Digital Logic Design Lab #3

Objectives

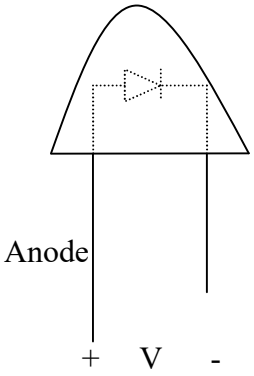
1) Application of sum of products (Minterms), Product of Sums (Maxterms) and function minimization.
2) Understanding of requirement analysis, logic design, implementation and testing processes.

Materials

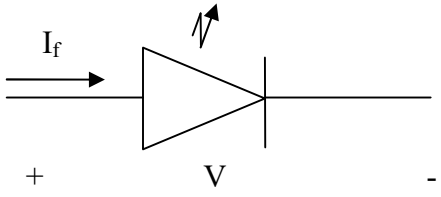
1) Textbook: Digital Logic Design
2) Course Website: www.EngrCS.com
3) Instruments: Power Supply, Multimeter, Function Generator and Oscilloscope
4) Supplies:
   * Proto Board
   * Jumper Wires
   * 8-switch DIP
   * LED (3xRed & 3XGreen)
   * 1 kΩ resistor (6 units)
   * 74LS00, 74LS02, 74LS04, 74LS08, 74LS32 (0 or more based on design)

Experiment #1. LED Usage

Light Emitting Diode (LED) is used as indicator in many applications from power on/off light to traffic signal lights. LED lamination, current and power specifications vary depending on design and application. LEDs used in this lab are specified below (Lumex SSL-LX5093LXX):



Packaging Configuration

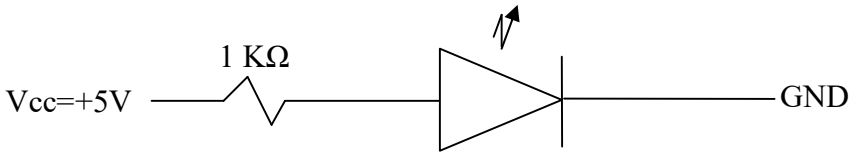


Functional Diagram

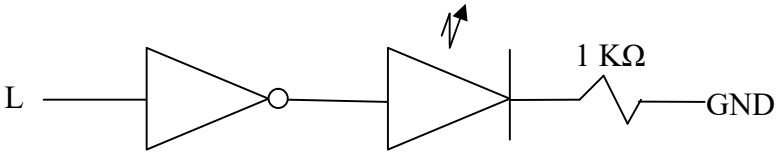
Rating: $I_f < 30$ mA at 2.5 Volts
Typical: +5 V at 1= 5 ma

Set up the following three configurations and record your observations. Explain any observed differences.

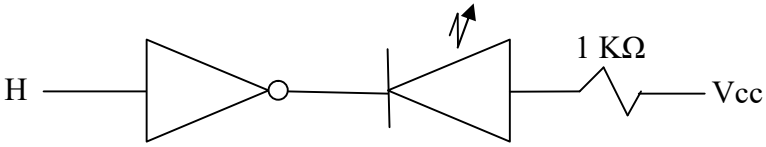
Configuration #1:



Configuration #2:

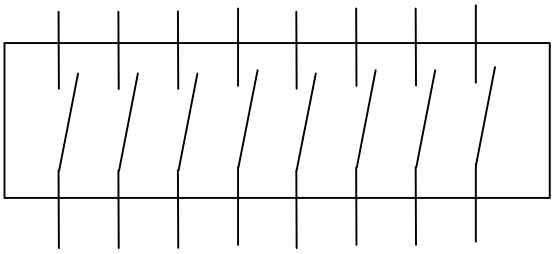


Configuration #3:

