IDS (BEE01T1005)

1) which gates are called as the universal gates ? what are its advantage

⇒ The NAND and NOR gates are called as the universal gates.

Advantage:-

(i) These gates are easier to fabricate

(ii) It can implement any Boolean function without need of to use any other gate type

2) Explain classification of number system

Number System

Positional/weighted Number system	Non positional/Non weighted Number system
Decimal	Excess-3 code
Octal	Cyclic code
Binary	Roman code
Hexadecimal	Gray code.
BCD	

3) Explain about Diminished Radix complement.

⇒ Diminished radix complement ((r-1)'s complement):
If we give a number N in base-r having n digit the (r-1)'s complement is defined as

$$(r^n - 1) - N$$

Eg:-
Let us take N=1988 Here, r=10 and n=4, So 9's complement of 1988 is

$$9999 - 1998 = 8001$$

4) what is meant by parity bit?

⇒ A parity bit is a bit, with a value of 0 or 1, that is added to a block of data for error detection purpose

5) Define duality purpose?

⇒ Duality teach us that every aspect of life is created from a balanced interaction of opposite and competing forces.

(6) Perform (-50)-(-10) in binary using the signed-2's complement

⇒ ~~110010~~ ~~-1010~~

(7) Determine the value of base x if $(211)_x = (152)_8$

$$2x^2 + 1x^1 + 1x^0 = 1\times 8^2 + 5\times 8^1 + 2\times 8^0$$

$$2x^2 + 1x + 1 = 64 + 40 + 2$$

$$2x^2 + x + 1 = 106$$

$$2x^2 + x - 105 = 0$$

$$x_1 = 7 \checkmark$$

$$x_2 = -7.5 \times$$

[value of $x = 7$]

(8) Define Binary Logic?

⇒ Binary logic is the basis of electronic system such as computers and cell phone. It work on 0's and 1's. It involve addition, subtraction, multiplication & division. It include logic gate function

9) Convert the following number,

(i) $(163.789)_{10}$ to Octal number

$$\cancel{163.789 = (1\times 8^2) + (6\times 8^1) + (3\times 8^0) + (7\times 8^{-1}) + (8\times 8^{-2}) + (9\times 8^{-3})}$$

$$\cancel{64 + 4.8 + 3 + 7/8 + 1/8 + 9/8^3}$$

$$\cancel{115 + 8/8 + 9/8^3}$$

$$\cancel{116 + 9/8^3}$$

$$\cancel{116 + 9/512}$$

$$\cancel{\frac{59401}{512}} = 116.017$$

$\frac{163}{8} = 20$ remainder 3

$\frac{20}{8} = 2$ remainder 4

$\frac{2}{8} = 0$ remainder 2

163 decimal to octal number = 243

Now, for 0.789

$0.789 \times 8 = 6 + 0.312$

$0.312 \times 8 = 2 + 0.496$

$0.496 \times 8 = 3 + 0.968$

0.789 decimal to octal is 0.623

Therefore decimal number

$(163.789)_{10} = (243.623)_8$

(iii) $(11001101 \cdot 0101)_2$ to base 8 and base 1

⇒ For base 8

Convert binary to decimal

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

$128+64+8+4+1+ \frac{1}{4}+\frac{1}{16}$

$204+1+ \frac{5}{16}$

$205+\frac{5}{16}$

$(205\cdot 3125)_{10}$

Now convert decimal to octal

take 205

$\frac{205}{8} =$ 25 remainder 5

$\frac{25}{8} =$ 3 remainder 1

$\frac{3}{8} =$ 0 remainder 3

$(205)_{10} \longrightarrow (315)_8$

Now take 0.3125

$0.3125 \times 8 = 2 + 0.5$

$0.5 \times 8 = 4 + 0$

$(0.3125)_{10} = (0.24)_8$

So that

$(205.3125)_{10} \rightarrow (315.24)_8$

Now for base 4.
convert binary to decimal

$(1\times 2^7)+(1\times 2^6)+(1\times 2^3)+(1\times 2^2)+(1\times 2^0)+(1\times 2^{-2})+(1\times 2^{-4})$

$(205.3125)_{10}$

Now convert into base 4
first take 205

$\frac{205}{4}$ = 51 remainder 1

$\frac{51}{4}$ = 12 remainder 3

$\frac{12}{4}$ = 3 rem 0.

