INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Department of Mathematics

Date: February, 2012 Time: 2 Hrs Full Marks: 30 No. of Students: 40

MID (SPRING) SEMESTER EXAMINATION (2011-2012)

Sub. No. MA 30108/MA61002

Subject Name: Swaitching and Finite Automate / Switching and Automata Theory

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Answer **ALL QUESTIONS**. Marks are indicated at the end of each question.

1. Using the basic identities of Boolean algebra, show that:

   a) $x(\bar{x} + y) = xy$

   b) $x + \bar{x}y = x + y$

   c) $xy + \bar{x}z + yz = xy + \bar{x}z$ [3]

2. Given the function $F(x, y, z) = x\bar{y}z + \bar{x}\bar{y}z + xyz$

   a) Draw the logic diagram using the original Boolean expression.

   b) Simplify the expression **using Boolean algebra and identities**.

   c) Draw the logic diagram for the simplified expression in part b. [3]

3. Draw the combinational circuit that directly implements the following Boolean expression:

   a) $F(x, y, z) = \bar{x}yz + yz + x\bar{y}$

   b) $F(x, y, z) = \left(xy \; XOR \; \overline{(y + \bar{z})}\right) + \bar{x}z$ [3]

4. a) Construct the XOR operator using only AND, OR, and NOT gates.

   b) Construct the XOR operator using only NAND gates. [3]

5. Assume you have the following truth tables for functions $F_1(x, y, z)$ and $F_2(x, y, z)$:

x	y	z	F_1	F_2
0	0	0	1	0
0	0	1	1	0
0	1	0	1	1
0	1	1	0	1
1	0	0	0	0
1	0	1	0	0
1	1	0	0	1
1	1	1	0	1

   a) Simplify F_1 and F_2 **using Boolean algebra and identities**.

   b) Draw one combinational logic circuit to implement the above two function. [3]

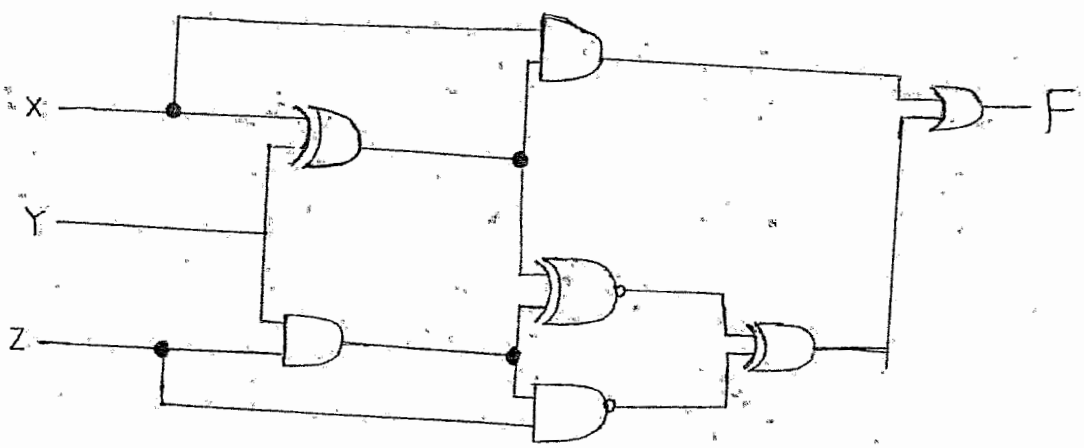
—P.T.O.—

6. a) Draw a half-adder using only NAND gates.
   b) Draw a full-adder using only NAND gates. [2]

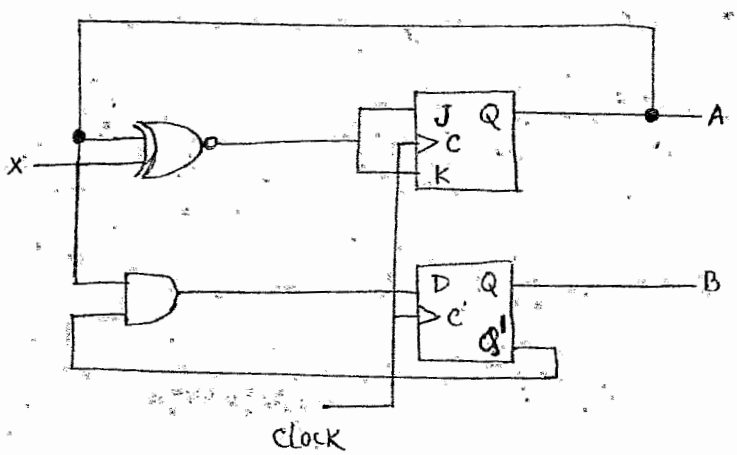
7. Create the Kmaps and then simplify for the following functions:
   a) $F(x, y, z) = \bar{x}\bar{y}\bar{z} + \bar{x}y\bar{z} + x\bar{y}\bar{z} + xy\bar{z}$
   b) $F(w, x, y, z) = \bar{y}z + w\bar{y} + \bar{w}xy + \bar{w}\bar{x}y\bar{z} + w\bar{x}y\bar{z}$ [4]

8. Describe how each of the following circuits works and indicate typical inputs and outputs. Also provide a carefully labeled black box diagram for each.
   a) Decoder (3×8)
   b) Multiplexer (8×1) [3]

9. Find the truth table that describes the following circuit: [2]



10. Complete the truth table for the following sequential circuit: [4]



A	B	X	Next State A	Next State B
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

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