Tutorial - 5 (solutions)

Q1 The given expression is in SOP form. So first convert the expression into POS and then to standard POS (

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

The function has three variables: A, B and C. Each OR term is missing one variable. Therefore

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

Combining all the terms and removing those that appear more than once, we finally obtain

$$F = (A+B+C)(A+\overline{B}+C)(\overline{A}+B+C)(\overline{A}+B+\overline{C})$$
$$= M_0 \cdot M_2 \cdot M_4 \cdot M_5$$
$$= \Pi(0, 2, 4, 5)$$

Q2 $F' = \Sigma(0, 4, 6)$

and $F = (x+y+z)(x'+y+z)(x'+y'+z)$

Q3 $F(x, y, z) = \Sigma(0, 2, 5, 7)$

$$= x'y'z' + x'yz' + xy'z + xyz$$

Q4 $F = \overline{B}D + \overline{A}D + BD$

$$= X0X1 + 0XX1 + X1X1$$
$$= 0001, 0011, 1001, 1011, 0001, 0011, 0101, 0111, 0101, 0111, 1101, 1111$$
$$= \Sigma(1, 3, 5, 7, 9, 11, 13, 15)$$

$= \Pi(0, 2, 4, 6, 8, 10, 12, 14)$

Q5

$F = (xy + z)(xz + y)$

$= (x + z)(y + z)(x + y)(y + z)$

$= (x + y)(x + z)(y + z)$

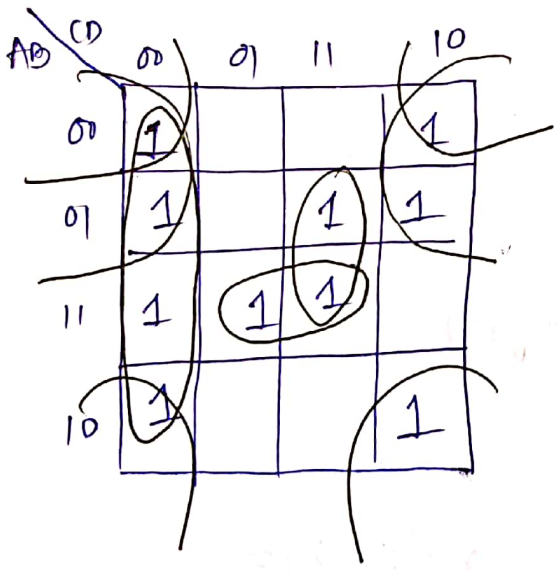
$= (00X)(0X0)(X00)$

$= (000)(001)(000)(010)(000)(100)$

$= \Pi(0, 1, 2, 4)$

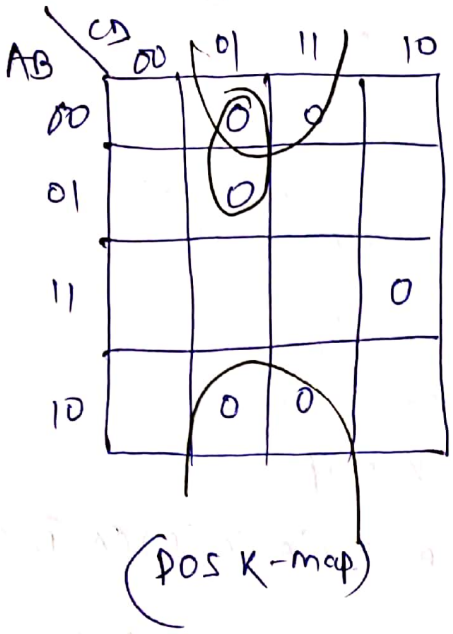
$= \Sigma(3, 5, 6, 7)$

Q6 The given expression in the pos form is $f = \Pi(1, 3, 5, 9, 11, 14)$. The K-maps for the sop and pos form, their minimization and the minimal expressions obtained from them are shown below.



