$F = \bar{A}\bar{B}\bar{D}\bar{E} + \bar{A}C\bar{D} + B\bar{C}\bar{D} + BCDE + A\bar{B}\bar{D}E + AB\bar{C}E + \bar{A}\bar{B}\bar{C}\bar{E}$

TABULATION METHOD

(Quine Mckluskey Method)

[consider the highest number
→ convert into binary
→ group with no of one
→ dont care symbol

Q.

Total 6 groups

	A	B	C	D	E		(—) Iteration-1
0	0	0	0	0	0	✓	(0,1) 0000–
1	0	0	0	0	1	✓	(0,2) 000–0
2	0	0	0	1	0	✓	(0,8) 0–000
8	0	1	0	0	0	✓	(1,9) 0–001
9	0	1	0	0	1	✓	(1,17) –0001
17	1	0	0	0	1	✓	(8,9) 0100–
24	1	1	0	0	0	✓	(8,24) –1000
21	1	0	1	0	1		(9,25) –1001 (17,21) 10–01
25	1	1	0	0	1	✓	(17,25) 1–001
							(24,25) 1100–
15	0	1	1	1	1	✓	(25,27) 11D–1
27	1	1	0	1	1	✓	(15,31) –1111
							(27,31) 11–11
31	1	1	1	1	1	✓	

Iteration-2

Iteration - 1

(0,1)	0000 (A B C D E)
(0,2)	000-0
(0,8)	0-000
(1,9)	0-001
(1,17)	-0001
(8,9)	0100-
(8,24)	-1000
(9,25)	-1001
(17,21)	10-01
(17,25)	1-001
(24,25)	1100-
(25,27)	110-1
(15,31)	-1111
(27,31)	11-11

Iteration 2

(0,1,8,9)	0--00-
(1,9,17,25)	--001
(8,9,24,25)	-100-

Prime Implicants)

(0,2) $\bar{A}\bar{B}\bar{C}\bar{E}$

(17,21) $A\bar{B}\bar{D}E$

(25,27) $A\bar{B}\bar{C}E$

(15,31) $BCDE$

(27,31) $ABDE$

(0,1,8,9) $\bar{A}\bar{C}\bar{D}$

(1,9,17,25) $\bar{C}\bar{D}E$

(8,9,24,25) $B\bar{C}\bar{D}$

P. Implicants	Minterm	0 ✓	? 1	2 ✓	8 ✓	9 ✓	15 ✓	17 ✓	21 ✓	24 ✓	25 ✓	? 27	31 ✓
$\bar{A}\bar{B}\bar{C}\bar{E}$	(0, 2) ⊙	X	*	(X)									
$A\bar{B}\bar{D}E$	(17, 21) ⊙							X	(X)				
$A\bar{B}\bar{C}E$	(25, 27)										X	X	
$BCDE$	(15, 31) ⊙						(X)						X
$ABDE$	(27, 31)											X	X
$\bar{A}\bar{C}\bar{D}$	(0, 1, 8, 9)		X	X		X	X						
$\bar{C}\bar{D}E$	(1, 9, 17, 25)			X			X		X		X		
$B\bar{C}\bar{D}$	(8, 9, 24, 25) ⊙					X	X			(X)	X		

$P = \bar{A}\bar{B}\bar{C}\bar{E} + AB\bar{D}E + BCDE + A\bar{B}\bar{C}E + \bar{A}\bar{C}\bar{D} + B\bar{C}\bar{D}$

Steps

1. Single entry from each column should be selected as essential P.I
2. They have to be marked & put a tick mark
3. Their min terms are selected and ticked [on the top]
4. The left over values are denoted as (?) [ie] 1, 27

2. $F = \sum(1, 3, 4, 5, 10, 11, 12, 13, 14, 15)$

	A	B	C	D
1	0	0	0	1
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

[Separate according to no of 1s]

	A	B	C	D
✓1	0	0	0	1
✓4	0	1	0	0
✓3	0	0	1	1
✓5	0	1	0	1
✓10	1	0	1	0
✓12	1	1	0	0
✓11	1	0	1	1
✓13	1	1	0	1
✓14	1	1	1	0
✓15	1	1	1	1

