# Homework problems

20CSE1042
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Date : 17/1/22

1) Perform Hexadecimal addition $(1F2E)_{16} + (2F31)_{16} + (3C2A)_{16}$

```
 2 1
 1F2E
 2F31
 3C2A
 ----
 8A89
```

25 = 1×16+9
Result = carry*base + remainder
42 = 2×16+10
8 = 0×16+8

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

Result :- $(8A89)_{16}$

2) Perform Binary addition $(11101)_2 + (101011)_2 + (10101)_2$

```
 1 1 1 1 1
    11101
   101011
    10101
 --------
 10111001
```

3 = 1×2+1
2 = 1×2+0

Result:- $(1011101)_2$

3) Perform octal addition $(2431)_8 + (3763)_8 + (7776)_8$

```
  2 2 1
  2431
  3763
  7776
 -----
 16412
```

10 = 1×8+2
17 = 2×8+1
20 = 2×8+4
14 = 1×8+6

Result:- $(16412)_8$

4) Hexadecimal subtraction $(321C)_{16} - (1950)_{16}$

```
 2  1 16 16   C+16
 3  2  1  C
 1  9  5  D
 ---------
 1  8  B  F     18BF
```

12+16−13 = 15 = F
16−5 = 11 = B
16+1−9 = 8
2−1 = 1

Result: $(18BF)_{16}$

5) Binary subtraction $(111000)_2 - (101011)_2$

$$\begin{array}{r} 111000 \\ 101011 \\ \hline 001101 \\ \hline \end{array}$$

Result :- $(001101)_2$

6) Octal Subtraction $(41231)_8 - (26746)_8$

$$\begin{array}{r} 41231 \\ 26746 \\ \hline 12263 \\ \hline \end{array}$$

Result :- $(12263)_8$

7) Binary Multiplication $(110110)_2 \times (1101)_2$

$$\begin{array}{r} 110110 \\ \times\ 1101 \\ \hline 110110 \\ 000000\phantom{0} \\ 110110\phantom{00} \\ 110110\phantom{000} \\ \hline 1010111110 \\ \hline \end{array}$$

$3 = 1 \times 2 + 1$

$2 = 1 \times 2 + 0$

Result : $(1010111110)_2$

8) Convert the following decimal to Hexadecimal no.system

$(76293.125)_{10} \rightarrow (\ )_{16}$

$$\begin{array}{r|l} 16 & 76293 \\ 16 & 4768 - 5 \\ 16 & 298 - 0 \\ 16 & 18 - 10 \\ & 1 - 2 \end{array}$$

$0.125 \times 16 = 2.0 \quad 2$

$0.0 \times 16 = 0 \quad 0$

$(0.2)_{16}$

$(12A05)_{16}$

$(76293.125)_{10} \rightarrow (12A05.2)_{16}$

9) Convert the following into decimal number system.

(i) $(3ACB.AB)_{16} \rightarrow (\ )_{10}$

$$\begin{array}{cccccc} 3 & A & C & B. & A & B \\ 16^3 & 16^2 & 16^1 & 16^0 & 16^{-1} & 16^{-2} \end{array}$$

$= 3\times16^3 + A\times16^2 + C\times16^1 + B\times16^0 + A\times16^{-1} + B\times16^{-2}$

$= 3\times16^3 + 10\times16^2 + 12\times16 + 11\times16^0 + 10\times16^{-1} + 11\times16^{-2}$

$= (15051.66796875)_{10}$

(ii) $(3765.65)_8 \rightarrow (\ )_{10}$

$$\begin{array}{cccccc} 3 & 7 & 6 & 5. & 6 & 5 \\ 8^3 & 8^2 & 8^1 & 8^0 & 8^{-1} & 8^{-2} \end{array}$$

$= 3\times8^3 + 7\times8^2 + 6\times8 + 5\times8^0 + 6\times8^{-1} + 5\times8^{-2}$

