31 May

Chapter 2

Boolean Logic

Notes

1) Boolean logic : It is important for computer science because ~~if~~ it fits with binary number system in which each bit has the value of 0 ~~on~~ or 1.

2) Logic Gates : It is an electronic circuit which operates on one or more input signals to produce an output signal.

3) Truth table : It is a tabular representation of all the combinations of values for inputs and their corresponding output.

4) NOT Gate (Inverter gate) : It is a gate with only one input and only one output signal. The output is always opposite of input.

$Y = \overline{X}$

Truth table

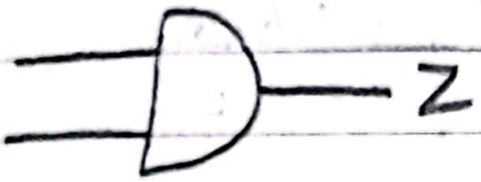
X	$Y = \overline{x}$
0	1
1	0

5) <u>OR gate</u> : It has two or more input signals but only one output signal. If any one of the input signal is 1, Then the output signal is always 1.

$Z = X + Y$

Input		Output
X	Y	$Z = X + Y$
0	0	0
0	1	1
1	0	1
1	1	1

6) <u>AND gate</u>: It has two or more input signals but only one output signal. If all the input signals are 1, Then the output signal will be 1. Otherwise it will be 0.

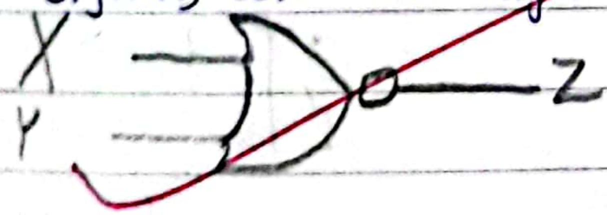


$Z = X \cdot Y$

X	Y	$Z = X \cdot Y$
0	0	0
0	1	0
1	0	0
1	1	1

7) NOR gate (NOT + OR)

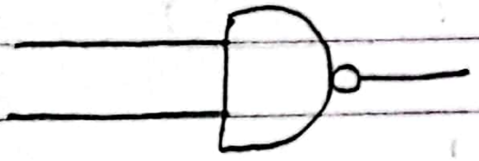
It has two or more input signals but only one output signal. If all the inputs ~~is~~ are low then the output signals will be high.



Truth Table

Input		Output
X	Y	X+Y
0	0	1
0	1	0
1	0	0
1	1	0

8) **NAND gate (NOT+ AND)** : It has two or more input signals but only one output signal. If all the inputs are high, then the output will be low.



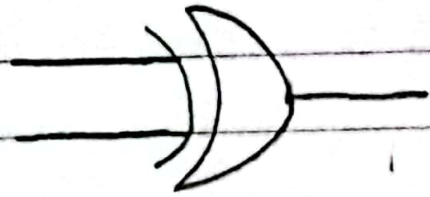
$C = \overline{X \cdot Y}$

X	Y	X NAND Y
0	0	1
0	1	1
1	0	1
1	1	0

9) <u>XOR Gate</u>: XOR gate produces output 1 for only those input combinations that have odd number of once.

x

y



X	Y	X XOR Y
0	0	0
0	1	1
1	0	1
1	1	0

10) <u>De Morgan's Law</u>: De Morgan's states that

i) $\overline{XY} = \overline{X} + \overline{Y}$

ii) $\overline{X+Y} = \overline{X} \cdot \overline{Y}$

Proving $\overline{XY} = \overline{x} + \overline{Y}$

X	Y	X.Y	$\overline{XY}$	$\overline{X}$	$\overline{Y}$	$\overline{X}+\overline{Y}$
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
			LHS			RHS

LHS = RHS

Proving $\overline{X+Y} = \overline{X} \cdot \overline{Y}$

X	Y	X+Y	$\overline{X}$	$\overline{Y}$	$\overline{XY}$
0	0	1	1	1	1
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	0
		LHS			RHS

LHS = RHS

) Prove the following boolean expressions using truth table

i) $x + \overline{X}Y = X + Y$

X	Y	$\overline{X}$	$\overline{X}.Y$	$X+\overline{X}Y$	$X+Y$
0	0	1	0	0	0
0	1	1	1	1	1
1	0	0	0	1	1
1	1	0	0	1	1
				LHS	RHS

