Boolean Algebra.

1. Explain closure, associative, commutative, and distributive property. What is identity and inverse element?
2. What are Huntington postulates of Boolean algebra.
3. Compare between Boolean algebra and ordinary algebra.
4. State duality principle. Find dual of the following:
   $x+0=x$; $x+x'=1$, $x+x=x$, $x+1=1$
5. Prove that:
   i) $x+x=x$ and $x.x=x$
   ii) $x+1=1$
   iii) $x+xy=x$
6. State absorption and involution law.
7. State and prove De Morgan's law. Apply your law to find:
   i) $(x'y'z'+x'y'z)'$
   ii) $[x(y'z'+yz)]'$
8. What do you mean by maxterm & minterm? What is cannonical form?
9. Express the Boolean function $F=A+B'c$ in sum of minterm.
10. Express $F=xy+x'z$ in product of maxterm.
11. convert to other cannonical form:
    $F(x,y,z)=\sum(1,4,5,6,7)$.
    $F(x,y,z)=\sum(1,3,6,7)$.
    $F(x,y,z)=\prod(0,2,3,4)$.
12. What is standard form? What do you mean by positive & negative logic.
13. Given the Boolean function $F=xy+x'y'+y'z$.
    a) Implement it with AND, OR and NOT gates.
    b) Implement it with only OR and NOT gates.
    c) Implement it with only AND and NOT gates.
14. Obtain the truth table of the function: $F=xy+xy'+y'z$.
15. Express the following functions in a sum of minterms and product of maxterms:
    i) $F(A,B,C)=(A'+B)(B'+C)$
    ii) $F(x,y,z)=1$.
    iii) $F(x,y,z)=(xy+z)(y+zx)$.
16. Convert the following to other cannonical form:
    i) $F(x,y,z)=\sum(1,3,7)$
    ii) $F(x,y,z)=\prod(0,3,6,7)$.
17. What is the difference between cannonical form and standard form? Which form is preferable when implimenting with gates? Which form is obtained fromm truth table.
18. Show that dual of XOR is equal to its complement.

19. "Sum of all minterm of a Boolean Function of 3 variable is 1" — Prove it.
20. "Product of all maxterm of a Boolean Function of 3 variable is 0" — Prove it.
21. Show that :
    i) XOR and NXOR are commutative and associative.
    ii) NAND is not associative.
    iii) NAND and NOR are not distributive.
22. A majority gate is a digital circuit whose output is equal to 1 if majority of the inputs are 1's. The output is 0 otherwise. Draw a 3 input majority gate.
23. Verify the truth table of 3 input XOR gate with a digital circuit whose output is equal to the number of 1's in the input (mod 2.
24. Show that a positive logic AND gate is a negative logic OR gate & vice-versa.
25. Write steps to minimize a Boolean function using K-map method.
26. What are the advantages & disadvantages of K-map method?
27. Simplify the Boolean functions using K-map :
    i) $F = x'yz + x'yz' + xy'z' + xyz'$ in SOP & POS.
    ii) $F = x'yz + xy'z' + xyz + xyz'$ in SOP
    iii) $F = A'C + A'B + AB'C + BC$ in SOP & POS
    iv) $F = \sum(0,2,4,5,6)$ in SOP & POS.
    v) $F = \sum(0,1,2,4,5,6,8,9,12,13,14)$ in SOP
    vi) $F = A'B'C' + B'CD' + A'BCD' + AB'C'$ in SOP
    vii) $F = \sum(0,1,2,5,8,9)$ in SOP & POS
28. Write steps to implement a Boolean function using 1. NAND gates only. 2. NOR gates only.
29. Simplify the Boolean Function $F(w,x,y,z) = \sum(1,3,7,11,15)$ with don't care condition $d(w,x,y,z) = \sum(0,2,5)$.
30. Show that NAND and NOR are universal gate.
31. Design a combinational circuit that accept a three bit number and generates square of the input.
32. Design a combinational circuit that multiply two 2-bit numbers.
33. Design a combinational circuit that accept a BCD number & find 9's complement of the input.
34. Design a combinational circuit that accept a 4-bit number & produces 2's complement of the input.
35. Design a combinational circuit that multiplies by 5 an input decimal digit in BCD.
36. Design a combinational circuit that detects an error in representation of decimal digit in BCD.

37. Show that $A \odot B \odot C \odot D = \sum(0, 3, 5, 6, 9, 10, 12, 15)$.
38. Design a combinational circuit that converts a four bit reflected code to a four bit binary number. Implement it with XOR gates.
39. Design a combinational circuit to check for even parity of four bits. A logic-1 output is required when four bit do not constitute an even parity.
40. What is self dual & self complementary function ? Verify whether the Boolean function $\sum(1, 3, 5, 7)$ is a self dual function.