

Assignment - 02

EE22BTECH11025

K-1)

a) $f_1(w, x, y, z) = \sum(0, 1, 2, 3, 4, 6, 8, 9, 10, 11)$

wz	yz	00	01	11	10
00	1	1	0	0	1
01	1	0	0	0	1
11	1	0	0	1	
10	1	1	0	1	

wz	yz	00	01	11	10
00	1	1	0	0	1
01	1	0	0	0	1
11	1	0	0	0	1
10	1	1	0	1	

$$\therefore f_1(w, x, y, z) = w' + w'z' \quad (\text{unique})$$

b) $f_2(w, x, y, z) = \sum(0, 1, 5, 7, 8, 10, 14, 15)$

wz	yz	00	01	11	10
00	1	0	0	1	
01	1	1	0	0	
11	0	1	1	0	
10	0	0	1	1	

$$\therefore f_2(w, x, y, z) = w'y'z' + w'y'z + xyz + wxyz$$

$$\text{or, } f_2(w, x, y, z) = w'w'y + w'xw + wwy + w'w'z'$$

(not unique)

c) $f_3(w, x, y, z) = \sum(0, 2, 4, 5, 6, 8, 10, 12)$

wz	yz	00	01	11	10
00	1	1	0	1	1
01	0	1	0	0	0
11	0	0	0	0	0
10	1	1	0	1	1

$$f_3(w, x, y, z) = y'z' + w'z' + w'z + w'wy$$

(unique)

$$4.2) a) f(w, x, y, z) = \overline{\prod} (1, 4, 5, 6, 11, 12, 13, 14, 15)$$

wz	00	01	11	10
yz	00	01	11	10
00	1	0	0	1
01	0	0	0	1
11	1	1	0	0
10	1	0	0	1

minimal SOP, $f = w'z' + wx'y' + w'yz$, unique

wz	00	01	11	10
yz	00	01	11	10
00	1	0	0	1
01	0	0	0	1
11	1	1	0	0
10	1	0	0	1

minimal POS, $f = (w' + x')(w' + z)(w' + y' + z')(w + y + z')$

or, $f = (w' + z)(w' + y)(w + y + z')(w' + y' + z')$

not (not unique)

$$b) f(w, x, y, z) = \sum (0, 2, 4, 9, 12, 15) + \sum_{\phi} (1, 5, 7, 10)$$

wz	00	01	11	10
yz	00	01	11	10
00	1	1	1	0
01	x	x	0	1
11	0	x	1	0
10	1	0	0	x

$$\therefore f = w'x'z' + wy'z' + wxyz + w'y'z'$$

u.6) $f = \sum (5, 6, 13)$

$$f_1 = \sum (0, 1, 2, 3, 5, 6, 8, 9, 10, 11, 13)$$

$$f = f_1 f_2'$$

f consist of summation of minterms ^{common} consist of to f_1 and f_2'

The various combination for $f_2 = \sum$

f_2' must have $\sum (5, 6, 13)$ and must not have other terms in $+$

f_2 must not have $\sum (5, 6, 13)$ and must have $\sum (0, 1, 2, 3, 8, 9, 10, 11)$

f_2 is not unique

$$\Rightarrow f_2 = \sum (0, 1, 2, 3, 8, 9, 10, 11) + \sum_{\phi} (4, 7, 12, 14, 15)$$

Clearly, f_2 has $2^{n(\Phi)} = 2^5 = 32$ functions

u.20) a) $f_1(w, x, y, z) = \sum (1, 5, 6, 12, 13, 14) + \sum_{\phi} (2, 4)$

Tabulation method:

wxyz	wxyz
1 0001 ✓	1,5
2 0010 ✓	2,6
4 0100 ✓	4,5
5 0101 ✓	4,6
6 0110 ✓	4,12
12 1100 ✓	5,13
13 1101 ✓	6,14
14 1110 ✓	14,14
	11-0 ✓