RHS = LHS

ii) $A + \overline{A}\overline{B} = A + \overline{B}$

A	B	$\overline{A}$	$\overline{B}$	$\overline{A}\,\overline{B}$	$A+\overline{A}\overline{B}$	$A+\overline{B}$
0	0	1	1	1	1	1
0	1	1	0	0	0	0
1	0	0	1	0	1	1
1	1	0	0	0	1	1
					LHS	RHS

iii) $(X+Y)(X+Z) = X+YZ$

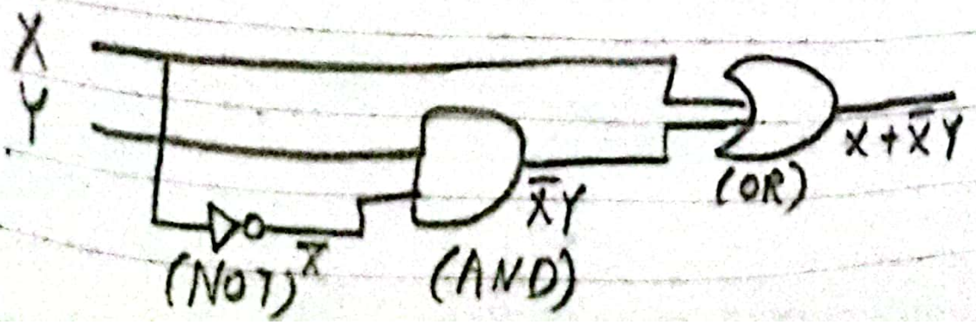
X	Y	Z	X+Y	X+Z	(X+Y)(X+Z)	YZ	X+YZ
0	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0
0	1	0	1	0	0	0	0
0	1	1	1	1	1	1	1
1	0	0	1	1	1	0	1
1	0	1	1	1	1	0	1
1	1	0	1	1	1	0	1
1	1	1	1	1	1	1	1
					LHS		RHS

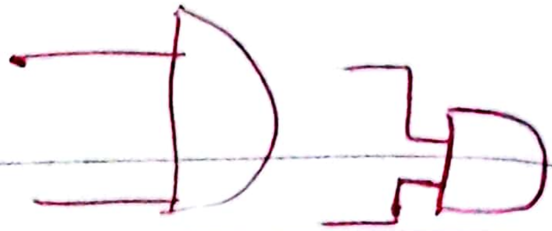
LHS = RHS

11) Logic Circuits : It's a diagram used to represen[t] boolean logic gates. The diagram is known as logic Circuits.

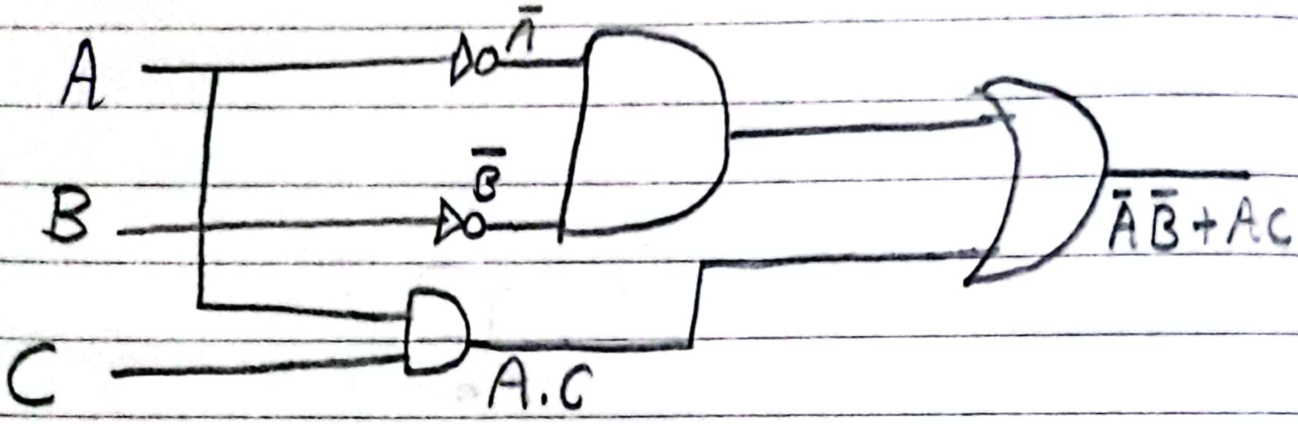
12) Draw the logic circuit of following questions.