Iteration-I

	A	B	C	D
(1,3)	0	0	–	1
(1,5)	0	–	0	1
(4,5) ✓	0	1	0	–
(4,12) ✓	–	1	0	0
(3,11)	–	0	1	1
(5,13) ✓	–	1	0	1
(10,11) ✓	1	0	1	–
(10,14) ✓	1	–	1	0
(12,13) ✓	1	1	0	–
(12,14) ✓	1	1	–	0
(11,15) ✓	1	–	1	1
(13,15) ✓	1	1	–	1
(14,15) ✓	1	1	1	–

Iteration-2

	A	B	C	D
(4,5,12,13)	–	1	0	–
(4,12,5,13)	–	1	0	–
(10,11,14,15)	1	–	1	–
(10,14,11,15)	1	–	1	–
(12,13,14,15)	1	1	–	–
(12,14,13,15)	1	1	–	–

PRIME implicants.-

(4, 5, 12, 13) → $B\bar{C}$

(10, 11, 14, 15) → AC

(12, 13, 14, 15) → AB

(1, 3) ⟶ $\bar{A}\bar{B}D$

(1, 5) ⟶ $\bar{A}\bar{C}D$

(3, 11) ⟶ $\bar{B}CD$

1
3
4
5
10
11
12
13
14
15

P.I	Min term.	1	3	4 ✓	5 ✓	10 ✓	11 ✓	12 ✓	13 ✓	14 ✓	15 ✓
• $\bar{A}\bar{B}D$	(1, 3)	×	×								
$\bar{A}\bar{C}D$	(1, 5)	×			×						
$\bar{B}CD$	(3, 11)		×				×				
$B\bar{C}$	(4, 5, 12, 13) •			(×)	×			×	×		
AC	(10, 11, 14, 15) •					(×)	×			×	×
AB	(12, 13, 14, 15)							×	×	×	×

⇒ $\bar{A}\bar{B}D + B\bar{C} + AC$

27.7.11

Q. $F = (A,B,C,D) = \Sigma m(0,6,8,13,14)$

$d(A,B,C,D) = \Sigma d(2,4,10)$

Follow the same procedure for both Σ

Exclude don't care in PI table.

		Iteration-I	Iteration-II
0	0000	(0,2) 00-0 ✓	(0,2,4,6) 0--0
2	0010	(0,4) 0-00 ✓	(0,2,8,10) -0-0
4	0100	(0,8) -000 ✓	(0,4,2,6) 0--0
8	1000	(2,6) 0-10 ✓	
		(2,10) -010 ✓	(0,8,2,10) -0-0
6	0110	(4,6) 01-0 ✓	
		(8,10) 10-0 ✓	(2,6,10,14) --10
10	1010	(6,14) -110 ✓	(2,10,6,14) --10
	1101	(10,14) 1-10 ✓	
14	1110		

(Neglect the don't care terms in the table)

P.I

$(0,2,4,6) \longrightarrow \bar{A}\bar{D}$

$(0,2,8,10) \longrightarrow \bar{B}\bar{D}$

$(2,6,10,14) \longrightarrow C\bar{D}$

P.I	Minterms	0 ✓	6 ✓	8 ✓	14 ✓	13 ✓
$\bar{A}\bar{D}$	(0,2,4,6)	×	×			
• $\bar{B}\bar{D}$	(0,2,8,10)	×		×		
• $C\bar{D}$	(2,6,10,14)		×		×	
$AB\bar{C}D$	13					×

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

Tutorial on Unit-1

Do the following conversion:

1. A. convert $(27.315)_{10}$ to binary
   B. $(C3DF)_{16}$ to binary
   C. $(26.24)_8$ to decimal.
   D. $(DADA.B)_{16}$ to decimal.

2. Obtain 1's and 2's complement of the number.
   A. 11011010
   B. 1010.1101

3. e. Perform subtraction using 2's complement of the subtranant
   A. 1001 − 110101
   B. 101000 − 10101

4. Convert Perform the binary equivalent of 49 and 29 (of base 10) using signed 2's complement representation.
   Then perform
   (i) (−29) + (+49)
   (ii) (−29) + (−49)
   convert the answer back to decimal and verify the result.

