Boolean Algebra - III

Comprehensive Course on Digital Logic Design 2023/2024

B V Reddy • Lesson 3 • Oct 22, 2022

DIGITAL LOGIC DISIGN

(CS IT)

DIGITAL LOGIC DESIGN

Syllabus

1.Basics
- Boolean Algebra
- Logic Gates
- K-Map
- Number Systems

2. Combinational Circuits
- Arithmetic Circuits
- Multiplexer and De- multiplexer
- Decoder and Encoder
- Comparator
- Code Converter
- Parity Generator and Checkers

3. Sequential Circuits
- Flip Flops
- Registers
- Counter's
- State Machines

UNIQUE WAY OF TEACHING

- BUILIDING THE STRONG CONCEPT
- SOLVING BASIC PROBLEM TO MAKE MORE STRONG IN CONCEPTS
- SOLVING PRVIOUS GATE and ESE PROBLEMS

Preparation Strategy

1. Class notes
2. Previous paper of GATE
    - ECE
    - EEE
    - IN
    - CS
3. Previous Papers of ESE
    - ECE
    - EEE

Preparation Strategy

1. Class notes
2. Previous paper of GATE
   - ECE
   - EEE
   - IN
   - CS
3. Previous Papers of ESE
   - ECE
   - EEE

Things I will provide

1. Complete Notes
2. Short Notes
3. DPPs with all PYQs
4. My Contact No :

SOLVE ALL THE DPPs

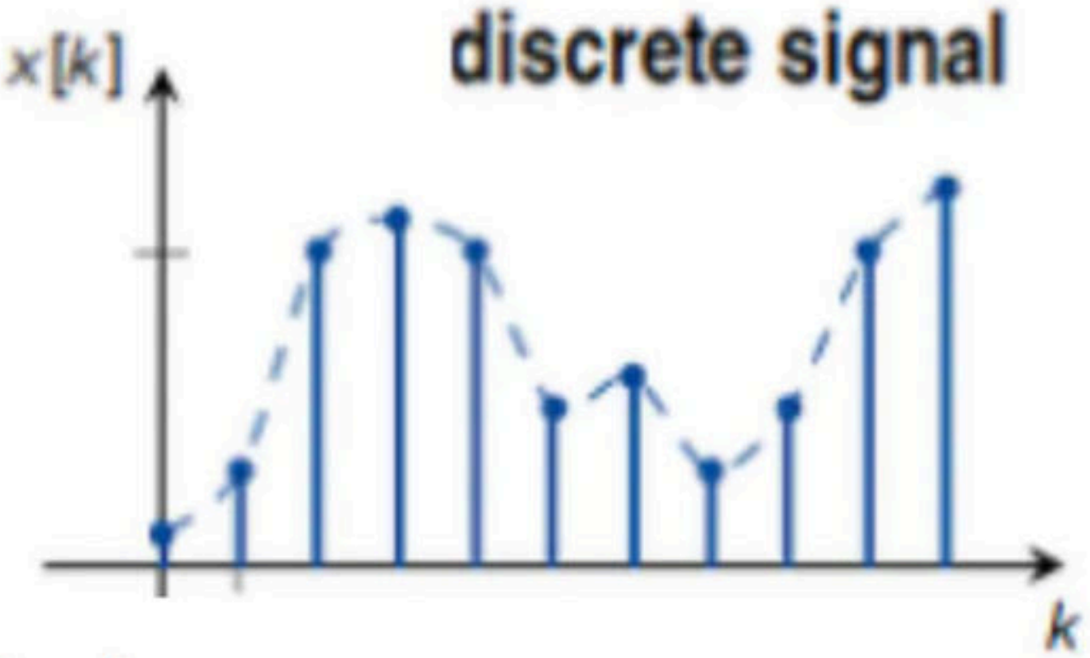
Analog Signal :

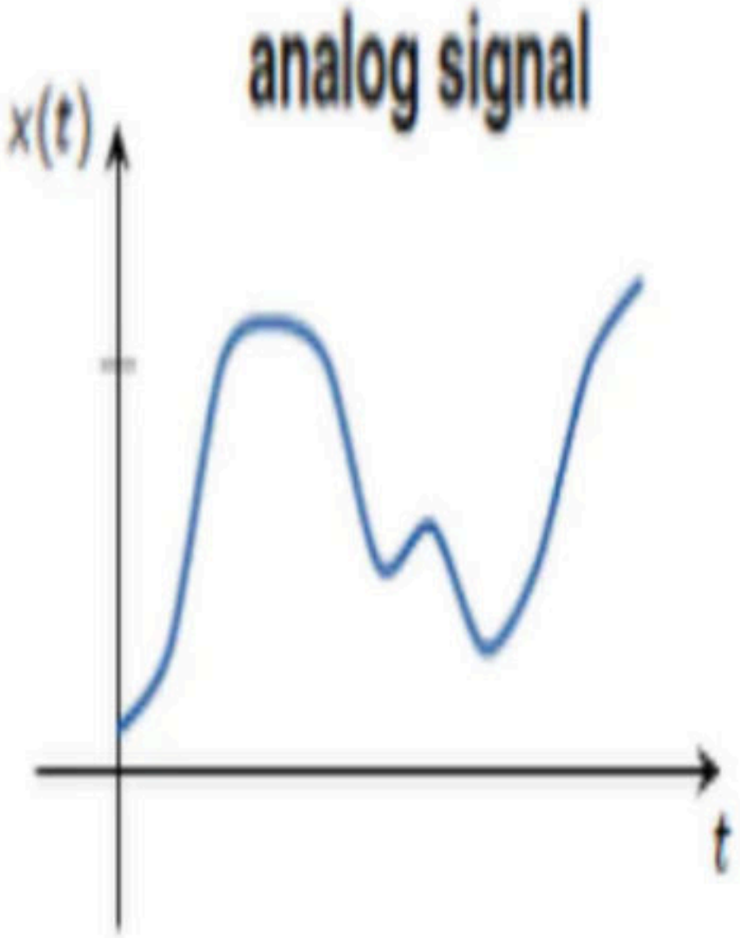
If the signal amplitude can take infinite number of possibilities then it is called as analog signal .

