18ECC103J - Digital Electronics Principle

Assignment - I

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ECE A

1. Convert the following Decimal Numbers into Binary and then to Octal and Hexadecimal.

(i) 4097.188 → To Binary

$$
\begin{array}{r|l}
2 & 4097 \\
2 & 2048 - 1 \\
2 & 1024 - 0 \\
2 & 512 - 0 \\
2 & 256 - 0 \\
2 & 128 - 0 \\
2 & 64 - 0 \\
2 & 32 - 0 \\
2 & 16 - 0 \\
2 & 8 - 0 \\
2 & 4 - 0 \\
2 & 2 - 0 \\
 & 1
\end{array}
$$

$0.188 \times 2 = 0.376 \rightarrow 0$
$0.376 \times 2 = 0.752 \rightarrow 0$
$0.752 \times 2 = 1.504 \rightarrow 1$
$0.504 \times 2 = 1.008 \rightarrow 1$
$0.008 \times 2 = 0.016 \rightarrow 0$
$0.016 \times 2 = 0.032 \rightarrow 0$
....

$(4097)_{10} = (1000000000001)_2$

$\boxed{\therefore (4097.188)_{10} = (1000000000001.001100\ldots)_2}$

(ii) 4097.188 → To octal

$$
\begin{array}{r|l}
8 & 4097 \\
8 & 512 - 1 \\
8 & 64 - 0 \\
8 & 8 - 0 \\
 & 1
\end{array}
$$

$(4097)_{10} = (1001)_8$

$0.188 \times 8 = 1.504 \rightarrow 1$
$0.504 \times 8 = 4.032 \rightarrow 4$
$0.032 \times 8 = 0.256 \rightarrow 0$
....

$\boxed{\therefore (4097.188)_{10} = (1001.140\ldots)_8}$

(iii) 4097.188 → To Hexadecimal

$$
\begin{array}{r|l}
16 & 4097 \\
16 & 256 - 1 \\
16 & 16 - 0 \\
 & 1
\end{array}
$$

$(1001)_{16} = (4097)_{10}$

$0.188 \times 16 = 3.008 \rightarrow 3$
$0.008 \times 16 = 0.128 \rightarrow 0$
$0.128 \times 16 = 2.048 \rightarrow 2$
$0.048 \times 16 = 0.768 \rightarrow 0$

$\boxed{\therefore (4097.188)_{10} = (1001.3020)_{16}}$

(ii) 2048·0625 → To Binary

2 | 2048
2 | 1024 - 0
2 | 512 - 0
2 | 256 - 0
2 | 128 - 0
2 | 64 - 0
2 | 32 - 0
2 | 16 - 0
2 | 8 - 0
2 | 4 - 0
2 | 2 - 0
1

0.0625 × 2 = 0.125 → 0
0.125 × 2 = 0.25 → 0
0.25 × 2 = 0.5 → 0
0.5 × 2 = 1 → 1

$$\boxed{\therefore (2048\cdot 0625)_{10} = (100000000000\cdot 0001)_2}$$

(ii) b 2048·0625 → To octal

8 | 2048
8 | 256 - 0
8 | 32 - 0
4 - 0

0·0625×8 = 0.5 → 0
0.5×8 = 4 → 4

$$\boxed{\therefore (2048\cdot 0625)_{10} = (4000\cdot 04)_8}$$

(iii) c 2048·0625 → To Hexadecimal

16 | 2048
16 | 128 - 0
8 - 0

0·0625 × 16 = 1

$$\boxed{\therefore (2048\cdot 0625)_{10} = (800\cdot 1)_{16}}$$

2. Convert the following Binary Numbers to Decimal.

(i) 10001101

Applying weighted binary representation.

1 0 0 0 1 1 0 1
2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0

$= 1\times2^0 + 0\times2^1 + 1\times2^2 + 1 2^3 + 0\times2^4 + 0\times2^5 + 0\times2^6 + 1\times2^7$

