Answer Key, DSD - CAT-I, FAL, F2+TF2

Q1i) $AB + CD + A\bar{C}B$

$= AB(C+\bar{C}) + CD(A+\bar{A}) + A\bar{C}B(D+\bar{D})$

$= ABC + AB\bar{C} + ACD + \bar{A}CD + AB\bar{C}\bar{D} + AB\bar{C}D$

$= ABCD + ABC\bar{D} + AB\bar{C}\bar{D} + AB\bar{C}D$
$+ A\bar{B}CD + A\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}BCD + AB\bar{C}\bar{D} + AB\bar{C}D$

$= \boxed{\bar{A}\bar{B}CD + \bar{A}BCD + AB\bar{C}\bar{D} + AB\bar{C}D + ABC\bar{D} + ABCD}$

Canonical SOP form.

Pos form: $\prod M = 1 - \sum m$ (minterm terms SOP)

$= 1 - \sum m(3, 8, 12, 13, 14, 15)$ terms only

Pos = $\prod M(0, 1, 2, 4, 5, 6, 7, 9, 10, 11)$

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

(ii) $WX\bar{Y} + WX\bar{Z} + XY\bar{Z}$

$= WX\bar{Y}(\bar{Z}+Z) + WX\bar{Z}(\bar{Y}+Y) + XY\bar{Z}(\bar{W}+W)$

$= \boxed{WX\bar{Y}\bar{Z} + WX\bar{Y}Z + \bar{W}XY\bar{Z} + WXY\bar{Z} + W\bar{X}Y\bar{Z} + WXYZ}$

$= WX\bar{Y}\bar{Z} + WX\bar{Y}Z + \bar{W}XY\bar{Z} + WXY\bar{Z}$ Canonical form in SOP.

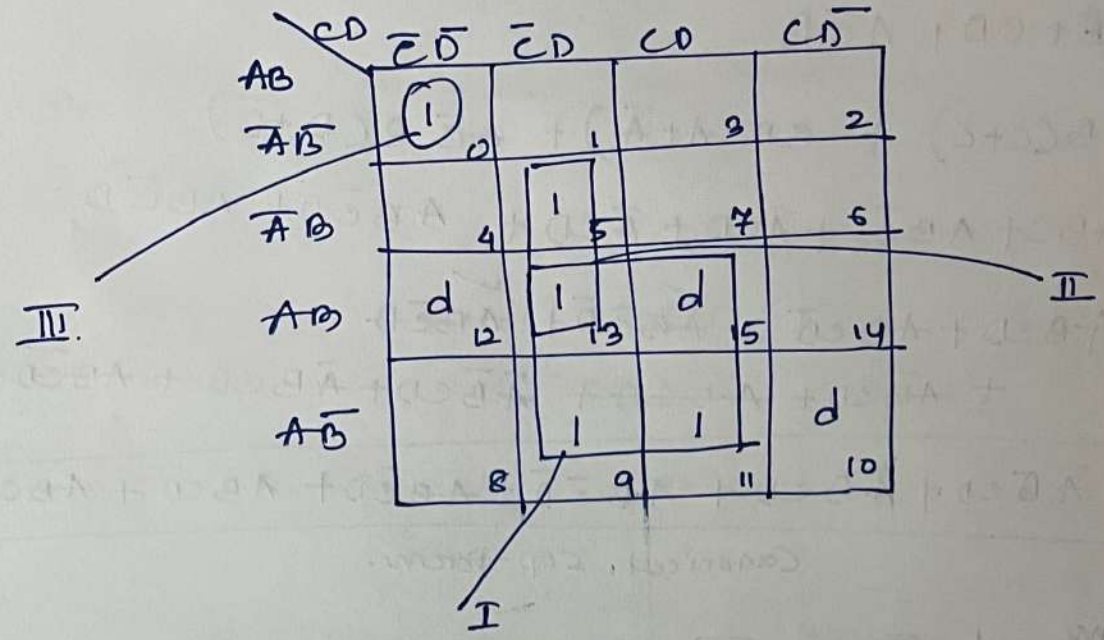
Pos form: $\prod M_{max} = 1 - \sum$ (minterm terms SOP)