(Q2)

	wxyz	w'yz'
4, 5, 12, 13	- 10 -	wy'
4, 6, 12, 14	- 1 - 0	xz'
4, 12, 5, 13	- 10 -	wy'
4, 12, 6, 14	- 1 - 0	xz'

Primary implicant	minterms involved	1	2	4	5	6	1/2	13	14
w'yz	1, 5	(X)			x				
w'yz'	2, 6		(X)		x				
wy'	4, 5, 12, 13			x	x		x	x	x
xz'	4, 6, 12, 14			x	x	x	x	x	(X)

Primary implicant	minterms involved	1	5	6	12	13	14
w'yz	1, 5	(X)	x				
w'yz'	2, 6			x			
wy'	4, 5, 12, 13		x	x	x	(X)	
xz'	4, 6, 12, 14			x	x	x	(X)

$$f_1 = w'y'z + xz' + wy' \quad \text{Ans}$$

$f(v, u, x, y, z)$

b) $f_2(v, u, x, y, z) = \sum (0, 1, 3, 8, 9, 13, 14, 15, 16, 17, 19, 24, 25, 27, 31)$

Vwxyz

0 00000

1 00001

3 00011

8 01000

9 01001

13 01101

14 01110

15 01111

16 10000

17 10001

19 10011

24 11000

25 11001

27 11011

31 11111

Vwxyz

0,1 0000-

0,8 0-000

0,16 -0000

1,3 000-1

1,9 0-001

1,7 -0001

8,9 0100-

16,17 1000-

3,19 -0011

9,13 01-01

9,25 -1001

17,19 100-1

17,25 1-001

24,25 1100-

13,15 011-1

14,15 0 111-

Vwxyz

0,1,8,9 0-00- L

0,1,16,17 -000- L

0,8,1,9 0-00- L

0,16,17 -000- L

1,3,17,19 -00-1 w'x'z

1,9,17,25 -001 L

1,17,4,25 --001 L

8,9,24,25 -100- L

16,17,24,25 1-00- L

17,19,25,27 1-0-1 v'x'z

17,25,19,27 1-0-1 Vx'z

19,27 1-011

25,27 110-1

15,31 -1111

27,31 11-11

Vwxyz

0,1,8,9 --00-

16,17,24,25 --00-

0,1,16,17 --00-

8,9,24,25 --00-

8,9,24,25 --00-

w'y'

Primary
implicant

	①	1	3	8	9	13	14	15	16	17	19	24	25	27	31
$v'uy'z$						x	x								
$v'wn'z$						⊗	x		x						
$v'wxy$								⊗	x						x
$wxyz$								x			x			x	x
$vwyz$										x	x				
$w'n'z$			x	⊗											
$v'n'z$										x	x		x	x	
$w'y'$	⊗	x		⊗	x			⊗	x	⊗	x	⊗	x		

$$\therefore f_2 = w'y' + v'wy'z + v'wxz + vwyz \quad \text{Ans}$$

$$c) f_3(w, u, y, z) = \sum(0, 1, 4, 5, 6, 7, 9, 11, 15) + \sum_{\phi}(10, 14)$$

wxyz		wxzy	
0	0000 ✓	0,1	000- ✓
1	0001 ✓	0,4	0-00 ✓
4	0100 ✓	1,5	0-01 ✓
5	0101 ✓	1,9	-001 x'y'z
6	0110 ✓	4,5	010- ✓
7	0111 ✓	4,6	01-0 ✓
9	1001 ✓	5,7	01-1 ✓
11	1011 ✓	6,7	011- ✓
15	1111	6,14	-110 ✓
10	1010 ✓	9,11	10-1 w'n'z
14	1110 ✓	10,14	1-10 ✓
		7,15	-111 ✓
		11,15	1-11 ✓
		14,15	111- ✓

w'yz	
0, 1, 4, 5	0 - 0 -
4, 5, 6, 7	0 1 - -
6, 14, 7, 5	- 1 1 -
10, 14, 11, 15	1 - 1 -

w'y'

w'z

iy

wy

Primary
implicant

minterms

Primary
implicant

0 1 4 5 6 7 9 11 | s

x'y'z

x

✓ w'x'z

x

x

✓ w'y'

