Philadelphia University **Student Name:**
Faculty of Engineering **Student Number:**

Final Exam, Second Semester: 2008/2009
Mechatronics Department

Course Title: Microcontrollers / Embedded Systems	**Date: 5/6/2009**
Course No: 640476 / 630470	**Time: 2 hours**
Lecturer: Dr. Tarek A. Tutunji	**No. of pages: 4**

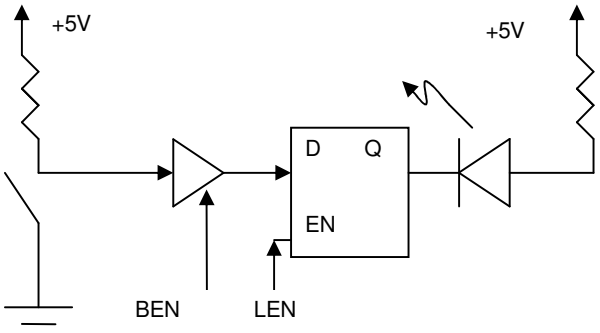
Question 1: ***(18 marks)***

a) List the main differences between microprocessors and microcontrollers. (2)

b) List the main differences between the PIC16F84 and PIC16F877. (2)

c) Specify the Hex codes that need to be written in INTCON and OPTION registers if the task it to use an ISR when an active high input is given to RB0. (2)

d) Indicate in the table the state of the LED (ON, OFF, No Change, or Don't Care) for the 1-bit data system shown below. (2)



Switch	BEN	LEN	LED
Open	1	1	
Open	1	0	
Closed	1	1	
Closed	0	1	

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e) The control word for an 8255 chip is given below. If Port A (addressed at 08H) is specified as input while Ports B and C are specified as outputs. Write the 8085 assembly code to enter the appropriate hex code in the control register. (3)

D7	D6	D5	D4	D3	D2	D1	D0
1	0	0	Port A	Port C Upper	0	Port B	Port C Lower

f) Calculate the hex value for COUNT to get a total of 5 msec delay in the subroutine below. Assume that the external clock is 150 KHz. (3)

```
Delay   MOVLW   COUNT
        MOVWF   Timer
Down    DECFSZ  Timer
        GOTO    Down
        RETURN
```

g) Write the assembly code (no need for schematic) for PIC16F84 to move a stepper motor continuously. The stepper motor inputs are connected to Port B in the PIC as shown below. (4)

PIC Pin	**RB7**	**RB6**	**RB5**	**RB4**
Step	*A1*	*A2*	*B1*	*B2*
1	H	L	H	L
2	L	H	H	L
3	L	H	L	H
4	H	L	L	H
5	Repeat 1 to 4			

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Question 2: ***(8 marks)***

a) Draw the block diagram for temperature control systems that uses the PIC 16F877.
b) In the same system, if the temperature sensor used has a resolution of 15 mV per C, the ADC reference voltage is 1.8 Volt, and the ADC uses 8 bits. What would the ADC read when the temperature is 30 C?

Question 3: ***(10 marks)***

Use the 8085 microprocessor to design a microcontroller with the following specifications:
-- ROM with size of 1Kx8 with a starting address at 0000H
-- RAM with size 4Kx8 with a starting address at 4000H
-- One bidirectional port addressed at F0H

Draw the schematic diagram of your design showing clearly all the connections between address, data, and control lines. Use latches, buffers, decoders, and logic gates as needed.

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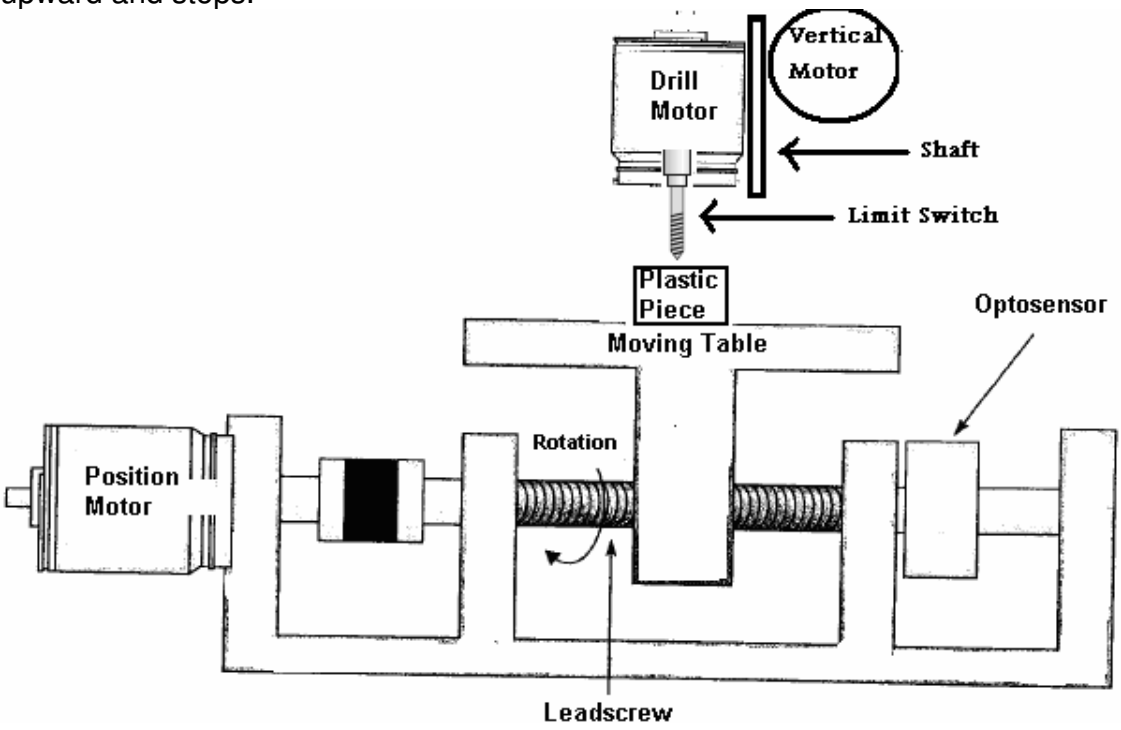
Question 4: ***(14 marks)***

Design a circuit using PIC16F84 to control the drilling operation shown below: First, a position DC motor is used to move the table into a desired position set by a 4-bit binary switch (not shown). The Optosensor is used to read the shaft revs (use the TMR0 to count revs). Second, once the piece is in the desired position, a Drill Motor is activated at a speed of 1,000 rpm (its nominal speed is 2,000) and moved downward using the vertical motor / shaft (until it hits the limit switch) to drill the plastic piece. Finally, after a specified time delay, the drill motor moves upward and stops.



1) Draw the complete schematic circuit used in your design.
2) Write the Assembly code and include your comments.

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