German-Jordanian University
School of Electrical Engineering and Information Technology
Department of Computer Engineering

CE2120-Digital Systems Lab
Lab 7

I. Objectives

The objective of this lab is to become familiar with Decoders and Multiplexers, and to use them to construct Boolean functions.

II. Preparations

1. A 2^n :1 MUX has 2^n data input, n control input, and 1 data output. It selects one of the data inputs and connects to its output depending on the value of the control input.
    a. Design a 2:1 MUX using **logic gates**.
    b. Build a 4:1 MUX which has 4 data inputs, 2 control inputs, and 1 output **using an appropriate number of the 2:1 MUX(s) you have designed in part (a)**.

   For each part, show the truth table and provide a Boolean expression for the MUX output. Also, draw the logic circuit for each part.

2. An n :1 multiplexer can be used to implement a logic function with (n+1) variables **without additional gates.** Implement the function F using a 4:1 MUX (74LS153)

   F (X,Y,Z) = XZ' +XY +X'Y'Z

   Show the design of your logic circuit and obtain the truth table for this function.

3. Design a logic unit that performs logical operation on two 1-bit inputs depending on the value of the 3 selection inputs. The required functions are AND, OR, NAND, NOR, and XNOR. Draw the logic circuit that performs the required functionality using 8:1 MUX (74LS152) and additional gates.

4. Design a 1:2 decoder with enable input using NOR gates. Provide the truth table and the logic circuit of your design.

5. Design a 3:8 decoder using 2:4 decoders (74LS139). Provide the truth table and the logic circuit of your design

III. Lab work

In this experiment:

a. Setup the circuits in part 1.a and 1.b on your breadboard and check its operation.
b. Setup the circuit in 2 on your breadboard and use LEDs to check the logic level of the outputs. Also, check the operation of the circuit using the obtained truth table.
c. Setup the circuit in 3 on your breadboard and use LEDs to check the logic level of the outputs. Also, check the operation of the circuit using the obtained truth table.
d. Setup the circuit in 4 on your breadboard and use LEDs to check the logic level of the outputs. Also, check the operation of the circuit using the obtained truth table.
e. Setup the circuit in 5 on your breadboard and use LEDs to check the logic level of the outputs. Also, check the operation of the circuit using the obtained truth table.