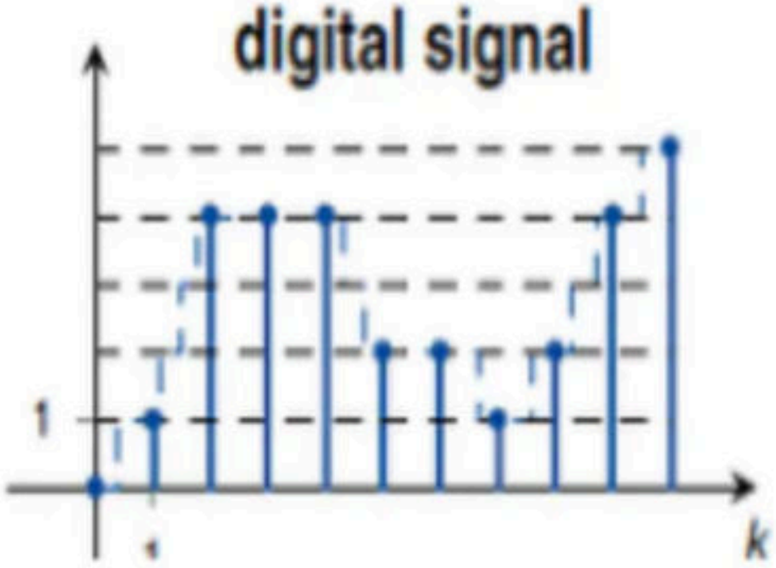
Digital Signal :

If the signal amplitude can take only finite number of possibilities, then it is called as Digital signal .

Amplitude	Time	Signal
Continuous	Continuous	Analog signal
Continuous	Discrete	Discrete signal
Discrete	Discrete	Digital signal







- If the digital signals takes only two possible amplitudes , then it is called as **Binary Digital Signal**
- The system which process the analog signals is called as analog system .
- The system which process the digital signals is called as digital system .

Logic Systems

1. Positive logic system

High voltage corresponds to logic “ 1”

+5V ---->

0V ---->

Positive logic system

Positive logic system

Logic Systems

2. Negative logic system

High voltage corresponds to logic “ 0”

+5V ---->

0V ---->

Negative logic system

Negative logic system

A	B	Y

Positive Logic System

A	B	Y

Negative Logic System

A	B	Y

Duality

- A positive logic system is converted into negative logic system by using the concept of duality .

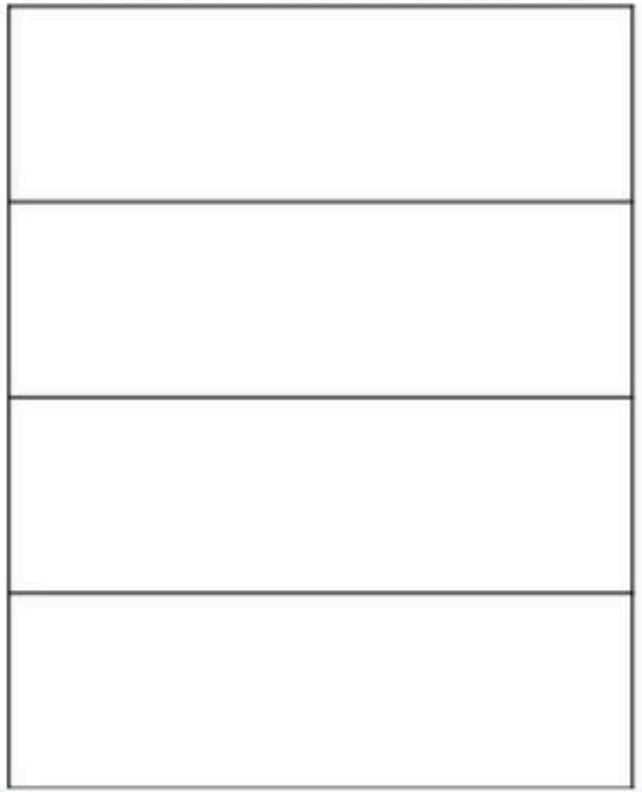
Q. Find the Dual of the expression f = AB+C

Q. Find the Dual of the expression $f = A(B+C)$

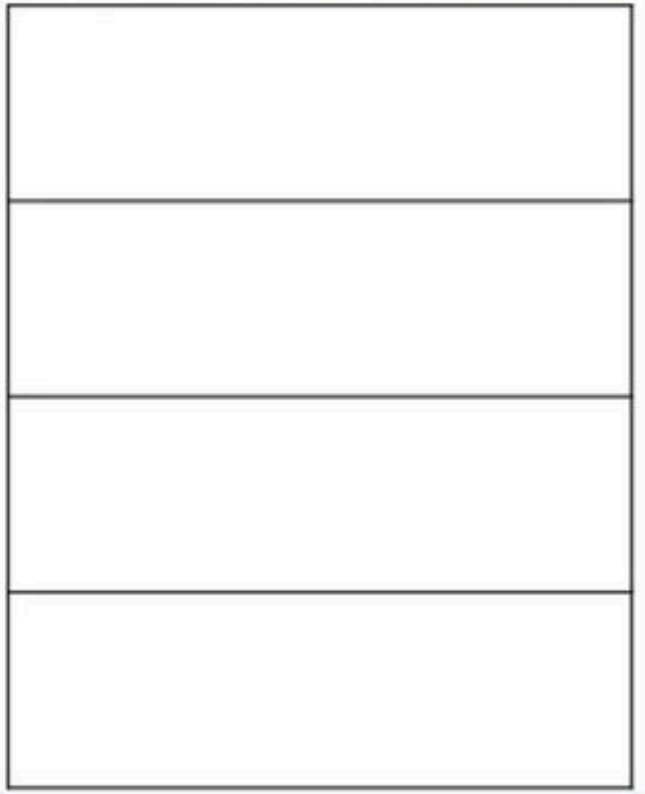
Boolean Algebra

- It is an analysis tool that is used for analyzing and designing of various digital system .
- The *i/p vs o/p* relationship in digital system is known as logic expression.

