Embedded Real-Time Systems (AME 3623)
Homework 3

February 27, 2009

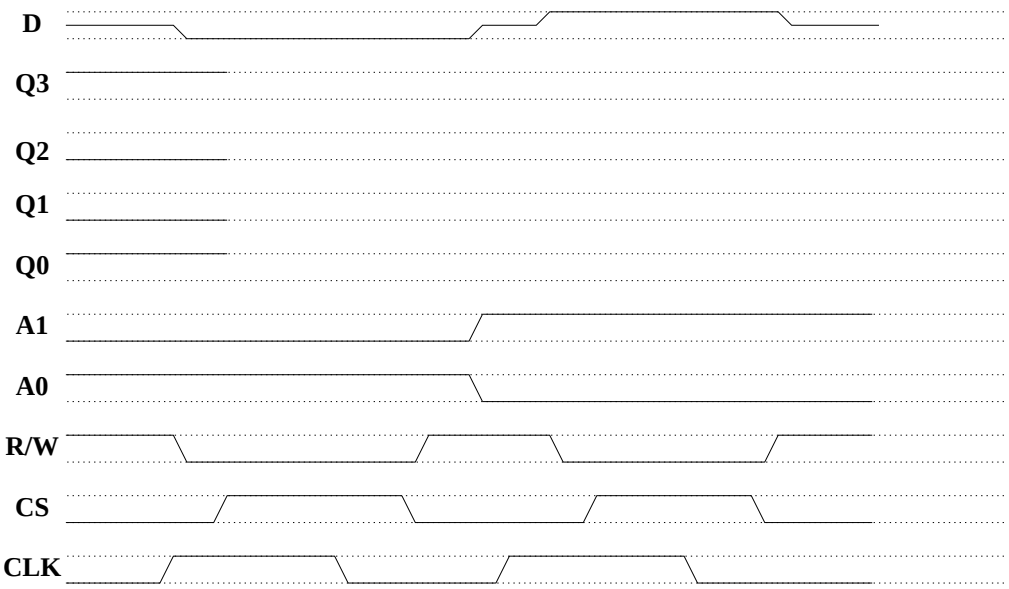
This homework assignment is due on Tuesday, March 10th in class (9:00 am). Your work may be handed in electronically (use the **Homework 3** digital dropbox on D2L), but please bring a hardcopy to class.

This assignment must be done individually: do not share/discuss your answers with others or look at the answers of others.

Question 1

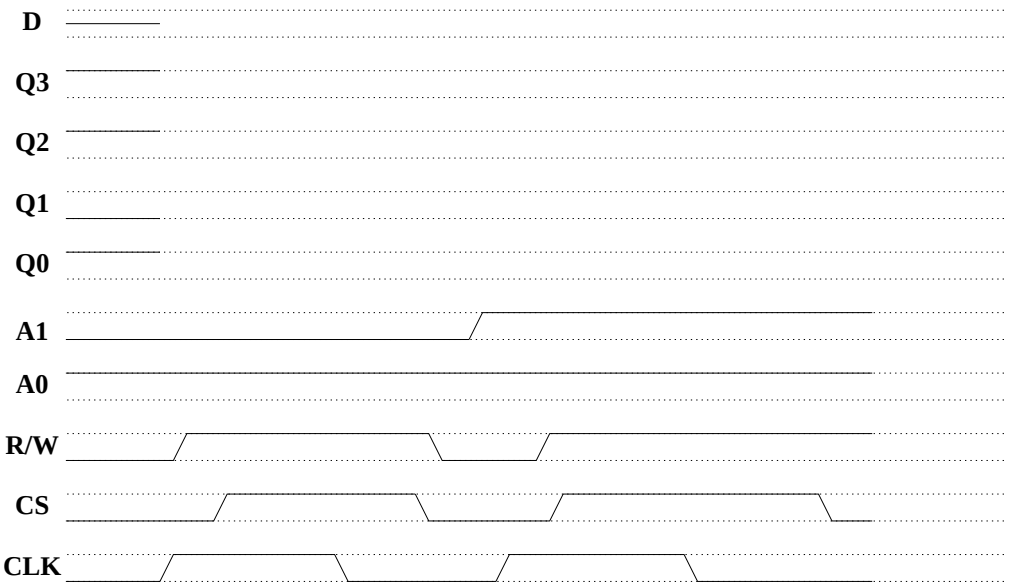
(10pts) Consider the four-element memory "chip" that we discussed in class (each element is "one bit wide"). Given the following timing diagram, fill in the missing traces ($Q0$, $Q1$, $Q2$, and $Q3$).

Hint: first re-examine the rules for writing to and reading from a memory chip.



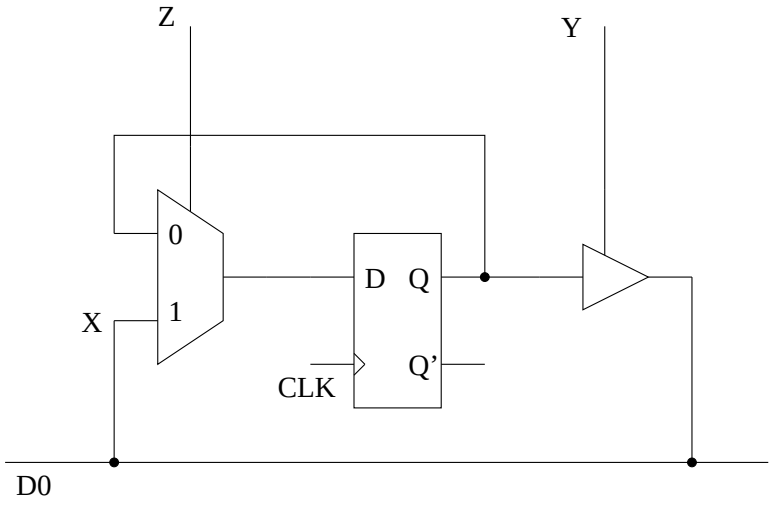
Question 2

(10pts) Consider the same four-element memory chip. Given the following timing diagram, fill in the missing traces (D, $Q0$, $Q1$, $Q2$, and $Q3$).



Question 3

The following circuit is a partial implementation of a 1-bit memory sitting on the data bus $D0$.



1. (10pts) Suppose that Q is initially set to 1. If $Z = 0$, $Y = 0$, $D0 = 0$ and the clock transitions from high to low, what happens to Q?

2. (10pts) Suppose that Q is initially set to 1. If $Z = 1$, $Y = 0$, $D0 = 0$ and the clock transitions from high to low, what happens to Q?

3. (10pts) Suppose that Q is initially set to 1. If $Z = 0$, $Y = 1$ and the clock transitions from high to low, what happens to $D0$ and when?

4. (10pts) Generally, what is the meaning of Z?

5. (10pts) Assume memory control signals in the previous problems (CS, R/W, $A1$, and $A0$), and that this is memory element number 2 (counting from 0). Give the truth table for Z.

CS	R/W	$A1$	$A0$	Z
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

6. (10pts) Design a circuit that implements Z.

Question 4

1. (5pts) Briefly define *serial communication.*

2. (10pts) Under what conditions does the LED attached to port B, pin 1 flash?

```
while(1) {
   c = getchar();
   if(c >= '0' && c <= '9') {
      PORTB ^= 4;
   }
   PORTB ^= 2;
}
```

Question 5

How much time did you spend on this assignment?