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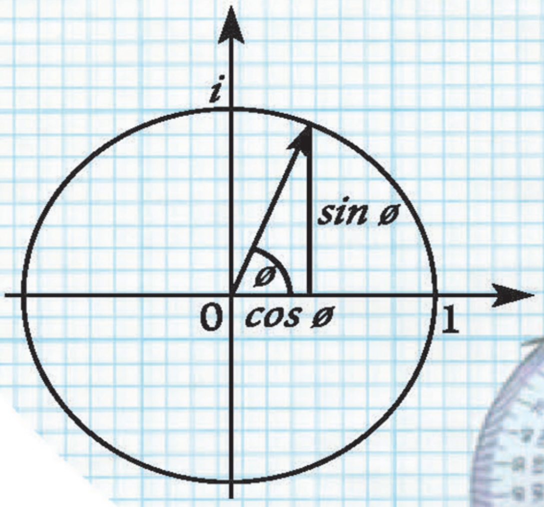

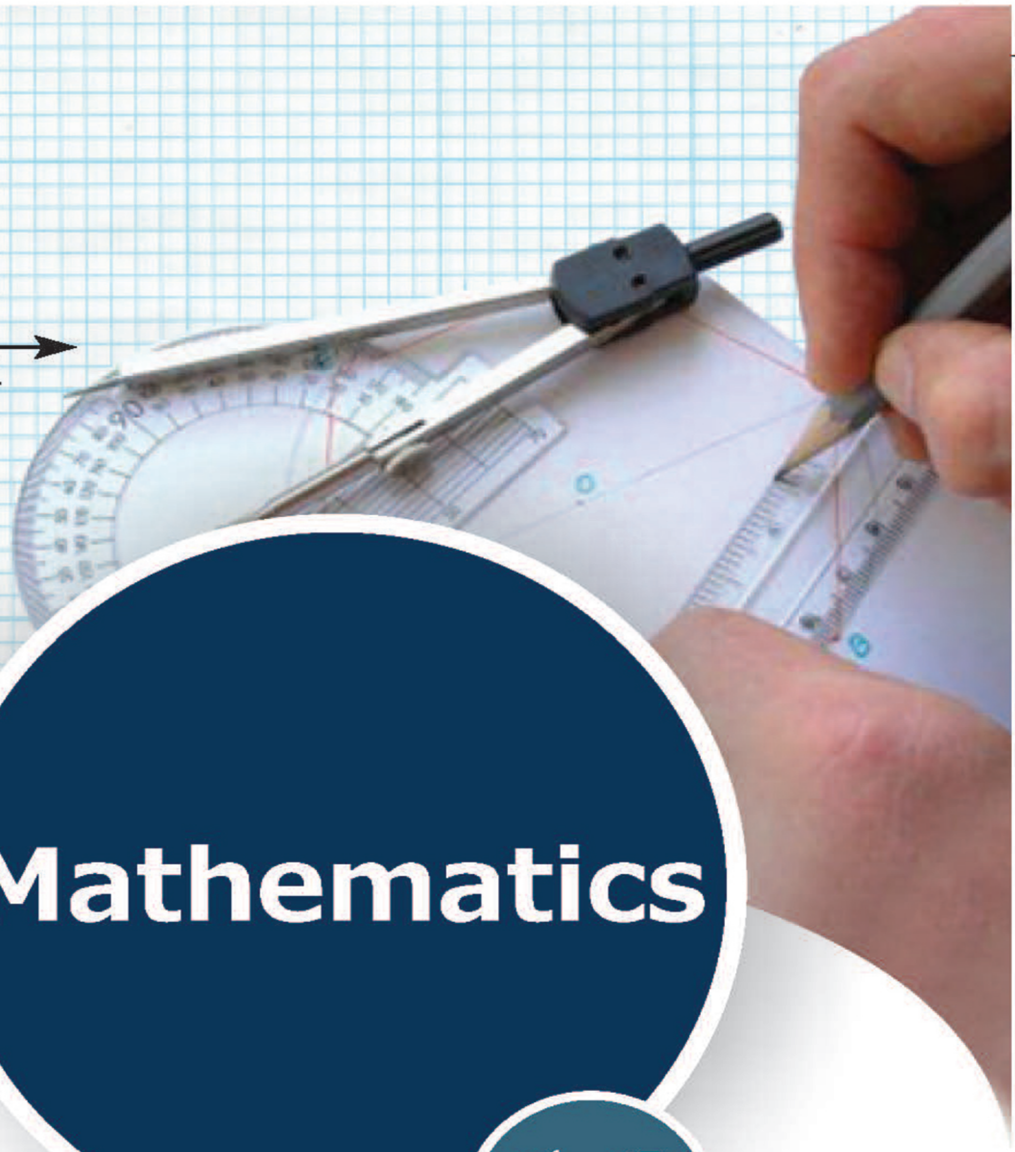

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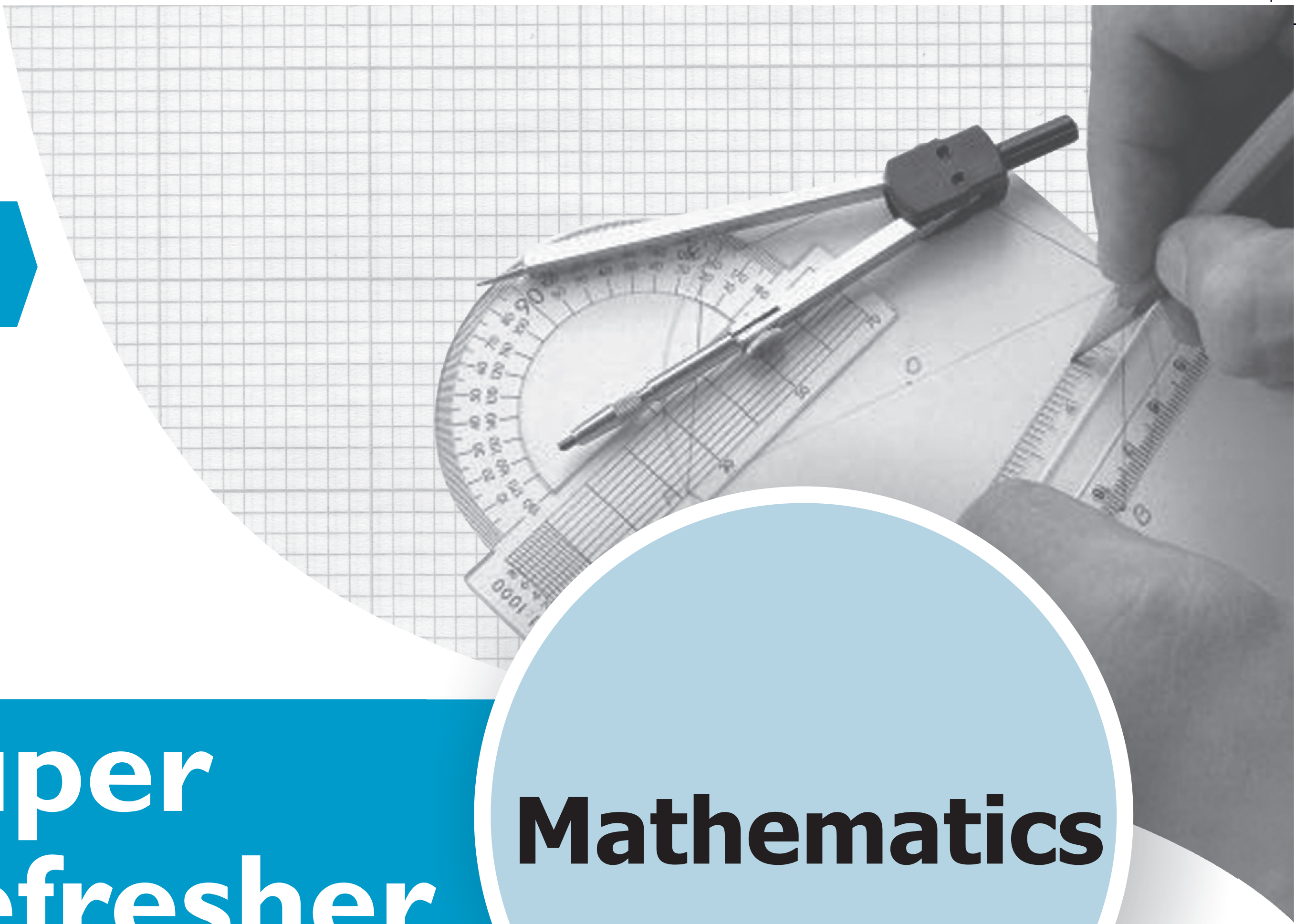

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J.P. Mohindru
&
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SYLLABUS

MATHEMATICS

CLASS–XII

(2016–17)

Paper I

100 Marks
3 Hours

Units		Periods	Marks
I.	Relations and Functions	30	10
II.	Algebra	50	13
III.	Calculus	80	44
IV.	Vectors and Three-Dimensional Geometry	30	17
V.	Linear Programming	20	06
VI.	Probability	30	10
	Total	**240**	**100**

Unit 1: Relations and Functions

1. Relations and Functions (15 Periods)

Types of relations : reflexive, symmetric, transitive and equivalence relations. One to one and onto functions, composite functions, inverse of a function. Binary operations.

