

CHAPTER 2
BOOLEAN ALGEBRA

One mark questions:

1. What is another name of Boolean algebra? (S)
2. What is the use of Boolean algebra? (A)
3. What type of problems can be solved in Boolean algebra? (A)
4. Define truth values. (A)
5. What do you understand by logic functions? (U)
6. Give an example for logic function. (A)
7. What do you mean by binary valued variables? (U)
8. What is meant by tautology? (U)
9. What is meant by fallacy? (U)
10. Prove that $1 + Y$ is tautology. (S)
11. Prove that $0 \cdot Y$ is fallacy. (S)
12. What is a truth table? (U)
13. Write Venn diagram for AND operator. (A)
14. Write Venn diagram for NOT operator. (A)
15. Write Venn diagram for OR operator. (A)
16. Which operator is complementation? (U)
17. What are postulates of Boolean algebra? (K)
18. What is proof by perfect induction? (S)
19. Write the truth table for: $X + X = X$ (A)
20. Write the truth table for: $X \cdot X = X$ (A)
21. Prove that $1 + X = 1$ (S)
22. State idempotence law. (U)
23. State involution law. (U)
24. State complementarity law. (U)
25. Draw logic diagram to represent complementarity law. (S)
26. State commutative law. (U)
27. State associative law. (U)
28. Draw logic diagram to represent associative law. (A)
29. State distributive law. (U)
30. State absorption law. (U)
31. Write the truth table for $X + Y = Y + X$ (A)
32. What is minterm? (U)
33. Find the minterm of $\bar{X}\bar{Y}Z$ (A)
34. What is maxterm? (U)
35. Find the maxterm of $X + \bar{Y} + \bar{Z}$ (A)
36. What is canonical form of Boolean expression? (U)
37. Define map rolling. (U)
38. What is K-map? (K)

39. Who introduced K-maps? (U)
40. Write the general K-map for 2 variables X and Y. (A)
41. Find the dual of $A + \bar{A}B = A + B$ (A)
42. Write the complement of $\bar{A} (B\bar{C} + BC)$ (A)
43. Write the complement of $A\bar{B} + \bar{C}\bar{D}$ (A)
44. Write the complement of $\bar{X}\bar{Y} + X\bar{Y}Z$ (A)
45. Write the complement of $XY + \bar{Y}Z + \bar{Z}\bar{Z}$ (A)
46. Write the complement of $X + X\bar{Y} + \bar{X}\bar{Z}$ (A)

Two marks questions

1. What is tautology and fallacy? (U)
2. Name the three logical operators. (U)
3. Write the truth table of AND operator. (U)
4. Write the truth table of OR operator. (U)
5. Name the two forms of expressing Boolean functions. (A)
6. Write the truth table to the Boolean expression $\bar{X}\bar{Y} + XY$ (A)
7. Mention the different basic gates. (U)
8. Write the logic symbol and truth table of AND gate. (A)
9. Write the logic symbol and truth table of OR gate. (A)
10. Write the postulates of complement rules. (U)
11. Prove that $0 + X = X$ using proof by perfect induction method. (S)
12. Prove that $1 + X = 1$ using proof by perfect induction method. (S)
13. Prove that $0 \cdot X = 0$ using proof by perfect induction method. (S)
14. Prove that $1 \cdot X = X$ using proof by perfect induction method. (S)
15. Prove that $X + \bar{X} = 1$ (S)
16. Prove that $X \cdot \bar{X} = 0$ (S)
17. Prove complementarity law using truth table. (S)
18. Write the truth table for $X \cdot Y = Y \cdot X$ (A)
19. Write the truth table for $X + Y = Y + X$ (A)
20. State and prove commutative law. (U)
21. Prove algebraically $X + XY = X$ (S)
22. Draw logic diagram for $X(Y + Z) = XY + XZ$ (S)
23. Prove algebraically $X + \bar{X}Y = X + Y$ (S)
24. Prove that $X + \bar{X}Y = X + Y$ using truth table. (A)
25. Prove algebraically $X(X + Y) = X$ (S)
26. State and prove idempotence law. (S)
27. State and prove involution law. (S)
28. Prove complementarity law. (S)
29. Prove commutative law. (S)
30. Prove that $X + XY = X$ using truth table. (S)
31. The following input expression $ABCD = 0010, ABCD = 1100$ and $ABCD = 1110$.
Write SOP expression. (A)