i) $X+\bar{X}Y$

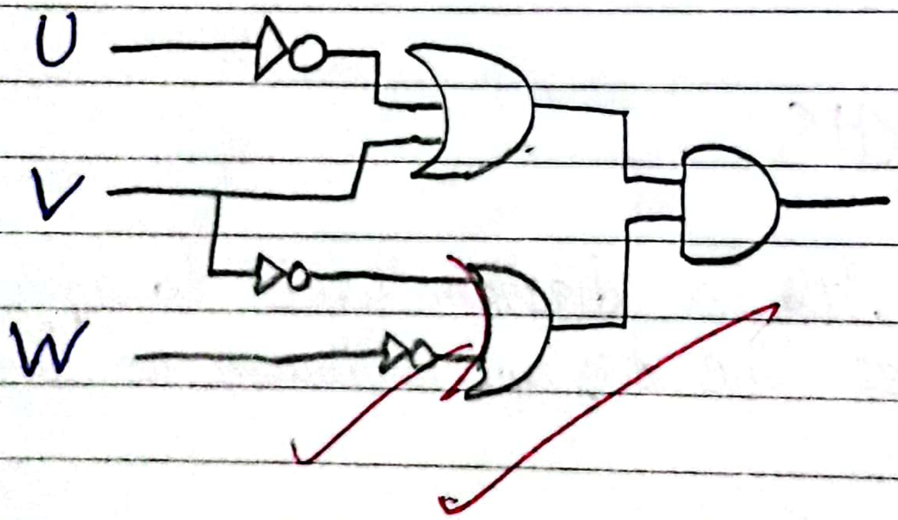


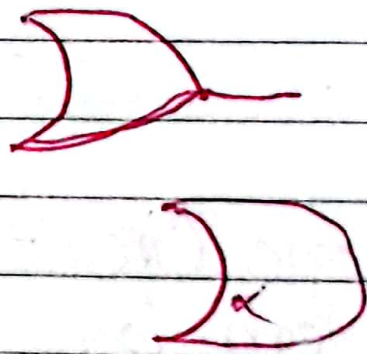


ii) $\overline{A}\,\overline{B} + AC$

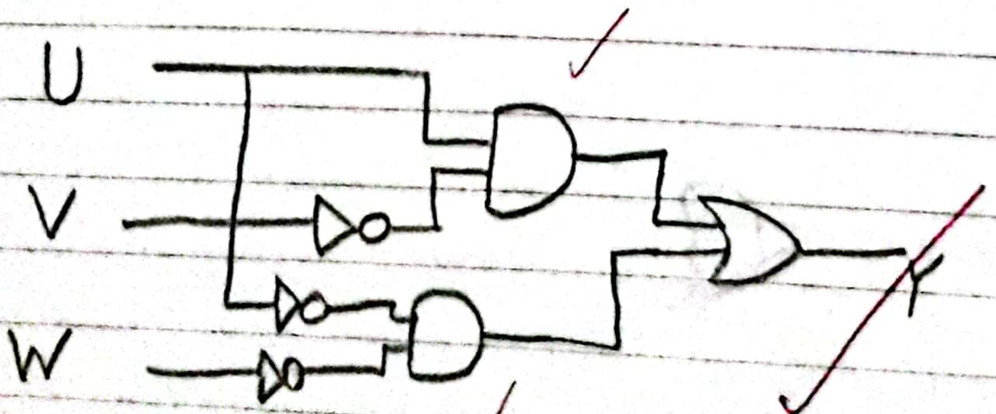


iii) $(\overline{U}+V)\cdot(V'+W')$





iv) $Y = (U.\overline{V}) + (\overline{U}.\overline{W})$