2. Inverse Trigonometric Functions : (15 Periods)

Definition, range, domain, principal value branch. Graphs of inverse trigonometric functions. Elementary properties of inverse trigonometric functions.

Unit 2: Algebra

1. Matrices : (25 Periods)

Concept, notation, order, equality, types of matrices, zero and identity matrix, transpose of a matrix, symmetric and skew-symmetric matrices. Operation on matrices: addition and multiplication and multiplication with scalar. Simple properties of addition, multiplication and scalar multiplication. Non-commutativity of multiplication of matrices and existence of non-zero matrices whose product is the zero matrix (restrict to square matrices of order 2). Concept of elementary row and column operations. Invertible matrices and proof of the uniqueness of inverse, if it exists ; (Here all matrices will have real entries).

2. **Determinants :** **(25 Periods)**

Determinant of a square matrix (up to 3 × 3 matrices), properties of determinants, minors, co-factors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix. Consistency, inconsistency and number of solutions of system of linear equations by examples, solving system of linear equations in two or three variables (having unique solution) using inverse of a matrix.

Unit III: Calculus

1. **Continuity and Differentiability :** **(20 Periods)**

Continuity and differentiability, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit functions. Concept of exponential and logarithmic functions.

Derivatives of logarithmic and exponential functions. Logarithmic differentiation, derivative of functions expressed in parametric forms. Second order derivatives. Rolle's and Lagrange's Mean Value Theorems (without proof) and their geometric interpretation..

2. **Applications of Derivatives :** **(10 Periods)**

Applications of derivatives : rate of change of bodies, increasing/decreasing functions, tangents and normals, use of derivatives in approximation, maxima and minima (first derivative test motivated geometrically and second derivative test given as a provable tool). Simple problems (that illustrate basic principles and understanding of the subject as well as real-life situations).

3. **Integrals :** **(20 Periods)**

Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts. Evaluation of simple integrals of the following types and problems based on them:

$$\int \frac{dx}{x^2 \pm a^2},\ \int \frac{dx}{\sqrt{x^2 \pm a^2}},\ \int \frac{dx}{\sqrt{a^2 - x^2}},\ \int \frac{dx}{ax^2 + bx + c},\ \int \frac{dx}{\sqrt{ax^2 + bx + c}}$$

$$\int \frac{px+q}{ax^2 + bx + c}dx,\ \int \frac{px+q}{\sqrt{ax^2 + bx + c}}dx,\ \int \sqrt{a^2 \pm x^2}\,dx,\ \int \sqrt{x^2 - a^2}\,dx$$

$$\int \sqrt{ax^2 + bx + c}\ dx, \int (px+q)\sqrt{ax^2 + bx + c}\ dx$$

Definite integrals as a limit of a sum, Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals.

4. **Applications of the Integrals :** **(15 Periods)**

Applications in finding the area under simple curves, especially lines, circles/parabolas/ellipses (in standard form only). Area between the two above said curves (the region should be clearly identifiable).

5. **Differential Equations :** **(15 Periods)**

Definition, order and degree, general and particular solutions of a differential equation. Formation of differential equation whose general solution is given. Solution of differential equations by method of separation of variables, solution of homogeneous differential equations of first order and first degree. Solutions of linear differential equation of the type :

$\frac{dy}{dx} + py = q$, where p and q are functions of x or constants.

$\frac{dx}{dy}$ + px = q, where p and q are functions of y or constants.

Unit IV: Vectors and Three-Dimensional Geometry.

1. Vectors : (15 Periods)

Vectors and scalars, magnitude and direction of a vector. Direction cosines and direction ratios of a vector. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Definition, Geometrical Interpretation, properties and applications of scalar (dot) product of vectors, vector (cross) product of vectors, scalar triple product of vectors.

2. Three-dimensional Geometry : (15 Periods)

Direction cosines and direction ratios of a line joining two points. Cartesian and vector equation of a line, coplanar and skew lines, shortest distance between two lines. Cartesian and vector equation of a plane. Angle between (i) two lines, (ii) two planes, (iii) a line and a plane. Distance of a point from a plane.

