Netaji Subhas Institute of Technology, Bihta, Patna

Department of Electrical & Electronics Engineering

B.Tech-3rd Sem.(session 2021-2022)

Digital electronics

Assignment-1

Sr.no.	Assignment questions	course outcome	Relevance to PO,PSO
1	Convert following numbers as specified a) (345)8=(----------)2 b) 11011101.1101=(----------)8 c) (673.23)8=(----------)16 d) (78.325)10=(----------)8 e) (198)10=(----------)16 f) (34B.C)16=(----------)8	CO1	PO1,PO2, PO3, PO10,PO12
2	Convert the following numbers from the given base do the bases indicated a) Decimal 225.225 to binary ,octal and hexadecimal. b) Binary 11010111.110 to decimal ,octal and hexadecimal. c) Octal 623.77 to decimal, binary and hexadecimal. d) Hexadecimal 2AC5.D to decimal ,octal and binary.	CO1	PO1,PO2, PO3, PO10,PO12
3	Express following functions in a sum of minterms and product of maxterms. a) F(A,B,C,)=A+B'C b) F(w,x,y,z)=y'z+wxy'+wxz'.+w'x'z	CO2	PO1,PO2, PO3,PO4 PO10,PO11,PO12
4	Design combinational circuit of A. full adder B. half adder.	CO2	PO1,PO2, PO3,PO4 PO10,PO11,PO12
5	State and prove D Morgan's theorem for two and three Boolean literals.	CO2	PO1,PO2, PO3,PO4 PO10,PO11,PO12

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Assignment Evaluation

1. Task Identification : 3/3
2. Formation of truth table : 3/3
3. Submission on time : 1/1
4. Design of circuit / Soln explanation : 2½
5. Originality. : 1/1

Total : 10/10.

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Name : Khushi
Roll no : 204001

Assignment

1) Convert the following numbers as specified.

(a) $(3485)_8 = (\quad)_2$

→ We write 3, 4 and 5 as —

3 = 011 ; 4 = 100 ; 5 = 101

$\therefore (345)_8 = (011100101)_2$

(b) 11011101.1101 = $(\quad)_8$

→ Arranging the binary no. as a collection of 3 bits —

011 011 101 . 110 100

↓ ↓ ↓ ↓ ↓

3 3 5 . 6 4

$\therefore$ 11011101.1101 = $(335.64)_8$

(c) $(673.23)_8 = (\quad)_{16}$

→ Converting octal to binary as —

$(673.23)_8 = (110111011.010011)_2$

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Now converting from binary to hexadecimal -

0001 1011 1011 . 0100 1100

↓ ↓ ↓ ↓ ↓

1 B B . 4 C

$\therefore (673.23)_8 = (1BB.4C)_{16}$

(d) $(78.325)_{10} = (\ )_8$

→

8	78	
8	9	→ 6
8	1	→ 1
	0	→ 1

$\therefore (78)_{10} = (116)_8$

0.325	0.600	0.800
× 8	× 8	× 8
2.600	4.800	6.400
↓	↓	↓
2	4	6

$\therefore (0.325)_{10} = (0.246)_8$

Hence, $(78.325)_{10} = (116.246)_8$ Ans

(e) $(198)_{10} = (\ )_{16}$

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→

2	198
2	99 → 0
2	49 → 1
2	24 → 1
2	12 → 0
2	6 → 0
2	3 → 0
2	1 → 1
	0 → 1

$\therefore (198)_{10} = (11000110)_2$

Now, grouping in 4 bits -

1100 0110

↓ ↓

C 6

$\therefore (198)_{10} = (C6)_{16}$

(f) $(34B.C)_{16} = (\quad)_8$

→ 3 = 0011 , 4 = 0100 , B = 1011 , C = 1100

Now, $(34B.C)_{16} = (001101001011.1100)_2$

converting binary to octal -

001 101 001 011 . 110 000

↓ ↓ ↓ ↓ ↓ ↓

1 5 1 3 6 0

$\therefore (34B.C)_{16} = (1513.60)_8$

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2.) Convert the following numbers from given base to the bases.

(a) Decimal 225.225 to binary, octal and hexadecimal.

