



Instructions: • Answer all questions

• Assume missing data suitably, by clearly stating the assumption

1. Perform subtraction of the given unsigned numbers using 2's complement method and obtain the result

(a) $00001000 - 00000011$

(b) $00001100 - 11110111$

2. Add the following numbers and obtain their sum.

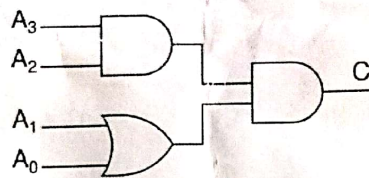
(a) $(58)_{10} + (22)_{10}$

(b) $(01100111)_{BCD} + (01010011)_{BCD}$

3. The solutions to the quadratic equation $x^2 - 11x + 22 = 0$ are $x = (3)_n$ and $x = (6)_n$. What is the base of the numbers? (2 marks)

4. Represent the decimal number 6.24 in (a) BCD, (b) excess-3 code (3 marks)

5. A four bit address $A (= A_3A_2A_1A_0)$ from a microprocessor is used to generate a chip select signal C in order to enable a peripheral chip. The chip will get enabled when the signal C is high. Find the range of values of A (in hex) for which the peripheral chip will be enabled if the chip select signal generation circuit is as given below. (2 marks)



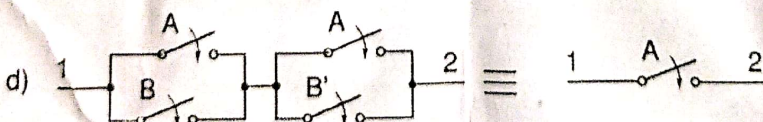
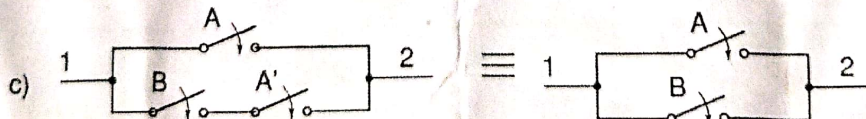
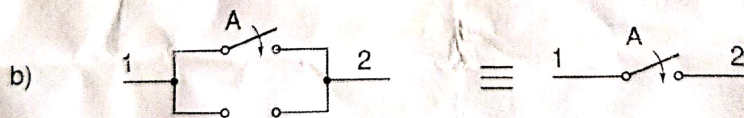
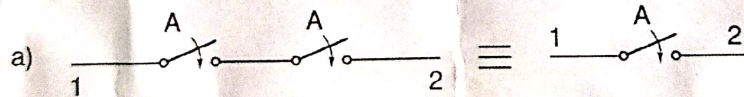
$$(x_n)^2 - 11(x_n) + 22 = 0$$

$$x = (3)_n, (6)_n$$

$$x^2 - (n+1)x + (2n+2) = 0$$

$$\Rightarrow n = 3_n \text{ and } 6_n$$

6. Identify the Boolean algebra identity for the following switching circuit realizations. The switch will be closed when the Boolean variable is 1 and open when the Boolean variable is 0. The existence of transmission between the points 1 and 2 is considered as logic one and no transmission between 1 and 2 is considered as logic zero. (2 marks)



[P.T.O.]

Using Boolean algebra simplify each of the following Boolean expressions as product of sum (POS) terms

- (a) $(A'B' + C)' + C + AB + DE$
 (b) $W + W'X + W'X'Y + W'X'Y'Z$

8. Prove the following theorems using Boolean algebra postulates

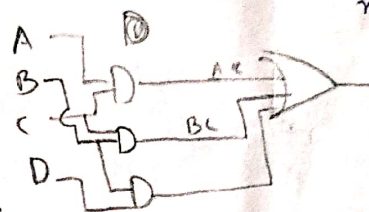
- (a) $1 + y = 1$
 (b) $xy + x'z + yz = xy + x'z$

9. Four chairs are placed in a row.



Each chair may be occupied or empty. Occupied chair is considered as logic 1 and empty chair is considered as logic 0. A logic function $F(A, B, C, D)$ is to be formulated which is "1" if there are no adjacent empty seats. A and D should not be treated as adjacent chairs.

- (a) Express F as sum of minterms
 (b) Express F as product of maxterms
 (c) Simplify the function F using K-map
 (d) Implement the function F using NAND gates alone.



10. The Boolean expression $A' + B'D'$ is a simplified version of the expression $A'B'C' + A'B'CD + A'BD + B'C'D'$. Are there any don't care conditions considered during simplification? If so, what are they?

11. Following table shows the prime implicants (covering two minterms and covering 4 minterms obtained while simplifying the following function, $F(A, B, C, D) = \sum_m(0, 1, 2, 5, 6, 7, 8, 9, 10, 14)$, using Quine McCluskey Procedure. Obtain the minimal sum of product (SOP) expression for F .

Minterms			Group of 2 minterms			Group of 4 minterms		
Group	Minterm	Binary	Group	Minterms	Binary	Group	Minterms	Binary
Group 1A	0	0000	Group 2A	0,1 0,2 0,8	000- 00-0 -000	Group 4A	0,1,8,9 0,2,8,10 0,8,1,9 0,8,2,10	-00- -0-0 -00- -0-0
Group 1B	1 2 8	0001 0010 1000	Group 2B	1,5 1,9 2,6 2,10 8,9 3,10	0-01 -001 0-10 -010 100- 10-0	Group 4B	2,6,10,14 2,10,6,14	-10 -10
Group 1C	5 6 8 10	0101 0110 1001 1010	Group 2C	5,7 6,7 6,14 10,14	01-1 011- -110 1-10			
Group 1D	7 14	0111 1110						