$= 1 - \sum$ (12, 13, 14, 6) SOP terms

$\prod M_{max}(0, 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 15)$

$= (W+X+Y+Z)(W+X+Y+\bar{Z})(W+X+\bar{Y}+Z)(W+X+\bar{Y}+\bar{Z})(W+\bar{X}+Y+Z)$
$(W+\bar{X}+Y+\bar{Z})(W+\bar{X}+\bar{Y}+Z)(\bar{W}+X+Y+Z)(\bar{W}+X+Y+\bar{Z})$
$(\bar{W}+X+\bar{Y}+Z)(\bar{W}+X+\bar{Y}+\bar{Z})(\bar{W}+\bar{X}+\bar{Y}+\bar{Z})$

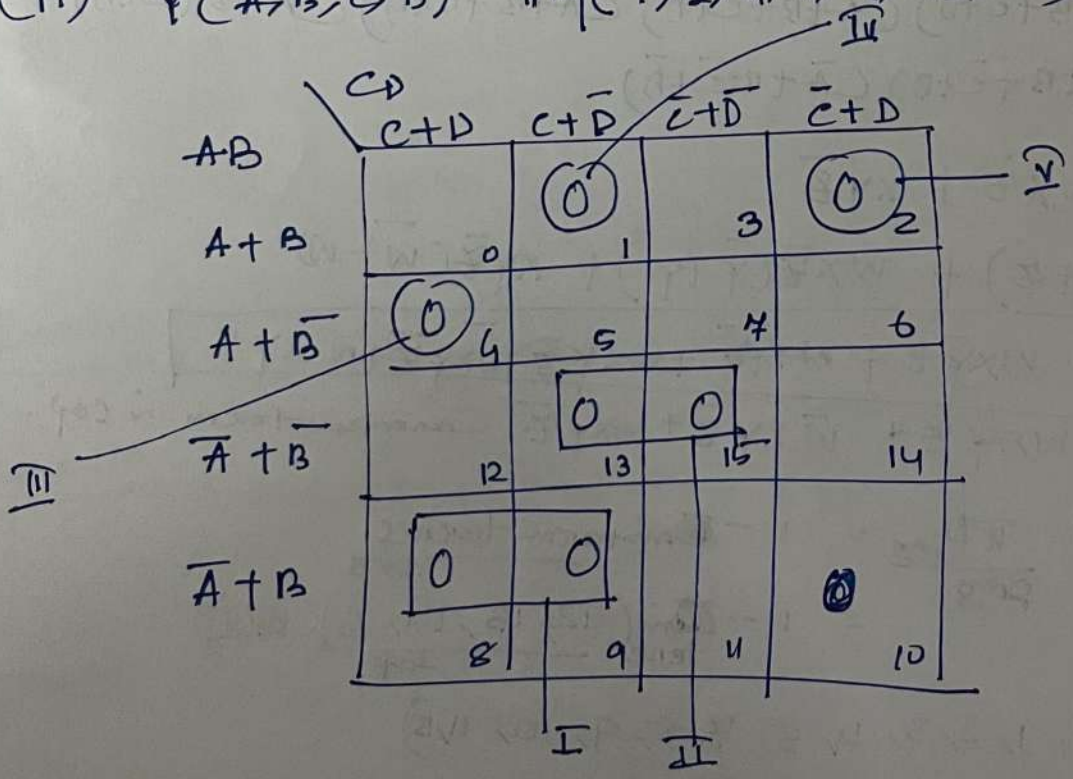
2(i) $X(A,B,C,D) = \sum m(0,5,9,11,13) + dC(10,12,15)$



$X(A,B,C,D) = L_I + L_{II} + L_{III}$

$= AD + B\bar{C}D + \bar{A}\bar{B}\bar{C}\bar{D}$

(ii) $Y(A,B,C,D) = \prod M(1,2,4,8,9,13,15)$



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

$(A+B+C+\bar{D})(A+B+\bar{C}+D)$

3(i)

line-1 module fig-1 (in A, B, C; out Y);

↳ captcay should be in small caps!