$\frac{3}{4}$ = 0 rem 3

$\Rightarrow (3031)_4$

Now for 0.3125

$0.3125 \times 4 = 1 + 25$

$0.25 \times 4 = 1.00$

$\Rightarrow (0.11)_4$

So;

$(11001101.0101)_2 = (3031.11)_4$

(iii) $(4567)_{10}$ to octal number

$$\begin{array}{r|l l}
8 & 4567 & 7 \\
8 & 57 & 1 \\
 & 7 &
\end{array}$$

$(4567)_{10} \rightarrow (717)_8$

(iii) $(4567)_{10}$ to base 2

$$\begin{array}{r|l l}
2 & 4567 & 1 \\
2 & 2283 & 1 \\
2 & 1141 & 1 \\
2 & 570 & 0 \\
2 & 285 & 1 \\
2 & 142 & 0 \\
2 & 71 & 1 \\
2 & 35 & 1 \\
2 & 17 & 1 \\
2 & 8 & 0 \\
2 & 4 & 0 \\
2 & 2 & 0 \\
 & 1 &
\end{array}$$

$\Rightarrow (1000111010111)_2$

(IV) $(4D.56)_{16}$ to binary

4	D	5	6
8 4 2 1	8 4 2 1	8 4 2 1	8 4 2 1
0 1 0 0	1 1 0 1	0 1 0 1	0 1 1 0

01001101.01010110

(10) (a) $(2ED)_{16} = (\ )_8 = (\ )_2$

⇒ 2ED conver to binar

2 E D

8421 8421 8421

0010 1110 1101

$(001011101101)_2$

Now binary to octal

001 011 101 101

421 421 421 421

1 3 5 5

$(1355)_8$

(b) $(250.5)_{10} = (\ )_8 = (\ )_4$

⇒ $\frac{250}{8} = 31$ remainder 2

$\frac{31}{8} = 3$ remainder 7

$\frac{7}{8} = 0$ remainder 7

now for 0.5

$0.5 \times 8 = 4 + 0.0$

$(772.4)_8$

⇒ $\frac{250}{4} = 62$ remain 2

$0.5 \times 4 = 2 + 0.0$

$\frac{62}{4} = 15$ remain 2

$\frac{15}{4} = 3$ rem 3

$\frac{3}{4} = 0$ rem 3

$(33 22.2)_4$

(a) $(516)_7 = (\ )_{10} = (\ )_{16}$

$\Rightarrow (516)_7 \rightarrow (5\times7^2) + (1\times7^1) + (6\times7^0)$

$(5\times49) + (7) + (6)$

$245 + 13$

$(268)_{10}$

Now decimal to hexadecimal

16	268	12
16	16	0
	1	

1 0 12 → C

[10C]

11) Represent the decimal number 3452 in
(i) BCD (ii) Excess 3

(i) 3452 in BCD is:

3	4	5	2
8 4 2 1	8421	8421	8421

$(0011010001010010)_{BCD}$

(ii) for excess 3 add 0011 in BCD

0011010001010010
0011

~~0011010001111~~

0110100001010101

12) State and explain demorgan's theorem.

⇒ DeMorgan's theorem states that inverting the output of any gate results in same function as opposite type of gate (AND vs. OR) with two inverted variables A and B.
It is use to solve Boolean Algebra expression. it perform gate operation like NAND gate and NOR gate.

13) Evaluate $(192)_{12} + (12121)_3 = (?)_8$

Convert it into decimal

$(192)_{12} = (1\times12^2) + (9\times12^1) + (2\times12^0)$
$144 + 108 + 2$
$(254)_{10}$

$(12121)_3 = (1\times3^4) + (2\times3^3) + (1\times3^2) + (2\times3^1) + (1\times3^0)$
$81 + 36 + 9 + 6 + 1$
$(133)_{10}$

$254 + 133 = (387)_{10}$

8) 387 (48
32
67
64
3

8	387	3
8	48	0
	6	

$\Rightarrow (603)_8$

(14) Define Associative law and distributive la

⇒ In Associative law, either of two law relating to number operation of addi and multiplication

$$(a+b)+c = a+(b+c)$$

and, $a(bc) = (ab)c$

The law relating the operation of multip and addition.

$$a(b+c) = ab+ac)$$

(15) Convert the following number.

(a) $(163.789)_{10}$ to octal number and Hexadecimal number

⇒ $\frac{163}{8} = 20$ remainder 3

$\frac{20}{8} = 2$ remainder 4

$\frac{2}{8} = 0$ remainder 2 ⇒ $(243)_8$

for 0.789

$0.789 \times 8 = 6 + 0.312$

$0.312 \times 8 = 2 + 0.496$

$0.496 \times 8 \quad 3 + 0.968$ ⇒ $(0.623)_8$

⇒ $(243.623)_8$

$$\begin{array}{r|l} 16 & 163 \quad 3 \\ & 10 \end{array}$$

10 3

$(A3)_{16}$

$0.789 \times 16 = 12 + 0.624$
$0.624 \times 16 = 9 + 0.984$
$0.984 \times 16 = 15 + 0.744$

12 9 15
C 9 F

$\Rightarrow \boxed{A3.C9F}_{16}$

(16). Give the two binary number X = 1010101 and Y = 1001011, perform the subtraction X − Y using 2's complements.

