



# IT 1107 – Mathematics for IT



## Sets & Basic Set Operations



# Definition of set

A set is an unordered collection of zero or more distinct well defined objects

Eg:

$$A = \{1, 2, 3\}$$

$$B = \{\text{Numbers less than } 10\}$$

$$C = \{\text{All the positive numbers}\}$$



# Set Theory Notations

Symbol	Meaning	Example
Upper case	Designates set name	$A=\{1,2,3\}$
Lower case	Designates set elements	$A=\{a,b,c\}$
{ }	a collection of elements	$A = \{3,7,9,14\},$ $B = \{9,14,28\}$
$\in$ or $\notin$	Is / is not an element of	$A=\{1,2,3\}$ $5 \notin A$ $1 \in A$
$\subseteq$	Is a subset of (includes equal sets)	$\{9,14,28\} \subseteq \{9,14,28\}$
$\subset$	Is a proper subset of	$\{9,14\} \subset \{9,14,28\}$
$\not\subseteq$	left set not a subset of right set	$\{9,66\} \not\subseteq \{9,14,28\}$



# Properties of Sets

- Sets are inherently **unordered**

The order in which the elements are presented in a set is not important

$A = \{a,e,i,o,u\}$  and

$B = \{ i,o,a,u,e\}$  both define the same set

- All elements are **distinct** (unequal)

One member does not appear more than once

$F = \{a,e,i,o,u,a\}$  is not a set since the element 'a' repeats



# Elements

- The items contained in a set are called **elements** or **members** of the set
- Notation
  - $\in$  means “is an element of”
  - $\notin$  means “not an element of”
- Eg:  $S = \{ x, y, z \}$ 
$$x \in S$$
$$p \notin S$$



# Specifying set

- There are 2 ways to specify a set
  - Listing notation
    - List all the members of the set
    - Eg:  $A = \{a,e,i,o,u\}$
  - Set builder notation
    - State those properties which characterized the members in the set
    - Eg:  $B = \{ x : x \text{ is an even integer , } x>0 \}$



# Some common sets

- $Z$ 
  - $Z$  is the set of all integers
  - $Z = \{ \dots, -2, -1, 0, 1, 2, \dots \}$
  - $Z^+$  - the set of positive integers
  - $Z^-$  - the set of negative integers
- $N$ 
  - Set of non negative integers
  - $N = \{0, 1, 2, 3, \dots\}$



- P
  - Set of prime numbers
  - $P = \{2, 3, 5, 7, 11, 13, \dots\}$
- Q
  - Set of rational numbers
  - $Q = \left\{ \frac{a}{b} : a, b \text{ integers}, b \neq 0 \right\}$
  - $Q^+$  - Set of positive rational numbers
  - $Q^*$  - Set of non zero rational numbers



- $\mathbb{R}$ 
  - Set of all real numbers consisting of integers , rational numbers like  $-3/4$  , $22/7$  and irrational numbers like  $\sqrt{2}, \pi$
  - $\mathbb{R}^+$  - Set of positive real numbers
  - $\mathbb{R}^*$  - Set of non zero real numbers
- $\mathbb{C}$ 
  - Set of complex numbers



# Equality of two sets

- A set “A” is equal to a set “B” if and only if both sets have same elements
- If set “A” and “B” are equal we write  $A=B$
- Eg:  $A = \{1,2,3,4,5\}$

$$B = \{ x : x < 6, x \in \mathbb{Z}^+ \}$$

$$C = \{1,2,3,4\}$$

Then  $A=B$  and  $A \neq C$



# Cardinality of sets

- **Cardinality** refers to number of elements in a set
- Let “A” be any set. Then cardinality of “A” is denoted by  $|A|$
- Eg:  $A = \{a,e,i,o,u\}$   
then  $|A| = 5$



# Finite Sets

- a finite set is a set that has a finite number of elements.
- It is countable
- Eg:  $A = \{1,3,5,7,9\}$



# Infinite Sets

- An infinite set is a set that is not a finite set.
- Infinite sets may be countable or uncountable.
- Eg:  $A = \{ \text{all the negative numbers} \}$   
 $B = \{ \text{all real numbers} \}$



# Complement of a set

- The complement of a set “A” is the set of elements which belongs to the universal set but which does not belong to “A”
- This is denoted by  $A^c$  /  $\bar{A}$  /  $A'$
- Eg: let  $Y = \{ x: x \geq 0 \}$   
then  $Y' = \{x: x < 0 \}$