#### (I) Predicates

- 1. Mohan is a student.
- 2. Shrikant is a student.
- 3. Shefali is a student.
- > The part "is a student" of the sentence is common in all these sentences.
- -> So, it can be written as 'n is a student'.

  where is a student is called a predicate.

a set X of students from where or can take its values.

Here, the set x is called the universe of discourse for x.

- -> A predicate is denoted as P(n), Q(n), R(n)....etc
  - Eg:- PM): nis a student.

g(m): x is an animal.

> 26 we assign a particular value to x, then the predicate is converted into a proposition.

Eg:- P(n): x is less than five.

The universe of discourse for x is the set of oreal numbers. Thus, P(2) is a proposition whose touth value is true.

- Two variables are also possible:
- Eg:- P(x,y): x is greater than y

  if ne is 6 and y is 3 the 6 is greater than 3'
  becomes a proposition whose touth value is true.

## I Quantifiers

- · Rakesh is brilliant and Moham is brilliant and Alka is brilliant.
- . The above sentence can be written as ;
  " All the students of the set A are brilliant".

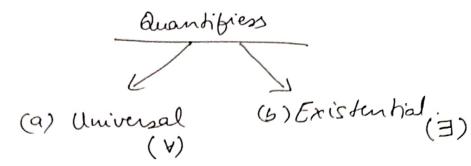
  Where set A = { Rakesh, Moham, Alka}
- · In the predicate form the given sentence can be stated as:

P(n): X is brilliant and set A becomes the Universe of discourse

But how to supresent 'all the shidents'?

- · To tackle this we need some supresentation of the phrase "for all".
- · This leads to the use of quantifiers.

. There are two types of quantitiens:



(a) Example of universal Quantifies

(i) Let PM): x is even numbers and the universe of discourse for n is the Set {1,2,3,4}.

Find the truth value of Y(n) P(n).

Ans. Yx P(n) is FALSE.

(b) Example of Existential Quantifier

(i) Let [P(n): 21 is even number] and the universe of discourse for n is the set \{1,2,3,4\}. Find the truth value of \( \frac{1}{2} \text{2} \text{1} \text{2} \text{1}.2,3,4\}.

Ans. In P(n) is TRUE.

(III) Fre and Bound Variables

- -> Avariable in a predicate is bound by a quantifier.
- A variable is bree it it is not bounded.

Eg:- Vn P(2,y) and In P(2,y)
In both cases, nie a bound variable and y is a free
Variable.

# (W) regation of Quantifiers

-> Every politician is clever.

UOD: Set of politicians

:. [4n P(n)]

Here, the negation of the statement would be "It is not the case that every politician is clever".

<u>OR</u>

"There is a politician who is not cleves".

Symbolically, it can be supresented as:

IN NP(M)

## > Lans of Equivalence

- -> Negation of Quantified Statements with more than One Variable:
  - · Quantified statements with more than one variable may be obtained by successively applying the scale for negating a statement with only one quantifier.
  - · Thus, each & is changed to I and each I is changed to V as the negation symbol passes through the statement from left to right.

- 2) Write the regation of the following statements:
  - (a) All states in India are highly populated.
  - (b) Some states in India are highly populated.

#### -> Removing Quantifiers from Predicates

• Let P(x) be the predicate on x and the universe of discourse of x is the set  $\{x_1, x_2, x_3, \dots, x_n\}$ Then, (a)  $\forall x$   $P(x) \iff P(x_1) \land P(x_2) \land \dots \land P(x_n)$ (b)  $\exists x P(x_1) \iff P(x_1) \lor P(x_2) \lor \dots \lor P(x_n)$ 

Eg:- Let us assume that p(n) and a(n) are two predicates on x where  $x \in \{1,2,3\}$ . Remove the quantifies from the following:

(a) ]x P(n) = P(1) V P(2) V P(3)

(b) Yu P(n) = P(1) 1 P(2) 1 P(3)

(c) 3 n P(n) N Yn 9(n)

# -) Nested Quantifiers

 $\forall x \exists y P(x,y)$ : This proposition is some as  $\forall x \mathcal{B}(x)$  where,  $\boxed{g(x)}$  is  $\exists y P(x,y)$ .

Let the UoD for the variable  $\chi$  and y be the set cB positive vistegers and let  $P(\chi,y): \chi^2 = y$ .

Translate  $Y \in \mathcal{Y}$   $P(\chi,y)$  into an english sentence.

"The square of every positive integer is a positive without

## (I) Fallacies

- · A fallacy is an error in reasoning that results in an invalid argument.
- · Two types of fallacies are:
  - 1. The fallacy of affirming the consequent (or affirming the converse).
  - 2. The fallacy of danying the hypothesis (or assuming the inverse).

Eg: (1.) it siddharth solved this problem correctly, then he obtained the answer 5.

Siddharth obtained the answer 5.

Thoughose, Siddharth solved the problem correctly.

Note: - The argument is of the form p-9, and 9 then p. and is vivalid because [(p-9) 19] -> p is not a tautology.

This is Fallacy of affirming the consequent

(2) Test the validity of the following argument:

If two sides of a towngle are equal, then the opposite angles are equal.

Two sides of a towngle are not equal.

Therefore, we opposite angles are not equal.