1. State and prove DeMorgan's theorem and expand the function: (A+B '+C+D')' + (ABCD')'.
2. Simplify the Boolean function using K-map methods.

   F (A, B, C, D) =m(4,5,6,7,8)

   d (A, B, C, D) = m(11,12,13,14,15)

3. What is the minimum number of 2-input NAND gates required to implement a 4-variable function expressed in sum-of-minterms from as f = (0, 2, 5, 7, 8,10, 13, 15)?
4. Draw and explain the logic diagram of a half adder using only NAND gates.
5. Evaluate the 2's complement of decimal 28.
6. Convert the following:

   (145.21)10 -> (X)16

   (AB9)16 -> (x)8

   (176.23)10 -> (x)8

   (36.89)10 -> (x)4

   (10AE)16 -> (X)8

   (7.75)8 -> (x)2

7. Minimize the following:

   Z= ∑A,B,C(0,4,5)

   Z= ∑A,B,C(1,5,6,7,9,13)

   Y = AB'C + A'B'C + A'BC + AB'C' + A'B'C'

   F=A'+AB'+ABC'

   Y = ABC'D + ABC'D' + ABCD + A'BCD + ABCD' + A'BCD'.

   Y(A, B, C, D) = ∑ m (0, 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 14)

   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).

8. Design 8x1 Multiplexer using 4x1 Multiplexer and 2x1 Multiplexer.

9. Design 3 to 8 decoder using 2 to 4 decoders.
10. Design Mod-10 Counter.