↓ first output ↓ then Declare input

line-2

wires W1; W2; W3; W4; W5; W6; W7; W8; W9; W10;

no-s

Semicolon should be common

if should be semicolon.

line-3 not (W1, A); —— semicolon (';')

↳ it should be ';'

line-4 not (W2, C); the output ~~c~~ input should be 'B'

↳ it should be ';'

line-5 not (W3, B); the input should be 'C'

↳ it should be ';'

line-6 nor (W4, A, W1); — 'B'

line-7 nor (W5, B, W2); — 'A'

line-8 nor (W6, W7, W2); — 'W1' ↳ small caps.

line-9 nand (W7, W3, W4); — (;) — 'W4'

line-10 nand (W8, W4, W5); — (;) — 'W' — 'W3'

line-11 nand (W9, W6, W1); — (;) — 'W5' — 'B'

line-12 nand (W10, W2, W6); — (;) — 'C'

line-13 (Y, W5, W8, W7, W9); — (;)

line-14

end module

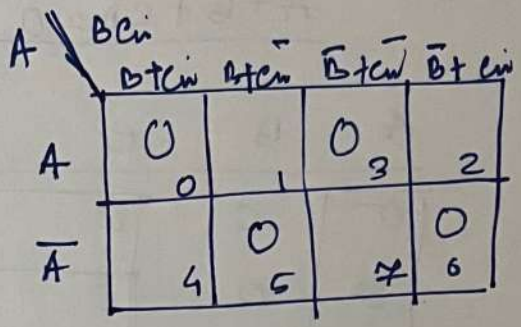
↳ no space.

Finally the student have to write the error free case separately for the structure.

