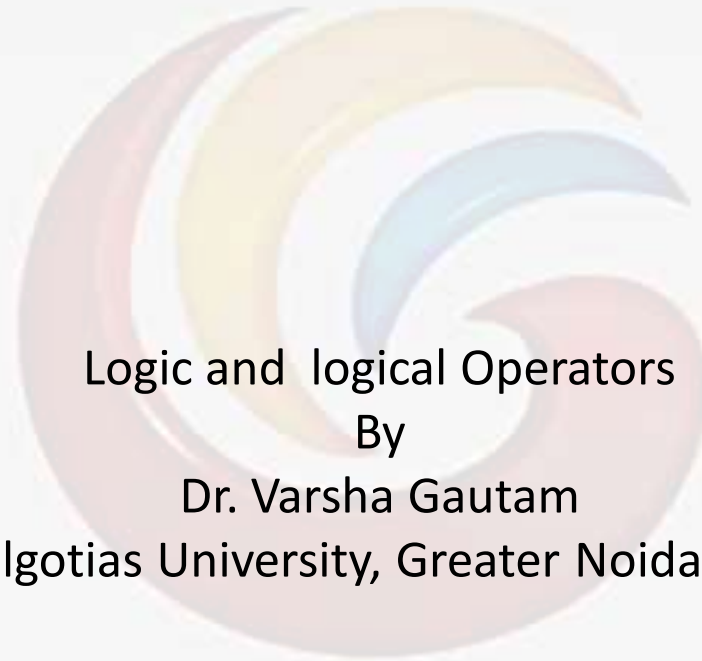


# School of Computing Science and Engineering

Course Code : MATH2007

Course Name: Discrete Mathematics



Logic and logical Operators

By

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In this presentation we will discuss following things:

- Logic and Proposition
- Logical Operators
- Truth table

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***Mathematical Logic*** is a tool for working with complicated *compound* statements. It includes:

- A language for expressing them.
- A concise notation for writing them.
- A methodology for objectively reasoning about their truth or falsity.
- It is the foundation for expressing formal proofs in all branches of mathematics.

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## Proposition

A **proposition** is a **declarative** sentence (a sentence that declares a fact) that is either **true or false**, but not both.

Are the following sentences propositions?

- Toronto is the capital of Canada. (Yes)
- Read this carefully. (No)  $1+2=3$ (Yes)
- $x+1=2$ (No)
- What time is it? (No)

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## Propositional Logic

**Propositional Logic** – the area of logic that deals with propositions.

**Propositional Variables** – variables that represent propositions:  $p, q, r, s$

E.g. Proposition  $p$  – “Today is Friday.”

**Truth values** – T, F



## Operator/Connectives

An *operator* or *connective* combines one or more *operand* expressions into a larger expression. (E.g., “+” in numeric exprs.)

*Unary* operators take 1 operand (e.g.,  $-3$ ); *binary* operators take 2 operands (eg  $3 \times 4$ ).

*Propositional* or *Boolean* operators operate on propositions or truth values instead of on numbers.

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## Negation

The unary *negation operator* “ $\neg$ ” (*NOT*) transforms a prop. into its logical *negation*.

*E.g.* If  $p$  = “I have brown hair.”

then  $\neg p$  = “I do **not** have brown hair.”

*Truth table* for NOT:

T  $\equiv$  True; F  $\equiv$  False

“ $\equiv$ ” means “is defined as”

$p$	$\neg p$
T	F
F	T

## Conjunction

The binary *conjunction operator* “ $\wedge$ ” (*AND*) combines two propositions to form their logical *conjunction*.

*E.g.* If  $p$  = “I will have salad for lunch.” and  $q$  = “I will have steak for dinner.”, then

$p \wedge q$  = “I will have salad for lunch **and** I will have steak for dinner.”

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## Conjunction truth table

Note that a conjunction  $p_1 \wedge p_2 \wedge \dots \wedge p_n$  of  $n$  propositions will have  $2^n$  rows in its truth table.

$p$	$q$	$p \wedge q$
F	F	F
F	T	F
T	F	F
T	T	T

Also:  $\neg$  and  $\wedge$  operations together are sufficient to express *any* Boolean truth table!

## Disjunction

The binary *disjunction operator* " $\vee$ " (*OR*) combines two propositions to form their logical *disjunction*.

$p$ ="My car has a bad engine."

$q$ ="My car has a bad carburetor."

$p \vee q$ ="Either my car has a bad engine, **or** my car has a bad carburetor."

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## Disjunction truth table

Note that  $p \vee q$  means that  $p$  is true, or  $q$  is true, **or both** are true! So, this operation is also called *inclusive or*, because it **includes** the possibility that both  $p$  and  $q$  are true. “ $\neg$ ” and “ $\vee$ ” together are also universal

$p$	$q$	$p \vee q$
F	F	F
F	T	<b>T</b>
T	F	<b>T</b>
T	T	T

## Assignment

1. Which of these sentences are **propositions**? What are the **truth values** of those that are propositions?  
**a)  $2 + 3 = 5$ . b) Answer this question!**
2. Construct truth table for:  $(p \rightarrow q) \leftrightarrow (\neg q \rightarrow \neg p)$

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Video link: <https://www.youtube.com/watch?v=q2eyZZK>

[OIk&list=PLHXZ9OQGMqwersk8fUxiUMSIx0DBqsKZS&index=10](https://www.youtube.com/watch?v=q2eyZZK)

References: Discrete Mathematics and its application by Kenneth H Rosen



The logo of Galgotias University is a circular emblem with a stylized 'G' shape in the center. The 'G' is composed of several curved segments in shades of yellow, orange, and blue. The background of the emblem is a light, textured grey.

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**Thank you!!!!**

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