$= 1536 + 448 + 48 + 5 + 0.75 + 0.078125$

$= (2037.828125)_{10}$

(iii) $(4561.35)_8 \rightarrow (\ )_{10}$

$$\begin{array}{cccccc} 4 & 5 & 6 & 1. & 3 & 5 \\ 8^3 & 8^2 & 8^1 & 8^0 & 8^{-1} & 8^{-2} \end{array}$$

$= 4\times8^3 + 5\times8^2 + 6\times8 + 1\times8^0 + 3\times8^{-1} + 5\times8^{-2}$

$= 2048 + 320 + 48 + 1 + 0.375 + 0.078125$

$= (2417.453125)_{10}$

(iv) $(11011.1011)_2 \rightarrow (\ )_{10}$

$$\begin{array}{ccccccccc} 1 & 1 & 0 & 1 & 1. & 1 & 0 & 1 & 1 \\ 2^4 & 2^3 & 2^2 & 2^1 & 2^0 & 2^{-1} & 2^{-2} & 2^{-3} & 2^{-4} \end{array}$$

$= 1\times2^4 + 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0 + 1\times2^{-1} + 0\times2^{-2} + 1\times2^{-3} + 1\times2^{-4}$

$= 16 + 8 + 2 + 1 + 0.5 + 0.125 + 0.0625$

$= (27.6875)_{10}$

10) Hexadecimal to Binary to Octal

$(3ABC.AC)_{16} \rightarrow (\ )_2 \rightarrow (\ )_8$

3 A B C . A C

0011 1010 1011 1100 . 1010 1100

$(11101010111100.101011)_2.$

011 101 010 111 100 . 101 011

3 5 2 7 4 5 3

$(35274.53)_8$

$(3ABC.AC)_{16} \rightarrow (11101010111100.101011)_2 \rightarrow (35274.53)_8$

11) Binary to Octal to Hexadecimal

$(01101111011.101101)_2 \rightarrow (\ )_8 \rightarrow (\ )_{16}.$

0011 0111 1011 . 1011 0100

3 7 11 11 4

$(37B.B4)_{16}$

001 101 111 011 . 101 101

1 5 7 3 5 5

$(1573.55)_8$

$(01101111011.101101)_2 \rightarrow (1573.55)_8 \rightarrow (37B.B4)_{16}.$

Date : 18/1/22

1) Conversions.

$(5621)_7 \rightarrow (\ )_9$

$\hookrightarrow (\ )_{10} \uparrow$

5 6 2 1

$7^3\ 7^2\ 7^1\ 7^0$

$= 5\times7^3+6\times7^2+2\times7+1$

$= (2024)_{10}.$

$(5621)_7 = (2024)_{10}$

$$
\begin{array}{l|l}
9 & 2024 \\
9 & 224 - 8 \\
9 & 24 - 8 \\
 & 2 - 6
\end{array}
$$

$= (2688)_9$

$(5621)_7 \rightarrow (2024)_{10} \rightarrow (2688)_9$

2) Find 7's & 8's complement of $(235400)_8$

$$
\begin{array}{r}
777777 \\
235400 \\
\hline
542377 \\
+1 \\
\hline
542400
\end{array}
$$

542377 → 7's complement

542400 → 8's complement

7's complement = 542377

8's complement = 542400

3) Binary subtraction using 2's complement

(i) $(1000)_2 - (1010)_2$

A = 1000

B = 1010

↳ 2's complement = 0101 + 1 = 0110

$$
\begin{array}{r}
0101 \\
+1 \\
\hline
0110
\end{array}
$$

$$
\begin{array}{r}
1000 \\
0110 \\
\hline
1110
\end{array}
$$

no carry (-ve number)

Final answer = 2's complement of 1110

$$
\begin{array}{r}
= 0001 \\
+1 \\
\hline
0010
\end{array}
$$

$= -(0010)_2$

(ii) $(1101)_2 - (0111)_2$

A = 1101
B = 0111
↳ 2's complement 1000
+ 1
1001

  1101
+ 1001
(1) 0110

carry (+ve number)
Neglect the carry

Result = $(0110)_2$

4) Binary subtraction using 1's complement

(i) $(1110)_2 - (0110)_2$

A = 1110
B = 0110
↳ 1's complement = 1001

  1110
+ 1001
(1) 0111

carry
(+ve number)