OR -Operation



AND-Operation



Practice Questions
Day - 1

1 The dual of a Boolean theorem is obtained by

(a) interchanging all zeros and ones only (b) changing all zeros to ones only

(c) changing all ones to zeros only d) interchanging operators and identity elements

2. In Boolean Algebra `1' is called

(a) Additive identity (b) Multiplicative identity (c) Either 1 or 2 (d) None

3. In Boolean Algebra `0' is called

(a) Additive identity (b) Multiplicative identity (c) Both 1 and 2 (d) None

4] What is dual of A+[B+(AC)] + D

(a) A+[B(A+C)] + D

(b) A[B+AC] D

(c) A+[B(A+C)] D

(d) A[B(A+C)] D

5. In the following equations the equals sign means is equal to Which of the following is a positive logic?

(a) 0 = 0 V and 1 = +5 V

(b) 0 = 0 V and 1 = -5 V

(c) 0 = +5 V and 1 = 0 V

(d) None of these

6. The dual of Boolean theorem $x(y+z) = xy+xz$ is

(a) $x + yz = xy + xz$ (b) $x(y+z) = (x+y)(x+z)$ (c) $x+yz = (x+y)(x+z)$ (d) None

7. Given Boolean theorem AB+A'C+BC = AB+A'C which of the following is true?

(a) (A+B)(A'+C)(B+C) = (A+B)(A'+C)

(b) AB+A' C+BC = AB+BC

(c) AB+A' C+BC = (A+B)(A'+C)(B+C)

(d) (A+B)(A'+C)(B+C) = AB+A' C

8. The voltage levels for positive logic system

a) must necessarily be positive

(b) must necessarily be negative

(c) may be positive or negative

(d) must necessarily be 0 V and 5 V

9. The voltage levels for negative logic system

(a) must necessarily be negative
(b) must necessarily be positive
(c) need not be negative
(d) must necessarily be 0 V and –5 V

10. **The dual of a Boolean expression is obtained by**

(a) interchanging all 0s and 1s

(b) interchanging all 0s and 1s, all + and '·' signs

(c) interchanging all 0s and 1s, all + and '·' signs and complementing all the variables

(d) interchanging all + and '·' signs and complementing all the variables

11. which one of the following is the dual form of the Boolean identity?

$\overline{A}B + \overline{A}C = (A+C)(\overline{A}+B)$?

(a) $AB + \overline{A}C = AC + \overline{A}B$

(b) $(A+B) + (A+C) = (A+C)(A+B)$

(c) $(\overline{A}+B)(\overline{A}+C) = AC + \overline{A}B$

(d) $AB + \overline{A}C = AB + \overline{A}C + BC$

12. The Boolean theorem:

$AB + \overline{A}C + BC = AB + \overline{A}C$ corresponds to

(a) $(A+B).(\overline{A}+C).(B+C) = (A+B).(\overline{A}+C)$

(b) $AB+\overline{A}C+BC = AB+BC$

(c) $AB+\overline{A}C+BC = AB+BC$

(d) $(A+B).(\overline{A}+C).(B+C) = (AB).(\overline{A}C)$

13. Given Boolean theorem, $AB+\overline{A}C+BC = AB+\overline{A}C$. Which one of the following identities is true?

(a) $(A+B)(\overline{A}+C)(B+C) = (A+B)(\overline{A}+C)$

(b) $(AB + \overline{A}C + BC) = AB+BC$

(c) $AB+\overline{A}C+BC = (A+B)(\overline{A}+C)(B+C)$

(d) $(A+B)(\overline{A} + C)(B+C) = AB + \overline{A}C$

14. $AB + \overline{A}C = (A + C)(\overline{A} + B)$ Which one of the following is the dual form of the Boolean identity given above?

(a) $AB + \overline{A}C = AC + \overline{A}B$

(b) $(A + B)(\overline{A} + C) = (A + C)(\overline{A} + B)$

(c) $(A + B)(\overline{A} + C) = AC + \overline{A}\,B$

(d) $AB + \overline{A}C = AB + \overline{A}C + BC$

15. If A and B are Boolean variables, then what is $(A + B).(A + \overline{B})$ equal to?

(a) B

(b) A

(c) A + B

(d) AB

Laws of Boolean Algebra

1. Commutative Law

2. Associative Law

3.Distributive Law

4. De Morgan's Law

5. Transposition theorem (T- 1)

6. Transposition theorem (T- 2)

Problems

Q) Minimize the following

$$(x + y)(x + \overline{y})(\overline{x} + y)$$

Q) Minimize the following

$$(x + y + z)(x + y + \overline{z})$$

Q) Minimize the following

$$(\overline{A} + B)(\overline{A} + \overline{B})$$

Q) Minimize the following

$$A + \overline{A}B =$$

Q) Minimize the following

$$A + \overline{A}\,\overline{B}$$

Q) Minimize the following

$\overline{A} + AB$

Q) Minimize the following

$$\overline{A} + A\overline{B}$$

Q. Find the complement of the expression $f = AB+C$

Q. Find the complement of the expression $f = A(B+C)$

Q. Find the complement of the expression f = $a[b + z(x + \bar{a})]$

Q. Find the complement of the expression f = $a(b + c) + \bar{a}b$

Consensus Theorem (Rajinikanth Wala)

Q) Minimize the following

$$\overline{A}B + AC + BC$$

Q) Minimize the following

$$A\overline{B} + AC + BC$$

Q) Minimize the following

$$AB + AC + B\overline{C} =$$

Q) Minimize the following

$$(A + B)(\overline{A} + C)(B + C)$$

Q) Minimize the following

$$(A + B)(A + C)(B + \overline{C})$$

Q) Minimize the following

$$\bar{A}\bar{B} + \bar{B}\bar{C} + \bar{C}A$$

Q) Minimize the following

$$AB + \bar{A}CD + BCD$$

Q) Minimize the following

$$AB + \bar{A}CD + BCD$$

Q) Minimize the following

$$ABC + \bar{A}D + \bar{B}D + CD$$

Q) If $X^* Y = \overline{XY}$, then the minimized expression of $\left[\left((x+y)*y\right)*z\right]$ *is* ..

