

ECT 213  
Spring 2008  
Lab #1  
Digital Circuit Simulation

Name: \_\_\_\_\_

**Purpose:** To familiarize students with the basic logic gates and their function by experimentation using simulation

**Introduction:** There are many ways to simulate a digital circuit to see how they operate without actually building the circuit. Software such as Multisim, Altera, Xilinx, Altium and Orcad all have the ability of simulating a drawn circuit to test it.

In this lab we will use a free digital circuit simulator to investigate the basic gates and then a combinational circuit.

**Software** For this lab, you will be supplied with a CD that includes a JAVA program that allows you to draw and simulate a digital logic circuit.

To use this simulator, JAVA must be installed on the machine. To verify that java is operating correctly goto

<http://java.com/en/download/installed.jsp?detect=jre&try=1>

If it notifies you that you do NOT have java install, it can be installed off the cd. Open “My Computer” and brows to the JAVA directory and execute **jre-6u3-windows-i586-p-s.exe** to install.

Once installed, you can start the Simulation software (called HADES) by browsing the CD for the /HADES directory. Open the directory and click on the file named HADES.JAR

This should give you the following window:



When you get to this point, wait for the instructor, who will step you through drawing the first circuit.

**NND Gate:** With the instructor guiding you, draw a basic NOT circuit with an input and an output.

Once the simulation works, fill in the following truth table based on the simulation output:

<b>Input</b>	<b>Output</b>
0	
1	

Save the simulation file (to be submitted electronically at the end of lab)

**AND GATE** On your own, draw a basic AND gate circuit.

Once the simulation works, fill in the following truth table based on the simulation output:

<b>Input A</b>	<b>Input B</b>	<b>OUTPUT</b>
0	0	
0	1	
1	0	
1	1	

Again, save the simulation file (to be submitted electronically at the end of lab)

**OR Gate** Now draw a basic OR gate circuit.

Once the simulation works, fill in the following truth table based on the simulation output:

Input A	Input B	OUTPUT
0	0	
0	1	
1	0	
1	1	

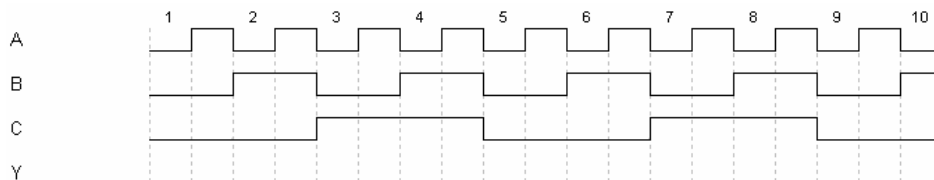
Again, save the simulation file (to be submitted electronically at the end of lab)

Combination By hand , figure out the truth table for the following Boolean equation:  
al Circuit

$$Y = A + (B \bullet \overline{C})$$

C	B	A	$\overline{C}$	$B \bullet \overline{C}$	Y
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

By hand, fill in the timing diagram below based on the truth table.



Now draw the circuit in HADES and simulate the circuit.

Fill in the truth based on the simulation:

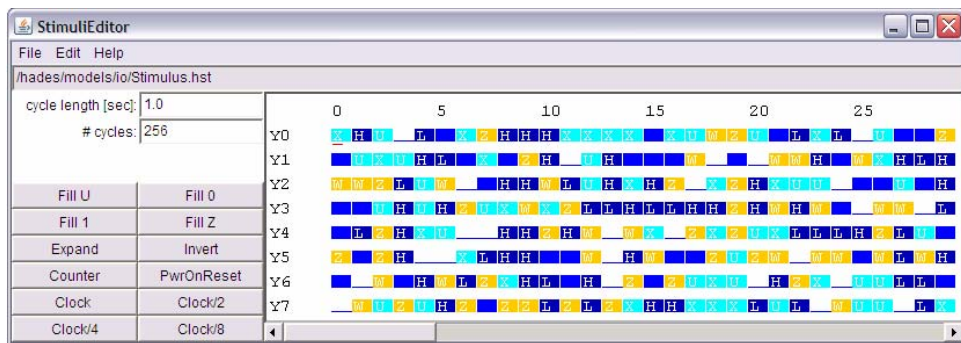
C	B	A	Y
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Do the two truth tables match? If not ask the instructor for help before continuing.

Again, save the simulation file (to be submitted electronically at the end of lab)

Now, replace the inputs A, B and C with the Stimulus Generator (Right Click | Create | IO | Stimulus Generator) outputs Y0, Y1 and Y2 as counted from the Bottom -> UP.

Now, with the cursor on the Stimulus Generator, right click and choose EDIT. This will bring up a Stimulus Generator editor that looks like this:



To clear the pre-defined waveform, select EDIT | CLEAR ALL.



Now Click on the # cycles box and change it from 255 to 16.

Now click on the COUNTER button. This will fill the stimulus generator (waveforms) with a binary count.

Now, click back on the Hades main window and change the run time from 100 ns to 16 S (100 nano seconds to 16 seconds)

Lastly from the menu choose SIGNALS | ADD PROBES | ALL SIGNALS.

Save the HADES simulation file so you can submit it latter.

Now press the  button to restart the stimulus generator from time 0 and then press  which will start the stimulus generator and go though the binary count. When  $t=16.0$  and the indicator light goes from green to yellow, select SIGNAL | SHOW WAVES. This will show a timing diagram for your circuit.

Save this waveform (in the WAVEFORM VIEWER) using FILE | SAVE AS to be submitted as part of the lab.

Submit each of the 6 files (NOT gate, AND gate, OR Gate, Combinational Circuit (with inputs), Combinational Circuit (with Stimulus Generator) and the Waveform via the online submission tool. Submit each file individually!)

Turn in this sheet when finished.