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Q1: Convert each of number to the required number System:

A) $(1011100.10101)_2 = (\ldots\ldots)_{10}$

Soll:

1011100.10101

$= (1\times2^6)+(0\times2^5)+(1\times2^4)+(1\times2^3)+(1\times2^2)+(0\times2^1)+(0\times2^0)$
$+(1\times2^{-1})+(0\times2^{-2})+(1\times2^{-3})+(0\times2^{-4})+(1\times2^{-5})$
$= 64+0+16+8+4+0+0+0.5+0.00+0.125+0.0000+$
0.03125
$= (92.65625)_{10}$ Answer.

B. $(111100.101)_2 = (\ldots\ldots)_{10}$

Soll:

$\underset{1}{\overset{5}{2}}\ \underset{1}{\overset{4}{2}}\ \underset{1}{\overset{3}{2}}\ \underset{1}{\overset{2}{2}}\ \underset{0}{\overset{1}{2}}\ \underset{0}{\overset{0}{2}}\ \underset{1}{\overset{-1}{2}}\ \underset{0}{\overset{-2}{2}}\ \underset{1}{\overset{-3}{2}}$
$1\ 1\ 1\ 1\ 0\ 0.\ 1\ 0\ 1$
$32+16+8+4+0+0.05+0+0.125$
$60.0.5+0.125$
$(60.625)_{10}$ Answer.

D. $(10)_{10} = (\ldots)_{16}$

Soll:

$10/16 = 10$ Reminder

So $10 = A$
$(10)_{10} = (A)_{16}$ Answer.

C) $(ABCD)_{16} = (\ldots)_2$

Soll: A B C D
1010 1011 1100 1101

$(1010101111001101)_2$ Answer.

E) $(7777)_8 = (\ldots)_{10}$

Soll: 7777
$= (7\times8^3)+(7\times8^2)+(7\times8^1)+(7\times8^0)$
$= 3584 + 448 + 56 + 7$
$= 4095$
$(4095)_{10}$ Answer.

F. $(7777)_8 = (\ldots)_2$

Soll: $(7777)_8 = (?)_2$

= 7 7 7 7
111 111 111 111

$(111111111111)_2$ Ans.

Q. $(7777)_8 = (\ldots)_{16}$

Soll:- $(7\times8^3)+(7\times8^2)+(7\times8^1)+(7\times8^0)$

$= 3584 + 448 + 56 + 7$

$= 4095$

$(4095)_8 = (\ldots)_{16}$

$4095/16 = 255$ 15 → Reminder

$255/16 = 15$ 15

$15/16 = 0$ 15

$15 = F$

$(7777)_8 = (FFF)_{16}$

I) $(101010)_{10} = (\ldots)_8$

Soll:- $\frac{101010}{8} = 126262.5 \rightarrow 0.25\times8 = 2$

$\frac{12626}{8} = 1578.25 \rightarrow 0.25\times8 = 2$

$\frac{1578}{8} = 197.25 \rightarrow 0.25\times8 = 2$

$\frac{197}{8} = 24.625 \rightarrow 0.625\times8 = 5$

$\frac{24}{8} = 3 \rightarrow 0$

J) $(98)_{10} = (\ldots)_{BCD}$

Soll:- $(98)_{10} = (\ldots)_{BCD}$

9 8

1001 1000

0011 0001

3 1

$(31)_{BCD}$ Answer.

2	98
2	49 - 0
2	24 - 1
2	12 - 0
2	6 - 0
2	3 - 0
2	1 - 1

H) $(10101111)_2 = (\ldots)_8$

Soll:- $(10101111)_2 = (\ldots)_8$

010 = 2

101 = 5

111 = 7

$(257)_8$ Answer.

Q2: Apply De-Morgan's theorems to each expression:

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

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

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

Sol: Applying De-Morgans theorem.

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

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

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

$\boxed{X = \bar{A}+B+\bar{C}\bar{D}}$ Ans.

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

Applying De-Morgan's theorem.

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

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

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

$\boxed{X = \bar{A}BC\bar{D}+\bar{A}+\bar{B}+\bar{C}+\bar{D}}$ Ans.

Q4. Convert the following expressions to Sum of product (SOP) forms.

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

Sol:- Converting to SoP form.

$BC + DE(B\bar{C} + DE)$

$= BC + DE\,B\bar{C} + DEDE$

Using Rule No 7 $A.A = A$

$= BC + DE\,B\bar{C} + DE$

$= BC + DE(1 + B\bar{C})$

Using Rule No 2 $A + 1 = 1$

$\boxed{X = BC + DE}$ Required SoP form.

B. $BC(\bar{C}D + CE)$

Sol:- Converting to SoP form.

$BC(\bar{C}\bar{D} + CE)$

$= BC\bar{C}\bar{D} + BCCE$

Using Rule No 8 $A.\bar{A} = 0$

$= B\bar{D}(0) + BCCE$

$= BCCE$

Using Rule No 7 $A.A = A$

$\boxed{X = BCE}$ Required SoP form

This is single product term.

Q4.

C. $B + C[BD + (C + \bar{D})E]$

Sol:- Converting to SOP form.

$B + C[BD + (C + \bar{D})E]$

$= B + CBD + C(CE + E\bar{D})$

$= B(1 + CD) + (CE + CE\bar{D})$

Using Rule No 2 $A + 1 = 1$

$= B + CCE + CE\bar{D}$

Using Rule No 7 $A \cdot A = A$

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

$= B + CE(1 + \bar{D})$

Using Rule No 2 $A + 1 = A$

$\boxed{X = B + CE}$ Required SOP form.

Q3. Develop a truth table for each of the following Standard SOP expressions:

A $\bar{X}\bar{Y}\bar{Z} + \bar{X}Y\bar{Z} + X\bar{Y}Z + \bar{X}YZ + XYZ$

Sol:-

	Input			output
	X	Y	Z	
	0	0	0	1
	0	0	1	0
	0	1	0	1
	0	1	1	1
	1	0	0	0
	1	0	1	1
	1	1	0	1
	1	1	1	0

Q3

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

Soll:

	Input			output Net output
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0