Q) If f(A, B) = $\bar{A} + B$, then the simplified expression of

$f[(f(x+y, y)), z]$ is ……..

Q) Minimize the following Boolean expression $(A + B + C)(A + B + \bar{C})(A + \bar{B} + C)$

Q) Minimize the following Boolean expression

$$\mathbf{F} = \boldsymbol{xy} + \overline{\boldsymbol{x}}\overline{\boldsymbol{y}}\boldsymbol{wz}$$

Q) Minimize the following Boolean expression $v + \bar{v}w + \bar{v}\bar{w}x + \bar{v}\bar{w}\bar{x}g$

Q) Minimize the following Boolean expression $A + \bar{A}B + \bar{A}\bar{B}C + \bar{A}\bar{B}\bar{C}D$

Q) Minimize the Boolean expression

$$F = \bar{A}B + \bar{B}C + \bar{C}A + \bar{B}A + AC + B + \bar{C}$$

Practice Questions
Day - 2

16. Which of the following Boolean Algebra rules is correct?

(a) $A.\overline{A} = 1$

(b) $A + AB = A + B$

(c) $A + \overline{A}\ B = A + B$

(d) $A\,(A + B) = B$

17. The Boolean equation $X = [(A + \overline{B})(B + C)]\ B$ can be simplified to

(a) $X = \overline{A}\ B$

(b) $X = A\ \overline{B}$

(c) $X = A\ B$

(d) $X = \overline{A}\ \overline{B}$

18. Logic function $(\overline{A}+B)(A+B)$ can be reduced to:

(a) B
(b) $\overline{B}$
(c) A
(d) $\overline{A}$

19. The simplified form of the Boolean expression $AB + A(B + C) + B(B + C)$ is given by

(a) $AB + AC$

(b) $B + AC$

(c) $BC + AC$

(d) $AB + C$

20. The expression $(X+Y)\,(X+\overline{Y})\,(\overline{X}+Y)$ is equivalent to

(a) $\overline{X}\,\overline{Y}$ (b) $\overline{X}\,Y$

(c) $X\overline{Y}$ (d) XY

21. In Boolean algebra if $F=(A+B)(\overline{A}+C)$ then

(a) $F = AB+\overline{A}C$

(b) $F = AB+\overline{A}\,\overline{B}$

(c) $F = AC+\overline{A}\,B$

(d) $F = A\overline{A}+\overline{A}\,B$

22. Which of the following expression is not correct?

(a) $X+\overline{X}Y = X$

(b) $X.(\overline{X} + Y) = XY$

(c) $X+X\overline{Y}=X$

(d) $ZX+Z\overline{X}Y = ZX+ZY$

23. What is the simplified form of the Boolean expression $T=(X+Y)\ (X+\overline{Y})(\overline{X}+Y)$

(a) $\overline{X}\,\overline{Y}$ (b) $\overline{X}\,Y$

(c) XY (d) $X\overline{Y}$

24. $(A' + B' + C')'$ is equal to

(a) A' B' C' (b) ABC (c) A+B+C (d) A'+B'+C'

25. The Boolean expression $(x+y)(x+z)$ is equal to

(a) $x+z$ (b) $x+y$ (c) $x+yz$ (d) $y+xz$

26. **Expression**

$$A + \bar{A}B + \bar{A}\bar{B}C + \bar{A}\,\bar{B}\,\bar{C}D + \bar{A}\,\bar{B}\,\bar{C}\,\bar{D}E$$

would be simplified to

(a) $A + \bar{A}B + CD + E$

(b) $A + B + CDE$

(c) $A + BC + CD + DE$

(d) $A + B + C + D + E$

27. **If $X\overline{Y} + \overline{X}Y = Z$ then $X\overline{Z} + \overline{X}Z$ is equal to**

(a) $\overline{Y}$ (b) Y (c) 0 (d) 1

28. **If A = 0 in logic expression**

$Z = [A + EF + \bar{B}C + D].[A + \bar{D}\bar{E} + \bar{B}C + \bar{D}\bar{F}]$, then

(a) Z = 0

(b) Z = 1

(c) $Z = \bar{B}C$

(d) $Z = B\bar{C}$

29. **What does the expression AD + ABCD + ACD + $\bar{A}B$ + $A\bar{C}D$ + $\bar{A}\bar{B}$ on minimization result into?**

(a) A + D (b) $AD + \bar{A}$ (c) AD (d) $\bar{A} + D$

30. **A + AB +ABC +ABCD + ABCDE + ... =**

(a) 1 (b) A (c) A + AB (d) AB

Boolean function representation

1. Canonical form

2.Minimal Form

Boolean function representation

Canonical form : Each minterm (maxterms) contains all the Boolean variables

F(A, B,C)=

F(A, B, C) =

Minimal Form : The minimized form of Boolean expression

F(A, B,C)=

F(A, B, C) =

Literal : A Boolean variable either in normal form (or) complemented form is known as literal

Minterm : Each term in canonical SOP representation is known as minterm

Maxterm: Each term in canonical POS representation is known as maxterm

With **n- variable** number of possible input combinations =

A	B	C	Y

Sum of Product (SOP)

Product of Sum (POS)

