Purpose: In this experiment, you will design and implement a combinational circuit on the breadboard that takes its inputs from outputs of a 4-bit counter and demonstrate circuit's output(s) by turning on and off LED(s).

NOTES:

1. Examine the document **"LogicGates.pdf"** and search for the datasheets of gates on the internet that you find useful for your design. After studying the datasheets finalize your design by deciding which gates you will use. Also, study **"LEDcircuit.jpg"** to understand how to drive a LED circuit. Some useful information about **74HC163 4-bit counter** is given in **Figure 1**. Please study **74HC163 4-bit counter's datasheet** for your design.

2. You must prepare and upload your preliminary work report to Moodle before its due date. *Late submissions are not allowed*. If you have not done your preliminary work on time, you are welcome to attend the lab but you will get zero from that lab.

3. Before you leave the lab you must upload the Lab reports to Moodle. You are not allowed to write our reports after the lab. *Late submissions are not allowed*.

4. You can write your lab report in Open Office or Microsoft Office. After the completing writing process, **"Save the report in pdf format"**, upload it to Moodle before leaving the laboratory. This report will also used as a proof of your attendance. Your laboratory report is an individual effort and should be unique. Original work is required by all the students (NO PHOTOCOPIES, DUPLICATE PRINTOUTS OR CHEATING).

The Lab Preliminary Report should contain the following (necessarily in this order):

- **Heading**

  The experiment number, lab title, your name, and date should be at the top right hand side of each page.

- **Abstract / Objective**

  The purpose of the abstract is to provide a brief overview of the report. In your own words, state the purpose of the laboratory exercise, the basic concepts covered, a very brief (two or three sentences) overview of the procedure followed.

- **Design Specification Plan**

  For a set of requirements, there are many ways to design a system that meets the requirement. The Design Specification Plan describes the methodology chosen and the reason for the selection.

- **Proposed Design Methodology**

  The experiment can be done from the information given in your report. Include and explain the needed steps taken in the design of the circuit: truth table, assumptions, definitions, Karnaugh Map(s), algebraic simplification steps, circuit diagram with gates demonstrating all the connections between pins, voltage supply, ground etc…, if necessary.

The Lab Report should contain the following (necessarily in this order):

- **Heading**

  The experiment number, the lab title, date of the experiment, your section and your name should be at the top right hand side of each page.

- **The Design Methodology**

  The design methodology presents much of theory behind the lab exercise, which was confirmed with hardware implementation, algebraic, etc. You should write how to design it, so you might re-state your truth table, equations and circuit diagram in your preliminary work here. Also, you must write the changes according to the "Proposed Design Methodology" compared to your preliminary work. Additionally, you should clearly explain how to make circuit work (signals applied from signal generator or voltage applied from DC supply).

- **Results**

  In this section, you will include your observations and measurements. The laboratory report is the record of all work pertaining to your experiment. The results section will have subsection if there is more than one result to present. You will include the results of your design procedure. The results section will typically attach waveforms observed, observed results, etc. Any of included figures must be labelled. All results must be explained and discussed.

- **Conclusion**

  In this section you should write about the concepts that you learned in the laboratory and how they relate to other aspects of the course or digital design in general. If you experienced problems or obtained data that was incorrect, here is where you might elaborate on the causes and ideas for solutions.

- **Appendices**

  Other materials that are referred in your report.

HINTS:

First, analyze the datasheet of 74HC163. You should make 74HC163 work in “count” mode (study function table in page 4 of the datasheet). Then, you know clk/vcc/gnd connections of 74HC163. If you make the correct connections, you will able to see Y0, Y1, Y2, Y3 signals given in “74HC163signals.jpg”. You may realize that these signals look like a truth table, so by using logic gates (and, or, ..., etc.) you will make some logic combinations of all/some of Y0, Y1, Y2, Y3 signals, so you should have at most 4 inputs. Hence, when you connect LED(s) to the output(s) of logic gates, you can make LED light on (off) at some conditions of logic gate inputs Y0, Y1, Y2, Y3. You can start with a truth table by deciding when LED(s) will light on and off and write logic equations using Karnaugh map, so you will figure out logic connections for Y0, Y1, Y2, Y3. We recommend you to use at most two logic gates because you will build this circuit on breadboard and you may not be able to work the circuit in lab hours if you have too many gates/connections but of course you can challenge yourself.

You are to use one 74HC163 to obtain the signals Y0, Y1, Y2, and Y3 from a clock signal. 74HC163 has many pins but you use only the ones which are necessary.

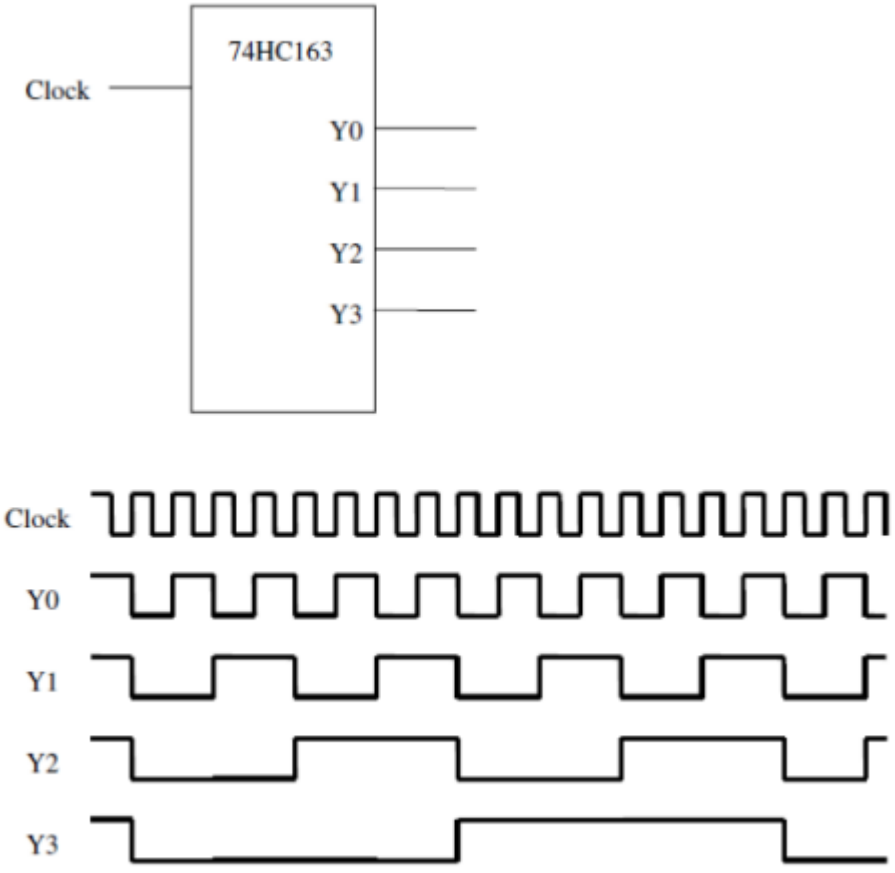

Figure 1. About information 74HC163 gates as using 4-bit counter