$= 141$

$$\boxed{\therefore (10001101)_2 = (141)_{10}}$$

(ii) 10111.1011

$$\underset{2^4}{1}\underset{2^3}{0}\underset{2^2}{1}\underset{2^1}{1}\underset{2^0}{1}.\underset{2^{-1}}{1}\underset{2^{-2}}{0}\underset{2^{-3}}{1}\underset{2^{-4}}{1} = 1\times2^{-4} + 1\times2^{-3} + 0\times2^{-2} + 1\times2^{-1} + 1\times2^{0} + 1\times2^{1} + 1\times2^{2} + 1\times2^{3} + 0\times2^{4} + 1\times2^{5}$$

$$= 0.0625 + 0.125 + 0.5 + 1 + 2 + 4 + 0 + 16$$

$$\boxed{\therefore (10111.1011)_2 = (23.6875)_{10}}$$

(iii) 1101111.101

$$\underset{2^6}{1}\underset{2^5}{1}\underset{2^4}{0}\underset{2^3}{1}\underset{2^2}{1}\underset{2^1}{1}\underset{2^0}{1}.\underset{2^{-1}}{1}\underset{2^{-2}}{0}\underset{2^{-3}}{1} = 1\times2^{-3} + 0\times2^{-2} + 1\times2^{-1} + 1\times2^{0} + 1\times2^{1} + 1\times2^{2} + 1\times2^{3} + 0\times2^{4} + 1\times2^{5} + 1\times2^{6}$$

$$= 0.125 + 0.5 + 1 + 2 + 4 + 8 + 0 + 32 + 64$$

$$\boxed{\therefore (1101111.101)_2 = (111.625)_{10}}$$

3. Convert the following Hexadecimal number to octal.

(i) 381B

Converting to binary first,

3 = 0011

8 = 1000

1 = 0001

B = 1011

$\therefore$ 381B = 0011 1000 0001 1011.

Converting to octal by group of 3;

$$\underbrace{00\,0}_{0}\,\underbrace{011}_{3}\,\underbrace{100}_{4}\,\underbrace{000}_{0}\,\underbrace{011}_{3}\,\underbrace{011}_{3}$$

$\boxed{\therefore (381B)_{16} = (34033)_8}$ → is the required octal number.

(ii) 2647

Converting to binary

2 = 0010

6 = 0110 $(2647)_{16} = (0010\ 0110\ 0100\ 0111)_2$

4 = 0100

7 = 0111   Converting to octal by grouping into 3.

$\underbrace{000}_{0}\ \underbrace{010}_{2}\ \underbrace{011}_{3}\ \underbrace{001}_{1}\ \underbrace{000}_{0}\ \underbrace{111}_{7}$

$\boxed{\therefore (2647)_{16} = (23107)_8}$ is the required octal number.

4. Convert the following Decimal numbers to BCD

(i) 379, 3 → 0011 ; 7 → 0111 ; 9 → 1001

Required $\boxed{\text{BCD} = 0011\ 0111\ 1001 \text{ for } 379}$

(ii) 2647 ; 2 → 0010 ; 6 → 0110 ; 4 → 0100 ; 7 → 0111

Required $\boxed{\text{BCD} = 0010\ 0110\ 0100\ 0111 \text{ for } 2647}$

5. Perform the following BCD addition.

(i) 19+14

19 -	0001	1001
14 -	0001	0100
33	0010	$\boxed{1101}$
	0000	0110
	0011	0011
	3	3

13 > 9, adding 6

∴ 19+14 = 33.

(ii) 184 + 576

$$
\begin{array}{rl}
184 \rightarrow & 0001 \quad 1000 \quad 0100 \\
576 \rightarrow & 0101 \quad 0111 \quad 0110 \\
\hline
760 & 0110 \quad \boxed{1111} \quad \boxed{1010} \rightarrow \\
 & 0000 \quad 0110 \quad 0110 \\
\hline
 & 0111 \quad 0110 \quad 0000 \\
 & \quad 7 \qquad\quad 6 \qquad\quad 0
\end{array}
$$

15 > 9 and 10 > 9
adding 6

$\therefore$ 184 + 576 = 760 hence proved //.

6. Simplify the following Boolean Expressions

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

Applying demorgans Law and multiplying in for the 3rd term,

$\overline{AC} = \bar{A} + \bar{C}$.

$\Rightarrow AB + \bar{A} + \bar{C} + AA\bar{B}BC + A\bar{B}CC$

$B\bar{B} = 0$
$CC = C$.

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

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

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

$\Rightarrow AB + AC + \bar{A} + \bar{C}$

$\Rightarrow (\bar{A} + AB) + (\bar{C} + AC)$ $\qquad [\bar{A} + AB = \bar{A} + B;$
$\bar{C} + CA = \bar{C} + A]$

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

$\Rightarrow \boxed{B + \bar{C}}$ is the simplified boolean expression

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

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

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$\Rightarrow B(\bar{A}+D) + C(B + A\bar{D})$ $[\bar{A} + AD = \bar{A} + D]$

$\Rightarrow B\bar{A} + BD + CB + CA\bar{D}$ $[B + \bar{B}A\bar{D} = B + A\bar{D}]$

$\Rightarrow \boxed{B(\bar{A} + D + C) + CA\bar{D}}$ is the simplified boolean expression.