A	B	C	Y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

$$y(A,B,C) = \Sigma m(1,2,3,6,7)$$

$$y(A,B,C) = \pi M(0,4,5)$$

n	2^n
$n = 3$	
$2^3 = 8$	

Note :

1. Maximum possible minterms = 2^n

2. Maximum possible maxterms = 2^n

3. Number of minterm's + number of maxterm's = 2^n

4. The sum of all maximum possible minterms =

A	B	y
0	0	1
0	1	1
1	0	1
1	1	1

$$y = \overline{A}\,\overline{B} + \overline{A}B + A\overline{B} + AB$$

$$y = \overline{A} + A$$

$$y = 1$$

$$\sum_{i=0}^{3} m_i = 1$$

$$\sum_{i=0}^{4-1} m_i = 1$$

$$\sum_{i=0}^{2^n-1} m_i = 1$$

5. The product of all maximum possible maxterms =

A	B	y
0	0	0
0	1	0
1	0	0
1	1	0

$y = M_0 M_1 M_2 M_3$

$y = (A+B)(A+\bar{B})(\bar{A}+B)(\bar{A}+\bar{B})$

$y = (A+0)(\bar{A}+0)$

$y = 0$

$$\prod_{i=0}^{3} M_i = 0$$

$$\prod_{i=0}^{4-1} M_i = 0$$

$$\prod_{i=0}^{2^n-1} M_i = 0$$

6. Minterm's and maxterm's are of same index are complement to each other

$n=3$

$m_5 = A\bar{B}C$

$M_5 = \bar{A}+B+\bar{C}$

$\overline{m_5} = \overline{A\bar{B}C}$

$\overline{m_i} = M_i$

$\overline{m_5} = \bar{A}+B+\bar{C}$

$\overline{M_i} = m_i$

$\boxed{\overline{m_5} = M_5}$

7. The product of two minterms of different index is .....

$n=3$

$$m_3 \cdot m_6 = (\bar{A}BC)(A B \bar{C}) = 0$$

$$m_3 m_3 = (\bar{A}BC)(\bar{A}BC) = \bar{A}BC = m_3$$

$$m_i \cdot m_j = m_i \qquad i = j$$

$$= 0 \qquad i \neq j$$

8. The sum of two arbitrary maxterms of different index is ……..

$n=3$

$M_2 + M_5 = (A+\overline{B}+C) + (\overline{A}+B+\overline{C})$

$2 = 010$

$= 1 + 1 + 1 = 1$

$5 = 101$

$M_2 + M_2 = M_2$

$$M_i + M_j = M_i \quad i = j$$

$$= 1 \quad i \neq j$$

Q) Find the Minterms and Maxterms of the following

$$f(A,B,C) = AB + \bar{A}BC + C$$

SOP → minterms.

$f(A,B,C) = AB\underline{1} + \bar{A}BC + \underline{1}\,\underline{1}\,C$

$= AB(C+\bar{C}) + \bar{A}BC + (A+\bar{A})(B+\bar{B})C.$

$f(A,B,C) = \underline{ABC} + AB\bar{C} + \underline{\bar{A}BC} + \underline{ABC} + A\bar{B}C + \bar{A}BC + \bar{A}\bar{B}C$

$f(A,B,C) = \underset{111}{ABC} + \underset{110}{AB\bar{C}} + \underset{011}{\bar{A}BC} + \underset{101}{A\bar{B}C} + \underset{001}{\bar{A}\bar{B}C}$

$f(A,B,C) = \sum m(1, 3, 5, 6, 7)$

$$f = \pi M(0, 2, 4)$$

$$f(A, B, C) = AB\underline{1} + \bar{A}BC + \underline{1}\,\underline{1}\,C$$

6	1	1	0	0	1	1	
7	1	1	1	3	0	1	1	3
					1	0	1	5
					1	1	1	7

$$f(A, B, C) = \Sigma m(1, 3, 5, 6, 7)$$

$$f(A, B, C) = \pi M(0, 2, 4)$$

Q) Find the Minterms and Maxterms of the following

$$f(A,B,C) = (B+C)(\bar{A})(\bar{A}+\bar{B}+C)$$

	B+C	$\bar{A}$	–	–	$\bar{A}+\bar{B}+C$
0	0	0	0		1 1 0 6
4	1	0	0		
		1	0	0 4	
		1	0	1 5	
		1	1	0 6	
		1	1	1 7	

$$f = \pi M(0, 4, 5, 6, 7)$$

$$f = \Sigma m(1, 2, 3)$$

POS

↓

maxterms

↓

minterms.

Q) Find the Minterms and Maxterms of the following

$$f(A,B,C) = \bar{A}B + A\bar{C} + B + ABC$$

$\bar{A}B$_		A_$\bar{C}$		_ B _		ABC.	
0	1 0	1 0 0	4	0 1 0	2	1 1 1.	7
0	1 1	1 1 0	6	0 1 1	3		
				1 1 0	6		
				1 1 1	7		

$$f(A,B,C) = \Sigma m(2,3,4,6,7)$$

$$f(A,B,C) = \pi M(0,1,5)$$

Q) Find the Minterns and Maxterms of the following

$$f(A,B,C) = A + B + C$$

A _ _		_ B _		_ _ C	
4	1 0 0	0 1 0	2	0 0 1	1
5	1 0 1	0 1 1	3	0 1 1	3
6	1 1 0	1 1 0	6	1 0 1	5
7	1 1 1	1 1 1	7	1 1 1	7

$f(A,B,C) = \sum m(1,2,3,4,5,6,7)$

$f(A,B,C) = \pi M(0)$

$f(A,B,C) = (A+B+C)$
0 0 0

$f(A,B,C) = \pi M(0)$

$f(A,B,C) = \sum m(1,2,3,4,5,6,7)$

Q) Find the Minterms and Maxterms of the following

$$f(A,B,C) = A + B + \bar{A}B + C$$

$$f(A,B,C) = A + B(1+\bar{A}) + C$$

$$f(A,B,C) = A + B + C \longrightarrow \text{POS}$$

$$f(A,B,C) = \pi M(0)$$

$$f(A,B,C) = \Sigma m(1,2,3,4,5,6,7)$$

Q) Find the Minterms and Maxterms of the following

$$f(A,B,C,D) = AB + \bar{A}BC + B\bar{C}$$

$AB--$	$\bar{A}BC-$	$-B\bar{C}-$
(12) 1100	0110 (6)	0100 (4)
(13) 1101	0111 (7)	0101 (5)
(14) 1110		1100 (12)
(15) 1111		1101 13.