Result :- 0111
+ 1
$(1000)_2$

(ii) $(0111)_2 - (1001)_2$

A = 0111
B = 1001
↳ 1's complement = 0110

0111
0110
1101

no carry (-ve number)

Result = - (1's complement of 1101)
= $-(0010)_2$

Date: 19/1/22

1) Represent the following decimal into BCD

(i) $(37)_{10} \rightarrow (0011\ 0111)_{BCD}$

(ii) $(271)_{10} \rightarrow (0010\ 0111\ 0001)_{BCD}$

(iii) $(141)_{10} \rightarrow (0001\ 0100\ 0001)_{BCD}$

2) Represent following BCD into decimal

(i) 010011

$\underbrace{0001}_{1}\ \underbrace{0011}_{3}$

$(010011)_{BCD} \rightarrow (13)_{10}$

(ii) 10110110110101

$\underbrace{0010}\ \underbrace{1101}\ \underbrace{1011}_{\substack{11 \\ >9}}\ \underbrace{0101}_{5}$ not possible

(iii) 1011010110

$\underbrace{0010}_{2}\ \underbrace{1101}_{\substack{13 \\ >9}}\ \underbrace{0110}_{6}$ not possible

3) Convert following into BCD

(i) $(1101101)_2$

$\begin{matrix} 1 & 1 & 0 & 1 & 1 & 0 & 1 \\ 2^6 & 2^5 & 2^4 & 2^3 & 2^2 & 2^1 & 2^0 \end{matrix}$

$= 2^6 + 2^5 + 2^3 + 2^2 + 2^0 = (109)_{10}$

$\downarrow$

$(0001\ 0000\ 1001)_{BCD}$

(ii) $(101010110)_2$

$\begin{matrix} 1 & 0 & 1 & 0 & 1 & 0 & 1 & 1 & 0 \\ 2^8 & 2^7 & 2^6 & 2^5 & 2^4 & 2^3 & 2^2 & 2^1 & 2^0 \end{matrix}$

$= 2^8 + 2^6 + 2^4 + 2^2 + 2^1 = (342)_{10} \rightarrow (0011\ 0100\ 0010)_{BCD}$

(iii) $(762.6)_8$

$$\begin{matrix} 7 & 6 & 2 & . & 6 \\ 8^2 & 8^1 & 8^0 & & 8^{-1} \end{matrix}$$

$= 7\times8^2 + 6\times8^1 + 2\times8^0 + 6\times8^{-1}$

$= (498.75)_{10}$

$\downarrow$

$(0100\ 1001\ 1000 . 0111\ 0101)_{BCD}$

4) Convert the following BCD into decimal and then binary.

(i) $(1010110)_{BCD}$

$\underbrace{0101}_{5}\ \underbrace{0110}_{6}$

$(1010110)_{BCD} \rightarrow (56)_{10}$

$\hookrightarrow (111000)_2$

$$\begin{array}{r|l} 2 & 56 \\ 2 & 28-0 \\ 2 & 14-0 \\ 2 & 7-0 \\ 2 & 3-1 \\ & 1-1 \end{array}$$

$= (111000)_2$

(ii) $(10110100)_{BCD}$

$\underbrace{1011}_{11}\ \underbrace{0100}_{4}$ Invalid BCD

Date: 21/1/22

1) Convert $(145)_{10}$ to 2421 code

$(145)_{10} \rightarrow (0001\ 0100\ 1011)_{2421}$

2) $(0100\ 0100\ 1110)_{2421}$ to $(\ )_{10}$

$$\begin{matrix} 0100 & 0100 & 1110 \\ \downarrow & \downarrow & \downarrow \\ 4 & 4 & 8 \end{matrix}$$

$(448)_{10}$

3) Convert the following into excess code (XS3)

(i) $(27)_{10}$

$$
\begin{array}{rr}
27 \rightarrow & 0010\ 0111 \\
 & 0011\ 0011 \\
\hline
 & 0101\ 1010
\end{array}
$$

