# EEE119 Digital System Engineering – Digital Logic Revision

1. Simplify to a minimum number of literals:

   (i) X(X'+ Y)
   (ii) X + X'Y

2. Write down De Morgan's Laws for three variables and prove one of them by truth table. How do you know that the other one holds?

3. Draw a truth table for F = X'Z' + YZ and use it to produce an expression for F'. Use De Morgan's law to express F as a fundamental product of sums.

4. Given A = 10101100 and B = 10110001, evaluate the 8 bit result for the operations:

   (i) AND (ii) OR (iii) XOR (iv) XNOR (v) NOT A (vi) NOT B

5. Show that the dual of the XOR function is equal to its complement.

6. Draw the truth table for a full adder and show how the sum and carry can be implemented using:

   (i) 8-to-1 multiplexers
   (ii) 4-to-1multiplexers and logic inverters
   (iii) line decoder with active high output plus one additional logic gate
   (iv) line decoder with active low output plus one additional logic gate

7. Perform the following calculations using 8-bit binary arithmetic:

   (i) 17 + 49
   (ii) 57 – 23
   (iii) 37 - 41

8. Design a sequential circuit which implements the two bit binary count sequence 00,01,10,11,00 etc.

9. Draw a circuit that uses full adders to add two 4-bit binary numbers.

10. Show how an XOR gate can be used as a controlled inverter. How do you produce the twos complement of a number? Hence, draw a circuit that has two 4-bit inputs, A and B, and a control line S which chooses between adding B to A or subtracting B from A.

11. Use the equation $g_k = b_k \oplus b_{k+1}$ to produce the Grey code for the consecutive binary values 01010111 and 01011000. How many bits change between the binary values? How many bits change between the Grey code values?

    Use the equation $b_k = g_k \oplus b_{k+1}$ to convert the result back to binary.

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