SOP K-map

$f_{min} = \bar{C}\bar{D} + \bar{A}\bar{D} + \bar{B}\bar{D} + ABD + BCD$



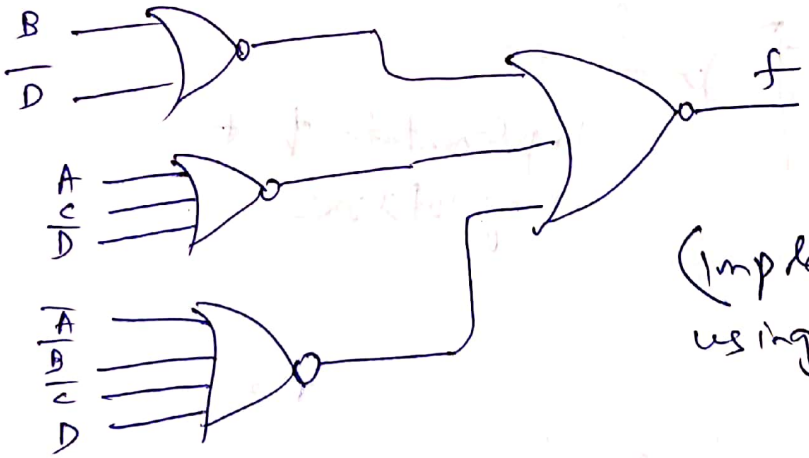
(POS K-map)

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

The SOP form requires 17 gate inputs whereas the POS form requires only 12 gate inputs. So the POS form is more economical.

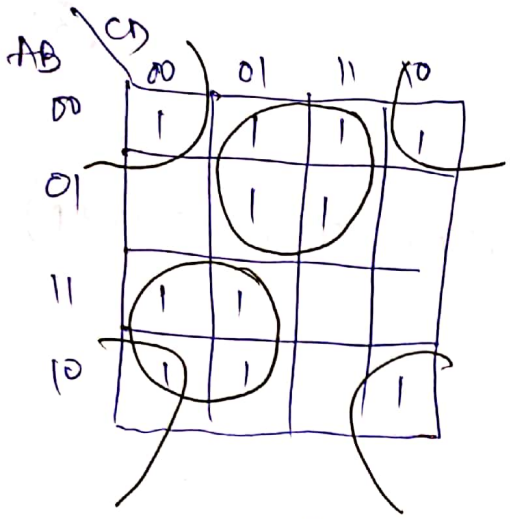
$$f_{min} = \overline{\overline{(B+\bar{D})(A+C+\bar{D})(\bar{A}+\bar{B}+\bar{C}+D)}}$$

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



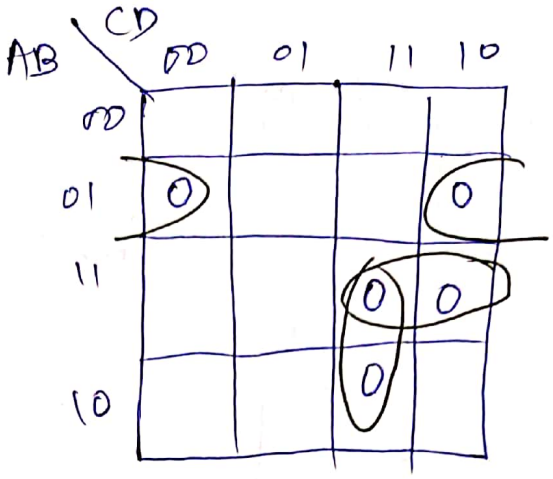
(Implementation of f using POS logic)

Q7 The given expression in the POS form is $f = \Pi(4, 6, 11, 14, 15)$. The K-maps for the SOP and POS forms, their reduction and the reduced expressions obtained from them are shown below.



SOP K-map.

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

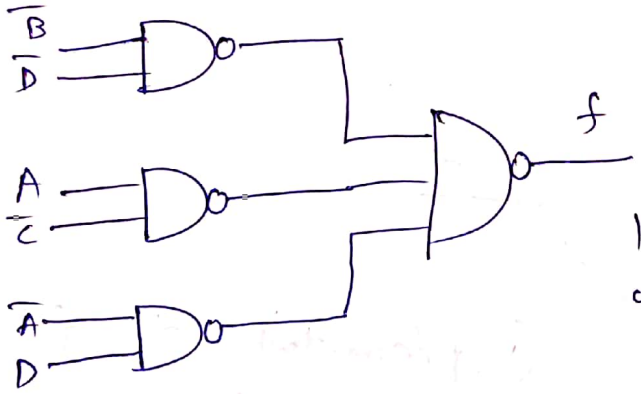


POS K-map

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

The SOP form requires 9 gate inputs, where as the POS form requires 12 gate inputs. So the SOP form of realization is more economical. Now,