$\longrightarrow (225.225)_{10} = (\quad)_2$

2	225	
2	112	$\to 1$
2	56	$\to 0$
2	28	$\to 0$
2	14	$\to 0$
2	7	$\to 0$
2	3	$\to 1$
2	1	$\to 1$
	0	$\to 1$

$(225)_{10} = (11100001)_2$

Now,

0.225	0.450	0.900	0.800
x 2	x 2	x 2	x 2
0.450	0.900	1.800	1.600
↓	↓	↓	↓
0	0	1	1

$\therefore (0.225)_{10} = (0.0011)_2$

Hence, $(225.225)_{10} = (11100001.0011)_2$ //

Now, $(225.225)_{10} = (\quad)_8$

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(ab) 011 100 001 . 001 100

3 4 1 1 4

$\therefore (225.225)_{10} = (341.14)_8$ //

Now, $(225.225)_{10} = (\quad)_{16}$

1110 0001 . 0011

E 1 . 3

$\therefore (225.225)_{10} = (E1.3)_{16}$ //

(b) Binary 11010111.110 to decimal, octal and hexadecimal.

→ $(11010111.110)_2 = (\quad)_{10}$

$(1 \times 10^7) + (1 \times 10^6)$

$(1 \times 2^7) + (1 \times 2^6) + (1 \times 2^4) + (1 \times 2^2) + (1 \times 2^1) + (1 \times 2^0) + (1 \times 2^{-1}) + (1 \times 2^{-2})$

$= 128 + 64 + 16 + 4 + 2 + 1 + 0.5 + 0.25$

$= 215.75$

$\therefore (11010111.110)_2 = (215.75)_{10}$ //

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Now, $(11010111.110)_2 = (\ )_8$

011 010 111 . 110

↓ ↓ ↓ ↓

3 2 7 . 6

$\therefore (11010111.110)_2 = (327.6)_8$ //

Now, $(11010111.110)_2 = (\ )_{16}$

1101 0111 . 1100

↓ ↓ ↓

D 7 C

$\therefore (11010111.110)_2 = (D7.C)_{16}$ //

(c) Octal 623.77 to decimal, binary and hexadecimal.

→ $(623.77)_8 = (\ )_{10}$

$(6 \times 8^2) + (2 \times 8^1) + (3 \times 8^0) + (7 \times 8^{-1}) + (7 \times 8^{-2})$

$= 384 + 16 + 3 + 0.875 + 0.109$

$= 403.984$

$\therefore (623.77)_8 = (403.984)_{10}$ //

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Now, $(623.77)_8 = (\quad)_2$

$6 = 110$, $2 = 010$, $3 = 011$, $7 = 111$.

$\therefore (623.77)_8 = (110010011.111111)_2$ //

Now, $(623.77)_8 = (\quad)_{16}$.

0001	1001	0011	.	1111	1100
↓	↓	↓		↓	↓
1	9	3	.	F	C

$\therefore (623.77)_8 = (193.FC)_{16}$

(d) Hexadecimal 2AC5.D to decimal, octal and binary.

→ $\therefore (2AC5.D)_{16} = (\quad)_{10}$.

$(2\times16^3) + (A\times16^2) + (C\times16^1) + (5\times16^0) + (D\times16^{-1})$

$= (2\times16^3) + (10\times16^2) + (12\times16^1) + (5\times16) + (13\times16^{-1})$

$= 8192 + 2560 + 192 + 5 + 0.8125$

$= (10949.8125)_{10}$

$\therefore (2AC5.D)_{16} = (10949.8125)_{10}$ //

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Now, $(2AC5.D)_{16} = (\quad)_2$

$2 = 0010$, $A = 1010$, $C = 1100$,
$5 = 0101$, $D = 1101$.

$\therefore (2AC5.D)_{16} = (0010\,1010\,1100\,0101.1101)_2$

$= (10101011000101.1101)_2$ //

Now, $(2AC5.D) = (\quad)_8$

010	101	011	000	101	.	110	100
↓	↓	↓	↓	↓		↓	↓
2	5	3	0	5		6	4

$\therefore (2AC5.D)_{16} = (25305.64)_8$ //

3. (a) $F(A, B, C) = A + B'C$.