⇒ 2's Complement of 1001011

```
  1111111
  1001011
  -------
  0110100  — 1's compleent
       +1
  -------
  0110101  → 2's compleet
```

$X - Y = (1010101 + 0110101)$

```
  1010101
  0110101
  --------
 10001010
```

(17) Subtract (111001) from (101011) using 2's complement?

$\Rightarrow$ 101011 → for 1's complement

$$\begin{array}{r} 111111 \\ -\ 111001 \\ \hline 000110 \end{array} \rightarrow 1's$$

$$\begin{array}{r} +1 \\ \hline 000111 \end{array} \rightarrow 2's$$

~~(101011) - (111001)~~

$(101011) + (000111) =$

$$\begin{array}{r} 101011 \\ +\ 000111 \\ \hline 110010 \end{array}$$

(18) Evaluate $(103)_4 + (507)_7 = (\ )_9$

Convert 103 and 507 into decimal.

$(103)_4 = (1 \times 4^1) + (3 \times 4^0)$

$4 + 3 = \underline{7}$

$(507)_7 = (5 \times 7^1) + (7 \times 7^0)$

$35 + 7 = \underline{42}$

$(7)_{10} + (42)_{10} = (49)_{10}$

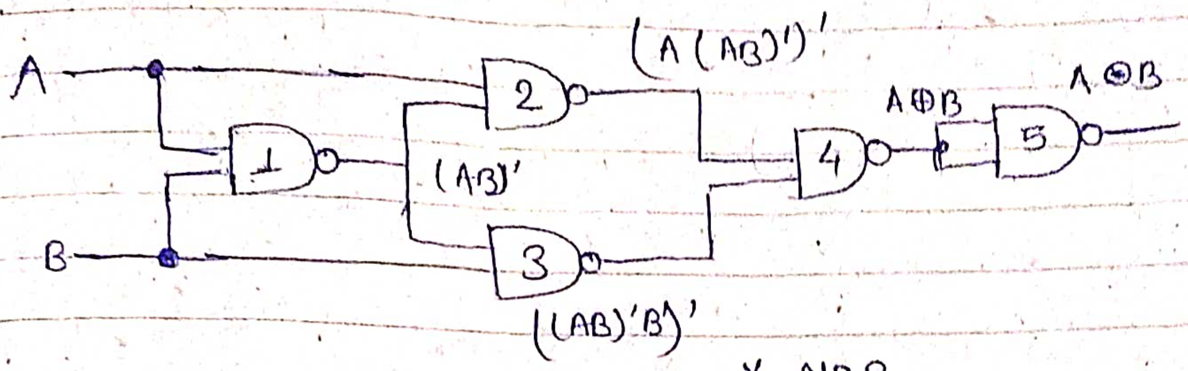
$(49)_{10} \rightarrow (\ )_9$

$9 \,|\, \underline{49}\ \ 4$
$\quad 5$

$(49)_{10} = (54)_9$

(19) Realize 2 input X-NOR gate using NAND gate only

=>



X-NOR

20

(21) Multiply these number in the given base without converting to decimal

(a) $(135)_6$ and $(43)_6$

$$\begin{array}{r} 135 \\ \times\ 43 \\ \hline 453 \\ 632\ \ \\ \hline 11213 \end{array}$$

$15 = 2 \times 6 + 3$
$11 = 1 \times 6 + 5$
$20 = 3 \times 6 + 2$
$15 = 2 \times 6 + 3$

$7 = 1 \times 6 + 1$
$8 = 1 \times 6 + 2$
$7 =$

(b) $(121)_3$ and $(12121)_3$

$$\begin{array}{r} 12121 \\ \times\ 121 \\ \hline 12121 \\ 222002\ \ \\ 12121\ \ \ \ \\ \hline 21022001 \end{array}$$

1002211

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

22) Design the circuit by using NAND gates.

