

ESC201A Assignment 10

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Topics

Boolean Expressions Minimization, Implementation, En/Decoder, Multiplexers/Demux, Modular Design

Questions

1. Simplify the following expressions into sum-of-products form using the don't care conditions (d) into account.

a. $F(A, B, C, D) = \sum(4, 5, 7, 12, 13, 14)$ $d(A, B, C, D) = \sum(1, 9, 11, 15)$

b. $F(A, B, C, D) = \sum(1, 2, 12, 13, 14)$ $d(A, B, C, D) = \sum(8, 9, 10, 11)$

2. Implement the following expression using only 2-input NAND gates and then repeat the problem with only 2 input NOR gates.

$$F(a, b, c, d) = ab + \bar{a}bc + \bar{a}\bar{b}\bar{c}d$$

3. Design a half subtractor circuit with inputs x and y and outputs Diff. and B_{out}. The circuit subtracts the bits x-y, places the result in Diff., and borrow in B_{out}.
4. Construct a 4-to-16 line decoder with five 2-to-4 line decoders with enable input.
5. Construct a 16 x 1 multiplexer with two 8-to-1 and one 2-to-1 multiplexers. Use block diagrams.
6. Implement the following Boolean function using one 4 to 1 multiplexer and external gates. (Hint: Connect inputs A and B to the control or selection lines of the mux and then use basic gates to apply appropriate combinations of C & D to the input lines of the Mux.)

$$F(A, B, C, D) = \sum(1, 3, 4, 11, 12, 13, 14, 15)$$

7. (i) Implement an AND gate with a 2 to 1 MUX.
(ii) Implement a NOT gate with a 2 to 1 MUX.
(iii) Now implement a NAND (a universal gate) with two 2 to 1 MUX.
8. (i) Implement the following function using a 3-to-8-lines decoder: $F(A, B, C) = \sum(3, 5, 6)$
(ii) Implement the above function using a 4-to-1 line multiplexer.
(iii) Implement the above function using an 8-to-1 line multiplexer.