32. Simplify the Boolean expression $X + \bar{X}Y + \bar{Y} + (X + \bar{Y})\bar{X}Y$ (S)
33. Simplify: $AB + A\bar{B} + \bar{A}C + \bar{A}\bar{C}$ (S)
34. Convert the expression $A\bar{B}(\bar{B} + \bar{C})$ into canonical sum-of-product form. (S)
35. Simplify: $XY + XYZ + XY\bar{Z} + X\bar{Z}Y$ (S)

Three marks questions:

1. Write any three basic postulates of Boolean algebra. (U)
2. State and prove any three theorems of Boolean algebra. (U)
3. Write the principles of duality theorems. (U)
4. Write the properties of 0 and 1 and prove them. (U)
5. Prove that $X + (Y + Z) = (X + Y) + Z$ (S)
6. Prove algebraically that $X + (Y + Z) = (X + Y) + Z$ (S)
7. State and prove associative law and commutative law. (U)
8. Write the truth table for $X + YZ = (X + Y)(X + Z)$ (U)
9. State and prove distributive law. (U)
10. State and prove absorption law. (U)
11. Write the circuit diagram for $X + \bar{X} = 1$ and $X \cdot \bar{X} = 0$. (S)
12. Prove that $X \cdot (Y \cdot Z) = (X \cdot Y) \cdot Z$ (S)
13. Prove that $X(Y + Z) = XY + XZ$ (S)
14. Prove that $X + YZ = (X + Y)(X + Z)$ (S)
15. Explain with an example how to express a Boolean function in its sum-of-products form. (U)
16. Explain with an example how to express a Boolean function in its products-of-sums form. (U)
17. Construct a truth table for minterms and maxterms of three variables and designate the terms. (U)
18. Draw K-map using following : $F(X, Y, Z) = \bar{X}\bar{Y}\bar{Z} + \bar{X}\bar{Y}Z + \bar{X}YZ$ (A)
19. Convert $F(X, Y, Z) = m_0 + m_1 + m_2 + m_5$ to canonical sum-of-product form. (A)
20. Convert $F(X, Y, Z) = M(0, 1, 4, 5, 7)$ to canonical product-of-sum form. (A)
21. Convert $F(X, Y, Z) = M(0, 2, 4, 5)$ to canonical product-of-sum form. (A)
22. Reduce $\bar{X}Y + \bar{X} + XY$ (A)
23. Reduce $\bar{X}\bar{Y}\bar{Z} + \bar{X}Y\bar{Z} + X\bar{Y}\bar{Z} + XY\bar{Z}$ (A)
24. Reduce the Boolean expression to the simplest form $A(B + C(\overline{AB + AC}))$ (A)
25. A truth table has output 1 for each of these inputs $ABCD = 0011, ABCD = 0101, ABCD = 1000$ what are the fundamental products and write minterm expression. (A)
26. Construct a Boolean function of three variables X, Y and Z that has an output 1 when exactly two of X, Y and Z are having values 0, and an output 0 in all other cases. (A)
27. Write the steps involved in minterm expansion of expression. (S)
28. Write the truth table 3 input variable minterm. (S)
29. Write the truth table 3 input variable maxterm. (S)
30. Convert $F(X, Y, Z) = X + \bar{X}Y + XZ$ to canonical sum-of-product form. (A)
31. Convert the expression $YZ + X\bar{Y}$ to canonical sum-of-product form. (A)
32. Convert the expression $(A + C)(C + D)$ to canonical product-of-sum form. (A)
33. Convert the expression $(X + Y)(Y + Z)(X + Z)$ to canonical product-of-sum form. (A)
34. Expand the expression $F(X, Y, Z) = \pi(0, 1, 2, 4, 5)$ (A)

35. Draw a general K-map of 3 variables A, B and C. (U)
36. Draw a general K-map of 4 variables W, X, Y and Z. (U)

Five marks questions:

