DIGITAL ELECTRONICS

1)

a) $(340)_{10}$ convert into binary $(?)_2$?

Sol

$$
\begin{array}{r|l}
2 & 340 \\
\hline
2 & 170 - 0 \\
\hline
2 & 85 - 0 \\
\hline
2 & 42 - 1 \\
\hline
2 & 21 - 0 \\
\hline
2 & 10 - 1 \\
\hline
2 & 5 - 0 \\
\hline
2 & 2 - 1 \\
\hline
 & 1 - 0
\end{array}
$$

$= (340)_{10} = (101010100)_2$.

b) $(22.44)_{10}$ convert into Hexadecimal Number $(?)_{16}$

base number - $(22)_{10}$

$$
= \begin{array}{r|l}
16 & 22 \\
\hline
16 & 16 - 6 \\
\hline
 & 1 - 0
\end{array}
$$

decimal $= (0.44) \times 16$ =

$$
\begin{array}{r|l}
0. & 44 \times 16 \\
7 & .04 \times 16 \\
0 & .64 \times 16 \\
10 & .24 \times 16 \\
3 & .84 \times 16 \\
13 & .44
\end{array}
$$

=

$\therefore (22.44)_{10} = (16.70A3)_{16}$.

c) Explain De-Morgan Theorum?

Ans De-Morgan's Theorum are two fundamental rules in Boolean Algebra that relate AND, OR & NOT operation. They state that complement of conjuction $(\overline{A \cdot B})$ is the disjunction of complements $(\overline{A} + \overline{B})$ & complement of disjunction $(\overline{A + B})$ is conjunction of complement $(\overline{A} \cdot \overline{B})$.