$(27)_{10} \rightarrow (0101\ 1010)_{XS3}$

(ii) $(452)_{10}$

$$
\begin{array}{rr}
452 \rightarrow & 0100\ 0101\ 0010 \\
+ & 0011\ 0011\ 0011 \\
\hline
 & 0111\ 1000\ 0101
\end{array}
$$

$(452)_{10} \rightarrow (0111\ 1000\ 0101)_{XS3}$

(iii) $(1101011)_2$

$$
\begin{array}{ccccccc}
1 & 1 & 0 & 1 & 0 & 1 & 1 \\
2^6 & 2^5 & 2^4 & 2^3 & 2^2 & 2^1 & 2^0
\end{array}
$$

$= 2^6 + 2^5 + 2^3 + 2^1 + 2^0$

$= (107)_{10}$

$$
\begin{array}{rr}
107 \rightarrow & 0001\ 0000\ 0111 \\
+ & 0011\ 0011\ 0011 \\
\hline
 & 0100\ 0011\ 1010
\end{array}
$$

$(1101011)_2 \rightarrow (0100\ 0011\ 1010)_{XS3}$

4) Identify whether the code is self complementary or not

(i) 7421

| | 7 | 4 | 2 | 1 |
|---|---|---|---|---|
| 0 - | 0 | 0 | 0 | 0 |
| 1 - | 0 | 0 | 0 | 1 |
| 2 - | 0 | 0 | 1 | 0 |
| 3 - | 0 | 0 | 1 | 1 |
| 4 - | 0 | 1 | 0 | 0 |
| 5 - | 0 | 1 | 0 | 1 |
| 6 - | 0 | 1 | 1 | 0 |
| 7 - | 0 | 1 | 1 | 1 or 1 000 |
| 8 - | 1 | 0 | 0 | 1 |
| 9 - | 1 | 0 | 1 | 0 |

7421 is not self complementary code.

(ii) 5921

| | 5 | 9 | 2 | 1 |
|---|---|---|---|---|
| 0 – | 0 | 0 | 0 | 0 |
| 1 – | 0 | 0 | 0 | 1 |
| 2 – | 0 | 0 | 1 | 0 |
| 3 – | 0 | 0 | 1 | 1 |
| 4 – | not possible. | | | |
| 5 – | 1 | 0 | 0 | 0 |
| 6 – | 1 | 0 | 0 | 1 |
| 7 – | 1 | 0 | 1 | 0 |
| 8 – | 1 | 0 | 1 | 1 |
| 9 – | 0 | 1 | 0 | 0 |

5921 is not self complementary code.

(iii) 3321

| | 3 | 3 | 2 | 1 |
|---|---|---|---|---|
| 0 – | 0 | 0 | 0 | 0 |
| 1 – | 0 | 0 | 0 | 1 |
| 2 – | 0 | 0 | 1 | 0 |
| 3 – | 0 | 0 | 1 | 1 |
| 4 – | 0 | 1 | 0 | 1 |
| 5 – | 1 | 0 | 1 | 0 |
| 6 – | 1 | ~~0~~1 | 0 | 0 |
| 7 – | 1 | 1 | 0 | 1 |
| 8 – | 1 | 1 | 1 | 0 |
| 9 – | 1 | 1 | 1 | 1 |

3321 is self complementary code.

(iv) $84\bar{2}\bar{1}$

| | ~~8~~ | ~~4~~ | ~~2~~ | ~~1~~ |
|---|---|---|---|---|
| ~~0 –~~ | ~~0~~ | ~~0~~ | ~~0~~ | ~~0~~ |
| ~~1 –~~ | ~~0~~ | ~~0~~ | ~~0~~ | ~~1~~ |
| ~~2 –~~ | ~~0~~ | ~~0~~ | ~~1~~ | ~~0~~ |
| ~~3 –~~ | ~~0~~ | ~~0~~ | ~~1~~ | ~~1~~ |

| | 8 | 4 | $\bar{2}$ | $\bar{1}$ |
|---|---|---|---|---|
| 0 – | 0 | 0 | 0 | 0 |
| 1 – | 0 | 1 | 1 | 1 |
| 2 – | 0 | 1 | 1 | 0 |
| 3 – | 0 | 1 | 0 | 1 |
| 4 – | 0 | 1 | 0 | 0 |
| 5 – | 1 | 0 | 1 | 1 |
| 6 – | 1 | 0 | 1 | 0 |
| 7 – | 1 | 0 | 0 | 1 |
| 8 – | 1 | 0 | 0 | 0 |
| 9 – | 1 | 1 | 1 | 1 |

$84\bar{2}\bar{1}$ is self complementary code.