$$f(A,B,C,D) = \Sigma m(4,5,6,7,12,13,14,15)$$

$$f(A,B,C,D) = \pi M(0,1,2,3,8,9,10,11)$$

Q) Find the Minterms and Maxterms of the following

$$f(A,B,C) = B + \bar{A}BC + \bar{A}\bar{C}$$

$-B-$				$\bar{A}BC$				$\bar{A}-\bar{C}$			
0	1	0	(2)	0	1	1	(3)	0	0	0	(0)
0	1	1	(3)					0	1	0	(2)
1	1	0	(6)								
1	1	1	(7)								

$$f(A,B,C) = \Sigma m(0,2,3,6,7)$$

$$f(A,B,C) = \pi M(1,4,5)$$

Q) Find the Minterms and Maxterms of the following

$$f(A,B,C) = (\overline{B} + \overline{C})(\overline{A} + \overline{B})(A + B + C)$$ (A)

POS

	$\overline{B}+\overline{C}$	$\overline{A}+\overline{B}$	$A+B+C$	
	—	—		
3	0 1 1	1 1 0 6	0 0 0 0	0 0 0 0
7	1 1 1	1 1 1 7		0 0 1 1
				0 1 0 2
				0 1 1 3

$$f(A,B,C) = \pi M\,(0, 1, 2, 3, 6, 7)$$

$$f(A, B, C) = \Sigma m\,(4, 5)$$

Q. Find minterms and maxterms of the logic expression F (P, Q, R)= $\bar{P} + QR$

	$\bar{P}$					
	–			–	Q	R
0	0	0	0	0	1	1	3
1	0	0	1	1	1	1	7.
2	0	1	0				
3	0	1	1				

$f(P, Q, R) = \Sigma m(0, 1, 2, 3, 7)$

$f(P, Q, R) = \pi M\ (4, 5, 6)$

Q. f(P ,Q ,R, S) = PQ+$\bar{P}QR + \bar{P}Q\bar{R}S$, the function is equivalent to

a) $PQ+QR+QS$
b) $P + Q + R + S$
c) $\bar{P} + \bar{Q} + \bar{R} + \bar{S}$
d) $\bar{P}R + \bar{P}\bar{R}S + P$

$f = PQ + QR + QS$

$f = PQ + \bar{P}Q[R + \bar{R}S]$

$f = PQ + \bar{P}Q[R + S]$

$f = PQ + \bar{P}QR + \bar{P}QS + PQ$

$f = Q[P + \bar{P}R] + Q[P + \bar{P}S]$

$f = Q[P + R] + Q[P + S]$

$f = PQ + QR + \underline{PQ} + QS$

Q) $f_1(A,B,C) = \sum m(2,3,6)$ **and**
$f_2(A,B,C) = \sum m(1,2,5,7)$
Then $f_3 = f_1 f_2$ $\quad$ $f_4 = f_1 + f_2$

$m_i m_j = m_i \quad i = j$

$= 0 \quad i \neq j$

$f_1 = \Sigma m(2,3,6)$

$f_2 = \Sigma m(1,2,5,7)$

$A \cap B = AB$

$A \cup B = A + B$

$f_3 = f_1 f_2 = \Sigma m(2,)$

$f_4 = f_1 + f_2 = \Sigma m(1,2,3,5,6,7)$

Q) Find the Minterms $\bar{f}$

$$f(A,B,C) = AB + \bar{A}BC + C$$

$$f(A,B,C) = \Sigma m(1,3,5,6,7)$$

$$f(A,B,C) = \pi M(0,2,4)$$

$$\overline{f(A,B,C)} = \Sigma m(0,2,4)$$

Note :

1. minterms of $\overline{f}$ = maxterms of f

2. maxterm of $\overline{f}$ = minterms of f

Q. $f_1(A,B,C) = \pi M(1,2,3,6)$

$f_2(A,B,C) = \Sigma m(1,2,5,7)$

then find

$f_3 = f_1 f_2$

$f_4 = f_1 + f_2$.

Sol

$f_1(A,B,C) = \Sigma m(0,4,5,7)$

$f_2(A,B,C) = \Sigma m(1,2,5,7)$

$f_3(A,B,C) = \Sigma m(5,7)$

$f_4 = \Sigma m(0,1,2,4,5,7)$

Q) Using two Boolean Variables , how many different Boolean functions are possible

A	B	f_0	f_1	f_2	f_3	f_4	f_5	f_6	f_7	f_8	f_9	f_{10}	f_{11}	f_{12}	f_{13}	f_{14}	f_{15}
0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
0	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
1	0	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

$2^{2^4} = 2^{2^2} = 16$

$n=3$

$2^{2^3} = 256$

2^{2^n}

1. By using 2- Boolean variables

total number of possible Boolean functions = 16

2. By using n- Boolean variables

total number of possible Boolean functions = 2^{2^n}

3.By using 2- Boolean variables total number of possible Boolean functions having at most 3- minterms =