5. convert the binary 1101110 to gray code.

6. Reduce the boolean expression using boolean law.
   A. $(A'+C)(A'+C')(A+B+C'D)$
   for the reduced eqn draw circuit using universal gates.

7. Express the function
$(cd + b'c + bd')(b+d)$ sum of min terms & pdt of max terms (canonical form)

8. ~~Express~~ convert A. $F(x,y,z) = \Sigma(1,3,5)$ to other canonical form.

B. $F(A,B,C,D) = \Pi(3,5,8,11)$

9. Convert :-

A. $(u+xw)(x+u'v)$ into sum of pdt and pdt of sum (standard form)

10. Reduce using k-map

A. $F(w,x,y,z) = \Sigma(2,3,12,13,14,15)$

B. $F = w'z + xz + x'y + wx'z$

C.

11. Using Tabulation method find the reduced expression

A. $F = \Sigma(1,3,4,5,10,11,12,13,14,15)$

B. $F = \Sigma(5,6,7,12,14,15)$

$d = \Sigma(3,9,11,15)$

Verify the results using k-map.

ANSWERS for Tutorial on Unit-1

1. A $(27.315)_{10} \rightarrow (11011.01010)_2$

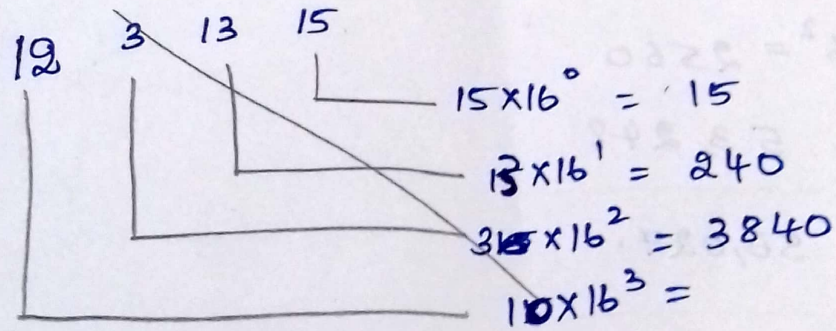
2	27
2	13 – 1
2	6 – 1
2	3 – 0
	1 – 1

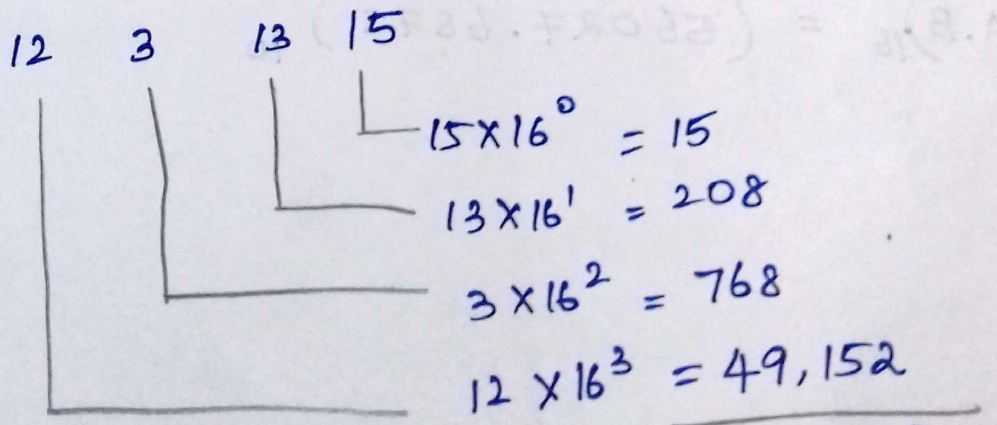
.315 X2 = 0.63
.63 X2 = 1.26
.26 X2 = 0.52
.52 X 2 = 1.04
.04 X2 = 0.08