Unit V: Linear Programming

1. Linear Programming : (20 Periods)

Introduction, related terminology such as constraints, objective function, optimization, different types of linear programming (L.P.) problems, mathematical formulation of L.P. problems, graphical method of solution for problems in two variables, feasible and infeasible regions (bounded and unbounded), feasible and infeasible solutions, optimal feasible solutions (up to three non-trivial constraints).

Unit VI: Probability

1. Probability : (30 Periods)

Conditional probability, multiplication theorem on probability, Independent events, total probability, Baye's theorem, Random variable and its probability distribution, mean and variance of a random variable. Repeated independent (Bernoulli) trials and Binomial distribution.

Prescribed Books:

1. Mathematics Textbook for Class XI NCERT
2. Mathematics Part I - Textbook for Class XII, NCERT
3. Mathematics Part II - Textbook for Class XII, NCERT
4. Mathematics Exemplar Problem for Class XI, NCERT
5. Mathematics Exemplar Problem for Class XII, NCERT

Question Paper Design

CBSE/ACAD/DD(SC)/2016 **Dated: 26.07.2016**
Circular No. Acad-32/2016

Subject: The question Ppaer Design in the subject of Mathematics (Class XII) for the Board Examination 2017

The following will be applicable in the subject Mathematics (041) for Class XII for the academic session 2016-17 and Board examination 2017

1. Question Paper Design

S.No.	Typology of Questions	VSA (1 Mark)	SA (2 Marks)	LA-I (4 Marks)	LA-II (6 Marks)	Marks	% Weightage
1	Remembering	2	2	2	1	20	20%
2	Understanding	1	3	4	2	35	35%
3	Application	1	–	3	2	25	25%
4	HOTS	–	3	1	–	10	10%
5	Evaluation	–	–	1(VBQ)*	1	10	10%
	Total	1×4=4	2×8=16	4×11=44		100	100%

*Value based question of 04 marks

2. Question Wise Break Up

Type of Question	Marks per Question	Total No. of Questions	Total Marks
VSA	1	6	06
SA	2	8	16
LA-I	4	11	44
LA-II	6	6	36
Total		**29**	**100**

3. Difficulty level

Difficulty level	WEightage
Easy	20%
Average	60%
Difficult	20%

4. Choice(s):

There will be no overall choice in the question paper. However, 30% internal choices will be given in 4 marks and 6 marks question.

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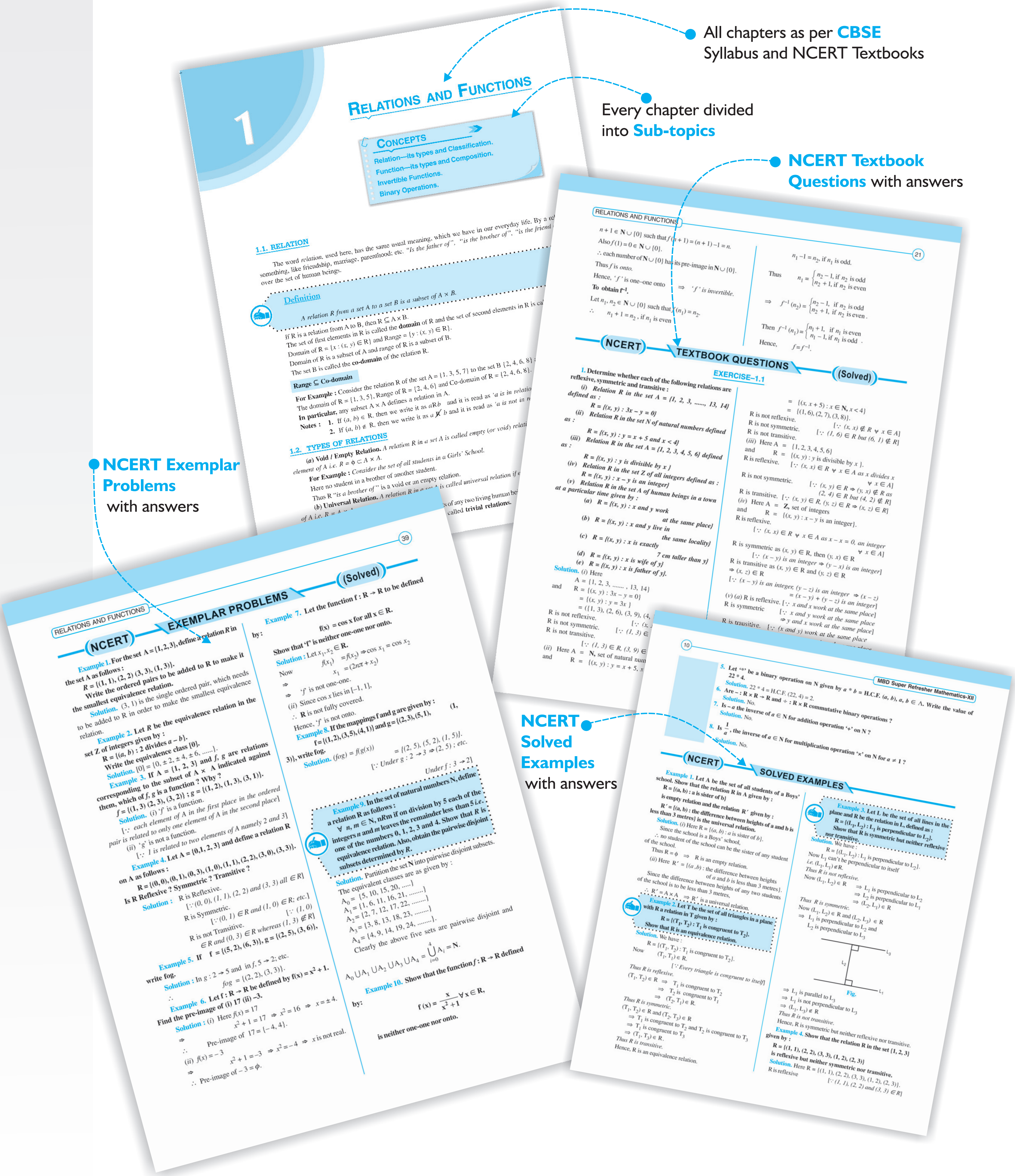

