

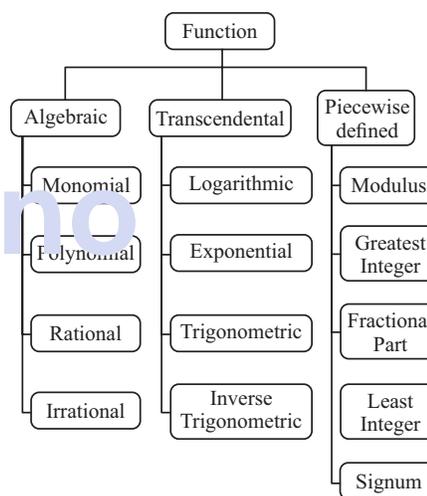
CHAPTER

3

Functions

- ❖ **Ordered pair** Pair formed by two elements that are separated by a comma and written as (x, y) .
- ❖ **Cartesian product** $A \times B$ of two sets A and B is given by $A \times B = \{(a, b) : a \in A, b \in B\}$
In particular $R \times R = \{(x, y) : x, y \in R\}$
and $R \times R \times R = \{(x, y, z) : x, y, z \in R\}$
- ❖ If $(a, b) = (x, y)$, then $a = x$ and $b = y$.
- ❖ If $n(A) = p$ and $n(B) = q$, then $n(A \times B) = pq$.
- ❖ $A \times \phi = \phi$
- ❖ In general, $A \times B \neq B \times A$.
- ❖ **Relation** A relation R from a set A to a set B is a subset of the cartesian product $A \times B$ obtained by describing a relationship between the first element x and the second element y of the ordered pairs in $A \times B$.
- ❖ **The image** of an element x under a relation R is given by y , where $(x, y) \in R$,
- ❖ The **domain** of R is the set of all first elements of the ordered pairs in a relation R .
- ❖ The **range** of the relation R is the set of all second elements of the ordered pairs in a relation R .
- ❖ **Function** A function f from a set A to a set B is a specific type of relation in which every element x of set A has one and only one image y in set B .
We write $f: A \rightarrow B$, where $f(x) = y$.
- ❖ A is the domain and B is the codomain of f .
- ❖ The range of the function is the set of images.

- ❖ **Algebra of functions** For functions $f: X \rightarrow R$ and $g: X \rightarrow R$, we have
 $(f + g)(x) = f(x) + g(x), x \in X$
 $(f - g)(x) = f(x) - g(x), x \in X$
 $(f \cdot g)(x) = f(x) \cdot g(x), x \in X$
 $(kf)(x) = k(f(x)), x \in X$, where k is a real number.
 $\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}, x \in X, g(x) \neq 0$



S.No.	Transformation	How to transform
1.	(a) $y = f(x) \rightarrow y = f(x + a)$	Shift the graph of $y = f(x)$ through 'a' units towards left.
	(b) $y = f(x) \rightarrow y = f(x - a)$	Shift the graph of $y = f(x)$ through 'a' units towards right.
2.	(a) $y = f(x) \rightarrow y + a = f(x)$	Shift graph of $y = f(x)$ by 'a' units downward.
	(b) $y = f(x) \rightarrow y - a = f(x)$	Shift graph of $y = f(x)$ by 'a' units upward.
3.	$y = f(x) \rightarrow y = f(-x)$	Take the mirror image of $y = f(x)$ in the y-axis.
4.	$y = f(x) \rightarrow y = -f(x)$	Take the mirror image of $y = f(x)$ in the x-axis.
5.	$y = f(x) \rightarrow y = f(x)$	Remove the left portion of the graph after that take the mirror image of the right portion of the curve in the Y-axis. Also include the right portion of the graph of $y = f(x)$.
6.	$y = f(x) \rightarrow y = f(x) $	Take the mirror image of the lower portion of the curve (the curve below x-axis) in x-axis and reject the lower part (or flip lower part into upper).
7.	$y = f(x) \rightarrow y = f(x)$	Remove the lower portion of the curve then take the mirror image of upper portion of the curve in the x-axis. Also include the upper portion of the graph of $y = f(x)$.
8.	$y = f(x) \rightarrow y = af(x)$	Stretch ($a > 1$) or squaeze ($a < 1$) the graph of the given function vertically.
9.	$y = f(x) \rightarrow y = f(ax)$	Stretch ($a > 1$) or squaeze ($a < 1$) the graph of the given function horizontally.