

Problem Set 1

Q1. Suppose a poll has to be conducted with three entities A, B and C, each of which can either vote a 'yes' (encoded as 1) or a 'no' (encoded as 0). The final output is equal to the majority opinion. Draw a truth table of the system, simplify the function, and implement it using logic gates.

Q2. Most circuits in modern computers are built using NAND and NOR gates, because they are easy to build using CMOS technology. Suppose another technology is invented in the near future, which implements a new gate, X, very efficiently. X takes 3 inputs A, B and C and computes:

$$X(A,B,C) = A \cdot B + C'$$

Using only X gates and NOT gates, how will you implement the following function:
 $f(A,B,C) = A + B + C$?

Q3. Using mathematical induction prove the De Morgan's theorem for n- variables.

Q4. Design a circuit with four inputs, x_1, x_2, x_3, x_4 , and seven outputs $p_1, p_2, m_1, p_3, m_2, m_3, m_4$, that receives BCD code words and generates the corresponding Hamming code words defined in Table below.

Decimal digit	Digit position and symbol						
	1 p_1	2 p_2	3 m_1	4 p_3	5 m_2	6 m_3	7 m_4
0	0	0	0	0	0	0	0
1	1	1	0	1	0	0	1
2	0	1	0	1	0	1	0
3	1	0	0	0	0	1	1
4	1	0	0	1	1	0	0
5	0	1	0	0	1	0	1
6	1	1	0	0	1	1	0
7	0	0	0	1	1	1	1
8	1	1	1	0	0	0	0
9	0	0	1	1	0	0	1