(x)

x

x

x

w'z

x

x

x

x

✓ ny

x

x

wy

x

x

$$\therefore f_3 = w'y' + w'z + ny$$

d) $f_y(v,w,u,y,z) = \sum (1, 5, 6, 7, 9, 13, 14, 15, 17, 18, 19, 21, 22, 23, 25, 29, 30)$

	VWXYZ		VWXYZ
1	00001 ✓	1,5	00-01 ✓
5	00101 ✓	1,9	0-001 ✓
6	00110 ✓	1,17	-0001 ✓
7	00111 ✓	5,7	001-1 ✓
9	01001 ✓	5,13	0-101 ✓
13	01101 ✓	5,21	-0101 ✓
14	01110 ✓	6,7	0011- ✓
15	01111 ✓	6,14	0-110 ✓
17	01111 10001 ✓	6,22	-0110 ✓
18	10010 ✓	9,13	01-01 ✓
19	10011 ✓	9,25	-1001 ✓
21	10101 ✓	17,19	100-1 ✓
22	10110 ✓	17,25	1-001 ✓
23	10111 ✓	18,9	1001- ✓
25	11001 ✓	19,22	10-10 ✓
29	11101 ✓	7,15	0-111 ✓
30	11110 ✓	7,23	-0111 ✓
		13,15	011-1 ✓
		13,29	-1101 ✓
		14,15	0111- ✓
		14,30	-1110 -
		19,23	10-11 ✓
		21,23	101-1 ✓
		21,29	1-101 ✓
		22,23	1011- ✓
		22,30	1-110 ✓
		25,29	11-01 ✓

vwxyz

1, 5, 4, 13	0 - - 01 ✓
19, 5, 13	0 - - 01 ✓
19, 17, 25	-- 001 ✓
1, 12, 5, 21	- 0 - 01 ✓
1, 17, 9, 25	- - 001 ✓
5, 7, 13, 15	0 - 1 - 1 v'uz
5, 7, 21, 23	- 0 1 - 1 w'uz
5, 13, 7, 15	0 - 1 - 1 v'uz
5, 13, 21, 29	-- 101 ✓
5, 21, 7, 23	- 0 1 - 1 w'uz
5, 21, 13, 29	-- 101 ✓
6, 7, 14, 15	0 - 11 - uv'z
6, 7, 22, 23	- 0 11 - v'uz ✓
6, 14, 7, 15	0 - 11 - v'uy
6, 14, 22, 30	-- 110 ✓
6, 22, 7, 23	- 0 110 - v'uy
6, 22, 14, 30	- 1 - 01 -- 110 uyz'
9, 13, 25, 24	- 1 - 01 ✓
9, 25, 13, 29	- 1 - 01 ✓
17, 19, 21, 23	1 0 - - 1 vw'z
17, 25, 21, 29	1 - - 01 ✓
18, 19, 22, 23	1 0 - 1 - vw'y
18, 22, 19, 23	1 0 - 1 - vw'y

zwnya

1, 5, 9, 13, 17, 25, 21, 29	-- 01 y'z
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Rime implicant	1	5	6	7	9	13	14	15	17	18	19	21	22	23	25	29	30
$y'z$	(x)	x		(x)	x			x			x			(x)	(x)		
$v'uz$	x		x	x			x										
$w'uz$	x		x							x		x					
$v'ny$		x	x		x	x											
$w'ny$		x	x								x	x					
uyz'	x			x							x		x				
$vw'z$				x			x	x	x		x		x			(x)	
$vw'y$					x			(x)	x		x	x					

$$\therefore f_4 = y'z + v'uz + uyz' + vw'y$$

or,

$$f_4 = y'z + v'ny + uyz' + w'nyv$$

e) $f_5(w, x, y, z) = \Sigma (0, 1, 5, 7, 8, 10, 14, 15)$

	wxyz		wxyz
0	0000 ✓	0, 1	000- $w'ny$
1	0001 ✓	0, 8	-000 $w'y'z'$
5	0101 ✓	1, 5	0-01 $w'y'z$
7	0111 ✓	8, 10	10-0 $w'nz'$
8	1000 ✓	5, 7	01-1 $w'nx$
10	1010 -	1014	1-70 wyz'
14	1110 -	7, 15	-111 uyz
15	1111 ✓	14, 13	111- w'ny

