THE UNIVERSITY OF ZAMBIA SCHOOL OF ENGINEERING

Department of Electrical & Electronic Engineering

MEC 3102

Assignment 3: Logic Gates (Due on 19/09/22)

TUTORIAL AND ASSIGNMENT QUESTIONS

INSTRUCTIONS:

i.   Answer and submit all the questions

[Problem 1]

(a) Write in binary decimal numbers 23 and 31
(b) Write in decimal the binary numbers 01010 and 10101

[Problem 2]

(a) Using signed 2's complement notation, express as 8-bit words the decimal numbers 25, 121, −17, and −96.
(b) Hence, show in binary notation the arithmetic operations: 121 − 25, 25 + (−17) , and 25 − 96.
(c) Explain briefly how subtraction is accomplished using 2's complement notation.
(d) What decides whether a particular binary addition or subtraction operation would be possible with 2's complement arithmetic?

[Problem 3]

(a) Multiply the numbers $(13.5)_{10}$ and $(2.5)_{10}$ directly and using their binary equivalents.
(c) Evaluate the following to two binary places: $(111001)_2 \div (1001)_2$.

[Problem 4]

From the three-input logic gate shown below, find the expression for the output **Y** and simplify the expression.
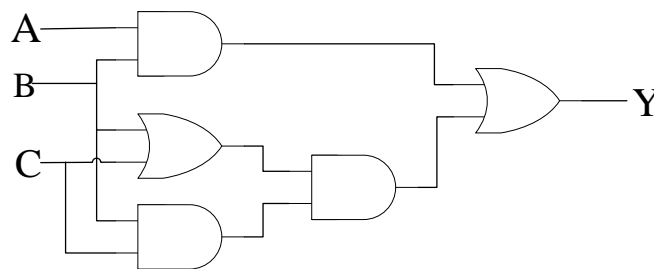
[Problem 5]

An electric light is to be controlled by three switches. The light is to be ON whenever switches A and B are in the same position; when A and B are in different positions, the light is to be controlled by switch C.

(a) Draw up a truth table for this situation.
(b) Represent the light function Y in terms of A, B and C.
(c) Simplify the function using the Boolean theorems and laws, hence design the practical switching circuit.

[Problem 6]

Simplify the following expressions using Boolean theorems and laws:

(a) $Y = A \cdot B \cdot C + A \cdot B \cdot \bar{C} + A \cdot \bar{B} \cdot C + A \cdot \bar{B} \cdot \bar{C} + \bar{A} \cdot B \cdot C + \bar{A} \cdot B \cdot \bar{C} + \bar{A} \cdot \bar{B} \cdot \bar{C} + \bar{A} \cdot \bar{B} \cdot C$;

(b) $Y = (\bar{A} + B + \bar{C}) \cdot (\bar{A} + B + C) \cdot (C + D) \cdot (C + D + E)$.

(c) Simplify the expression $Y = A \cdot \bar{B} \cdot C + A \cdot \bar{B} \cdot \bar{C} + A \cdot B \cdot C + A \cdot B \cdot \bar{C} + \bar{A} \cdot B \cdot C$ using the Karnaugh map method. **Draw** the simplified logic circuit.

[Problem 7]

Construct the K-map for the function $f = A\overline{B}CD + \overline{A}BC + \overline{A}\,\overline{B}C + BCD$ and find the min-term expression.