Assignment-4
(Logic and Boolean Algebra)

Name :- Deepanshi
Email ID :- d.807@mybvc.ca
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For question 1 to 5, please consider the following sets:

$A = \{3,5,7,9\}$
$B = \{2,4,6,8,10\}$
$C = \{12,14,18,20,24\}$
$D = \{21,26,31,36\}$
$E = \{a,b\}$
$U = \{1,2,3,4,5,6,7,8,9,10\}$ (Universal Set)

Ques-1 Of which set(s) are the number 3 and 8 an element?

Ans 1

For Number 3 :-

This is an element of set(s) A and U

Set $A = \{3,5,7,9\}$

and

Set $U = \{1,2,3,4,5,6,7,8,9,10\}$

For Number 8 :-

This is an element of set(s) B and U

Set $B = \{2,4,6,8,10\}$

and

Set $U = \{1,2,3,4,5,6,7,8,9,10\}$

Ques2 Is the number $4 \in B$ and Is the number $26 \in C$?

Ans 2

Check whether $4 \in B$ or not :-

$$\text{Set } B = \{2, 4, 6, 8, 10\}$$

Yes, the number/element belongs to B

check whether $26 \in C$ or not :-

$$\text{Set } C = \{12, 14, 18, 20, 24\}$$

NO, the number/element belongs to C

$$26 \notin C$$

Ques 3 What are all subsets for set E?

Ans 3

$$E = \{a, b\}$$

The set $\{a, b\}$ has two (2) elements so there are

$2^2 = 4$ possible subsets, including the empty set and the set itself.

Subsets are :-

$$\phi, \{a\}, \{b\}, \{a, b\}$$

Ques 4:- What is $\bar{A}$?

Ans 4

To find complement of A, we subtract the elements of set A from Universal set

$$\bar{A} = U - A$$

$\bar{A} = U - A$

$= \{1,2,3,4,5,6,7,8,9,10\} - \{3,5,7,9\}$

Ans: $\bar{A} = \{1,2,4,6,8,10\}$

$\bar{A} = \{1,2,4,6,8,10\}$

Q-5 What is $(\overline{A \cap B}) \cup D$?

Soln

$A = \{3,5,7,9\}$

$B = \{2,4,6,8,10\}$

$D = \{21, 26, 31, 36\}$

$U = \{1,2,3,4,5,6,7,8,9,10\}$

$A \cap B = \{3,5,7,9\} \cap \{2,4,6,8,10\}$

$A \cap B = \phi$

$\overline{A \cap B} = U - (A \cap B)$

$= \{1,2,3,4,5,6,7,8,9,10\} - \phi$

$(\overline{A \cap B}) = \{1,2,3,4,5,6,7,8,9,10\}$

$(\overline{A \cap B}) \cup D = \{1,2,3,4,5,6,7,8,9,10\} \cup \{21,26,31,36\}$

Ans: $(\overline{A \cap B}) \cup D = \{1,2,3,4,5,6,7,8,9,10,21,26,31,36\}$

Q-6 Write out the truth table for the expression $(A \cap B) \cup (\sim A \cap B)$

Sol^n 6:- Intersection :- AND (Conjunction)
Union :- OR (Disjunction)
NOT ∩A → complement

Ans →

A	B	A∩B	∩A	∩A∩B	(A∩B) ∪ (∩A∩B)
F	F	F	T	F	F
F	T	F	T	T	T
T	F	F	F	F	F
T	T	T	F	F	T

Q^n 7 Find a Boolean table for $(A \cdot B) + (\bar{A} \cdot B)$?

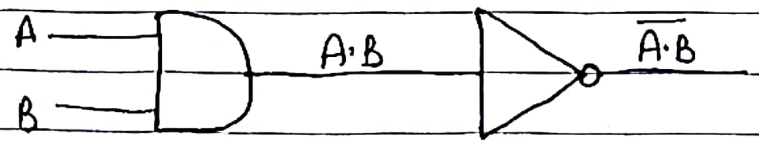
Sol^n 7 + → Addition (OR)
• → Multiplication (AND)
$\bar{A}$:- Inverter

Ans:-

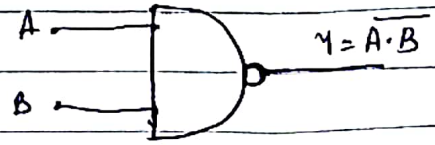
A	B	A·B	$\bar{A}$	$\bar{A} \cdot B$	$(A \cdot B) + (\bar{A} \cdot B)$
0	0	0	1	0	0
0	1	0	1	1	1
1	0	0	0	0	0
1	1	1	0	0	1

Q-8 What logic gate implements the boolean expression $(\overline{AB})$?

Ans8 NAND logic gate is used to implements the boolean expression $(\overline{AB})$



AND

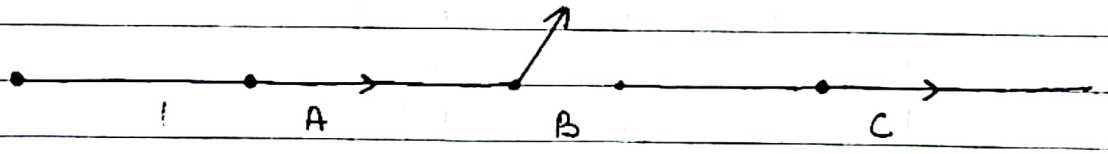


A	B	A.B	$\overline{AB}$
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

Q-9 Draw a circuit for the boolean expression

A·B·C ; If B is open and A, C is closed will electricity flow?