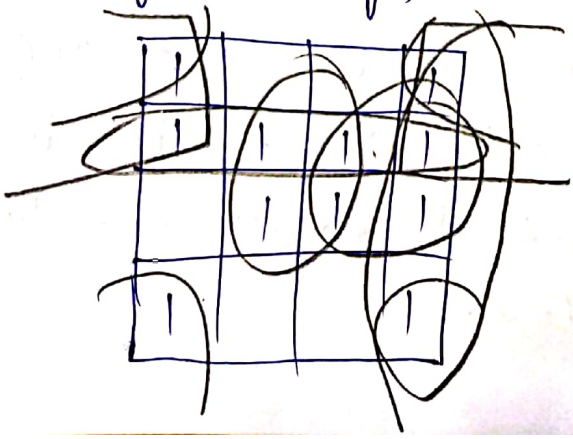
$$f_{min} = \bar{B}\bar{D} + A\bar{C} + \bar{A}D = \overline{\overline{\bar{B}\bar{D}} \cdot \overline{A\bar{C}} \cdot \overline{\bar{A}D}}$$



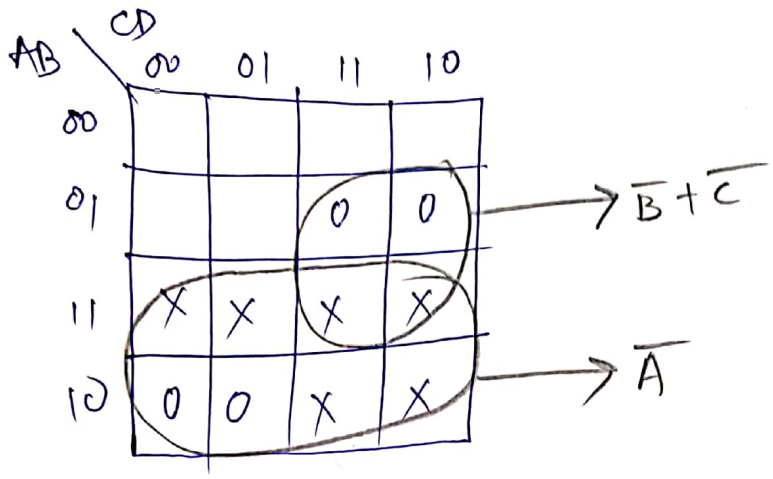
Implementation of f using SOP logic

Q8

$x'y', xz, xy, w'x, w'z', yz'$

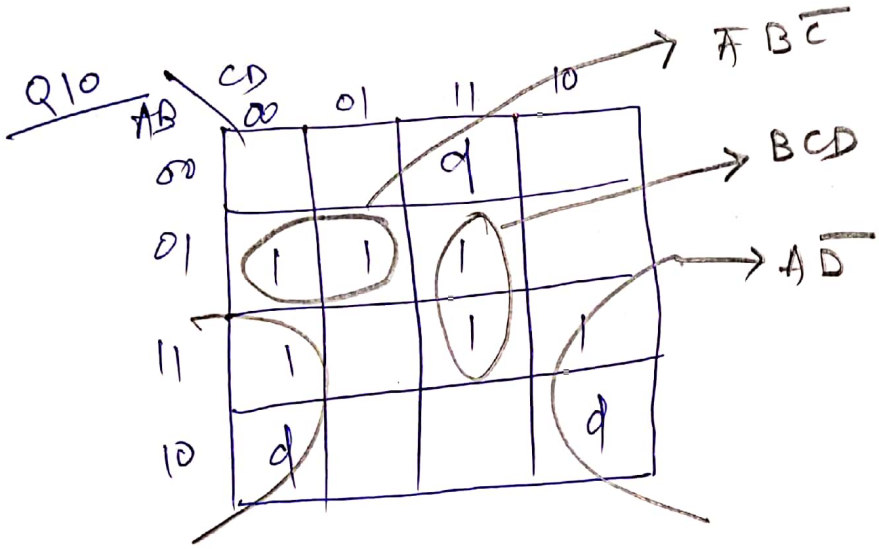


Q9



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

Q10



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