School of Electrical Engineering and Computer Science
National University of Sciences & Technology (NUST)

Practice Assignment No-2

Subject:	**Digital Logic Design**	Course:	**BEE-12CD**
Teacher:	**Engr. Arshad Nazir**	Issue:	**12 Oct 2021**

- ✓ *This is a non-graded assignment aimed to enhance problem-solving skills of students from chapter2 of the textbook.*
- ✓ *The students are advised to attempt it at any time of their convenience.*

Problem No-1 Complete each expression: -

a. a′.0=
b. w′(wxyz)′=
c. (x′+x′)′=
d. x≡xy=
e. f[a,b,(ab)′]=
f. f[a,b,ab]=

for e and f, use f(a,b,c)=a+b+c

Problem No-2 Reduce the given Boolean expressions to the indicated number of literals: -

a. X+Y[Z+(X+Z)′] to two literals
b. (AB+ÁB́) (ĆD́+CD) + (AĆ) to four literals
c. W´X(Z´+Y´Z)+X(W+W´YZ) to one literal

Problem No-3 Find the complement of the following expression by (1) duality and (2) DeMorgan's Law: -

F=(V′W+X) Y+Z′

Then Show that FF´=0 and F+F´=1.

Problem No-4 Convert the following to the sum-of-minterms canonical form: -

a. F(A,B,C)=(A′+B)(B′+C)
b. F(w,x,y,z)=π(0,1,2,3,4,6,12)

Problem No-5 The logical sum of all the minterms of a Boolean function of n variables is 1.

a. Prove the previous statement for n=3.
b. Suggest a procedure for a general proof.

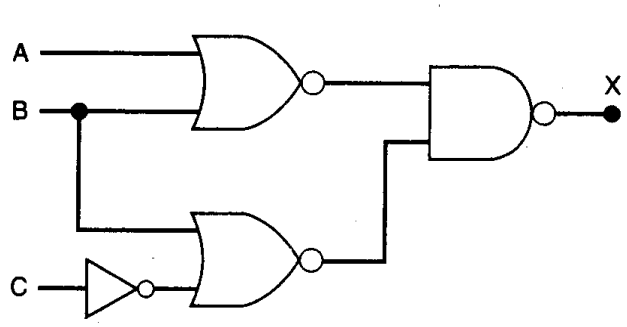
Problem No-6 By substituting the Boolean expression equivalent of the binary operations as defined in Table 2.8 of your textbook, show the following:-

a. The implication operation is neither commutative nor associative.
b. The exclusive-OR operation is commutative as well as associative.
c. The NAND operation is commutative but not associative

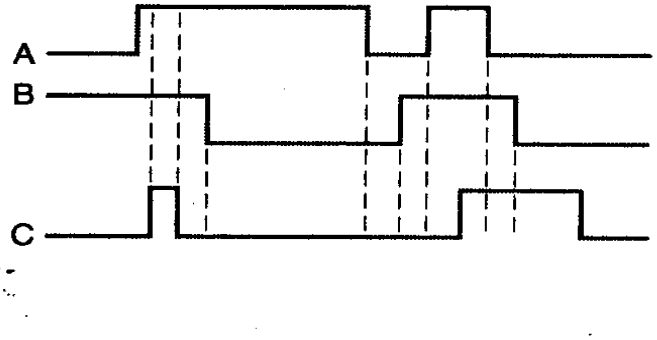
Problem No-7 Convert the given expressions into indicated forms: -

a.	(a+b+c+d´) (b+c+d) (b´+c´)	Sum-of-Product (SOP)
b.	wxy´+xy´z+wx´z´	Product-of-Sum (POS)
c.	(AB+C) (B+C´D)	Sum-of-Product (SOP)
d.	WXY´+WXZ´+WXZ+YZ´	Product-of-Sum (POS)

Problem No-8 Write the Boolean expression for the output of Figure P8a, and use it to determine the complete truth table. Then apply the waveform of Figure P8b to the circuit inputs and draw the resulting output waveform.



(a)



(b)

Figure P8 Logic Circuit and input waveforms

Convert the Boolean expression obtained above in sum of minterms canonical form using postulates and theorems of Boolean algebra.

Problem No-9 Prove the identity of the following Boolean equations, using algebraic manipulation: -

a. AB+BC′D′+A′BC+C′D=B+ C′D
b. WY+W′YZ′+WXZ+ W′XY′=WY+ W′XZ′+X′YZ′+XY′Z
c. CD+AB′+AC+A′C′+A′B+C′D′=(A′+B′+C+D′)(A+B+C′+D)
d. X´Y´+Y´Z+XZ+XY+YZ´= X´Y´+XZ+YZ´

Problem No-10 Seven switches operate a lamp in the following way; if switches 1, 3, 5, and 7 are closed and switch 2 is opened, or if switches 2, 4, and 6 are closed switch 3 is opened, or if all seven switches are closed the lamp will glow. Use basic gates to show how the switches are to be connected.

Problem No-11 A corporation having 100 shares entitles the owner of each share to cost one vote at the share-holders meeting. Assume that A has 60 shares, B has 30 shares, C has 20 shares, and D has 10 shares. A two-third majority is required to pass a resolution in a share-holders meeting. Each of these four men has a switch which he closes to vote **YES** and opens to vote **NO** for his percentage of shares. When the resolution passed, one output LED is **ON**. Derive a truth table for the output function and give the sum of product equation for it.

Problem No-12 Simplify the following functions to the minimum Sum-of-Product (SOP) form using rules of Boolean algebra: -

a. X=A´C´D´+AC´+BCD+A´CD´+A´BC+AB´C´
b. Y=A´B(D´+C´D) +B(A+A´CD)
c. P=ABC´+BCD+AB´CD+BCD´+AC´
d. Q=A´CD´+C´D+ABD+ABCD´+BC´D+AC´D´
e. R=A´B´C´+ABD+A´C+A´CD´+AC´D+AB´C´
f. F=A´C´+BC+AB´+A´BD+B´C´D´+ACD´

How many terms and literals the simplified expressions contain?

Problem No-13 Simplify the following functions to the minimum Sum-of-Product (SOP) and Product-of-Sum (POS) forms using rules of Boolean algebra: -

F1=AC´+B´D+A´CD+ABCD
F2=(A´+B´+D´) (A+B´+C´) (A´+B+D´) (B+C´+D´)
F3=(A´+B´+D) (A´+D´) (A+B+D´) (A+B´+C+D)

Problem No-14 Show that positive logic NAND gate is a negative logic NOR gate and vice versa.

Problem No-15 Complete the timing diagram at W for the following function: -

W=AB´C´+A´C´D+ABD+BCD