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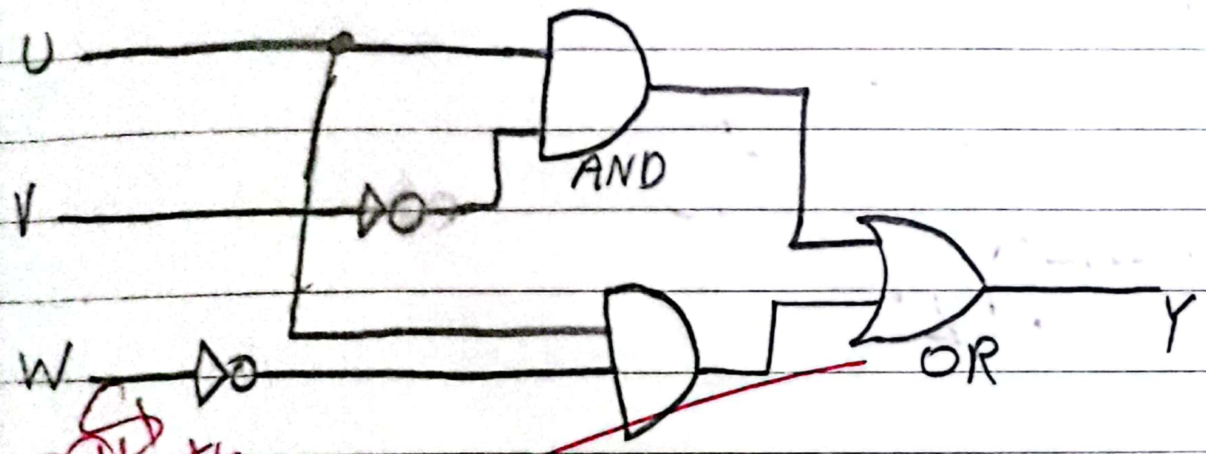
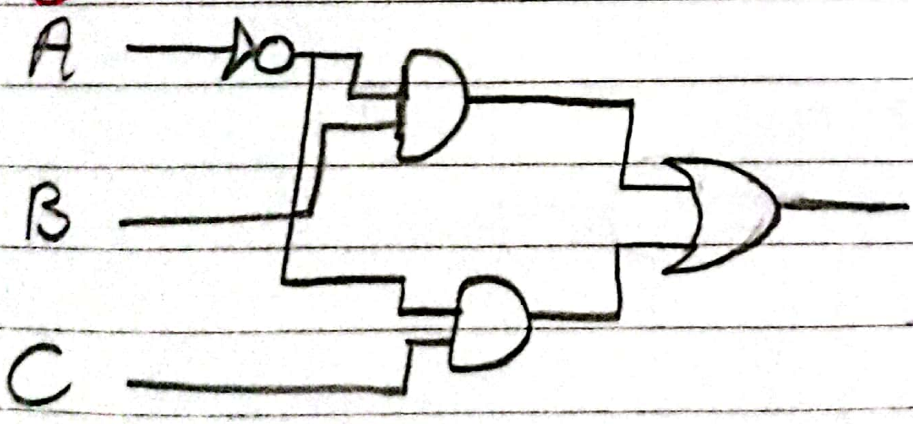
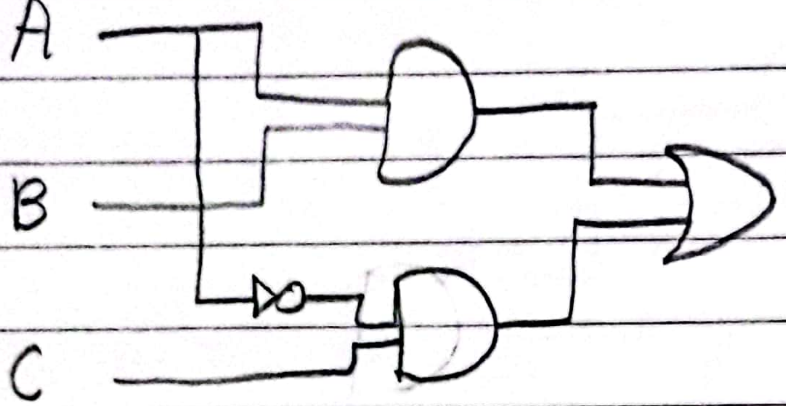
v) $Y = (U \cdot \overline{V}) + (\overline{U} \cdot \overline{W})$



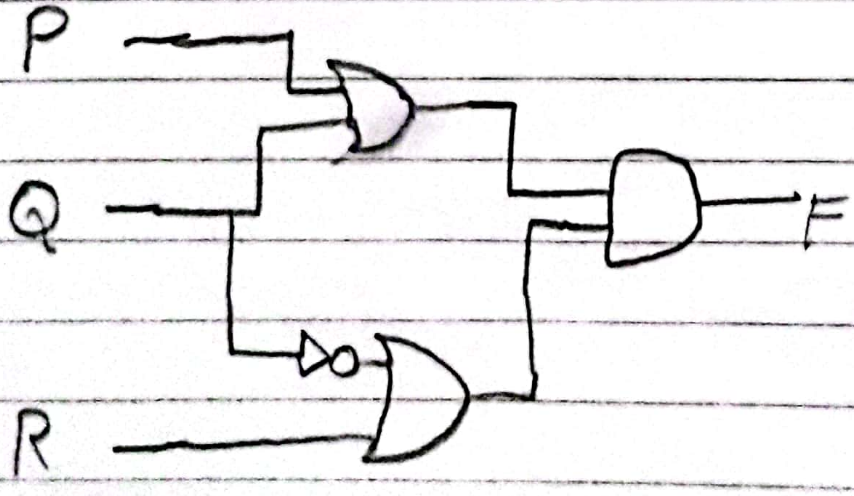
vi) $A'B + A'C$



vii) $AB + \bar{A}C$



viii)



$(P+Q)\cdot(\bar{Q}+R) = F$