Solution

CS M51A, Fall 2022, Midterm
(Total Mark: 15 points)

Student Name: Student ID:

1. (2 Points) Using boolean algebra, Simplify the following expression as much as possible.

   (a) $F = (B.C) + (B.1) + (C.0) + \underbrace{(B.B.C)'}_{(B.C)'}$ $= BC + B + (BC)' = 1$

   (b) $F = (C + A).(B + 1).(A + C)'.(B + C)$ $= (A+C).\underbrace{(A+C)'}_{0}.(B+C) = 0$

2. (2 Points) Present the following numbers in decimal.

   (a) 1101 is an unsigned number $2^3 + 2^2 + 2^0 = (13)_{10}$

   (b) 1101 is a two's complement $-2^3 + 2^2 + 2^0 = (-3)_{10}$

3. (3 Points) Present the Sum of MINTEMRS and Product of MAXTEMRS for the following system, where A, B and C are inputs and F is the output. (Hint: you may first draw a truth table and then write the expressions)

   $F = (A.B) + C$

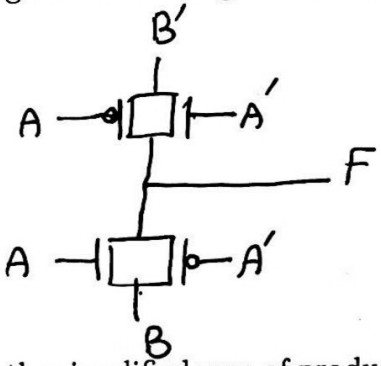
A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$SOP = A'B'C + A'BC + AB'C + ABC' + ABC$

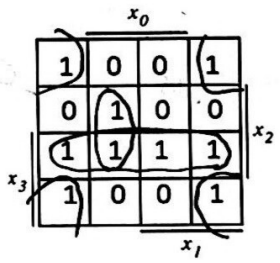
$POS = (A + B + C)(A + B' + C)(A' + B + C)$

4. (3 Points) Implement F = A XNOR B using transmission gates. You are allowed to use 1, 0, A, A', B, and B' as your signals.

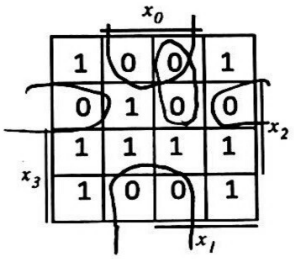
A	F
0	B′
1	B



5. (2 Points) Using the following K-Map, write the simplified sum of product (SoP) and product of sum (PoS) terms. (For your convenience, two same K-maps are provided. Use one for SoP and the other for PoS)

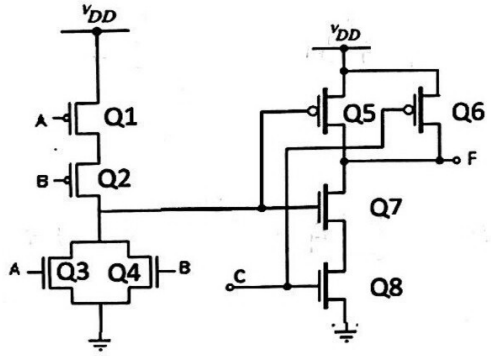


SOP : $x_0' x_2' + x_2 x_3 + x_0 x_1' x_2$



POS : $(x_0' + x_2)(x_0 + x_2' + x_3)(x_0' + x_1' + x_3)$

6. (3 Points) Given the circuit below, complete the table below, determining the resistances for Q_1 to Q_6 and the final output F. The transistors Q_1 to Q_8 should be High or Low (show by 'H' or 'L') resistance. The output F may be 0, 1, float (show by –) or short (show by *). Remember short means the output is connected to both VDD and ground at the same time.



A B C	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	F
0 0 1	L	L	H	H	H	H	L	L	0
1 0 0	H	L	L	H	L	L	H	H	1
1 1 0	H	H	L	L	L	L	H	H	1