Dr.SNS RAJALAKSHMI COLLEGE OF ARTS AND SCIENCE
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Coimbatore- 49

DEPARTMENT OF MATHEMATICS

25UCU303-Discrete Mathematics with Probability and Hypothesis Testing

TRUTH TABLE-PROBLEMS

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TRUTH TABLE

Truth Table for Binary Operations

The binary operation consists of two variables for input values. Here also, the output result will be based on the operation performed on the input or proposition values and it can be either True or False value. The major binary operations are;

- AND
- OR
- NAND
- NOR
- XOR
- Conditional or 'If-Then'
- Bi-conditional

Let us draw a consolidated truth table for all the binary operations, taking the input values as P and Q.

TRUTH TABLE

P	Q	AND ($\wedge$)	OR ($\vee$)	NAND ($\sim\wedge$)	NOR ($\sim\vee$)	XOR ($\underline{\vee}$)	Conditional ($\Rightarrow$)	Bi-conditional ($\Leftrightarrow$)
T	T	T	T	F	F	F	T	T
T	F	F	T	T	F	T	F	F
F	T	F	T	T	F	T	T	F
F	F	F	F	T	T	F	T	T

Where T stands for True and F stands for False.

TRUTH TABLE

Example

Write the truth table for the following given statement:$(P \vee Q) \wedge (\sim P \Rightarrow Q)$.

Solution: Given, $(P \vee Q) \wedge (\sim P \Rightarrow Q)$

Now let us create the table taking P and Q as two inputs,

P	Q	$P \vee Q$	$\sim P$	$\sim P \Rightarrow Q$	$(P \vee Q) \wedge (\sim P \Rightarrow Q)$
T	T	T	F	T	T
T	F	T	F	T	T
F	T	T	T	T	T
F	F	F	T	F	F

TRUTH TABLE

Example 2: Construct the truth table for ~P∨~Q and ~(P∧Q).

Solution:

P	Q	~P	~Q	~P∨~Q	(P∧Q)	~(P∧Q)
T	T	F	F	F	T	F
T	F	F	T	T	F	T
F	T	T	F	T	F	T
F	F	T	T	T	F	T

TRUTH TABLE

Example 3: Which of the following is the contrapositive of 'if two triangles are identical, then these are similar'?

A) If two triangles are not similar, then they are not identical.

B) If two triangles are not identical, then these are not similar.

C) If two triangles are not identical, then these are similar.

D) If two triangles are not similar, then these are identical.

Solution:

Consider the following statements

p: Two triangles are identical.

q: Two triangles are similar.

Clearly, the given statement in symbolic form is $p \Rightarrow q$.

Therefore, its contrapositive is given by $\sim q \Rightarrow \sim p$

Now,

$\sim p$: Two triangles are not identical.
$\sim q$: Two triangles are not similar.
$\therefore \sim q \Rightarrow \sim p$: If two triangles are not similar, then these are not identical.

TRUTH TABLE

Example 4: The statement ~(p↔ ~q) is

A) equivalent to p↔q

B) equivalent to ~p↔q

C) a tautology

D) a fallacy

Solution:

p	q	~q	p↔~q	~(p↔~q)	p↔q
T	T	F	F	T	T
T	F	T	T	F	F
F	T	F	T	F	F
F	F	T	F	T	T

TRUTH TABLE

Example 5: Let S be a non-empty subset of R. Consider the following statement: P: There is a rational number $x \in S$ such that $x>0$. Which of the following statements is the negation of the statement p?

A) $x \in S$ and $x \leq 0 \Rightarrow x$ is not rational.

B) There is a rational number $x \in S$ such that $x \leq 0$.

C) There is no rational number $x \in S$ such that $x \leq 0$.

D) Every rational number $x \in S$ satisfies $x \leq 0$.

Solution:

P: There is a rational number $x \in S$ such that $x > 0$.

~ P: Every rational number $x \in S$ satisfies $x \leq 0$.

TRUTH TABLE

Frequently Asked Questions

Q1 **What is a statement in truth table?**

A statement is a sentence or mathematical expression which is either definitely true or definitely false but not both.

Q2 **Define a truth table in Mathematics.**

A truth table is a chart of rows and columns showing the truth value (either “T” for True or “F” for False) of every possible combination of the given statements as operated by logical connectives.

Q3 **What is meant by the negation of a statement?**

The negation of a statement is the opposite of the given mathematical statement. It is denoted by the ~ symbol. If “P” is a statement, then the negation of statement P is ~P.
Let P: 5 is greater than 3.
Then ~P: 5 is not greater than 3.

Q4 **What is meant by conjunction in Mathematics?**

A conjunction is a statement formed by adding two statements with the connector AND. The symbol for conjunction is ‘∧’, and it is read as ‘and’.

TRUTH TABLE

THANK YOU