NTUEE 11/26/'99

Switching Circuit and Logic Design
Mid-term Eaxm

1. $G(A,B,C,D,E) = \Sigma m(1,2,3,9,16,17,18,19,26) + \Sigma d(15,28,29,30)$

   (a) Find all minimum sum-of-products expressions for G. (10%)

   (b) Circle the essential prime implicants in your answer. (2%)

   (c) If there were no don't cares present in the original function, how would your answer to (a) be changed? (Do this by inspection of the prime implicant chart; do not rework the problem.) (3%)

2. A BCD (binary-coded-decimal) priority encoder has nine inputs (X1, X2, ..., X9) and four outputs (A, B, C, D). If only the X*i* input is 1, the outputs ABCD represent a binary number equal to *i*. For example, if X1 = 1, then ABCD = 0001, and if X9 = 1, ABCD = 1001. If two or more of the X*i*'s are 1, then the smallest value of *i* takes priority. For example, if X2 = X5 = X6 = X9 = 1 (and the other inputs are 0), then ABCD = 0010. If all inputs are 0, then ABCD = 0000.

   (a) Derive a truth table for the priority encoder. Hint: A 10- row truth table is sufficient for representing the function of the encoder and there will be many X's(don't' cares) for the inputs in the table.(4%)

   (b) By inspection of the table, find sum-of-products expressions for A, B, C, and D. (4%)

3. Find a minimum two-level multiple-output AND-OR gate network to realize these functions(8 gates minimum). (12%)

   $F1(a,b,c,d) = \Sigma m(10,11,12,15) + \Sigma d(4, 8, 14)$

   $F2(a,b,c,d) = \Sigma m(0,4,8,9) + \Sigma d(1,10,12)$

   $F3(a,b,c,d) = \Sigma m(4,11,13,14,15) + \Sigma d(5,9,12)$

4. Devise a scheme for converting base 3 numbers directly to base 9. Use your method to convert the following number to base 9:(6%)

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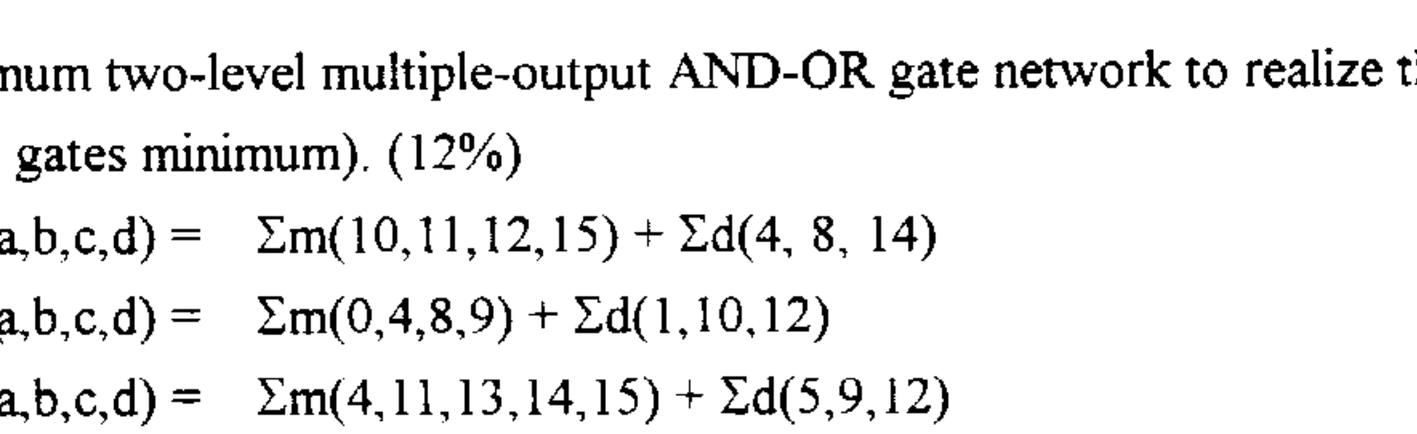
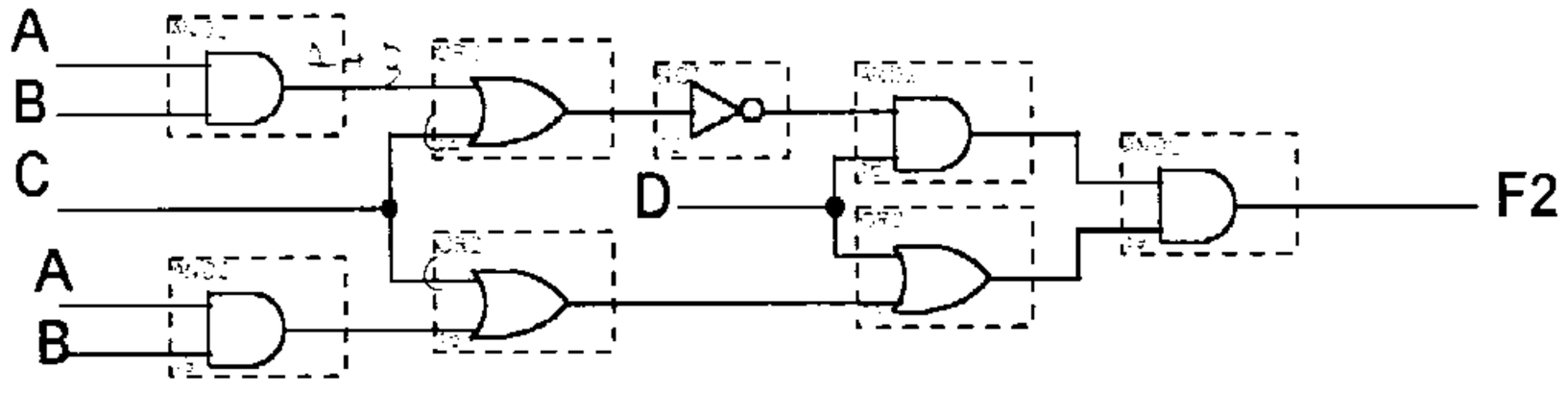
5. For each of the following networks, find the output and design a simpler network having the same output.

   (a)(4%)



   (b) (4%)



6. Simplify each of the following Boolean functions:

(a) F=AB'+AB'CD+ABC'D'(4%)

(b) F=(A'+B+C'+D)(A'+C'+D+E)(A'+C'+D+E')AC(4%)

7. Simplify the following Boolean function:

F=ABC' + (A'C'≡B) + (C ⊕ AD)

You should reduce F to a minimum sum of products. (8%)

8. A combinatorial switching network has four inputs(A,B,C and D) and one output Z. The output is 0 if and only if two or more inputs are 1. Design the network using four AND gates and three OR gates. Assume that each gate has a maximum of two inputs so that it will be necessary to partially factor your logic equation before you realize it.(10%)

9. A small corporation has 100 shares of stock, and each share entitles its owner to one vote at a stockholders' meeting. Mr. Akins owns 10 shares, Ms. Barnes owns 20 shares, Mr. Clay owns 30 shares, and Ms. Drake owns 40 shares. A two-thirds majority is required in order to pass a measure at a stockholders' meeting. Each of the four stockholders has a switch which he or she closes to vote yes for all of his or hers shares and opens to vote no. A switching circuit is to be designed to turn on a light if a measure passes.

(a) Derive a truth table for the output function (Z). (6%)

(b) Design a minimum AND-OR gate network to realize Z.(9%)

10. Find the minimum sum of products for F. Underline the essential prime implicants in your answer. (10%)