(v) $7 4 2 \bar{1}$

$7 4 2 \bar{1}$

0 - 0000

1 - 0111

2 - 0110

3 - 0101

4 - 0100

5 - not possible

6 - ~~0~~1001

7 - 1000

8 - 1100

9 - not possible

$742\bar{1}$ is not self complementary code.

5) Convert binary into ASCII code.

1001111 1~~0~~001111 1101111

$1001111 = 2^6+2^3+2^2+2^1+2^0 = 79 = O$ (capital O)

$1~~0~~001111 = 2^3+2^2+2^1+2^0 = 15+2^6 = 79 = O$ (capital O)

$1101111 = 2^6+2^5+2^3+2^2+2^1+2^0 = 111 = e$

$(1001111\ 1001111\ 1101111)_2 \Rightarrow$ OOe

6) Represent the given ASCII code in binary

'Bb48'

| B | b | 4 | 8 |
|---|---|---|---|
| 66 | 98 | 52 | 56 |

7) Represent the following in Gray code

(i) $(1011010)_2$

$G_n = b_n$

$G_{n-1} = b_{n-1} \oplus b_n$

$G_{n-2} = b_{n-2} \oplus b_{n-1}$

1 0 1 1 0 1 0

↓ ↓ ↓ ↓ ↓ ↓ ↓

1 1 1 0 1 1 1

$(1011010)_2 \rightarrow (1110111)_{GC}$

(iv) $(345)_6$ to GC

$$\begin{matrix} 3 & 4 & 5 \\ 6^2 & 6^1 & 6^0 \end{matrix}$$

$= 3\times6^2 + 4\times6^1 + 5\times6^0$

$= (137)_{10}$

$$\begin{array}{r|l} 2 & 137 \\ \hline 2 & 68 - 1 \\ \hline 2 & 34 - 0 \\ \hline 2 & 17 - 0 \\ \hline 2 & 8 - 1 \\ \hline 2 & 4 - 0 \\ \hline 2 & 2 - 0 \\ \hline & 1 - 0 \end{array} = (10001001)_2$$

$$\begin{matrix} 1 & 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 1 & 1 & 0 & 0 & 1 & 1 & 0 & 1 \end{matrix}$$

$(345)_6 \to (11001101)_{GC}$

Date: 24/1/22

1) How many bits are required to represent

(i) 10 digit decimal

$\log 2^n \geq \log b^x$

$n$ = no. of bits required

$b$ = base number

$x$ = no. of bit digits

$x = 12$

$b = 10$ (decimal)

$\log 2^n \geq \log 10^{12}$

$\log 2^n \geq 12 \log 10$

$n \geq 12\left(\frac{\log 10}{\log 2}\right)$

$n \geq 39.86 \simeq 40.$

$\therefore$ 40 bits are required to represent 10 digit decimal

(ii) 11 digit with base 5

$x = 11$

$b = 5$

$\log 2^n \geq \log b^x$

$n \log 2 \geq x \log b$

$n \log 2 \geq 11 \log 5$

$n \geq 11\left(\frac{\log 5}{\log 2}\right)$

$n \geq 25.54 \simeq 26$

$\therefore$ 26 bits are required to represent 11 digit with base 5.

