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1. Consider the combinational circuit shown in Fig. P4.1 . (HDLsee Problem 4.49.)

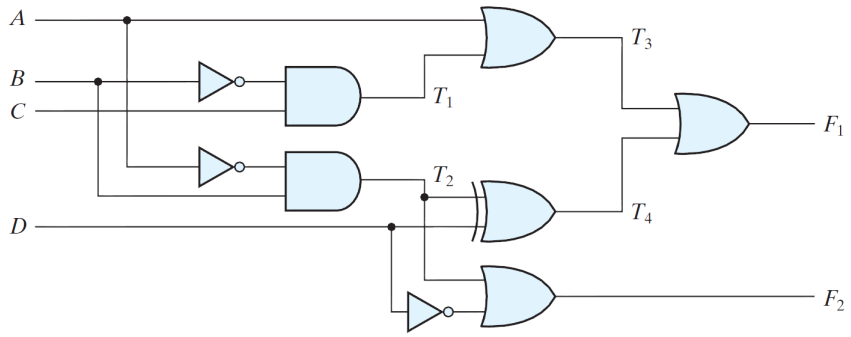

Figure 1: Figure P4.1

   (a) Derive the Boolean expressions for T_1 through T_4. Evaluate the outputs F_1 and F_2 as a function of the four inputs.

Sol:

   (a) $F_1 = A + B'C + BD' + B'D$
   $F_2 = A'B + D$

2. Obtain the simplified Boolean expressions for output F and G in terms of the input variables in the circuit of Fig. P4.2 .

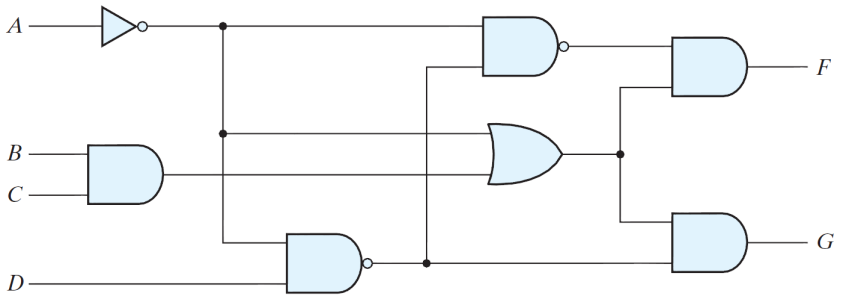

Figure 2: Figure P4.2

Sol: $F = ABC + A'D$
$G = ABC + A'D$

3. Design a combinational circuit with three inputs and one output. The output is 1 when the binary value of the inputs is less than 3. The output is 0 otherwise.

   Sol: $F = x'y' + x'z'$

4. A majority circuit is a combinational circuit whose output is equal to 1 if the input variables have more 1s than 0s. The output is 0 otherwise. Design a 3-input majority circuit by finding the circuits truth table, Boolean equation, and a logic diagram.

   Sol: $F = xy + xz + yz$

5. Design a four-bit combinational circuit 2s complementer. (The output generates the 2s complement of the input binary number.) Show that the circuit can be constructed with exclusive-OR gates. Can you predict what the output functions are for a five-bit 2s complementer?

   Sol: Inputs: A, B, C, D; Outputs: w, x, y, z
   z = D
   $y = C \bigoplus D$
   $x = B \bigoplus (C + D)$
   $w = A \bigoplus (B + C + D)$

6. Consider the addersubtractor circuit learned in class has the following values for mode input M and data inputs A and B. Find the output for each input.

	M	A	B
(a)	0	0111	0110
(b)	0	1000	1001
(c)	1	1100	1000
(d)	1	0101	1010
(e)	1	0000	0001

   Sol:

	Sum	C	V
(a)	1101	0	1
(b)	0001	1	1
(c)	0100	1	0
(d)	1011	0	1
(e)	1111	0	0