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

$\Rightarrow$ ~~Point;~~

~~$f = ABC' + A'B(C+C')$~~ $(C+C'=1)$

$\Rightarrow f = ABC' + A'B(C+C') + AB'C' + AC'(B+B')$ $(x+x'=1)$

$f = ABC' + A'BC + A'BC' + AB'C' + ABC' + AB'C'$

$f = ABC' + A'BC + A'BC' + AB'C'$ $[x+x=x]$

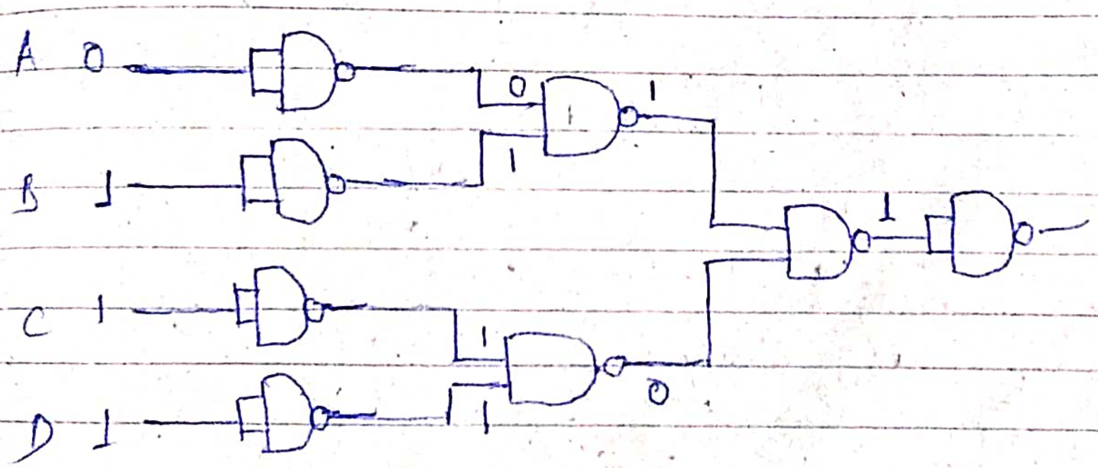
Now

$f = m_6 + m_3 + m_2 + m_4$

$\Sigma(2,3,4,6)$

Complement of f

$f' = \Sigma(0,1,5,7)$



23) Prove that

$AB + B'C + AC = AB + B'C$

$AB(C+C') + (A+A')BC + AC(B+B') = AB(C+C') + (A+A')B'C$

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

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

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

24) prove that:

(a) $AB + B'C + AC = AB + B'C$

$\Rightarrow AB(C+C') + (A+A')B'C + AC(B+B') = AB(C+C') + (A+A')B'C$

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

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

~~proved~~ proved.

(c) $(A+B)'(A'+B')' = 0$

$(A+B)' = A'B'$ (De morgan's law)

$(A'+B')' = AB$ (Demorgan's law)

$(A'B')(AB) = \cancel{(AA')(BB')}\ 0$

$(AA')(BB') = 0$ $\left[\begin{array}{l} AA' = 0 \\ BB' = 0 \end{array}\right]$

$0 = 0$

proved.

$4 \times 4 = 16 \rightarrow$

(25) using 10's complement perform $(4572)_{10} - (2102)_{10}$

(10's = 9's + 1)

for 9's

$$\begin{array}{r} 9999 \\ -\ 2102 \\ \hline 7897 \end{array} \rightarrow 9\text{'s}$$

~~Addition~~ Add 1 in 7897 for 10's

$7897 + 1 = 7898$ ↳ 10's

$$\begin{array}{r} 4572 \\ +\ 7898 \\ \hline 12470 \end{array}$$

drop carry

$\Rightarrow 2470$

(26) Multiply the $(267)_8$ and $(71)_8$ in the given base without converting to decimal.

$$\begin{array}{r} 267 \\ \times\ 71 \\ \hline 267 \\ 2401\ \ \\ \hline 24277 \end{array}$$

$49 = 6 \times 8 + 1$

$48 = 6 \times 8 + 0$

$20 = 2 \times 8 + 4$

=

8

(27) Evaluate $(103)_4 + (50)_7 = ( )_9$

$\Rightarrow$ First convert both in decimal

$(103) = (1 \times 4^2) + (3 \times 4^0)$
$16 + 3 = 19$

$(50)_7 = 5 \times 7^1 = 35$

$19 + 35 = (54)_{10}$

$9 \,|\, 54 \quad 0$
$\;\;|\; 6$

$(54)_{10} = (60)_9$

(28) Determine the value of base b if

$(211)_b = (152)_8$

$(2 \times b^2) + (1 \times b^1) + (1 \times b^0) = (1 \times 8^2) + (5 \times 8^1) + (2 \times 8^0)$
$2b^2 + b + 1 = 64 + 40 + 2$
$2b^2 + b = 106 - 1$
$2b^2 + b - 105 = 0$

$(2b + 15)(b - 7) = 0$
$b = 7.5$ ✗
$b = 7$ ✓

$b = 7$.

29) Demonstrate by mean of truth table the validity of the distributive law of +over.

⇒ this law state that:

~~① A(B+C) = AB+AC~~

① $A+BC = (A+B)\cdot(A+C)$

A	B	C	BC	A+(B·C)
1	1	1	1	1
1	1	0	0	1
1	0	1	0	1
1	0	0	0	1
0	1	1	1	1
0	01	0	0	0
0	0	1	0	0
0	0	0	0	0

(30) Show that the NOR and NAND operator are not associative.

⇒ For NOR

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

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

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

LHS ≠ RHS

For NAND.

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

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

$$AB+C = A+BC$$

LHS ≠ RHS

Since it is also not associative