Questions

1. Convert the following numbers into the number system indicated
   (a) $(1010.011)_2$ to decimal
   (b) $(FA)_{16}$ to decimal
   (c) $(101110101101)_2$ into hexadecimal
   (d) $(FA)_{16}$ to binary

2. Convert the decimal number 27.25 into a binary number.

3. What is the largest decimal number that you can represent using 8bits? How many bits are required to represent decimal numbers less than or equal to 10^6?

4. Determine the number system in which the following arithmetic operations have been carried out. Give justifications for your answer.
   (a) 24+17=40
   (b) 22 x 5 = 132

5. Obtain 1's and 2's complement of the following binary numbers:
   (a) 10000000
   (b) 10101010
   (c) 01110101
   (d) 10011100

6. (a) What is the minimum number of bits required to represent -32 in 2's complement form?
   (b) 11011111 is a number in 2's complement. Is it positive or negative? What is its magnitude?

7. Carry out the following four operations using 8bit 2's complement representation:
   $$\pm 24 \pm 32$$
   Verify that operations have been properly carried out.

8. Show that the Boolean expression $x + \overline{x}.y$ is equivalent to $x + y$ using basic postulates and theorems of Boolean algebra.

9. Reduce the following expressions to a minimum number of literals using basic postulates and theorems of Boolean algebra.
   (a) $f = (x + y).(\overline{y} + \overline{x})$
   (b) $f = ABCD + \overline{A}BD + AB\overline{C}D$

10. Consider four-input function F(A, B, C, D) that outputs 1 whenever an odd number of its inputs are 1, (a) construct the truth table and (b) write down the Boolean expressions.

11. Four switches operate a lamp as follows: the lamp lights up if switches 1,3 and 4 are closed and switch 2 is open, or if 2, 4 are closed and 3 is open, or if all the switches are kept closed. Express this as a boolean function in a standard sum of product form and solve it using k- map. (Use bit '1' when switch

is closed and bit '0' when switch is open).

12. Obtain the truth table for the following function: $(x.y + z)(y + x.z)$ and write it as sum of products (SOP) and product of sums (POS).

13. Simplify the following 4-variable functions into sum-of-products form using K-map.
    a. $\sum(1,5,6,7,14)$
    b. $\sum(0,4,6,8)$
    c. $\sum(0,1,4,6,8,9,14)$
    d. $\sum(1,4,7,11,13,14)$

14. Simplify the following 4-variable functions into product-of-sums form using K-map
    a. $\Pi(1,3,5,7,13,15)$
    b. $\Pi(1,3,6,9,11,12,14)$
    c. $\Pi(1,3,5,7,9,11,12,13,14,15,)$
    d. $\Pi(0,1,3,4,5,7,12,13,15)$

15. Design a combinational circuit with 3 inputs and 1 output
    (a) The output is 1 when the binary value of the inputs is less than 3. The output is 0 otherwise
    (b) The output is 1 when the binary value of inputs is an odd number.