

ASSIGNMENT_1.2

1. Use Truth Table to Verify:

- a) Identity laws b) Domination laws c) Idempotent laws d) Double negation law
e) Commutative laws f) Associative laws g) Distributive laws h) Negation laws
i) Absorption laws

2. State and prove De-Morgan's Law using Truth Table.

3. Use Truth Table to verify the following:

- a) $p \rightarrow q \equiv \neg p \vee q$ b) $p \rightarrow q \equiv \neg q \rightarrow \neg p$ c) $p \vee q \equiv \neg p \rightarrow q$ d) $p \wedge q \equiv \neg(p \rightarrow \neg q)$
e) $\neg(p \rightarrow q) \equiv p \wedge \neg q$ f) $p \leftrightarrow q \equiv (p \rightarrow q) \wedge (q \rightarrow p)$ g) $p \leftrightarrow q \equiv \neg p \leftrightarrow \neg q$
h) $\neg(p \oplus q) \equiv p \leftrightarrow q$ i) $\neg(p \leftrightarrow q) \equiv \neg p \leftrightarrow q$

4. Use De Morgan's laws to find the negation of each of the following statements.

- a) Ram is rich and happy.
b) John will bicycle or run tomorrow
c) Neha walks or takes the bus to class.
d) Aavash is smart and hard working.
e) Shyam will take a job in industry or go to graduate school.
f) Sudhir knows Java and calculus.
g) Shiva is young and strong.
i) Rita will move to Oregon or Washington.

5. Show that each of these conditional statements is a tautology by using truth tables.

- a) $(p \wedge q) \rightarrow p$ b) $p \rightarrow (p \vee q)$ c) $\neg p \rightarrow (p \rightarrow q)$ d) $(p \wedge q) \rightarrow (p \rightarrow q)$
e) $\neg(p \rightarrow q) \rightarrow p$ f) $\neg(p \rightarrow q) \rightarrow \neg q$ g) $[(p \rightarrow q) \wedge (q \rightarrow r)] \rightarrow (p \rightarrow r)$

6. Without using truth value show that:

- a) $\neg[p \vee (\neg p \wedge q)] \equiv \neg p \wedge \neg q$
b) $\neg(p \rightarrow q) \vee p \wedge q \equiv p$

7. Determine whether each of these compound propositions is satisfiable.

- a) $(p \vee \neg q) \wedge (\neg p \vee q) \wedge (\neg p \vee \neg q)$
b) $(p \rightarrow q) \wedge (p \rightarrow \neg q) \wedge (\neg p \rightarrow q) \wedge (\neg p \rightarrow \neg q)$
c) $(p \leftrightarrow q) \wedge (\neg p \leftrightarrow q)$

8. Use the logical equivalences above to show that $\neg(p \vee \neg(p \wedge q))$ is a contradiction.

9. Prove $(p \wedge q) \rightarrow p$ is a tautology using the propositional equivalences.

10. Prove $(p \wedge q) \rightarrow (p \vee q)$ is a tautology using the table of propositional equivalences.

11. Prove that the converse and the inverse of $p \rightarrow q$ are logically equivalent.