7. Obtain the Canonical sum of product form of the function.

(i) $Y = A + BC$.

It is a three variable SOP.

In 1st term B and C are not there and in second term A is not there,

wkt
$A + \bar{A} = 1$
$B + \bar{B} = 1$
$C + \bar{C} = 1$.

then $Y = A \cdot 1 \cdot 1 + B \cdot C \cdot 1$

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

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

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

$\boxed{Y = ABC + AB\bar{C} + A\bar{B}C + A\bar{B}\bar{C} + \bar{A}BC.}$ is the required Canonical form.

(ii) $Y = AB + ACD$.

It is a four variable SOP.

In first term C and D are missing, and in second term B is missing,

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

then $Y = AB \cdot 1 \cdot 1 + ACD \cdot 1$

$Y = ABC(C+\bar{C})(D+\bar{D}) + ACD(B+\bar{B})$

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

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

$\boxed{Y = ABCD + ABC\bar{D} + AB\bar{C}D + AB\bar{C}\bar{D} + A\bar{B}CD}$ is the required canonical form.

8. Encode data bits 0101 into a 7 bit even parity Hamming Code.

Soln Given Data bits = 0101, no of data bits, $x = 4$

Required no of Parity bits, q is

$$2^q \geq x + q + 1$$

when $q = 3$

$8 \geq 4+3+1$; which satisfies the condition.

Location of Parity bit, $2^0 = 1$, $2^1 = 2$, $2^2 = 4$.

then,

Bit Destination	M_7	M_6	M_5	C_4	M_3	C_2	C_1
Bit location	7	6	5	4	3	2	1
Information Bit	0	1	0		1		
(1, 3, 5, 7) - C_1							1
(2, 3, 6, 7) - C_2						0	
(4, 5, 6, 7) - C_4				1			

$\boxed{\text{Hamming Code: } 0\ 1\ 0\ 1\ 1\ 0\ 1}$ is the required even parity hamming code.

9. Simplify the expression using K-map method.

(i) $Y = \Sigma m(7, 9, 10, 11, 12, 13, 14, 15)$

It is a four variable K-map.

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$ 00	0	1	3	2
$\bar{A}B$ 01	4	5	1 7	6
AB 11	1 12	1 13	1 15	1 14
$A\bar{B}$ 10	8	1 9	1 11	1 10

$$Y = AB + AD + AC + BCD$$

(ii) $Y = \Pi M(0, 1, 4, 5, 6, 8, 9, 12, 13, 14)$

It is a four variable K-map.

AB \ CD	$(C+D)$ 00	$(C+\bar{D})$ 01	$(\bar{C}+\bar{D})$ 11	$(\bar{C}+D)$ 10
$(A+B)$ 00	0 0	0 1	1 3	1 2
$(A+\bar{B})$ 01	0 4	0 5	1 7	0 6
$(\bar{A}+\bar{B})$ 11	0 12	0 13	1 15	0 14
$(\bar{A}+B)$ 10	0 8	0 9	1 11	1 10

$\bar{Y} = C(\bar{C} + D + \bar{B})$ $\quad\quad C\bar{C} = 0$

$\bar{\bar{Y}} = \overline{CD + \bar{B}C} \Rightarrow (\overline{CD}) \cdot (\overline{\bar{B}C})$

~~$Y = (\bar{C}+\bar{D})C$~~ $\Rightarrow \boxed{(\bar{C}+\bar{D})(B+\bar{C}) = Y}$

10. Obtain (a) Minimal Sum of product and (b) minimal Product of Sum expression for the given function
$F(A,B,C,D) = \Sigma m(0,2,3,6,7) + \Sigma d(8,10,11,15)$.

Soln

there is no POS expression So there will no POS terms.
<u>only SOP is possible for the given expression.</u>

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$ 00	1_{0}	0_{1}	1_{3}	1_{2}
$\bar{A}B$ 01	0_{4}	0_{5}	1_{7}	1_{6}
AB 11	0_{12}	0_{13}	X_{15}	0_{14}
$A\bar{B}$ 10	X_{8}	0_{9}	X_{11}	X_{10}

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

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

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

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ECE – A

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