Unit 1
Set Theory

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FOUNDATION FOR SCIENCE, TECHNOLOGY & RESEARCH
(Deemed to be University) - Estd. u/s 3 of UGC Act 1956

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What is a Set?

- A set is a well-defined collection of objects.
  - {2, r, a, w}
  - {Vignan, Deemed, to, be, University}
  - The even integers: 2, 4, 6, …
  - The students in this class

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Well-Defined and Distinct

- **Well-defined** means:
  Every object either **belongs** to the set or **does not belong**, without personal opinion affecting it.
  - The set of interesting movies
  - The set of tall students in a class
  - The set of prime numbers
- 'Distinct' means no repetition.
- {1,2,2,3} = {1,2,3}

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Representations of Sets

- Roster Form: A = {2, 4, 6}
- Set-builder Form: B = {x | x is even and x < 10}

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Quiz 1: Identify Sets

- Which of the following are sets?
- 1. The set of all nice people
- 2. The letters in 'APPLE'
- 3. Set of largest planets

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Types of Sets

- Empty Set (Ø)
- Singleton Set
- Finite and Infinite Sets
- Equal Sets
- Subsets and Power Set
- Universal Set

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Equal and Equivalent Sets

- Equal: A = B if all elements same.
- Equivalent: A and B have same number of elements.

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Question

- A = { x : x^2 - 3x + 2 = 0 }
- B = {2, 1}
- C = {1, 2, 2, 1, 6/3}

- Are A, B, C sets?
- Are A, B, C related?

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Subset and Superset

- A ⊆ B: Every element of A is in B
- A ⊂ B: A is a proper subset
- A ⊇ B: A is a superset of B

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Quiz 2: True or False

- 1. {1,2} ⊆ {1,2,3}
- 2. {5} = {5,5}
- 3. Ø ⊆ {a, b}

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Power Set

- P(A): Set of all subsets
- A = {1, 2} → P(A) = {Ø, {1}, {2}, {1, 2}}

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Cardinality

- Number of elements in a set
- n({a,b,c}) = 3
- n(Ø) = 0

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Universal Set

- Set that contains all objects under discussion
- Denoted by U
- A ⊆ U always

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Venn Diagrams

- Visual representation of sets
- Circles inside a rectangle (Universal Set)

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Union (A ∪ B)

- All elements in A or B or both
- Venn: shaded all circles

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Intersection (A ∩ B)

- Common elements in A and B
- Venn: shaded overlapping area

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Difference (A − B)

- Elements in A but not in B
- Venn: shaded A excluding overlap

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Complement (A')

- Elements in Universal Set but not in A
- Venn: shaded outside A

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Symmetric Difference (A △ B)

- Elements in A or B but not in both
- (A − B) ∪ (B − A)

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Quiz 3: Set Operations

- Given A = {1,2,3}, B = {3,4,5}:
- 1. A ∪ B = ?
- 2. A ∩ B = ?
- 3. A − B = ?

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De Morgan's Laws

- $(A \cup B)' = A' \cap B'$
- $(A \cap B)' = A' \cup B'$

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Visual: De Morgan's Law

- Use Venn diagrams to verify laws visually

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Cartesian Product (A × B)

- Set of ordered pairs (a, b)
- A = {1,2}, B = {x,y} → A × B = {(1,x),(1,y),(2,x),(2,y)}

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Quiz 4: Product & Cardinality

- 1. If A has 3 elements, B has 2 elements, how many in A × B?
- 2. Is A × B = B × A?

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Symbols and Notations

- ∈ : in set
- ∉ : not in
- ⊆ : subset
- ⊂ : proper subset
- ∪ : union
- ∩ : intersection
- ∅ : Empty set

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Special Sets Symbols

$\mathbb{N}$ = the set of nonnegative integers: 0, 1, 2, …
$\mathbb{Z}$ = the set of integers: …, -2, -1, 0, 1, 2, …
$\mathbb{Q}$ = the set of rational numbers
$\mathbb{R}$ = the set of real numbers
$\mathbb{C}$ = the set of complex numbers

Unless otherwise mentioned.

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Think & Solve

- Let A = {x ∈ $\mathbb{N}$ | x < 10 and x divisible by 3},
- B = {x ∈ $\mathbb{N}$ | x < 10 and x divisible by 2}
- Find A ∩ B

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Final Quiz

- In a class:
- - 25 students like math
- - 20 like physics
- - 10 like both
- How many like only math?

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Final Quiz

- 1. Can Ø be a subset of every set?
- 2. Is {a,b} = {b,a,a}?
- 3. What is P({Ø})?

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Summary

- Understand elements, representations
- Master symbols & Venn diagrams
- Practice De Morgan and set operations
- Use symbols for operations and relationships.
- Visual tools: Venn Diagrams, Power Sets.
- Set theory is foundational in logic and math.

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