$= AB'C' + AB'C + ABC' + ABC + A'B'C + AB'C$

$= m_4 + m_5 + m_6 + m_7 + m_1 + m_5$

$= \sum(1, 4, 5, 6, 7)$

And, $\sum(1, 4, 5, 6, 7) = \Pi(0, 2, 3)$

$= (A+B+C)\cdot(A+B'+C)\cdot(A+B'+C')$

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Truth table :-

i/p			o/p	
x	y	z	S	C
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

Expression of sum (S) :-

x \ yz	00	01	11	10
0		1		1
1	1		1	

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

Expression of carry (C) :-

x \ yz	00	01	11	10
0			1	
1		1	1	1

$C = xy + yz + zx$

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∴ Sum of minterms $= \sum(1, 4, 5, 6, 7)$

Product of maxterms $= \Pi(0, 2, 3)$

(b) $F(w, x, y, z) = y'z + wxy' + wxz' + w'x'z$

$= w'x'y'z + w'xy'z + wx'y'z + wxyz +$
$wxy'z' + wxyz' + wxy'z +$
$wxyz' + w'x'y'z + w'xyz$

$= m_1 + m_5 + m_9 + m_{15} + m_{12} + m_{13} +$
$m_{14} + m_3$

Sum of minterms $= \sum(1, 3, 5, 9, 12, 13, 14, 15)$

Product of maxterms $= \Pi(0, 2, 4, 6, 7, 8, 10, 11)$

$= (w+x+y+z) \cdot (w+x+y'+z) \cdot (w+x'+y+z) \cdot$
$(w+x'+y'+z) \cdot (w+x'+y'+z') \cdot (w'+x+y'+z) \cdot$
$(w'+x+y'+z) \cdot (w'+x+y'+z')$

4.) Design combinational circuit of
A.) Full Adder

→ In a full adder,
no. of i/p = 3 (x, y, z)
no. of o/p = 2 (S, C)

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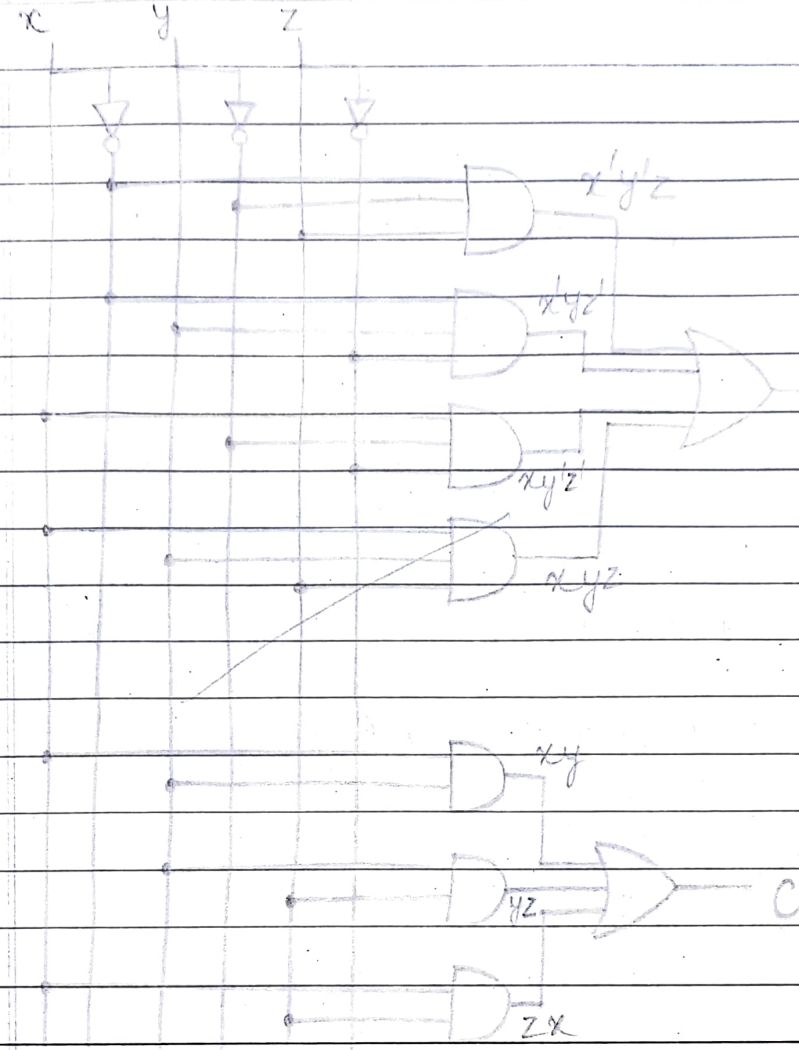
Circuit Implementation



B.) Half Adder

→ In a half adder,

No. of i/p = 2 (x, y)

No. of o/p = 2 (S, C)