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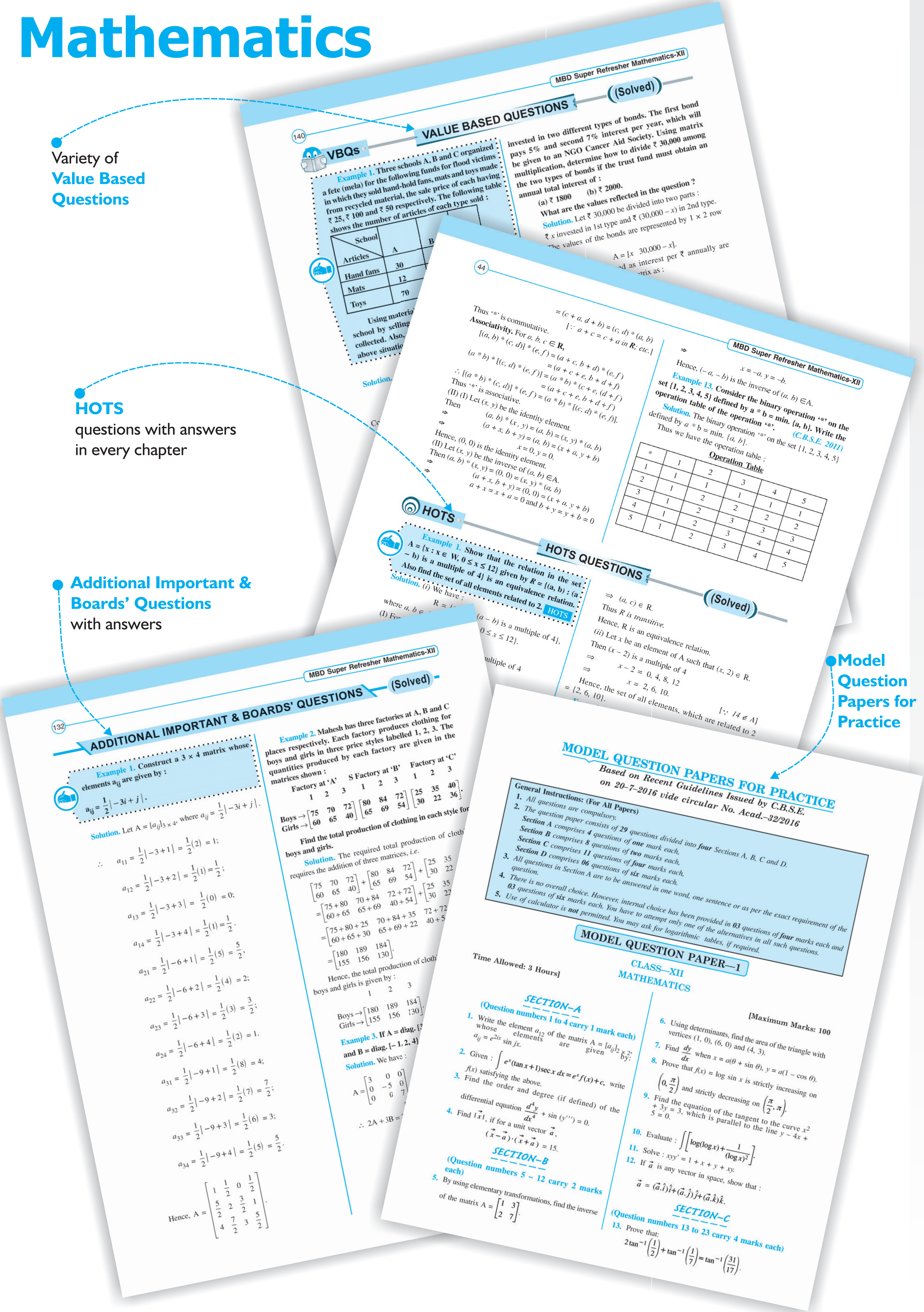


