Logic Design– Assignment 06

#	Student ID	Student Name	Grade (10)
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Delivery Date	

١. يتم تسليم التمرين محلولا في خلال أسبوع من تاريخ التمرين، و يتم حذف درجتين من التمرين عن كل أسبوع تأخير
٢. يتم التسليم لمعيد المقرر مباشرة
٣. تتم أجابه التمرين في نفس ورق الأسئلة

Q1

A combinational circuit has four inputs (A, B, C, D) and four outputs (W, X, Y, Z). $WXYZ$ represents an excess-3 coded number whose value equals the number of 1's at the input. For example, if $ABCD = 1101$, $WXYZ = 0110$.

(a) Find the minterm expansions for X, Y, and Z.

(b) Find the maxterm expansions for Y and Z.

Sol 1

A B C D	W X Y Z
0 0 0 0	0 0 1 1
0 0 0 1	0 1 0 0
0 0 1 0	0 1 0 0
0 0 1 1	0 1 0 1
0 1 0 0	0 1 0 0
0 1 0 1	0 1 0 1
0 1 1 0	0 1 0 1
0 1 1 1	0 1 1 0
1 0 0 0	0 1 0 0
1 0 0 1	0 1 0 1
1 0 1 0	0 1 0 1
1 0 1 1	0 1 1 0
1 1 0 0	0 1 0 1
1 1 0 1	0 1 1 0
1 1 1 0	0 1 1 0
1 1 1 1	0 1 1 1

$$X = A'B'C'D + A'B'CD' + A'B'CD + A'BC'D' + A'BC'D + A'BCD' + A'BCD + AB'C'D' + AB'C'D + AB'CD' + AB'CD + ABC'D' + ABC'D + ABCD' + ABCD$$

$$Y = A'B'C'D' + A'BCD + ABC'D + ABCD' + ABCD$$

$$Z = A'B'C'D' + A'B'CD + A'BC'D + A'BCD' + AB'C'D + AB'CD' + AB'CD + ABC'D' + ABCD$$

$$Y = (A + B + C + D')(A + B + C' + D)(A + B + C' + D')(A + B' + C + D)(A + B' + C + D')(A + B' + C' + D)(A' + B + C + D)(A' + B + C + D')(A' + B + C' + D)(A' + B + C' + D')(A' + B' + C + D)$$

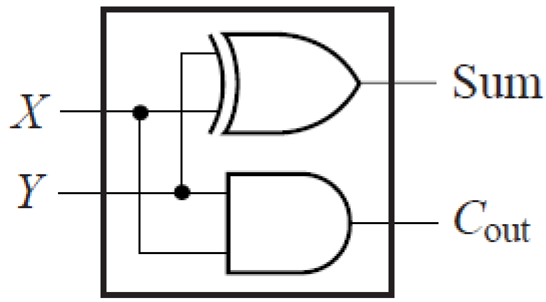
$$Z = (A + B + C + D')(A + B + C' + D)(A + B' + C + D)(A + B' + C' + D)(A' + B + C + D)(A' + B' + C + D')(A' + B' + C' + D)$$

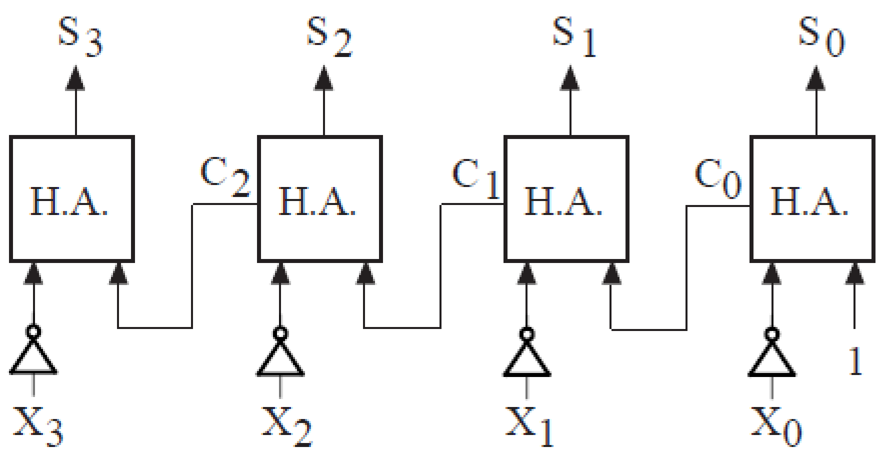
Q2

A half adder is a circuit that adds two bits to give a sum and a carry. Give the truth table for a half adder, and design the circuit using only two gates. Then design a circuit which will find the 2's complement of a 4-bit binary number. Use four half adders and any additional gates. (*Hint:* Recall that one way to find the 2's complement of a binary number is to complement *all* bits, and then add 1.)

Sol 2

XY	Sum	Cout
0 0	0	0
0 1	1	0
1 0	1	0
1 1	0	1





Q3	(a) If m_1 and m_2 are minterms of n variables, prove that $m_1 - m_2 = m_1 \oplus m_2$. (b) Prove that any switching function can be written as the exclusive-OR sum of products where each product does not contain a complemented literal. [*Hint*: Start with the function written as a sum of minterms and use Part (a).]
Sol 3	(a) $m_1 + m_2 = m_1(m_2' + m_2) + (m_1' + m_1)m_2$ $= m_1m_2' + m_1m_2 + m_1'm_2$ But $m_1m_2 = 0$, so $m_1 + m_2 = m_1m_2' + m_1'm_2$ $= m_1 \oplus m_2$. (b) Using part (a), any function can be written as the exclusive-or sum of its minterms. However, if a product contains a complemented literal, it can be written as the exclusive-or sum of two products without a complemented literal by using $x'p = (x \oplus 1)p = xp \oplus p$. By repeated application of the preceding relationship, all complemented literals can be removed from the products.