Charles Zhang
305413657
Academic Honesty: [signature]

CS M51A HW#3

1a) $A'B + AC + BC$

$A'B(C+C') + AC(B+B') + BC(A+A')$ – Complement

$A'BC + A'BC' + ABC + AB'C + ABC + A'BC$ – Distributivity

$A'BC' + ABC + AB'C + A'BC$ – Idempotency

$010 + 111 + 101 + 011$

$m_2 + m_7 + m_5 + m_3$

$\boxed{\Sigma m(2,3,5,7)}$

$\boxed{\Pi M(0,1,4,6)}$

1b) $A'B(AB+C)(B+A'C')$

$(A'BAB + A'BC)(B+A'C')$ – Distributivity

$A'BC(B+A'C')$ – Complement

$A'BBC + A'A'BCC'$ – Distributivity + Associativity

$A'BC$ – Complement + Idempotency

011

m_3

$\boxed{\Sigma m(3)}$

$\boxed{\Pi M(0,1,2,4,5,6,7)}$

1c) $A' + A(A'B + B'C)'$

$A' + (A'B + B'C)'$ – Simplification

$A' + (A'B)'(B'C)'$ – De Morgan's

$A' + (A+B')(B+C')$ – De Morgan's

$A' + (A+B')B + (A+B')(C')$ – Distributivity

$A' + AB + BB' + AC' + B'C'$ – Distributivity

$A' + AB + AC' + B'C'$ – Complement

$A' + B + AC' + B'C'$ – Simplification

$A' + B + C'$ – Simplification + Associativity

$1 + 0 + 1 = M_5$

$\boxed{\Pi M(5)}$

$\boxed{\Sigma m(0,1,2,3,4,6,7)}$

2a)

x_1	x_0	y_1	y_0	z_2	z_1	z_0
0	0	0	0	0	0	0
0	0	0	1	0	0	1
0	0	1	0	0	1	0
0	0	1	1	0	1	1
0	1	0	0	0	0	0
0	1	0	1	0	0	1
0	1	1	0	0	1	0
0	1	1	1	0	1	1
1	0	0	0	0	0	0
1	0	0	1	1	0	0
1	0	1	0	1	0	0
1	0	1	1	1	0	0
1	1	0	0	0	0	0
1	1	0	1	0	0	0
1	1	1	0	0	0	0
1	1	1	1	0	0	0

$x \in \{0,1,2\}$

$y \in \{1,2,3\}$

$z = \max(x^2, y)$

2b) $z_2 = x_1 x_0' y_1' y_0 + x_1 x_0' y_1 y_0' + x_1 x_0' y_1 y_0$

$= 1001 + 1010 + 1011$

$= m_9 + m_{10} + m_{11}$

$\boxed{z_2 = \Sigma m(9,10,11) = \Pi M(0,1,2,3,4,5,6,7,8,12,13,14,15)}$

$z_1 = 0010 + 0011 + 0110 + 0111$

$z_1 = m_2 + m_3 + m_6 + m_7$

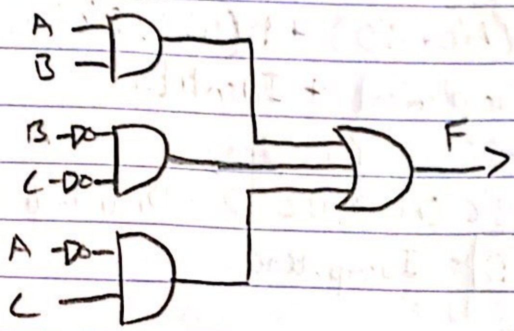
$\boxed{z_1 = \Sigma m(2,3,6,7) = \Pi M(0,1,4,5,8,9,10,11,12,13,14,15)}$

$z_0 = 0001 + 0011 + 0101 + 0111$

$z_0 = m_1 + m_3 + m_5 + m_7$

$\boxed{z_0 = \Sigma m(1,3,5,7) = \Pi M(0,2,4,6,8,9,10,11,12,13,14,15)}$

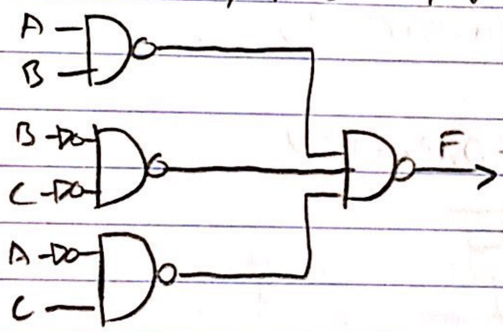
3a) $F = AB + \overline{B}\,\overline{C} + \overline{A}C$



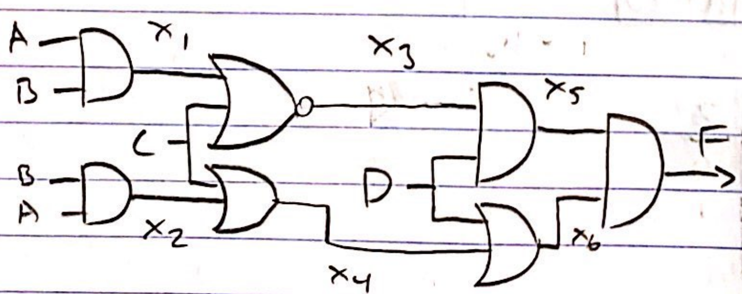
3b) $F = AB + B'C' + A'C = ((AB)'(B'C')'(A'C)')'$