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Truth table :-

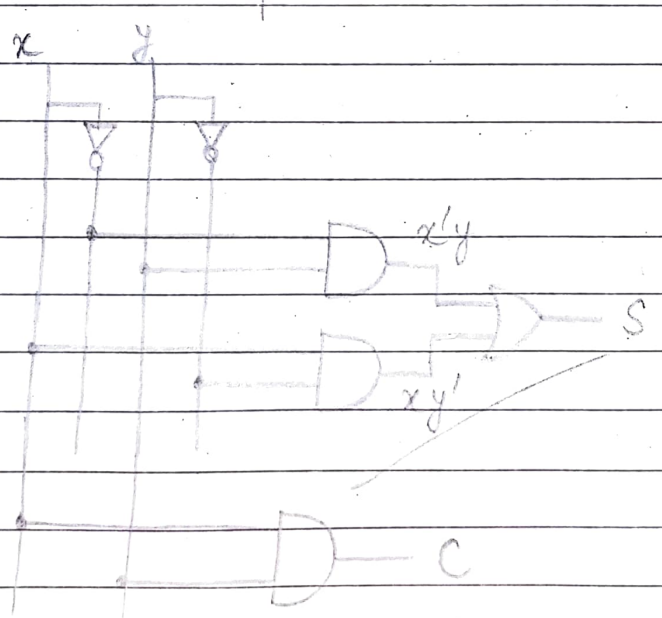
I/p		O/p	
x	y	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

∴ Expressions of Sum (S) and Carry (C) –

$$S = x'y + xy' = x \oplus y$$

$$C = xy$$

Circuit Implementation :-



5.) State and prove D'Morgan's theorem for two or more and three Boolean literals.

→ The D'Morgan's theorem states that

- When two or more variables are NOR'd together, the obtained result will be equal to AND of inverted variables.

$$\overline{A+B} = \overline{A} \cdot \overline{B}$$

$$\overline{A+B+C} = \overline{A} \cdot \overline{B} \cdot \overline{C}$$

- When two or more variables are NAND'd together, it is equivalent to OR of inverted variable.

$$\overline{A \cdot B} = \overline{A} + \overline{B}$$

$$\overline{A \cdot B \cdot C} = \overline{A} + \overline{B} + \overline{C}$$

Proof :-

(i) For two Boolean literals -

$$\overline{A+B} = \overline{A} \cdot \overline{B}$$

and, $A \cdot \overline{A \cdot B} = \overline{A} + \overline{B}$

A	B	(A+B)	$\overline{A+B}$	$\overline{A}$	$\overline{B}$	$\overline{A} \cdot \overline{B}$
0	0	0	1	1	1	1
0	1	1	0	1	0	0
1	0	1	0	0	1	0
1	1	1	0	0	0	0

Hence, $\overline{A+B} = \overline{A} \cdot \overline{B}$

Now,

A	B	A·B	$\overline{A \cdot B}$	$\overline{A}$	$\overline{B}$	$\overline{A} + \overline{B}$
0	0	0	1	1	1	1
0	1	0	1	1	0	1
1	0	0	1	0	1	1
1	1	1	0	0	0	0

Hence, $\overline{A \cdot B} = \overline{A} + \overline{B}$

(ii) For three Boolean literals —

A	B	C	A+B+C	$\overline{A+B+C}$	$\overline{A}$	$\overline{B}$	$\overline{C}$	$\overline{A} \cdot \overline{B} \cdot \overline{C}$
0	0	0	0	1	1	1	1	1
0	0	1	1	0	1	1	0	0
0	1	0	1	0	1	0	1	0
0	1	1	1	0	1	0	0	0
1	0	0	1	0	0	1	1	0
1	0	1	1	0	0	1	0	0
1	1	0	1	0	0	0	1	0
1	1	1	1	0	0	0	0	0

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Hence, $\overline{A+B+C} = \bar{A} \cdot \bar{B} \cdot \bar{C}$

Now,

A	B	C	$A \cdot B \cdot C$	$\overline{A \cdot B \cdot C}$	$\bar{A}$	$\bar{B}$	$\bar{C}$	$\bar{A}+\bar{B}+\bar{C}$
0	0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0	1
0	1	0	0	1	1	0	1	1
0	1	1	0	1	1	0	0	1
1	0	0	0	1	0	1	1	1
1	0	1	0	1	0	1	0	1
1	1	0	0	1	0	0	1	1
1	1	1	1	0	0	0	0	0

&

Hence, $\overline{A \cdot B \cdot C} = \bar{A} + \bar{B} + \bar{C}$ //

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