CONTENTS

1

Relations and Functions

Concepts

- Relation—its types and Classification.
- Function—its types and Composition.
- Invertible Functions.
- Binary Operations.

1.1. RELATION

The word *relation,* used here, has the same usual meaning, which we have in our everyday life. By a relation we mean something, like friendship, marriage, parenthood; etc. *"Is the father of", "is the brother of", "is the friend of"* are relations over the set of human beings.

Definition

A relation R from a set A to a set B is a subset of A × B.

If R is a relation from A to B, then R ⊆ A × B.

The set of first elements in R is called the **domain** of R and the set of second elements in R is called the **range** of R.

Domain of R = $\{x : (x, y) \in R\}$ and Range = $\{y : (x, y) \in R\}$.

Domain of R is a subset of A and range of R is a subset of B.

The set B is called the **co-domain** of the relation R.

Range ⊆ Co-domain

For Example : Consider the relation R of the set A = {1, 3, 5, 7} to the set B {2, 4, 6, 8} and R = {(1, 2), (3, 4), (5, 6)}.

The domain of R = {1, 3, 5}, Range of R = {2, 4, 6} and Co-domain of R = {2, 4, 6, 8}.

In particular, any subset A × A defines a relation in A.

Notes : **1.** If $(a, b) \in R$, then we write it as $a R b$ and it is read as *'a is in relation R to b'*.

2. If $(a, b) \notin R$, then we write it as $a \not{R}\, b$ and it is read as *'a is not in relation R to b'*.

1.2. TYPES OF RELATIONS

(*a*) Void / Empty Relation. *A relation R in a set A is called empty (or void) relation if no element of A is related to any element of A i.e.* $R = \phi \subset A \times A$.

For Example : *Consider the set of all students in a Girls' School.*

Here no student in a brother of another student.

Thus R "*is a brother of*" is a void or an empty relation.

(*b*) Universal Relation. *A relation R in a set A is called universal relation if each element of A is related to every element of A i.e.* $R = A \times A$.

For Example : The difference between the heights of any two living human beings is less than 3 meters is an universal relation.

Note. Both (empty and universal) relations are called **trivial relations.**

(*c*) Identity Relation. The relation $I_A = \{(x, x) : x \in A\}$ is called identity relation on A.
For Example : Let A = {1, 2, 3, 4}.
Then the identity relation on A is given by :

$$I_A = \{(1, 1), (2, 2), (3, 3), (4, 4)\}.$$

(*d*) Inverse Relation.

Let R be a relation from a set A to a set B and let (x, y) be the member of the subset D of A × B corresponding to the relation R from A to B.

To the relation R from the set A to the set B, there corresponds relation from the set B to the set A, called the inverse of the relation and denoted by R^{-1} such that the subset B × A corresponding to the relation R^{-1} is :

$$\{(y, x) : (x, y) \in B\} \quad i.e. \quad yR^{-1}x \Leftrightarrow xRy.$$

Examples : (I) The inverse of the relation *"is the father of"* in the set of all men is the relation *"is the son of."*
(II) The inverse of the relation *"is less than"* in **R** is the relation *"is greater than"* in **R**.

KEY POINT

Sometimes the inverse of a relation coincides with the relation itself.