(iii) $(129)_{12}$

$$2^n \geq 129$$
$$n \log 2 \geq \log(129)$$
$$n \geq \frac{\log(129)}{\log(2)}$$
$$n \geq 7.011 \simeq 8$$

$\therefore$ 8 bits are required to represent $(129)_{12}$

2) Find minimal decimal equivalent

(i) $(3162)_x$

Base = Max digit + 1
= 6 + 1
= 7

Minimum decimal equivalent will be

$$\begin{matrix} 3 & 1 & 6 & 2 \\ 7^3 & 7^2 & 7^1 & 7^0 \end{matrix}$$

$= 3\times7^3 + 1\times7^2 + 6\times7^1 + 2\times7^0$
$= 1029 + 49 + 42 + 2$
$= (1122)_{10}$

(ii) $(G6)_x$

Base = Max digit + 1
= G + 1
= 16 + 1 = 17

Minimum decimal equivalent =

$$\begin{matrix} G & 6 \\ 17^1 & 17^0 \end{matrix}$$

$= 16\times17^1 + 6\times17^0$
$= 272 + 6$
$= (278)_{10}$

(iii) $(11)_x$ Base = Max digit + 1
= 1 + 1 = 2

Minimum decimal equivalent $= \begin{matrix} 1 & 1 \\ 2^1 & 2^0 \end{matrix} = 2 + 1 = (3)_{10}$

3) 6 digit data 001101 is given, Represent the given data in hamming code.

$K$ = no. of bits = 6 bits

$2^P \geq P+K+1$

$2^P \geq P+6+1$

$2^P \geq P+7$

$2^4 \geq 4+7$ ✓ $\qquad P = 4$ bits

$n = K+P = 6+4 = 10$ bits.

code = (10, 6) code

| 0 | 0 | | 1 | 1 | 0 | | 1 | | |
|---|---|---|---|---|---|---|---|---|---|
| $D_{10}$ | $D_9$ | $P_8$ | $D_7$ | $D_6$ | $D_5$ | $P_4$ | $D_3$ | $P_2$ | $P_1$ |

$P_1 = D_3 \oplus D_5 \oplus D_7 \oplus D_9$

$= 1 \oplus 0 \oplus 1 \oplus 0 = 0$

$P_2 = D_5 \oplus \cancel{P_8} \oplus D_9$

$D_3 \oplus D_6 \oplus D_7 \oplus D_{10}$

$= 1 \oplus 1 \oplus 1 \oplus 0 = 1$

$P_4 = D_5 \oplus D_6 \oplus D_7$

$= 0 \oplus 1 \oplus 1 = 0$

$P_8 = D_9 \oplus D_{10}$

$= 0 \oplus 0 = 0$

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |

Hamming code = 0001100110.

Date: 25/1/22

1) Represent the following in IEEE 754 floating point single precision 32-bit format.

$(231.75)_{10}$

Step 1: 3066,25) $(231.75)_{10} \to (\ )_2$

$$\begin{array}{r|l} 2 & 231 \\ \hline 2 & 115-1 \\ \hline 2 & 57-1 \\ \hline 2 & 28-1 \\ \hline 2 & 14-0 \\ \hline 2 & 7-0 \\ \hline 2 & 3-1 \\ \hline 2 & 1-1 \\ \hline & 0-1 \end{array}$$

11100111

$0.75 \times 2 = 1.50$ 1

$0.5 \times 2 = 1.0$ 1

$0.0 \times 2 = 0.0$

0.11

$(231.75)_{10} \to (11100111.11)_2$

Step 2: $(11100111.11)_2$

$1.1100111111 \times 2^7 \to$ scientific form

Step 3: As the number is +ve, sign = 0.

Exponent - $(2^{k-1}-1)+7$

$\downarrow$

exponent bias

$= 2^7-1+7$

$= 2^7+6$

$= 134$

$\hookrightarrow$ 10000110

$2^7$ - 1000 0000
6 - 11

1000 0110

23-bit mantessa -

(110011111... 00)

$\downarrow$

23-bit mantessa
(zero padding)

| 0 | 10000110 | 110011111 00..00 |
|---|---|---|
| 1 | 8 | 23 |

2) Represent the following in IEEE 754 floating point double precision 64-bit format