	0	1	5	7	8	10	14	15
Prime implicant								
w'y'z'	x	x						
w'y'z'	x			x				
w'y'z		x	x					
w'x'z'				x	x			
w'xz		x	x					
wyz'				x	x			
wyz			x			x		
wxy					x	x		

$$\therefore f_S = w'y'z' + w'x'z' + w'xz + wxy$$

so,

$$f_S = w'y'z' + w'y z + wyz' + wyz$$

4.24) a) $A = b'd'$, $C = bcd$

A can be $-0-0$

A have $0, 2, 8, 10$

C can be -111

C have $7, 15$

As, 2 is not shown in prime implicant, it is in
don't care

	ab	00	01	11	10	
cd	00	1	0	0	1	$B = \Sigma(0, 1)$ or $q \Sigma(0, 4)$
01				1		
11		1	1	0		$D = \Sigma(15, 13)$ or $\Sigma(15, 11)$
10	X		0	1		or $\Sigma(15, 14)$

But, we know all prime implicant are shown

\therefore minterms at 11 and
14 is 0

$$\begin{aligned} D &= \Sigma(15, 13) \\ &= abd \end{aligned}$$

Now,	0	7	8	10	15	χ	19
A	X		X	X			
B	X					X	
C		X			X		
D				X			X
E			X				
F						X	

χ can
only be
1 or 4

	$a'b$	ab	$b'a$	ba
cd	00	01	11	10
00	1	0	1	
01	1		1	
11	1	1	0	
10	X	1	0	1

Q8

	$a'b$	ab	$b'a$	ba
cd	00	10	11	10
00	1	1	1	
01		0		1
11		1	1	0
10	X		0	1

One don't care must exist near 8 and 13, which must not be next to other prime implicant, so E and F can not be in a single minterm as it is already covered by A and D

	$a'b$	ab	$b'a$	ba
cd	00	01	11	10
00	1	0	X	1
01	1	0	1	0
11	0	1	1	0
10	X	0	0	1

Q8

	$a'b$	ab	$b'a$	ba
cd	00	01	11	10
00	1	1	0	1
01	0	0	1	X
11	0	1	1	0
10	X	0	0	1

New Prime implicant chart has two possibilities:-

	0	7	8	10	15	1	13
- $A = b'd'$	X		X	(X)			
- $B = a'b'c'$	X				(X)		
- $C = bcd$		(X)			X		
$D = abd$					X		X
$E = a'b'd'$			X				(8, 12)
$F = abc'$						X	(13, 12)

Q8)

	0	7	9	10	15	4	13
$\neg A = b' d'$	X		X	(X)			
$\neg B = \bar{a}' c' d'$	X					(X)	
$C = bcd$		(X)			X		
$D = abd$					X		X
$E = abc'$							(8,9)
$F = ac'd$						X	(13,9)

$$\therefore f_1 = \sum(0, 1, 7, 8, 10, 13, 15) + \sum_{\phi}(2, 12)$$

$$f_2 = \sum(0, 4, 7, 8, 10, 13, 15) + \sum_{\phi}(2, 9)$$

b) Not unique

c) for f to be '0' will be at {3, 5, 6, 11, 14}

f is '0' at 4 in the first case in f_1 and 1 in

f_2

$$d) f_1 = b'd' + a'b'c' + bcd + abc'$$

$$\text{or, } f_2 = b'd' + a'c'd' + bcd + a'c'd$$