Examples : (I) The inverse of the relation *"is perpendicular to"* in the set of straight lines, is a relation, which coincides with itself.
(II) The inverse of the relation *"is not equal to"* in the set **R** is a relation, which coincides with itself.

Types of Relations

- Void/Empty Relation
- Universal Relation
- Identity Relation
- Inverse Relation

1.3. CLASSIFICATION OF RELATIONS

(a) Reflexive Relations. We introduce the concept of this type of relations by means of **Example :**

Consider the relation *"is less than or equal to"* denoted by '≤' in the set of natural numbers.

Here we have : $2 \le 2$, $3 \le 3$; and so on.

In general, $x \le x \ \forall \ x \in \mathbf{N}$.

Thus, this relation '≤' is such that each member of the set bears this relation to itself.

A relation in a set is said to be reflexive if it is such that each member bears this relation to itself *i.e.* if $(a, a) \in R$, for every $a \in A$. This relation '≤' in the set of natural numbers is reflexive.

(a) Reflexive Relations.

Definition

A relation R in a set A is said to be reflexive if and only if $(a, a) \in \mathbf{R}$, *for all* $a \in A$.

(b) Symmetric Relations. We introduce this concept by means of **Example :**

Consider the set of lines in a plane and the relation "*is perpendicular to"* symbolised by '⊥'.

Let l, m be two straight lines such that $l \perp m$.

Surely when $l \perp m$, then $m \perp l$.

In fact $l \perp m \Rightarrow m \perp l$.

Such a relation is called a *symmetric relation.*

Definition

A relation R in a set A is said to be symmetric if $(a_1, a_2) \in R \Rightarrow (a_2, a_1) \in R$ *for all* $a_1, a_2 \in \mathbf{A}$.

(c) Transitive Relations. Again, we introduce this concept by means of **Example** :

Consider the relation "*is a factor of*" in the set of natural numbers.

Let us ask the following question :

Given three numbers a, b, c such that a "*is a factor of*" b and b "*is a factor of*" c. Does it follow that a "*is a factor of*" c ?

The answer to this question is affirmative.

For this, we consider 2, 4, 8.

Here 2 "*is a factor of*" 4 and 4 "*is a factor of*" 8.

And 2 "*is also a factor of*" 8.

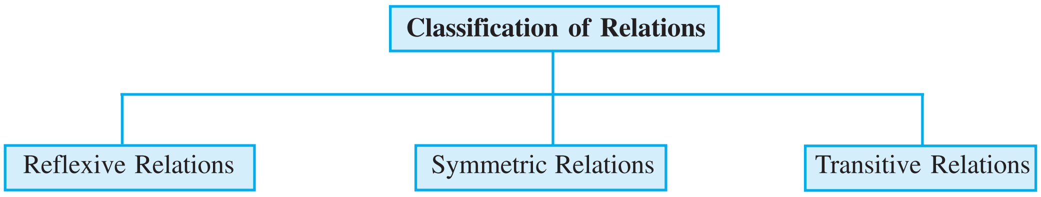
Definition

A relation R in a set A is said to be transitive if $(a_1, a_2) \in R$ *and* $(a_2, a_3) \in R$

$$\Rightarrow (a_1, a_3) \in R \text{ for all } a_1, a_2, a_3 \in A.$$

A relation R is not transitive if there exists even one triplet a_1, a_2, a_3 of members of A such that when we have $(a_1, a_2) \in$ R, $(a_2, a_3) \in$ R, we do not have $(a_1, a_3) \in$ R.

(d) Anti-symmetric Relations. *A relation R in a set A is said to be anti-symmetric if* $(a_1, a_2) \in$ R and $(a_2, a_1) \in$ R $\Rightarrow \quad a_1 = a_2$.



1.4. EQUIVALENCE RELATIONS

A relation R in a set A is said to be an equivalence relation if it is :
(i) reflexive (ii) symmetric and (iii) transitive.

Examples : (I) The relation '*is congruent to*' in the set of all triangles in a plane is an equivalence relation.

(II) The relation '*is similar to*' in the set of all triangles in a plane is an equivalence relation.

(III) The relation '*is a divisor of*' in the set of natural numbers is not an equivalence relation.

In fact, this relation is reflexive and transitive but not symmetric.

1.5. THEOREMS ON EQUIVALENCE RELATIONS

Theorem I. *The intersection of two equivalence relations on a set A is an equivalence relation on A.*

Proof. Let R and S be two equivalence relations on a set A.

Then either of them is reflexive, symmetric and transitive.