$(27.315)_{10} \Rightarrow (11011.01010)_2$

B. $(C3DF)_{16}$ to binary.

A B C D E F
10 11 12 13 14 15





$(50143)_{10}$

(or) $(1100\ 0011\ 1101\ 1111)_2$

C. $(26.24)_8$ to decimal:

26
- $6 \times 8^0 \Rightarrow 6$
- $2 \times 8^1 \Rightarrow 16$

22

.24
- $4 \times 8^{-1} = 0.5$
- $2 \times 8^{-2} = 0.03125$

0.53125

$(26.24)_8 = (22.53125)_{10}$

D. $(DADA.B)_{16}$ to decimal:

D A D A . B

- $10 \times 16^0 = 10$
- $13 \times 16^1 = 208$
- $10 \times 16^2 = 2560$
- $13 \times 16^3 = 53,248$

$11 \times 16^{-1} = 0.6875$

56,027.

$(DADA.B)_{16} = (56027.6875)_{10}$

2. 1's & 2's complement.

A. 11011010

1's → 00100101

2's → $\begin{array}{r} 00100101 \\ +\quad\ 1 \\ \hline 00100110 \end{array}$

B. 1010.1101

1's → 0101.0010

2's → $\begin{array}{r} 0101.0010 \\ +\quad\ 1 \\ \hline 0110.0010 \end{array}$

$\begin{array}{r} 0101.0010 \\ +\quad\ 1 \\ \hline 0101.0011 \end{array}$

3. Subtraction

A. 1001 − 110101 ⇒ 2's → 001010 + 1 = 001011

$\begin{array}{r} 001001 \\ (+)\ 001011 \\ \hline 010100 \end{array}$

1+8→9

1+2+8=11

−2

B. 101000 − 10101 ⇒ 2's → 010101 + 1 = 010110

$\begin{array}{r} 10100 \\ (+)\ 01011 \\ \hline 11111 \end{array}$

$\begin{array}{r} 101000 \\ (+)\ 010110 \\ \hline 100011 \end{array}$

$\begin{array}{r} 101000 \\ -\ 10101 \\ \hline 010011 \end{array}$

32+8 = 40 − 20 = 20

(without 2's complement)

Note:

1's complement

$$r^n - r^{-m} - N$$

For 2's complement

$$r^n - N$$

Using 2's complement:

$$\begin{array}{r} 101000 \\ 2^s \rightarrow \quad 10111 \\ \hline 1010011 \end{array}$$

4. Binary equivalence of 49 & 29.

2 | 49	
2 | 24 -1	
2 | 12 -0	
2 | 6 -0	
2 | 3 -0	
1 -1	

$(49)_{10} \rightarrow (110001)_2$

2 | 29	
2 | 14 -1	
2 | 7 -0	
2 | 3 -1	
1 -1	

$(29)_{10} \rightarrow (11101)_2$

Sign Magnitude Form.

	Sign Mag.	1's	2's
49	00110001		
+49	00110001	00110001	00110001
-49	10110001	11001110	11001111
29	00011101		
+29	00011101	00011101	00011101
29	10011101	11100010	11100011

(i) (-29) + (+49)

-29 → 1 1 1 0 0 0 1 1
+49 → 0 0 1 1 0 0 0 1 (+)
c 1 0 0 0 1 0 1 0 0

49
-29
20

(ii) (-29) + (-49)

-29 → 1 1 1 0 0 0 1 1
-49 → 1 1 0 0 1 1 1 1
c 1 1 0 1 1 0 0 1 0

Verification
1 0 1 1 0 0 1 0
1's 0 0 1 0 0 1 1 0 1
2's +1
0 1 0 0 1 1 1 0

(-29) + (+49) ⇒ 20 [To verify (i)]

0 0 0 1 0 1 0 0
0 × 2^0 = 0
0 × 2^1 = 0
1 × 2^2 = 4
0 × 2^3 = 8
1 × 2^4 = 16
20

20 → (i) is Verified

(-29) + (-49) ⇒ 0 1 0 0 1 1 1 0

29
+49
78

0 × 2^0
1 × 2^1 ⇒ 2
2^2 ⇒ 4
2^3 ⇒ 8
0 × 2^4
1 × 2^6 ⇒ 64

2 + 4 + 8 + 64 = 78 → (ii) is Verified.