

ECE 124: Homework 4

Spring 2023

Assigned: Friday, March 31st
Due: Friday, April 7th Midnight
Late submission Due: Saturday, March 8th Midnight

Show your work! (No credit even for correct answers without justification.)

Problems from the textbook (Digital Design 6th Ed., M. Mano and M. Ciletti)

(1) 3.12 Simplify the following Boolean functions: (6 points for each)

(a) $F(A, B, C, D) = \prod (1, 3, 5, 7, 13, 15)$

(b) $F(A, B, C, D) = \prod (1, 3, 6, 9, 11, 12, 14)$

(2) 3.13 Simplify the following expressions to (1) sum-of-products and (2) product-of-sums: (6 points for each)

(a) $A'C' + B'C' + BC' + AB$

(b) $ACD' + C'D + AB' + ABCD$

(c) $(A' + B + D')(A' + B' + C')(A' + B' + C)(B' + C + D')$

(d) $BCD' + ABC' + ACD$

(3) 3.15 Simplify the following Boolean function F, together with the don't-care conditions d, and then express the simplified function in sum-of-minterms form: (6 points for each)

(a) $F(x, y, z) = \sum (0, 1, 4, 5, 6)$, $d(x, y, z) = \sum (2, 3, 7)$

(b) $F(A, B, C, D) = \sum (0, 6, 8, 13, 14)$, $d(A, B, C, D) = \sum (2, 4, 10)$

(4) 3.17 (6 points for each)

Draw (a) a NAND logic diagram that implements the complement of the following function:

$$F(A, B, C, D) = \sum (0, 1, 2, 3, 6, 10, 11, 14)$$

and (b) repeat for a NOR logic diagram.

(5) 3.19 (6 points for each)

Simplify the following functions, and implement them with two-level NOR gate circuits:

(a) $F = wx' + y'z' + w'yz'$

(b) $F(w, x, y, z) = \sum (0, 3, 12, 15)$

(c) $F(x, y, z) = [(x + y)(x' + z)]'$

(6) 3.20 (6 points for each)

Draw (a) the multiple-level NOR circuit for the following expression:

$$CD(B + C)A + (BC' + DE')$$

and (b) repeat for a NAND logic diagram.

(7) 4.8 (10 points) *Obtain simplified Boolean expressions of outputs, and draw a logic diagram.

Design a code converter that converts a decimal digit from

(a) The 8, 4, -2, -1 code to BCD.