Since $R \subseteq A \times A$; $S \subseteq A \times A \Rightarrow R \cap S \subseteq A \times A$,

$\therefore$ $R \cap S$ is a relation on a set A.

Since R and S are reflexive,

$\therefore$ $(a, a) \in R$ and $(a, a) \in S \ \forall a \in A$

$\Rightarrow (a, a) \in R \cap S \quad \forall \ a \in A.$

Thus $R \cap S$ is reflexive.

Now $(a, b) \in (R \cap S)$

$\Rightarrow (a, b) \in R$ and $(a, b) \in S$

$\Rightarrow (b, a) \in R$ and $(b, a) \in S$

$\Rightarrow (b, a) \in (R \cap S)$. [$\because$ *R and S are symmetric*]

Thus $R \cap S$ is symmetric.

Again $(a, b) \in (R \cap S)$ and $(b, c) \in (R \cap S)$

$\Rightarrow$ $(a, b) \in R, (a, b) \in S$ and $(b, c) \in R, (b, c) \in S$

$\Rightarrow$ $[(a, b) \in R, (b, c) \in R]$ and $[(a, b) \in S, (b, c) \in S]$

$\Rightarrow$ $(a, c) \in R$ and $(a, c) \in S$ [$\because$ *R and S are transitive*]

$\Rightarrow$ $(a, c) \in (R \cap S)$.

Thus $R \cap S$ is transitive.

Hence, $R \cap S$ is an equivalence relation.

Cor. The union of two equivalence relations is not necessarily an equivalence relation.

CHECK YOUR UNDERSTANDING

1. What is the minimum number of ordered pairs to form a non-zero reflexive relation on a set of *n* elements ?

Solution. n . [$\because$ *If* $A = \{a_1, a_2, ..., a_n\}$, *then* $\{(a_1, a_1), ..., (a_n, a_n)\}$ *is reflexive of n pairs.*]

2. If R = {(1, –1), (2, –2), (3, –1)} is relation, then find the range of R.

Solution. Range of R = {–1, –2}.

3. A relation R on A = {1, 2, 3} defined by :

R = {(1, 1), (1, 2), (3, 3)} is not symmetric. Why ?

Solution. $(1, 2) \in R$ whereas $(2, 1) \notin R \Rightarrow R$ is not symmetric.

4. State the reason for the relation R, in the set {1, 2, 3} given by R = {(1, 2), (2, 1)}, not to be transitive.

Solution. R is not transitive because $(1, 2) \in R, (2, 1) \in R$ but $(1, 1) \notin R$.

5. If R = {(*x* , *y*) : *x* + 2*y* = 8} is a relation in N, write the range of R.

Solution. Range of R = {1, 2, 3}.

[$\because$ *When* $x = 2$, *then* $y = 3$; *when* $x = 4$, *then* $y = 2$; *when* $x = 6$, *then* $y = 1$]

6. If R is the relation "greater than" from A = {1, 4, 5} to B = {1, 2, 4, 5, 6, 7}. Write down the elements corresponding to R.

Solution. The elements corresponding to R are given by :

{(4, 1), (4, 2), (5, 1), (5, 2), (5, 4) }.

7. Give an example of a relation, which is :

(*i*) Symmetric but neither reflexive nor transitive

(*ii*) Transitive but neither reflexive nor symmetric.

Solution. Let A = {1, 2, 3}.

(*i*) The relation R = {(2, 3), (3, 2)} is symmetric but neither refloxive nor transitive.

[$\because (1, 1) \notin R; (2, 3), (3, 2) \in R$ *but* $(2, 2) \notin R$]

(*ii*) The relation R = {(1, 3), (3, 2), (1, 2)} is transitive but neither reflexive nor symmetric.

[$\therefore (1,1) \notin R; (1, 3) \in R$ *but* $(3,1) \notin R$]

8. Give an example of a relation, which is :

(*i*) Reflexive and symmetric but not transitive

(*ii*) Reflexive and transitive but not symmetric.

Solution. Let A = {1, 2, 3}.

(*i*) The relation {(1, 1), (2, 2), (3, 3), (2, 3), (3, 2), (1, 2), (2, 1)} is reflexive and symmetric but not transitive. [$\because (1, 2)$ *and* $(2, 3) \in R$ *but* $(1, 3) \notin R$]

(*ii*) The relation {(1,1), (2, 2), (3, 3), (1, 2)} is reflexive and transitive but not symmetric.

[$\because (1, 2) \in R$ *but* $(2, 1) \notin R$)]

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