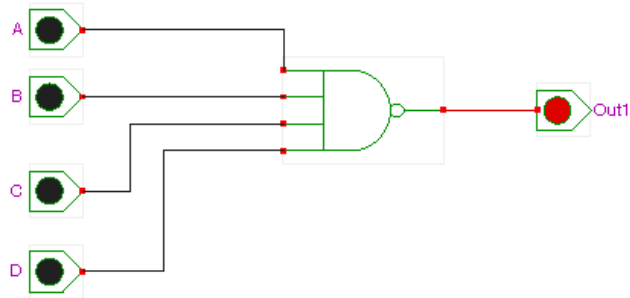


TECH 3232  
Lab #4  
Rev 3.5 (KiCad)  
DeMorgan's Theorem

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

Objectives: Verify DeMorgan's Theorem and to become acquainted with a logic probe.

Lab Procedure: Given the circuit below Answer the following:



**What is the Boolean Expression for the circuit?**

**What is the theoretical truth table for the circuit?**

Table I - Theoretical Truth Table

Inputs				Output
A	B	C	D	

Download and install KiCad from <https://www.kicad.org/> (the instructor will walk you through using KiCad and the drawing of this circuit).

**Redraw the circuit** above using standard schematic symbols, showing all components (including switches, led's, resistors, etc). Label all the components correctly (designators, part number and/or values and pin numbers) HINT: to find the proper part number for the gate(s) do a Google search for "74", the name of the gate and "4 input".

Build the circuit and **fill in the truth table** using the circuit to determine the outputs:

Table 2 – Original Circuit Truth Table

Inputs				Output
A	B	C	D	

Verify the Truth table above with the theoretical T.T. above.

***Demonstrate your circuit to the instructor and have him initial below:***

Now, use **DeMorgan's Theorem on the Boolean equation above** (show your work). Verify with the instructor the final equation (use back of page if more room is required).

Now add the new circuit to the existing schematic (already built) in KiCad. Use the existing switches/sip resistor as the input part of the new circuit.

Once the instructor has verified your circuit design, and **without destroying the previous circuit**, build the new circuit.

What is the **truth table** for the circuit?

Table 3 – Truth Table After Applying DeMorgan’s Theorem

Inputs				Output
A	B	C	D	

Verify the Truth table above with the T.T.s above.

*Demonstrate your circuit to the instructor and have him initial below:*

Make sure to fill out the title block of the schematic then print the schematic. Now save and close the project. **Zip** the project (instructor will demo) **and submit it via the online submission system** on the class website.

On the back of the page, describe **IN DETAIL** how this lab and the data collected during the performing of this lab confirms DeMorgan's Theorem. (write it in 3<sup>rd</sup> person and in a formal style).

Read *Microcomputer Theory and Servicing* By Stuart Asser section 2.8 (in supplied .pdf on the class webpage)

Remove the LED and Resistor from the output of the original circuit. Using the Logic Probe, confirm the truth table once more.

**How does the Logic Probe indicate a HIGH output?**

**How does the Logic Probe indicate a LOW output?**

Now touch the Logic Probe to pin 11 of the 3 input NAND IC from the original circuit. **What does the logic probe show?**

**What does it mean?**

**Describe in detail** how a logic probe can be used to find errors in a logic circuit (use back of page if more room is required).