4. By using 2- Boolean variables total number of possible Boolean functions having at most 3- maxterms =

5. By using 2- Boolean variables total number of possible Boolean functions having
   3- minterms =

6. By using n- Boolean variables total number of possible Boolean functions having
   2- minterms =

7. By using 5- Boolean variables total number of possible Boolean functions having at most
   3- minterms =

Q) Y (A,B,C) = $\sum m(1,4,6,7)$ identify the correct statements

1. Y= $m_1 + m_4 + m_6 + m_7$

2. Y= $M_0 M_2 M_3 M_5$

3. Y= $\overline{m_0 + m_2 + m_3 + m_5}$

4. Y= $\overline{M_1 M_4 M_6 M_7}$

5. Y= $\overline{m_0}\ \overline{m_2}\ \overline{m_3}\ \overline{m_5}$

6. Y= $\overline{M_1} + \overline{M_4} + \overline{M_6} + \overline{M_7}$

7. Y= $m_0 m_2 m_3 m_5$

8. Y= $M_1 + M_4 + M_6 + M_7$

9. Y= $\overline{m_1 m_4 m_6 m_7}$

10. Y= $\overline{M_0 + M_2 + M_3 + M_5}$

Q. If $A^* B = AB + \bar{A}\bar{B}$, let $C = A^* B$, then which of the following is correct .

a) $B * C = A$
b) $A*C = B$
c) $A*B*C = 1$
d) $A^* B = B^* A$

Neutral Function

If the number of minterms and number of maxterms are equal , then the Boolean function is called as neutral function.

Mutually Exclusive terms

Self Dual Expression

Self Dual Expression

If one time dual of the Boolean expression result the same expression , then it is called as self dual expression

$$f = AB+BC+AC$$

Conditions for the given expression is Self Dual

1. The given Boolean function must be Neutral function

i.e The number of minterms = number of maxterms

number of minterms+ number of maxterms =

number of minterms = number of maxterms =

2. It should not contains mutually exclusive terms

i.e If m_i belongs to f , then m_{2^n-i-1} should not belongs to f

Q) Verify the given Boolean functions are self dual or not

$f(A,B,C) = AB + BC + CA$

Q) Verify the given Boolean functions are self dual or not

$f(A,B,C) = m(1, 2, 4, 7)$

Q) Verify the given Boolean functions are self dual or not

$f(A,B,C) = m(0,1,2,5)$

Note:

1.Number of Boolean functions =

2.Maximum Number of minterms =

3.Maximum Number of maxterms =

4.Number of Neutral functions =

5.Number of self dual expressions =

Q) A logic circuit have 3 inputs A , B , C and output Y . Output Y is logic 1 for the following

1. A and C are true
2. B and C are false
3. A, B and C are true
4. A, B and C are false

then the minimized expression Y is---------

Q) A logic circuit have 3 inputs A , B and C . Output is F . F is logic 1 when majority number of inputs are at logic 1, then the minimized expression for F is

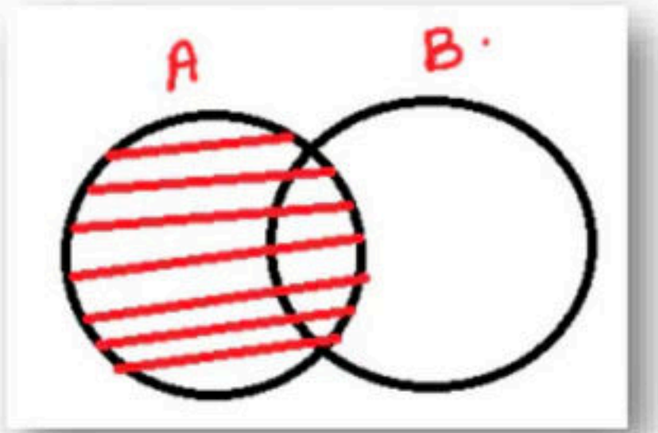
Q) A logic circuit have 3 inputs A , B and C . Output is F . F is logic 1 when minority number of inputs are at logic 1, then the minimized expression for F is

Q. A car alarm system is designed considering 4 inputs, Door closed (D) Key in (K), Seat pressure (S) and Seat belt closed (B). The alarm (A) should sound if

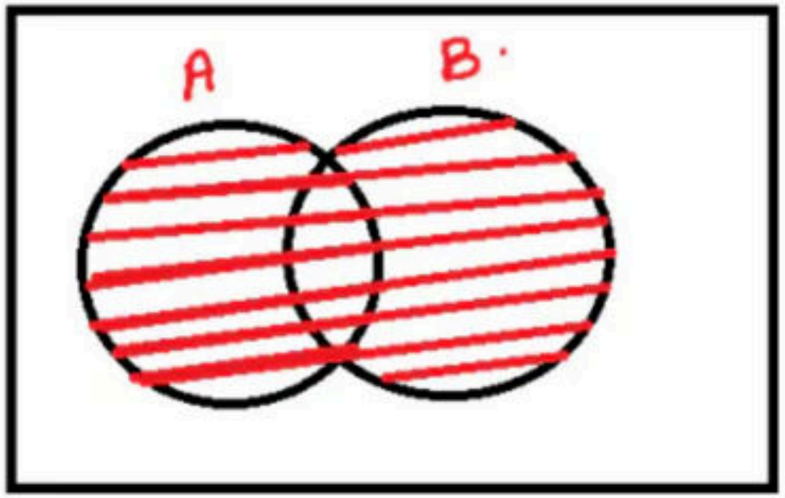
1. The key is in and door is not closed (or)
2. The door is closed, the key is in, driver in the seat and seat belt is not closed.