$x_2' = AB,\ x_1' = B'C',\ x_0' = A'C$

$x_2 = (AB)',\ x_1 = (B'C')',\ x_0 = (A'C)'$



4)



$F = x_5 x_6 \quad x_5 = x_3 D \quad x_6 = x_4 + D$

$x_3 = (x_1 + C)' \quad x_4 = x_2 + C$

$x_1 = AB \quad x_2 = BA$

$x_3 = (AB + C)' \quad x_4 = AB + C$

$x_5 = (AB + C)'D \quad x_6 = AB + C + D$

$F = ((AB + C)'D)(AB + C + D)$

$F = ((AB)'C'D)(AB + C + D)$ - De Morgan's Law

$F = ((A' + B')C'D)(AB + C + D)$ - De Morgan's Law

$F = (A'C'D + B'C'D)(AB + C + D)$ - Distributivity

$F = AB(A'C'D + B'C'D) + C(A'C'D + B'C'D) + D(A'C'D + B'C'D)$

$F = AA'BC'D + ABB'C'D + CC'(A'D + B'D) + D(A'C' + B'C')$

$F = A'C'D + B'C'D$ - Complement + Identity

$F = A'C'D(B+B') + B'C'D(A+A')$ - Complement

$F = A'BC'D + A'B'C'D + AB'C'D + A'B'C'D$ - Distributivity

$\boxed{F = A'BC'D + A'B'C'D + AB'C'D}$ - Idempotency

$F = 0101 + 0001 + 1001$

$F = m_1 + m_5 + m_9$

$F = M_0 M_2 M_3 M_4 M_6 M_7 M_8 M_{10} M_{11} M_{12} M_{13} M_{14} M_{15}$

$$\boxed{\begin{aligned} F = {} & (A+B+C+D)(A+B+C'+D)(A+B+C'+D')(A+B'+C+D)(A+B'+C'+D) \\ & (A+B'+C'+D')(A'+B+C+D)(A'+B+C'+D)(A'+B+C'+D')(A'+B'+C+D) \\ & (A'+B'+C+D')(A'+B'+C'+D)(A'+B'+C'+D') \end{aligned}}$$

5a) High = 3.5V - 5.0V, Low = 0.0V - 1.5V

1.0V = $\boxed{0}$

4.5V = $\boxed{1}$

2.0V = $\boxed{\text{Undefined}}$

-1.0V = $\boxed{\text{Undefined}}$

5b)

x	y	z
0	0	0
0	1	1
1	0	1
1	1	0

$\boxed{\text{XOR gate}}$

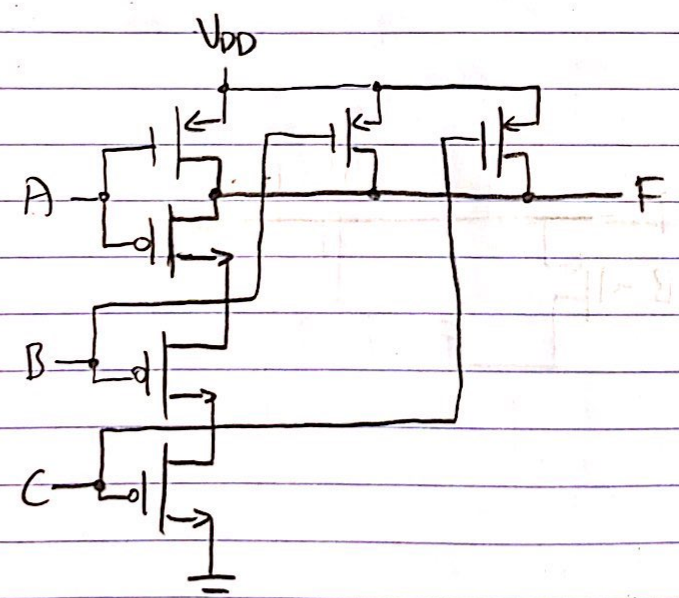
Scanned with CamScanner

6a)

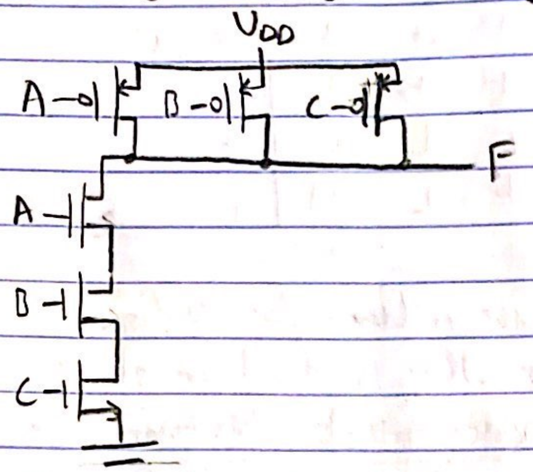
A	B	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Z
0	0	L	H	L	H	H	L	0
0	1	H	L	L	H	H	H	—
1	0	L	H	H	L	L	L	✗
1	1	H	L	H	L	L	H	1

6b) It is poor design to use a transistor configuration that is capable of resulting in float or short, as both results are indeterminant. This means the transistor configuration would be inconsistent and likely lead to errors during use.

7a) $F = A + B + C$



7b) $F=(A'+B'+C') \rightarrow$ NAND gate



8a)

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

$\boxed{F = A + B'}$

8b)