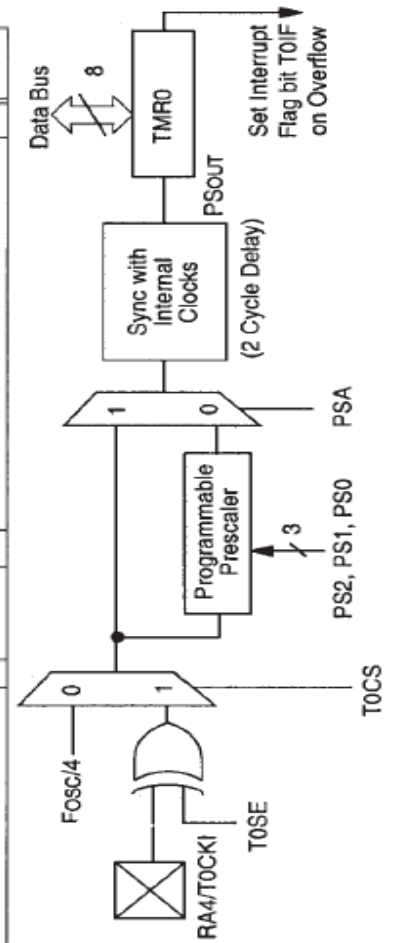
**[30%]**

*Objectives: Microcontroller Interfacing.*

Design an embedded system using a suitable microcontroller. The system has an ON/OFF switch, a manual reset switch, 12-button keypad, TWO LEDs to indicate system status, a PWM signal and a direction signal to control the operation of a DC motor.

1. Draw the general layout of the embedded system?
2. Show the detailed hardware design of the required system?
3. Outline a flowchart for the keypad scanning algorithm?
4. Explain why a pull-up resistor needed with a switch input?

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 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
CLRWF	- 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 0xxx 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
<b>BIT-ORIENTED FILE REGISTER OPERATIONS</b>						
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
<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	0xxx kkkk kkkk		
CLRWDI	- Clear Watchdog Timer	1	00	0000 0110 0100	$\overline{TO,PD}$	
GOTO	k Go to address	2	10	1xxx kkkk kkkk		
IORLW	k Inclusive OR literal with W	1	11	1000 kkkk kkkk	Z	
MOVLW	k Move literal to W	1	11	0xxx 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	$\overline{TO,PD}$	
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	



Good Luck

Dr. Kasim Al-Aubidy