1. State and prove Idempotence laws. (K)
2. State and prove De Morgan's first theorem. (U)
3. State and prove absorption laws of Boolean algebra. (U)
4. Simplify using laws of Boolean algebra $F = XY + XZ + XYZ$ (U)
5. Given the Boolean function $F(X, Y, Z) = \sum(0, 2, 4, 5, 6)$ reduce it using K-map. (A)
6. Given Boolean function $F(A, B, C, D) = \sum(5, 6, 7, 8, 9, 10, 14)$ reduce the function F using K-map.
Write a logic gate diagram for the reduced SOP expression. (S)
7. Given Boolean function $F(A, B, C, D) = \sum(0, 2, 7, 8, 10, 15)$ reduce the function F using K-map. (S)
8. Given Boolean function $F(A, B, C, D) = \sum(7, 9, 10, 11, 12, 13, 14)$ reduce the function F using K-map. (S)
9. Given Boolean function $F(W, X, Y, Z) = \sum(0, 4, 8, 12)$ reduce the function F using K-map. (S)
10. Given Boolean function $F(A, B, C, D) = \sum(0, 4, 8, 9, 10, 11, 12, 13, 15)$
reduce the function F using K-map. (S)
11. Given Boolean function $F(A, B, C, D) = m_0 + m_1 + m_2 + m_3 + m_4 + m_5 + m_8 + m_9 + m_{10} + m_{11} + m_{13} + m_{15}$
reduce the function F using K-map. (S)
12. Given Boolean function $F(A, B, C, D) = m_0 + m_1 + m_2 + m_6 + m_8 + m_9 + m_{10}$ reduce the
function F using K-map. (S)
13. Given Boolean function $F(W, X, Y, Z) = m_0 + m_1 + m_2 + m_3 + m_4 + m_5 + m_6 + m_7 + m_8 + m_9 + m_{10} + m_{11}$
reduce using K-map. (S)
14. Reduce the Boolean expression using K-map:
 $F(A, B, C, D) = m_1 + m_2 + m_3 + m_4 + m_5 + m_6 + m_7 + m_9 + m_{11} + m_{12} + m_{13} + m_{14} + m_{15}$ (S)
15. Using K-maps, simplify the expression $F(W, X, Y, Z) = m_1 + m_3 + m_5 + m_6 + m_7 + m_9 + m_{11} + m_{13}$ (S)
16. Simplify the following Boolean expression using K-map :
 $F(A, B, C, D) = \bar{A}\bar{B}CD + \bar{A}BCD + ABCD + A\bar{B}CD + AB\bar{C}D + ABCD + ABC\bar{D}$ (S)
17. Given the Boolean function $F(W, X, Y, Z) = \sum(0, 1, 2, 3, 5, 7, 8, 9, 10, 11, 13, 15)$. Reduce it by using
Karnaugh map. (S)
18. Given the Boolean function $F(W, X, Y, Z) = \sum(0, 1, 2, 3, 4, 6, 8, 10, 12, 14)$. Reduce it by using K-map. (S)
19. Given the Boolean function $F(A, B, C, D) = \sum(1, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15)$. Reduce it by using
Karnaugh map. (S)
20. Given the Boolean function $F(W, X, Y, Z) = \sum(0, 2, 3, 4, 7, 8, 11, 12)$
Reduce it by using Karnaugh map. (S)
21. Simplify the Boolean expression using K-map:
 $F(A, B, C, D) = m_1 + m_3 + m_4 + m_5 + m_7 + m_8 + m_9 + m_{14} + m_{15}$ (S)
22. Simplify the Boolean expression using K-map:
 $F(W, X, Y, Z) = m_0 + m_2 + m_5 + m_7 + m_8 + m_{10} + m_{13} + m_{15}$ (S)
23. Given Boolean function $F(A, B, C, D) = \pi(0, 2, 4, 6, 8, 10, 14)$ use K-map to reduce the function F. (S)
24. Simplify the Boolean function using K-map: $F(W, X, Y, Z) = \pi(0, 1, 3, 4, 5, 6, 7, 9, 10, 11, 13, 14, 15)$ (S)
25. Simplify the Boolean expression using K-map: $F(W, X, Y, Z) = \pi(0, 2, 4, 6, 8, 10, 12, 14)$ (S)