function of $(A,B,C,D) \cdot \Sigma(1,3,4,6,8,10,11,13,15)$

AB \ CD	00	01	11	10
00		1	1	
01	1			1
11		1	1	
10	1		1	1

i) $\bar{A}\bar{B}\bar{C}D$
$\bar{A}\bar{B}CD$
$\bar{A}\bar{B}D$

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

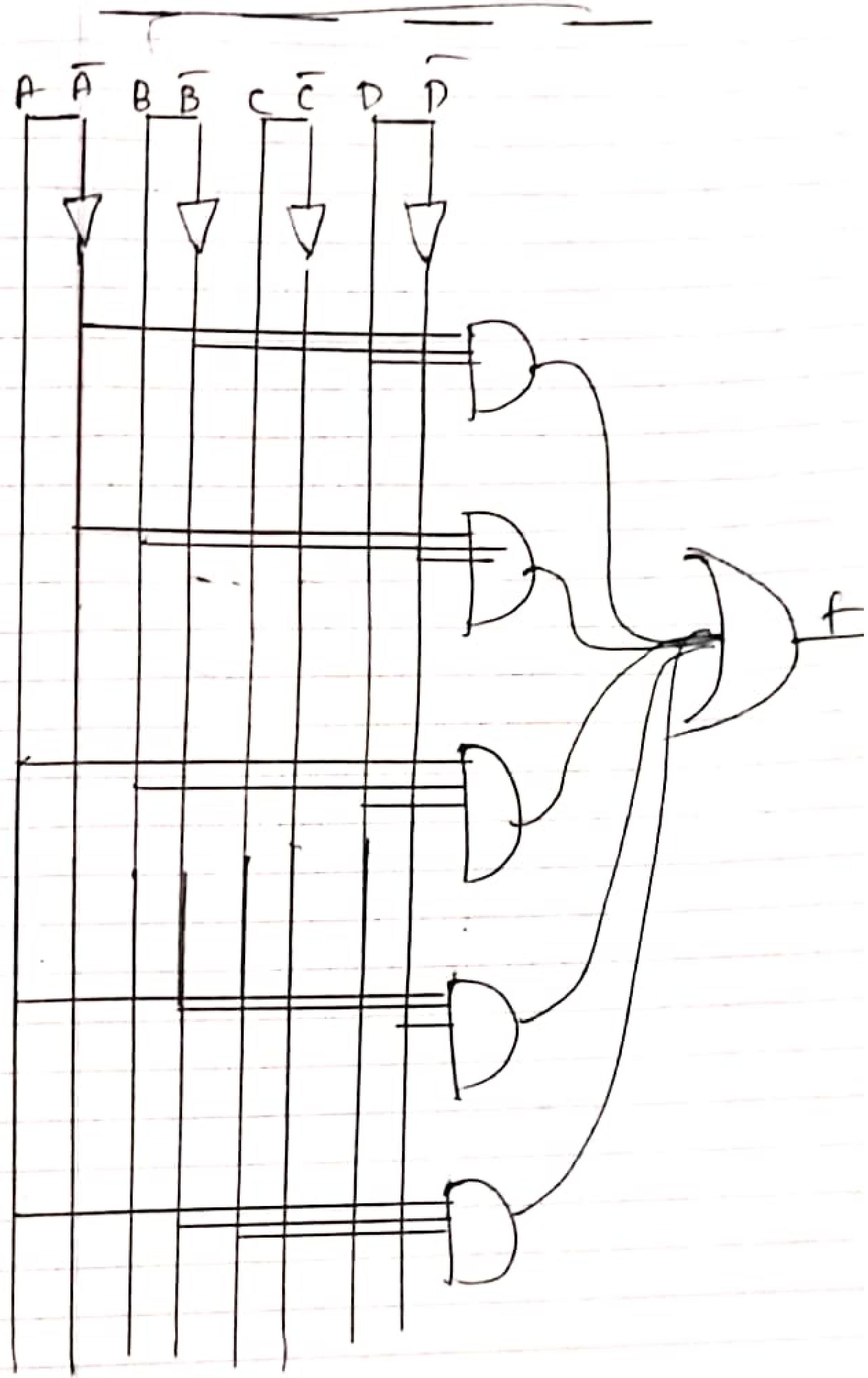
iii) $AB\bar{C}D$
$ABCD$
ABD

iv) $A\bar{B}\bar{C}\bar{D}$
$A\bar{B}C\bar{D}$
$A\bar{B}\bar{D}$

v) $A\bar{B}CD$
$A\bar{B}C\bar{D}$
$A\bar{B}C$

function of ABCD =

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



3) Explain Full Subtraction with logic circuits

An

Full Substractor:- A full substractor is a combinational logic circuit that performs the subtraction of three input bits: the minuend (A), the subtrahend (B) & Borrow-in (B_{in}) from previous stage. It produces two outputs: the Difference (D) & Borrow-out (B_{out})

Truth Table:- The operation of Full Substractor can be summar in following

A	B	C	Difference	Borrow
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

Output Equations

(37)

By analysing the truth table, the simplified Boolean expression for Difference (D) and Borrow-out (B_{out}) can be derived using methods like K-Maps (or) algebraic manipulation.

Difference (D):- The difference output (D) is high when an odd number of inputs are high. This is defination of EX-OR (or) XOR function for three variables

$$\boxed{D = \bar{A}\bar{B}B_{in} + \bar{A}B\bar{B}_{in} + A\bar{B}\bar{B}_{in} + ABB_{in}}$$

(or)

$$\boxed{D = A \oplus B + B_{in}.}$$

~~Outp~~ Borrow (B):- The Borrow-out output is high when a borrow is required from next stage. This occurs when $\bar{A}$ is high & substraction of B and Bin from A result in need for borrow

$$\boxed{B = \bar{A}\bar{B}B_{in} + \bar{A}B\bar{B}_{in} + \bar{A}BB_{in} + ABB_{in}}$$

(or)

$$\boxed{B = A(B_{in} + B) + BB_{in}}$$

* Logic Circuit Implementation:- The full substractor can be implemented using basic logic gates (AND, OR, NOT) based upon derived Boolean expression.

Difference(D): Requires two XOR gates to achieve the triple-XOR function

Borrow: Requires combination of AND, NOT and OR gates to implement $\bar{A}B_{in} + \bar{A}B + AB_{in}$

* Example:

Let us take an example where A, B, C inputs are 0, 1, 0 respectively.

