Homework 1

Computer Engineering 303

Problem 1. (30 Points, 10 Points for each part) Switch Representation of Digital Circuits:

Draw the CMOS circuit diagrams using NMOS and PMOS transistors for the following functions.

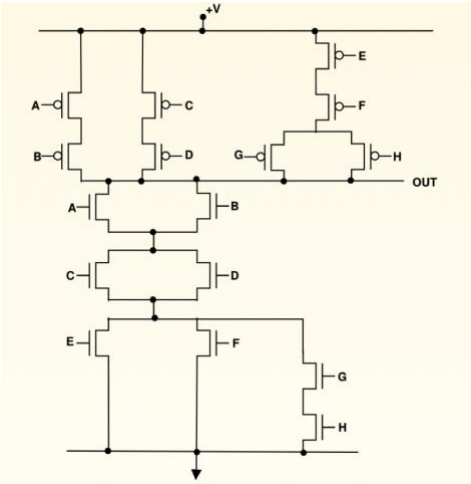
(1)

$F = \overline{(A+B+C)D}$

(2)

$F = \overline{A(BC+D)}$

(3) What is the logic equation describing the behavior of the complex CMOS gate depicted in the figure below?



Problem 2. (35 Points) Implement a decoder to generate "scrambled" codes for the first 12 letters of the English alphabet as follows: Each letter's initial code is equal to the binary value of their location in the alphabet starting at 0, i.e., A is at location 0 and L is at location 11. As for their scrambled codes, the 12 letters are divided into two groups of 6 (A through F is the first group, G through L the second). The scrambled code of a letter in the first group corresponds to the code of the letter in the second group located in the same relative order. Meaning, the scrambled code generated for A is the code of G (for G it is A), the scrambled code generated for D is J (for J it is D), the scrambled code generated for F is L (for L is F), etc.

a. Create the truth table for this decoder (5 Points)
b. Identify and include Don't Care Input Cases in the truth table (5 Points)
c. Create the K-Map for each output and identify all prime implicants of each output function (20 Points)
d. Create the minimal Sum-of-Products expressions for the decoder using the K-Map (5 Points)

Problem 3. (15 Points) For the function f = b'c'd'+bcd+acd'+a'b'c+a'bc'd

a. Create the K-Map and identify all Prime Implicants (10 Points)
b. Identify the Essential Prime Implicants (5 Points)

Problem 4. (20 Points, 10 Points for each part) Find all Prime Implicants for the following functions by applying the first step of the QM Method

a. F(A, B, C, D) = minterms of the ON-Set: {m1, m5, m7, m9, m11, m12, m14, m15}
b. F(A, B, C, D) = minterms of the ON-Set: {m0, m1, m3, m5, m6, m7, m8, m10, m14, m15}