Then the minimized expression is

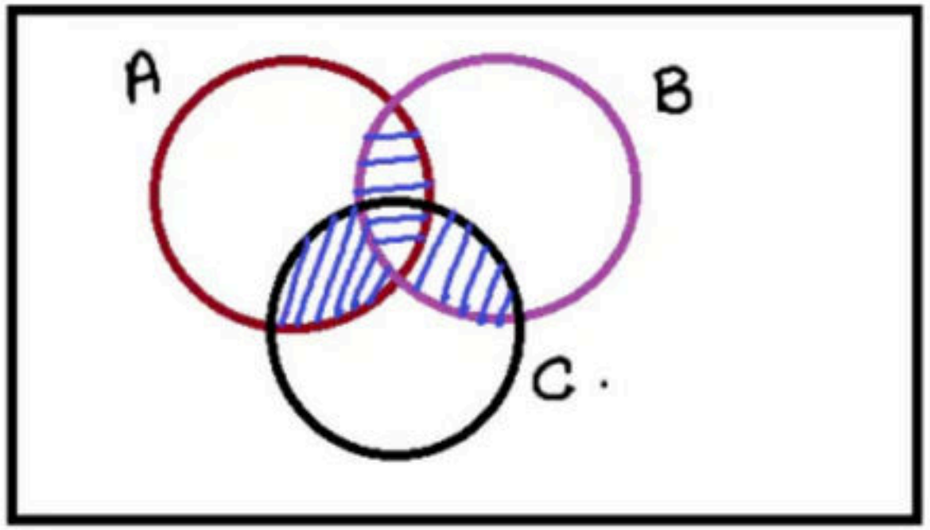
Q) For the given venn diagrams , find the minimized logical expression



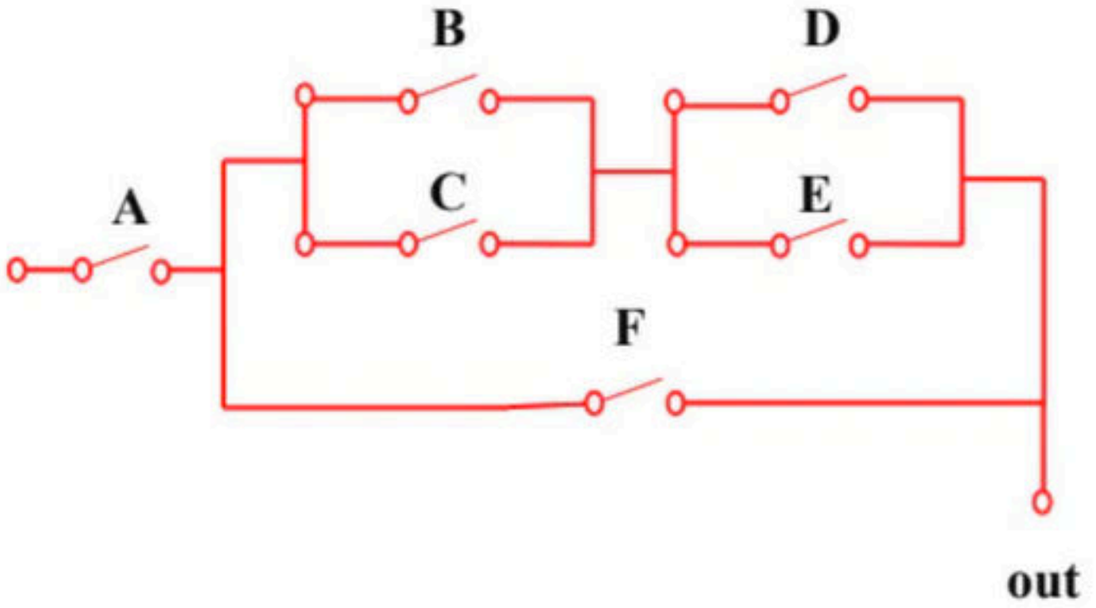
Q) For the given venn diagrams , find the minimized logical expression



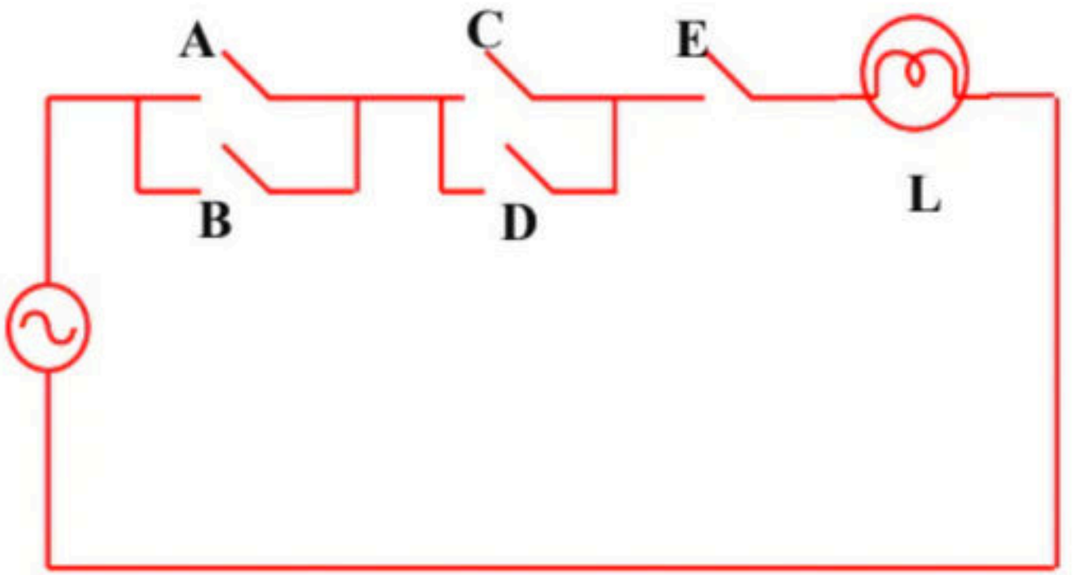
Q) For the given venn diagrams , find the minimized logical expression



Q. What Boolean function does the following circuit represents:



Q. The switching circuit given in the figure can be expressed in binary logic notation as



Q. How many Boolean functions of the type $f(x, y) = f(\bar{x}, \bar{y})$ are available with three variables

a) 4 b)15 c)3 d)16

Q. How many Boolean functions of the type $f(x, y, z) = f(\bar{x}, \bar{y}, \bar{z})$ are available with three variables

a) 4 b)15 c)32 d)16