The full substractor determines the Difference (D) and Borrow (B) based on input equation

1) Difference: $D = A \oplus B \oplus B$

$\rightarrow D = 0 \oplus 1 \oplus 0$

$\rightarrow 0 \oplus 1 = 1$

$\rightarrow 1 \oplus 0 = 1$

$\rightarrow$ Result Difference (D) is 1

2) Borrow: $B = \bar{A}B + \bar{A}B + BB_{in}$

$\rightarrow$ substitute valus

$B = (\bar{0} \cdot 1) + (\bar{0} \cdot 0) + (1 \cdot 0)$

$B = (1 \cdot 1) + (1 \cdot 0) + 0$

$B = 1 + 0 + 0 = 1$

$\rightarrow$ Borrow $= 1$

The operation is conceptually 0, 1, 0. Since, you cannot substract 1 from 0, you must borrow 1 from next column (A) which changes A to 10_2. The calculation then becomes $2-1-0=1$. The borrow itself is passed to next stage as $B=1$

6a) Convert $(1010110110)_2$ into Gray code?

Given $(1010110110)_2$

$\rightarrow (1111101101)$ grey.

b) Minimise Function $(A, B, C) = \Sigma(0,2,4,7)$ minimise the POS form with circuit diagram.

A \ BC	00	01	11	10
0	0			0
1	0		0	

$=$ ① $A+B+C$

$\bar{A}+B+C$

$B+C$

② $A+\bar{B}+C$

$A+B+C$

$A+C$

~~$A+\bar{B}C$~~

$A+\bar{B}+C$

③ $\bar{A}+B+\bar{C}$

~~$\bar{A}+\bar{B}+C$~~

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

Diagram

c) Explain Half Adder?

Ans A half adder is a combinational digital electronic circuit that performs the addition of two single binary digits, producing sum and carry-out bit.

★ Objectives

1) Write Excess 3 code for 8 is

a) 4 b) 5 c) 10 d) 11

2) Convert the 10101101 into 2's Complement's number

a) 10011011 b) 10110111

c) 01010011 d) 01011110

3) Min-terms and Max-terms of 1010

a) ABCD and A+B+C+D b) AB'CD' and A+B'+C+D'

c) AB'CD' and A+B'+C'+D d) AB'CD' and A+B+C+D

4) Convert $(84)_{16}$ to binary $(?)_2$

a) 1010100 b) 1010101 c) 10101110 d) 1010000

5) Write Boolean Expression for XOR

a) $A \oplus B = A'B + AB'$ b) $A+B = A'B' + AB$

c) $A \cdot B = A'B' + AB$ d) $A+B = A'B + AB'$

* Fill In Blanks

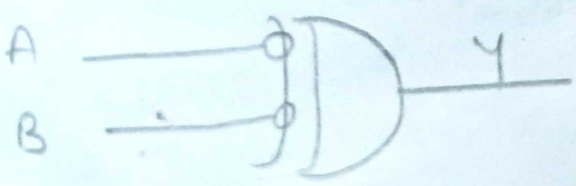
6) Define K-Map? A K-Map (Karnaugh) Map is graphical method for simplifying Boolean algebraic expression

7) What are special Gates and truth-tables? A special gate is that performs unique operation beyond basic logic functions

i) XOR Gate:

A B	Y
0 0	0
0 1	1
1 0	1
1 1	0

ii) XNOR Gate:



A B	Y
0 0	1
0 1	0
1 0	0
1 1	1

8) Convert $(255)_{10}$ to hexadecimal

$= (255)_{10} \longrightarrow (?)_{16}$

$$16 \,\underline{|\, 255}$$
$$\quad 15 - 15$$

According to conversions

$15 = F$

$= 15 - 15 = FF$

$\therefore (255)_{10} \longrightarrow (FF)_{16}$.

9) What is combinational circuit - A combinational circuit is a digital circuit where the output depends only on current input values.

10) What is magnitude comparator - A magnitude comparator is a digital circuit that compares the magnitude of two binary numbers.