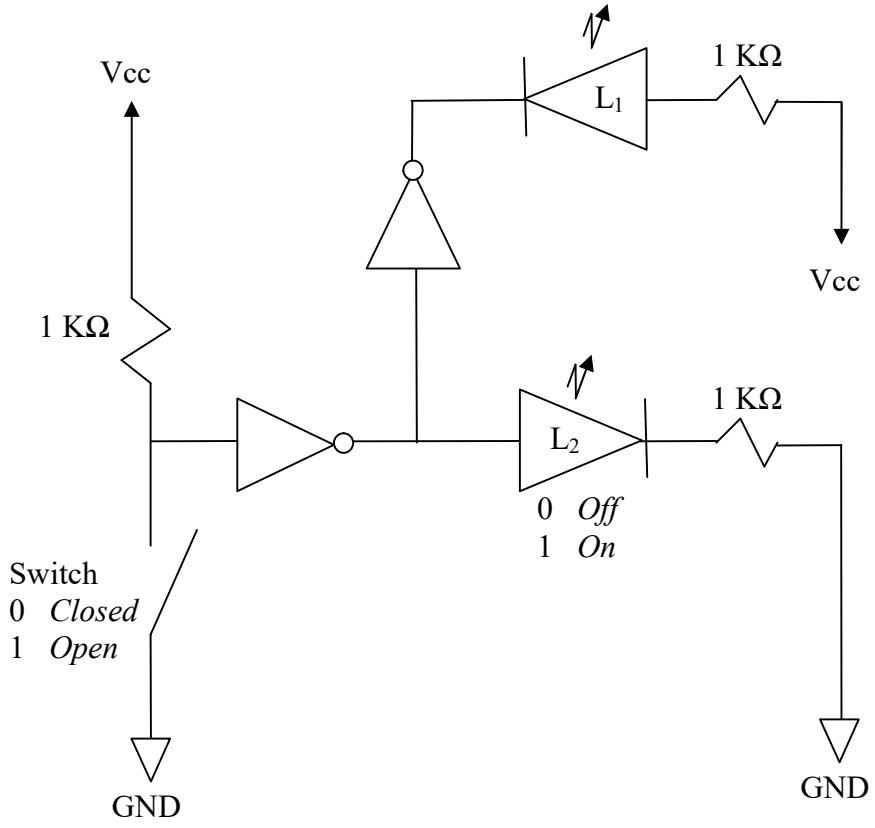


Experiment #2. Switch Usage

The 8-Switch Dual Inline Packaging contains 8 switches configured as shown below:



Set up the following circuit and complete the truth table relating the switch setting and status of LEDs. Use the assigned "1" and "0" values for switch setting and LED status in the truth table.



Experiment #3. Intersection Control Signal System

A three way intersection is in need of a traffic signal control system and you have been assigned the task to design and implement the system. Each direction has only one lane and one signal control light (green and red) per Lane. Further, you have been asked to give only one lane go or green sign at a time.

Your deliverables should include:

a) Sketch of the intersection with variables identified and respective values defined. Clearly describe any additional assumptions or rules you have added.
b) Truth Table for the Signal Control System based on input/output defined in part (a)
c) Using Sum of Products (Minterms) approach and Logic gates available on class website, design the light control system using the LEDs for the traffic light. Document your work including output expressions, schematics, truth table (do not minimize).
d) Using Product of Sums (Maxterms) approach and Logic gate available on class website, design the light control system using the LEDs for the traffic light. Document your work including output expressions, schematics, truth table (do not minimize).
e) Compare the designs from parts c and d. Explain which one is the optimum design that you recommend for implementation and why.
f) Minimize, Implement and test your recommended design from section e. Once you have completed your system verification, present your design to your instructor for review. It is important that you have a written test plan with step-by-step process validating that all system requirements have been met.

Include the approval signature in your report:

Team Members:	LAB3 Demo Instructor Approval Signature & Date:
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Report Requirements

All reports must be computer printed (Formulas and Diagrams may be hand drawn) and at minimum include:

For each Experiment

a) Clear problem statement; specify items given and to be found.
b) Identify the theory or process used.
c) Documents resulting Circuit design, tables, timing diagram, schematic and other results.

For the report as a whole

a) Cover sheet with your name, course, lab, date of completion and team members' names.
b) Lessons Learned from the experiments.
c) A new experiment and expected results which provide additional opportunity to practice the concepts in this lab.