EECS 281: **Lab 1 (Glennan 308)** **Due: Tuesday, February 22, 2005**

Name: _____ Email: _____

1a. Construct the following circuit shown in Figure 1. Assume resistor R3 is 2000 ohms and V_{dd} is 5 volts. If the voltage across the LED is 2 volts, what is the current, I_{dd} = ___

Note: Use red wires for V_{dd} or positive power. Use black wires for ground.

1b. Replace the resistor in Figure 1 with a value for R3 of 330 Ohms.

What is the color code for 330 Ohms = _____

What is the current, I_{dd} = ___ ? Is the LED brighter or dimmer than part 1? and why?

2. Now, construct an addition circuit in Figure 2. (Do not remove the circuit in Figure 1, that is you safety check if power is properly going to the circuit).

2a. Fill in the following table. Note: Avoid connecting a NMOS gate directly to V_{dd} but instead connect the gate to the resistor, R_2 which connects V_{dd}.

V_a	M1 on/off	LED on/off	V_f (Volts)
5 Volts			
0 Volts			

Why does the V_f behave has a NOT gate and the LED as a buffer?

When does this Figure 2 consume current, I_{dd}, when V_a is *on* or *off*?

When does Wakerly Figure 3-12 on page 89 consume current?

Argue under which conditions would you use one design over the other? (hint: number of wires, cost, availability)

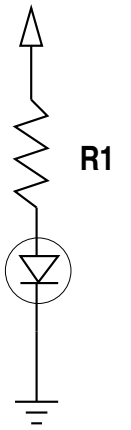

Figure 1: LED circuit

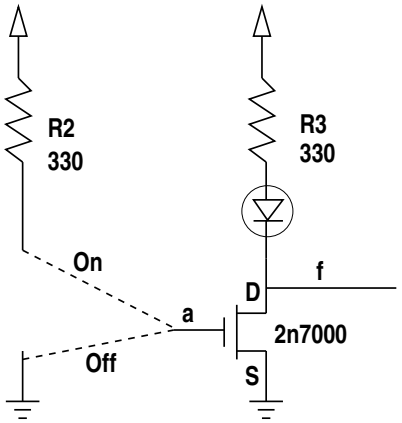

Figure 2: NMOS NOT

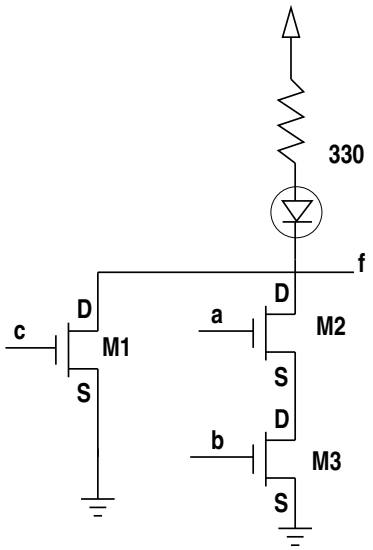

Figure 3: Mystery Circuit

3. Construct the circuit in Figure 3 and fill in the following table:

V_a	V_b	V_c	M1 on/Off	M2 on/off	M3 on/off	LED on/off	V_f (Volts)

When M1 is off, what type of logic is M2 and M3 in relation to V_f?

When M2 and M3 are off, What type of logic is M1 in relation to V_f?

What is the Boolean expression of this circuit, $f(a, b, c) =$

Compare this circuit with Wakerly Figure 3-20 (AOI) and Figure 3-22 (OAI) on pages 94 and 95. Draw the logic diagram of this circuit in the form of Figure 3-21 or Figure 3-23:

4. Determine which Figure 4, 5, or 6 is the XOR? Then draw the XOR circuit using the least number of NMOS transistors and resistors. (Hint: use the knowledge of problem 3). Build the circuit to verify your design.

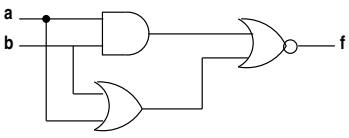

Figure 4: XOR1

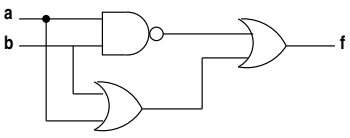

Figure 5: XOR2

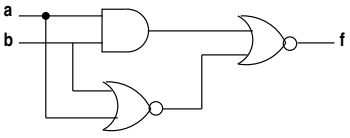

Figure 6: XOR2