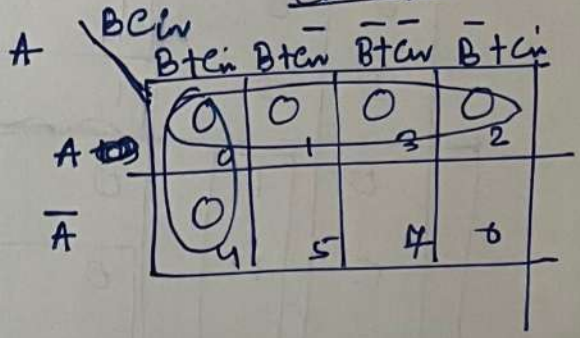
4.(i) Full adder

A	B	c_{in}	S	C_o
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Sum

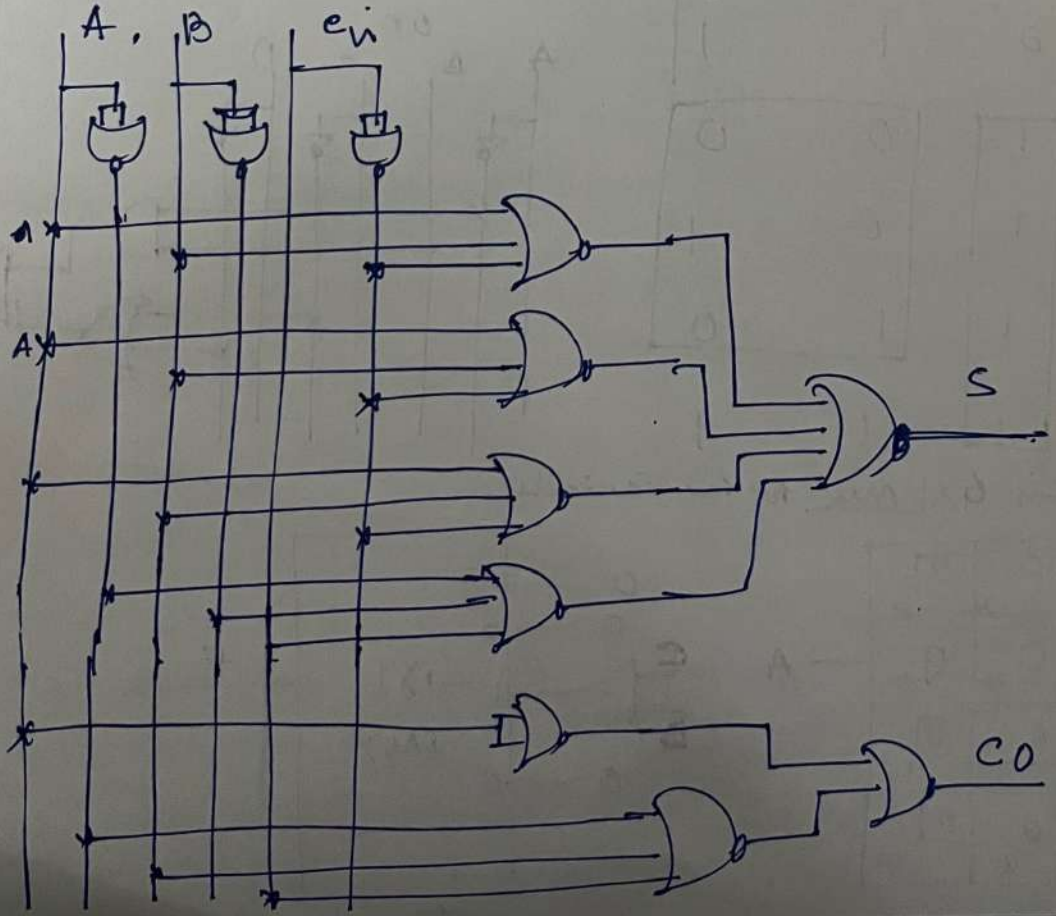


Carry



$S = (A+B+C_{in})(A+\bar{B}+\bar{C}_{in})(\bar{A}+B+\bar{C}_{in})(\bar{A}+\bar{B}+C_{in})$

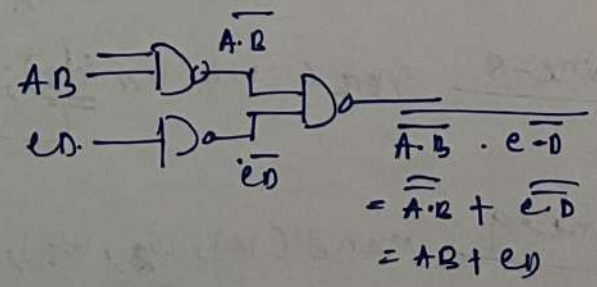
$C_o = A(\bar{A}+B+C_{in})$

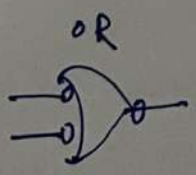


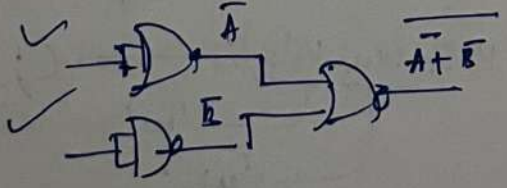
4 (b))

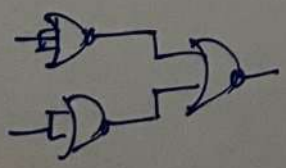
```
module fulladder( S,CO, A, B, Cin)

input A, B, Cin;

output S, Co;

assign S = (A|B|Cin) & (A|B|~(Cin) & (~(A)|B|~(Cin)) & (~(A)|~(B)|Cin);

assign CO = A & (~(A)|B|Cin)
```

