Embedded Systems (AME 3623)
Homework 2

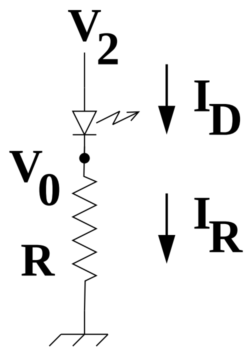
March 8, 2011

This homework assignment is due on Tuesday, March 8th **at 8:59 am**. Your work may be handed in electronically (use the **Homework 2** digital dropbox on D2L) or in hardcopy form.

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

Question 1

Consider the following circuit:



Assume that $V_f = 1.5V$ (the forward voltage of the diode).

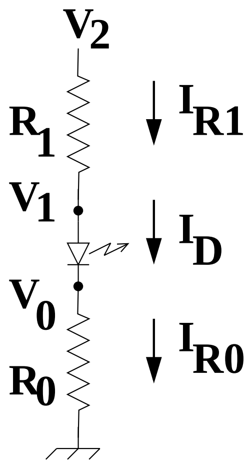
1. (10pts) What equations are always true, no matter the state of the diode? (i.e., what are the fundamental equations?)

2. (15pts) At what V_2 does the diode begin to conduct current?

3. (10pts) Assume that $R = 200\Omega$. Draw V_0 and I_D as a function of V_2. (use separate figures)

Question 2

Consider the following circuit:



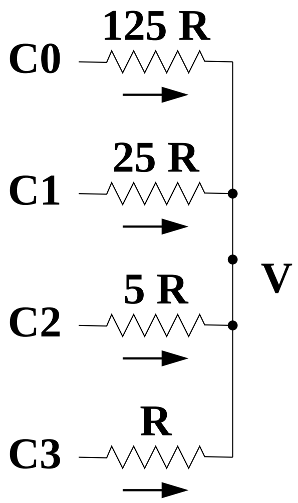
1. (10pts) What equations are always true, no matter the state of the diode? (i.e., what are the fundamental equations?)

2. (15pts) At what V_2 does the diode begin to conduct current?

3. (10pts) Assume that $R_0 = 500\Omega$ and $R_1 = 200\Omega$. Draw V_0 and V_1 (one figure) and I_D (second figure) as a function of V_2.

Question 3

Consider the following circuit:



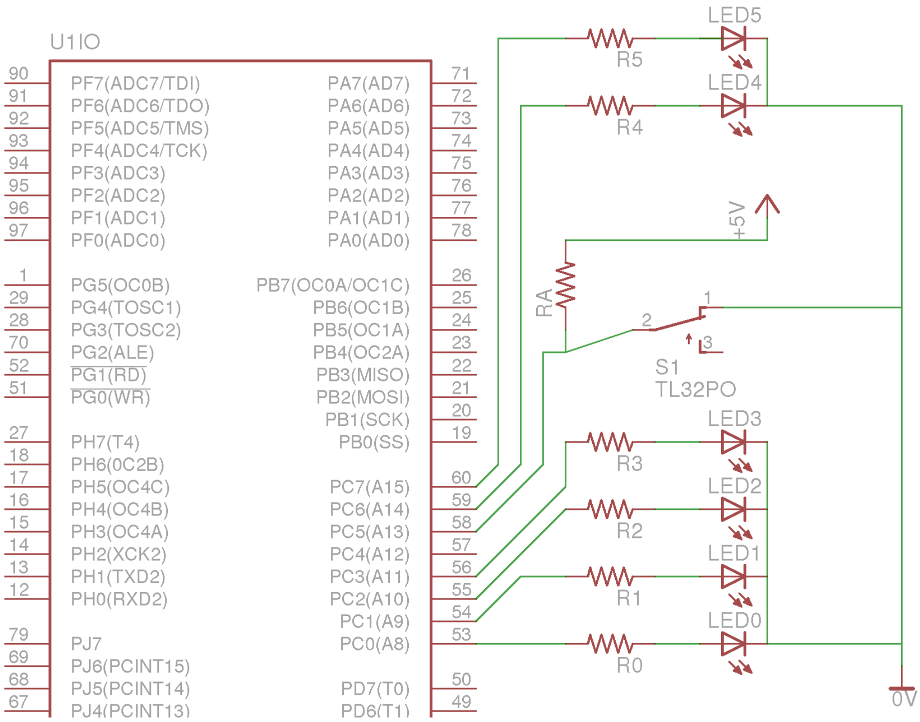
1. (10 pts) What are the fundamental equations that determine V and other associated unknown variables? (i.e., give the equations that are derived directly from fundamental electronic principles).

2. (10 pts) Derive an equation for V in terms of the known variables.

3. (10 pts) Show in graph form V as a function of the binary number C.

Question 4

Consider the following circuit:



and consider the associated program:

```
int main (void)
{
  DDRC = 0xCF;
  PORTC = 0;
  uint8_t count = 0;

  while(1) {
    while(PINC & 0x20) {};                          // Inner loop
    PORTC = (PORTC & 0xF0) | (count & 0xF);         // Set LEDs
    delay_ms(50);
    ++count;
  };
}
```

1. (10 pts) Briefly explain the behavior of the inner while loop.

2. (10 pts) At what frequency and duty cycle does LED0 flash?

3. (10 pts) At what frequency and duty cycle does LED2 flash?

4. (10 pts) At what frequency and duty cycle does LED5 flash?

5. (20 pts) Suppose we wanted to use the first 6 bits of the counter to drive the LEDs (as opposed to just the first 4 bits). Modify the *set LEDs* line so that we accomplish this.

Question 5

How much time did you spend on this homework assignment?