$[FAFA.01]_{16}$

Step 1: F A F A . 0 1

↓ ↓ ↓ ↓ ↓ ↓

1111 1010 1111 1010 0000 0001

$(1111\ 1010\ 1111\ 1010.0000\ 0001)_2$

Step 2: 1111 1010 1111 1010 . 0000 0001

$1.111\ 1010\ 1111\ 1010\ 0000\ 0001 \times 2^{15}$

Step 3: As the number is +ve, sign = 0

$= (2^{k-1}-1)+15$

$= (2^{10}-1)+15$

$= 2^{10}+14$

↓

$$\begin{array}{r} 10000000000 \\ +\quad 1110 \\ \hline 10000001110 \end{array}$$

→ exponent 11-bits

52-bit mantessa → (111 1010 1111 1010 0000 0001 ... 00)

↳ zero padding

| 0 | 10000001110 | 111 1010 1111 1010 0000 0001 ... 00 |
|---|---|---|
| 1 | 11 | 52 |

Date: 28/1/22

1) Simply the following Boolean Algebra

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

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

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

$= A\{[(B+\bar{C})(\bar{A})]+0\}$

$= A\bar{A}(B+\bar{C}) = 0.$

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

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

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

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

$= A[B+\bar{C}\bar{A}+\bar{C}(\bar{B}.C)]$

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

$= AB.$

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

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

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

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

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

$= 0.$

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

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

$= (\bar{A}\cdot BC)(A\bar{B})$

$= A\bar{A}\bar{B}BC$

$= 0.$

Date: 31/1/22

1) Convert the following sop to SSOP.

(i) $F(A,B,C,D) = AB+AC+ABC\bar{D}$

Step 1: $AB+AC+ABC\bar{D}$

$\downarrow$ C & D $\quad \downarrow$ B & D

Step 2: $F(A,B,C,D) = AB(C+\bar{C})(D+\bar{D}) + A(B+\bar{B})C(D+\bar{D}) + ABC\bar{D}$

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

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

$+ r$

<u>Step3:</u> $F(A,B,C,D) = \underset{m_{15}}{ABCD} + \underset{m_{14}}{ABC\bar{D}} + \underset{m_{13}}{AB\bar{C}D} + \underset{m_{12}}{AB\bar{C}\bar{D}} + \underset{m_{11}}{A\bar{B}CD} + \underset{m_{10}}{A\bar{B}C\bar{D}}$

$= \Sigma m(10,11,12,13,14,15)$

(ii) $F(A,B,C,D) = A + CD$

<u>Step1:</u> $F(A,B,C,D) = A + CD$

$A \downarrow$ B & C & D, $CD \downarrow$ A & B

<u>Step2:</u> $F(A,B,C,D) = A(B+\bar{B})(C+\bar{C})(D+\bar{D}) + (A+\bar{A})(B+\bar{B})CD$

$= ABCD + ABC\bar{D} + AB\bar{C}D + AB\bar{C}\bar{D} +$

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

$+ \cancel{ABCD} + \cancel{A\bar{B}CD} + \bar{A}BCD + \bar{A}\bar{B}CD.$

$= \underset{m_{15}}{ABCD} + \underset{m_{14}}{ABC\bar{D}} + \underset{m_{13}}{AB\bar{C}D} + \underset{m_{12}}{AB\bar{C}\bar{D}} + \underset{m_{11}}{A\bar{B}CD} + \underset{m_{10}}{A\bar{B}C\bar{D}}$

$+ \underset{m_9}{A\bar{B}\bar{C}D} + \underset{m_8}{A\bar{B}\bar{C}\bar{D}} + \underset{m_7}{\bar{A}BCD} + \underset{m_3}{\bar{A}\bar{B}CD}$

<u>Step3:</u> $F(A,B,C,D) = \Sigma m(3,7,8,9,10,11,12,13,14,15)$.

2) Convert the following into SSOP.