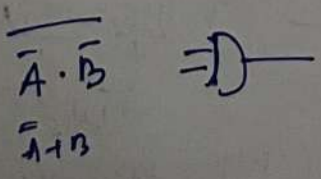
Extra work





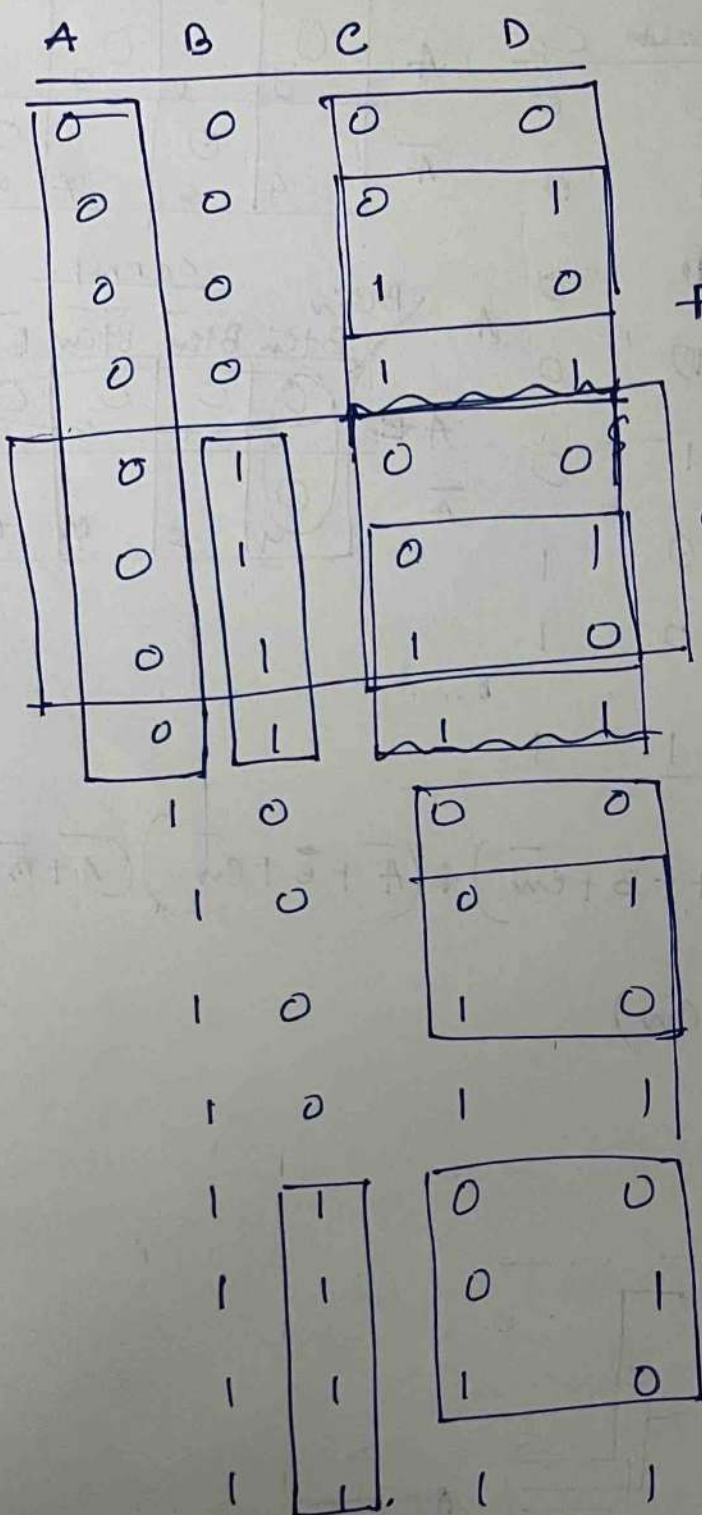






(5)(i) Design a combinational circuit $A+\bar{B}+CD=0$ gives a set value

so
A must = 0
B must = 1
C·D = 0, means C=0, D=0
or C & D = 0

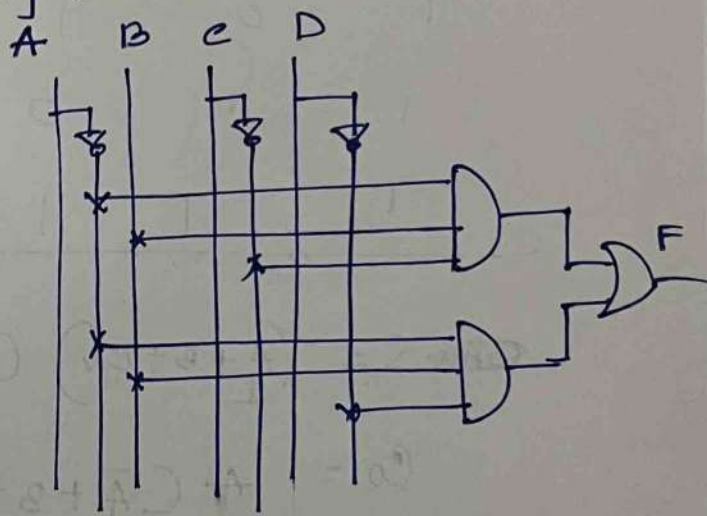


$F = \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}D + \bar{A}BC\bar{D}$

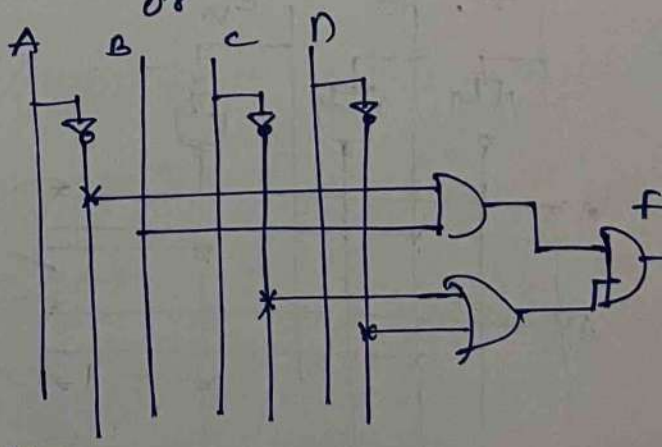
$= \bar{A}B\bar{C} + \bar{A}B\bar{D}$

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

only true



or



(b) $\Sigma m(4,5,6)$ using 4X1 mux for four variable