Ans 9:- Parallel Circuit → OR → Boolean Addition (+)
Series Circuit → AND → Boolean Multiplication (·)



When B is open (0), and A, C is closed (1) state due to opening of B the electricity is not passed in the circuit.

As A·B·C is a Boolean Multiplication expression and it is represented as Series Circuit.

Ques-10 Sketch out a circuit using logic gates to implement the boolean expression

$A+BC+\overline{DEA}$

Soln 10 $A + BC + \overline{DEA}$

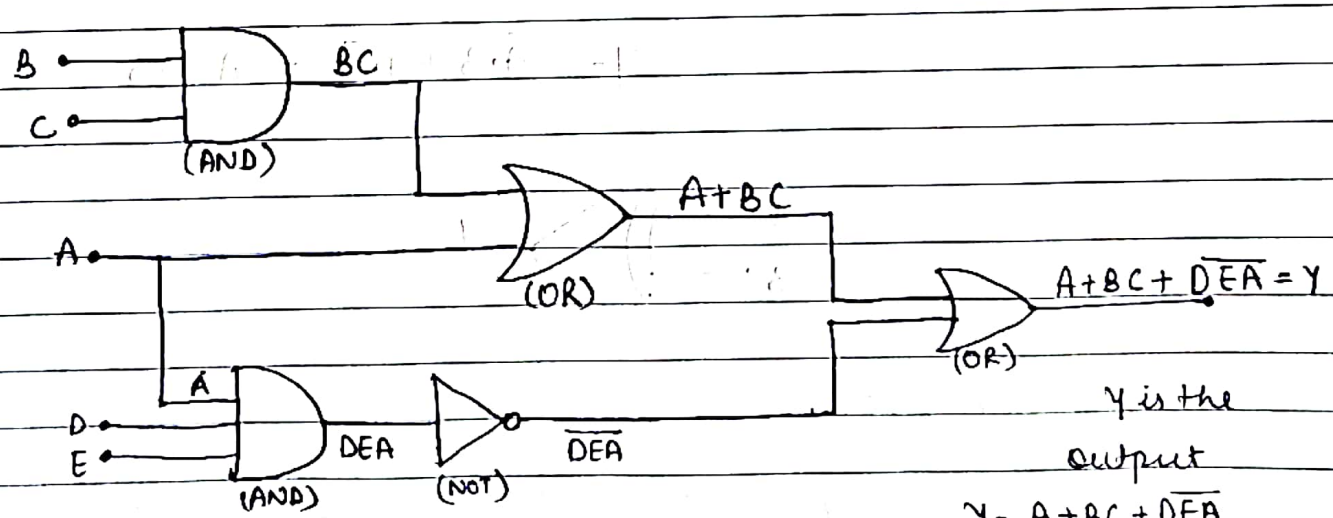
→ Firstly, start with A+BC, where BC can be implemented using AND logic gate.

→ A+BC can be implemented using OR logic gate.

Now move to $\overline{DEA}$

→ DEA can be implemented using AND logic gate.

→ And the result of DEA can be ~~converted~~ inverted using NOT gate.



Y is the output

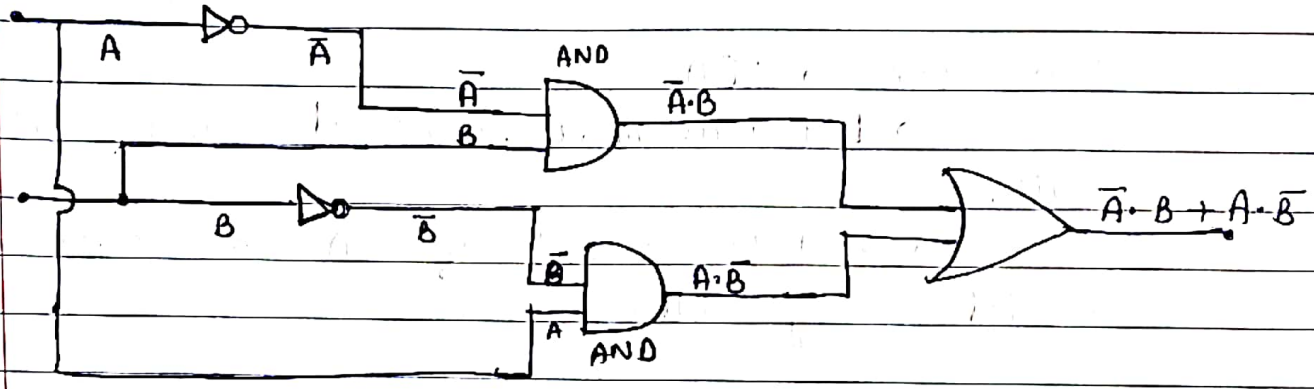
$Y = A + BC + \overline{DEA}$

Ques11 What logic gate implements the boolean expression

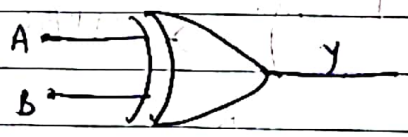
$(\bar{A} \cdot B) + (A \cdot \bar{B})$

Ans11: Exclusive OR (EOR) logic gate is used to implements the boolean expression $(\bar{A} \cdot B) + (A \cdot \bar{B})$

- $\bar{A} \cdot B$ can be implemented using AND gate for $\bar{A}$ and B
- $A \cdot \bar{B}$ can be implemented using AND gate for A and $\bar{B}$
- By getting final result we use OR gate for $\bar{A} \cdot B$ and $A \cdot \bar{B}$



$$Y = \bar{A} \cdot B + A \cdot \bar{B} = A \oplus B$$



Truth Table :-

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