(i) $F(A,B,C) = \underset{m_2}{(A+\bar{B}+C)}\underset{m_5}{(\bar{A}+B+\bar{C})}\underset{m_1}{(A+B+\bar{C})}$

$= \cancel{\Sigma m}\ \Pi m(1,2,5)$

$= \Sigma m(0,3,4,6,7)$ [complement of SPOS]

$$F(A,B,C) = \bar{A}\bar{B}\bar{C} + \bar{A}BC + A\bar{B}\bar{C} + AB\bar{C} + ABC$$

(ii) $y(A,B,C) = (A+B)(A+C)$

$$\downarrow C \quad \downarrow B$$

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

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

$$\downarrow m_0 \quad \downarrow m_1 \quad \downarrow m_2$$

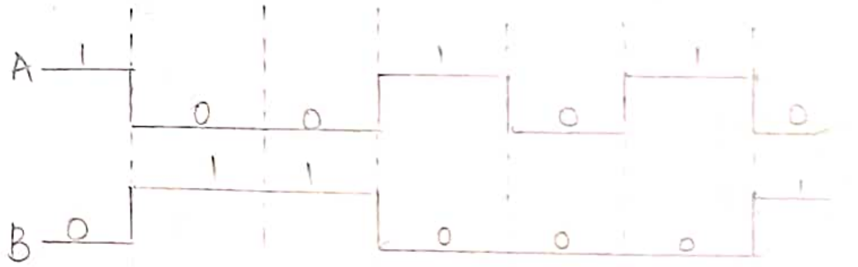
$$= \Pi m(0,1,2)$$

$$= \Sigma m(3,4,5,6,7) \quad \text{[complement of SPOS]}$$

$$y(A,B,C) = \bar{A}BC + A\bar{B}\bar{C} + A\bar{B}C + AB\bar{C} + ABC$$

Date: 1/2/22

1) Draw the waveform of A+B.




| A | B | A+B |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

Date: 2/2/22

1) If i/p to digital circuit consisting of cascade of 20 XNOR gates, then what will be the o/p y?


First gate o/p = $1 \odot x = x$
Second gate o/p = $x \odot x = 1$
third gate o/p = $1 \odot x = x$

Output of 1, 3, 5, 7, 9, 11, 13, 15, 17, 19 gates is $x$
Output of 2, 4, 6, 8, 10, 12, 14, 16, 18, 20 gates is 1.

$y$ = output of $20^{th}$ gate = 1.

2) Identify minimum no. of 2 i/p NAND gates.

(A) $F_1 = AB\bar{C}$
(B) $F_2 = \overline{AB\bar{C}}$
(C) $F_3 = \overline{\bar{A}\bar{B}}$

(A) $F_1 = AB\bar{C}$

No. of 2 i/p NAND gates to implement 3 i/p AND
$= 2(n-1)$
$= 2(3-1)$
$= 4$

$\bar{C}$ = To implement NOT gate we need one 2 i/p NAND gate

Total = 4 + 1 = 5

(B) $F_2 = \overline{AB\bar{C}}$

No. of 2 i/p NAND gate to implement 3 i/p NAND gate
$= 2n-3$
$= 2(3)-3 = 3$.

For $\bar{B}, \bar{C}$ we require two 2 i/p NAND gate

Total = 3+2 = 5

(c) $F_3 = \overline{\bar{A}\bar{B}}$

For, $\bar{A}, \bar{B}$ we require two 2 i/p NAND gates

No. of 2 i/p NAND gates to implement 2 i/p NAND gate

$= 2n-3$

$= 2(2)-3 = 1$

Total = 2+1 = 3

Date : 9/2/22

1) $f(A,B,C,D) = \Sigma m(1,4,5,9,11,12)$

$\Sigma m(1,4,5,9,11,12)$

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

| CD \ AB | $\bar{A}\bar{B}$ | $\bar{A}B$ | $AB$ | $A\bar{B}$ |
|---|---|---|---|---|
| $\bar{C}\bar{D}$ | | 1 | 1 | |
| $\bar{C}D$ | 1 | 1 | | 1 |
| $CD$ | | | | 1 |
| $C\bar{D}$ | | | | |

Group 1 = $B\bar{C}\bar{D}$

Group 2 = $\bar{A}\bar{C}D$

Group 3 = $A\bar{B}D$

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

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