RELATIONS AND FUNCTIONS

1. **Cartesian Product of Sets**
2. **Relations**
3. **Functions**

- **Ordered pair** A pair of elements grouped together in a particular order. Clearly, $(a,b) \neq (b,a)$.

- **Cartesian product of two sets** A and B is given by A × B = {(a, b): a ∈ A, b ∈ B}.

In particular **R × R** = {(x, y): x, y ∈ R} and **R × R × R** = (x, y, z): x, y, z ∈ R}

- If (a, b) = (x, y), then a = x and b = y.
- If n(A) = p and n(B) = q, then n(A × B) = pq.
- A × φ = φ
- In general, A × B ≠ B × A.
- **Relation**: Relation A relation R from a set A to a set B is a subset of the Cartesian product A × B obtained by describing a relationship between the first element x and the second element y of the ordered pairs in A × B, i.e., $R \subseteq A \times B$.
- **Number of Relations**: Let A and B be two non-empty finite sets, comtaining m and n elements respectively, then the total number of relaitons from A to B is 2^{mn}
- **Domain**: The domain of R is the set of all first elements of the ordered pairs in a relation R. Domain R = $\{a : (a, b) \in R\}$.

- The image of an element x under a relation R is given by y, where (x, y) ∈ R,
- **Range**: The range of the relation R is the set of all second elements of the ordered pairs in a relation R. Range R = $\{b : (a, b) \in R\}$.
- **Function**: Function A function f from a set A to a set B is a specific type of relation for which every element x of set A has one and only one image y in set B. We write f: A→B, where f(x) = y.

- **Domain and Co-domain**: The set A is called the domain of function f and the set B is called the co-domain of f.
- **Range**: If f is a function from A to B, then each element of A corresponds to ine and only one element of B, whereas every element in B need not be the image of some x in A. The subset of B comtaining the image of elements of A is called the range of the function. The range of f is denoted by $f(\mathrm{A})$. Mathematically, we write: $f(\mathrm{A}) = \{f(x) : x \in \mathrm{A}\}$
- **Image**: If the element x of A corresponds to $y \in \mathrm{B}$ under the function f, then we say that y is the image of x under f and we write, $f(x) = y$.
- **Pre-image**: If $f(x) = y$, then x is pre-image of y.