

Digital Electronic Circuits

Live Session Week 2
NPTEL Online Certification Course

5 February 2022

Brief Summary of Lecture 6, 7 and 8

Lecture 6 : Basic Gates and their representations

- Basic logic gates.
- Universality of NAND and NOR gates.
- AND-OR-Invert gates.

Lecture 7 : Fundamentals of Boolean Algebra

- Huntington postulates.
- Basic theorems and Duality.
- Derivation of theorems from postulates.
- Difference with ordinary Algebra.



Lecture 8 : Boolean Function to Truth Table and Implementation Issues

- Conversion of Boolean function to truth table.
- Implementation of a Boolean function.
- Algebraic simplifications.
- Shanon's expansion theorem.

Brief Summary of Lecture 9 and 10

Lecture 9 : Truth Table to Boolean Function and Implementation Issues

- Canonical representation using minterms and maxterms.
- 2 level and 3 level implementation.
- Positive and negative logic.



Lecture 10 : Karnaugh Map and Digital Circuit Realization

- Karnaugh Map (K-Map) representation.
- Simplification using Karnaugh Map.
- Use of don't care in Karnaugh Map simplification.
- Dual circuit and self-duality.

Q 1. Find the correct POS form of $F(x, y, z)$ by using the following values (Hint: Use three variable nesting of Shanon's expansion theorem).

$$\begin{array}{llll} F(0, 0, 0) = 0, & F(0, 0, 1) = 1, & F(0, 1, 0) = 0, & F(0, 1, 1) = 0, \\ F(1, 0, 0) = 1, & F(1, 0, 1) = 1, & F(1, 1, 0) = 1, & F(1, 1, 1) = 0. \end{array}$$

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- a. $\prod M(1, 2, 3, 4)$
 - b. $\prod M(1, 4, 5, 6)$
 - c. $\prod M(0, 5, 6, 7)$
 - d. $\prod M(0, 2, 3, 7)$



Q 2. Simplify the following expression:

$$F(A, B, C, D, E, F, G) = AB + B'CD + ABD(C' + EF)(DE + FG)$$

and find the corresponding representation from following options.

- a. $AB + BDE$
- b. $AB + B'CD$
- c. $AB + B'FG$
- d. $AB + BDF$



Q 3. Find the self-dual function among the given options:

a. $F(A, B, C) = \sum m(0, 2, 5)$

b. $F(A, B, C) = \sum m(0, 3, 5, 6)$

c. $F(A, B, C) = \sum m(2, 3, 5, 7)$

d. $F(A, B, C) = \sum m(1, 6, 7)$



Q 4. Which of the following in the place of x_1, x_2 and x_3 will make the function $F(A, B, C, D) = \sum m(0, 2, 5, x_1, 9, x_2, 12, x_3)$ self-dual?

a. 6, 10, 14

b. 8, 11, 14

c. 6, 11, 15

d. 8, 10, 15



Q 5. Consider the following truth tables for addition ('+'), multiplication ('×') and division ('/') operations.

A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

A	B	A×B
0	0	0
0	1	0
1	0	0
1	1	1

A	B	A/B
0	0	0
0	1	0
1	0	X (Don't care)
1	1	1

Find the Boolean logic (using k-map minimization) for the expression

$$F = (A + (B \times C))/D$$

- a. $F = A + B' D$
- b. $F = A + BC$
- c. $F = AB + CD$
- d. $F = AB + C$

Q 6. If $A = A_0A_1$ and $B = B_0B_1$ are 2-bit binary numbers. The Boolean function $Y(A_0, A_1, B_0, B_1)$ that satisfies the condition “If $A \geq B$, then $Y = 1$ ”, in its minimized form is _____.

a. $Y = A_0A_1 + B_0B_1 + A_1B'_0 + A_0B'_0 + A_0B'_1$

b. $Y = A_0A_1 + B'_0 + A_0B'_1$

c. $Y = A_0A_1 + B'_0B'_1 + A_0B'_0 + A_0B'_1 + A_1B'_0$

d. $Y = A_0A_1 + B'_0 + A'_0B_1$

Q 7. A chemical plant needs a microprocessor-driven alarm system to warn of critical conditions in one of its chemical tanks. The tank has four HIGH(1)/LOW(0) switches that monitor temperature (T), pressure (P), fluid level (L), and weight (W). Design a system that will notify the microprocessor to activate an alarm when any one of the following conditions arise:

- (1) High fluid level with high temperature and high pressure.
- (2) Low fluid level with high temperature and high weight.
- (3) Low fluid level with low temperature and high pressure.
- (4) Low fluid level with high temperature and low weight.

a. $TP + PL' + TL'$

b. $TP' + PL' + TL$

c. $TP + PL + TL$

d. $TP' + PL + TL'$

Q 8. A logic circuit implements a Boolean logic given by,

$$F(X, Y, Z) = XY' + X'YZ'$$

After implementation of the circuit, it is found that input combination $X = Y$ can never occur. Taking this into account, a simplified expression for $F(X, Y, Z)$ is?

- a. $X + YZ'$
- b. $Y' + Z'$
- c. $X' + Z'$
- d. $Y' + X'Z'$



Thank You

