JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

Year & Sem. – B. Tech II year, Sem.-IV

Subject –Discrete Mathematics Structure, Unit – 1

Topic – Functions

Presented by – Dr. Kashish Parwani

Designation - Associate Professor

Department - Mathematics

VISION OF INSTITUTE

To become a renowned centre of outcome based learning, and work towards academic, professional, cultural and social enrichment of the lives of individuals and communities.

MISSION OF INSTITUTE

❖**Focus on evaluation of learning outcomes and motivate students to inculcate research aptitude by project based learning.**

❖**Identify, based on informed perception of Indian, regional and global needs, the areas of focus and provide platform to gain knowledge and solutions.**

❖**Offer opportunities for interaction between academia and industry.**

❖**Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders may emerge in a range of professions.**

Engineering Mathematics: Course Outcomes

Students will be able to:

Upon successful completion of this course students will be able to:

CO1. Understand the concepts of Sets, Relations, Functions and their Operations.

CO2. Learn the concept of Propositional Logic and Finite State Machines.

CO3. Discuss and develop the Posets, Hasse Diagram, Lattices and Combinatorics.

CO4. Use and apply the concept of Algebraic Structures, Groups, Rings and Graph Theory.

Vision and Mission of the Institute

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RTU Scheme

4IT2-01: **Discrete Mathematics Structure**
Class: IVth Sem. B.Tech.
Branch: Information Technology
Schedule per Week- Lectures: 3
Examination Time = Three (3) Hours
Maximum Marks = 150
Evaluation: [Mid-terms (24), Assignments (06), External (120)]

4IT2-01: Discrete Mathematics Structure

Credit: 3 | **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P | **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	Set Theory: Definition of sets, countable and uncountable sets, Set operations, Partition of set, Cardinality (Inclusion-Exclusion & Addition Principles) Venn Diagrams, proofs of some general identities on sets. Relation: Definition, types of relation, composition of relations, Pictorial representation of relation, Equivalence relation, Partial ordering relation, Job-Scheduling problem. Function: Definition, type of functions, one to one, into and onto function, inverse function, composition of functions, recursively defined functions, pigeonhole principle. Theorem proving Techniques: Mathematical induction, Proof by contradiction. Composition of Functions. The Pigeonhole and Generalized Pigeonhole Principles.	7
3	Propositional Logic: Proposition, First order logic, Basic logical operation, truth tables, tautologies, Contradictions, Algebra of Proposition, logical implications, logical equivalence, predicates, Normal Forms, Universal and existential quantifiers. 2 way predicate logic. Introduction to finite state machine Finite state machines as models of physical system equivalence machines, Finite state machines as language recognizers.	8
4	Posets, Hasse Diagram and Lattices: Introduction, ordered set, Hasse diagram of partially, ordered set, isomorphic ordered set, well ordered set, properties of Lattices, bounded and complemented lattices. Combinatorics: Introduction, Permutation and combination, Binomial Theorem, Multimodal Coefficients Recurrence Relation and Generating Function: Introduction to Recurrence Relation and Recursive algorithms, linear recurrence relations with constant coefficients, Homogeneous solutions, Particular solutions, Total solutions, Generating functions, Solution by method of generating functions.	8
5	Algebraic Structures: Definition, Properties, types: Semi Groups, Monoid, Groups, Abelian group, properties of groups, Subgroup, cyclic groups, Cosets, factor group, Permutation groups, Normal subgroup, Homomorphism and isomorphism of Groups, example and standard results, Rings and Fields: definition and standard results.	8
6	Graph Theory: Introduction and basic terminology of graphs, Planer graphs, Multigraphs and weighted graphs, Isomorphic graphs, Paths, Cycles and connectivity, Shortest path in weighted graph, Introduction to Eulerian paths and circuits, Hamiltonian paths and circuits, Graph coloring, chromatic number, Isomorphism and Homomorphism of graphs, matching, vertex/edge covering.	8
	Total	**40**

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JECRC, Departme

COURSE OUTCOMES:

Subject – Discrete Structure Mathematics
Code – 4IT2-01
Branch – Information Technology
Semester- IVth
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By the end of this course, the students will be able to:
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CO3. Discuss and develop the Posets, Hasse Diagram, Lattices and Combinatorics.
CO4. Use and apply the concept of Algebraic Structures, Groups, Rings and Graph Theory.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	-	-	-	-	-	-	L	-	-	M
CO2	H	L	-	-	-	-	-	-	L	-	-	M
CO3	H	L	-	-	-	-	-	-	L	-	-	M
CO4	H	L	-	-	-	-	-	-	L	-	-	M

Functions:

KEY CONCEPTS:

DEFINITION OF A FUNCTION

DOMAIN

RANGE

INVERSE FUNCTION

A function is a special type of mapping such that each member of the domain is mapped to one, and only one, element in the range.

DOMAIN

The DOMAIN is the set of ALLOWED INPUTS TO A FUNCTION.

RANGE

The RANGE is the set of POSSIBLE OUTPUTS FROM A FUNCTION

A **function** is a special type of mapping such that each member of the **domain** is mapped to <u>one, and only one,</u> element in the **range.**

Only a **one-to-one** or a **many-to-one** mapping can be called a **function**.

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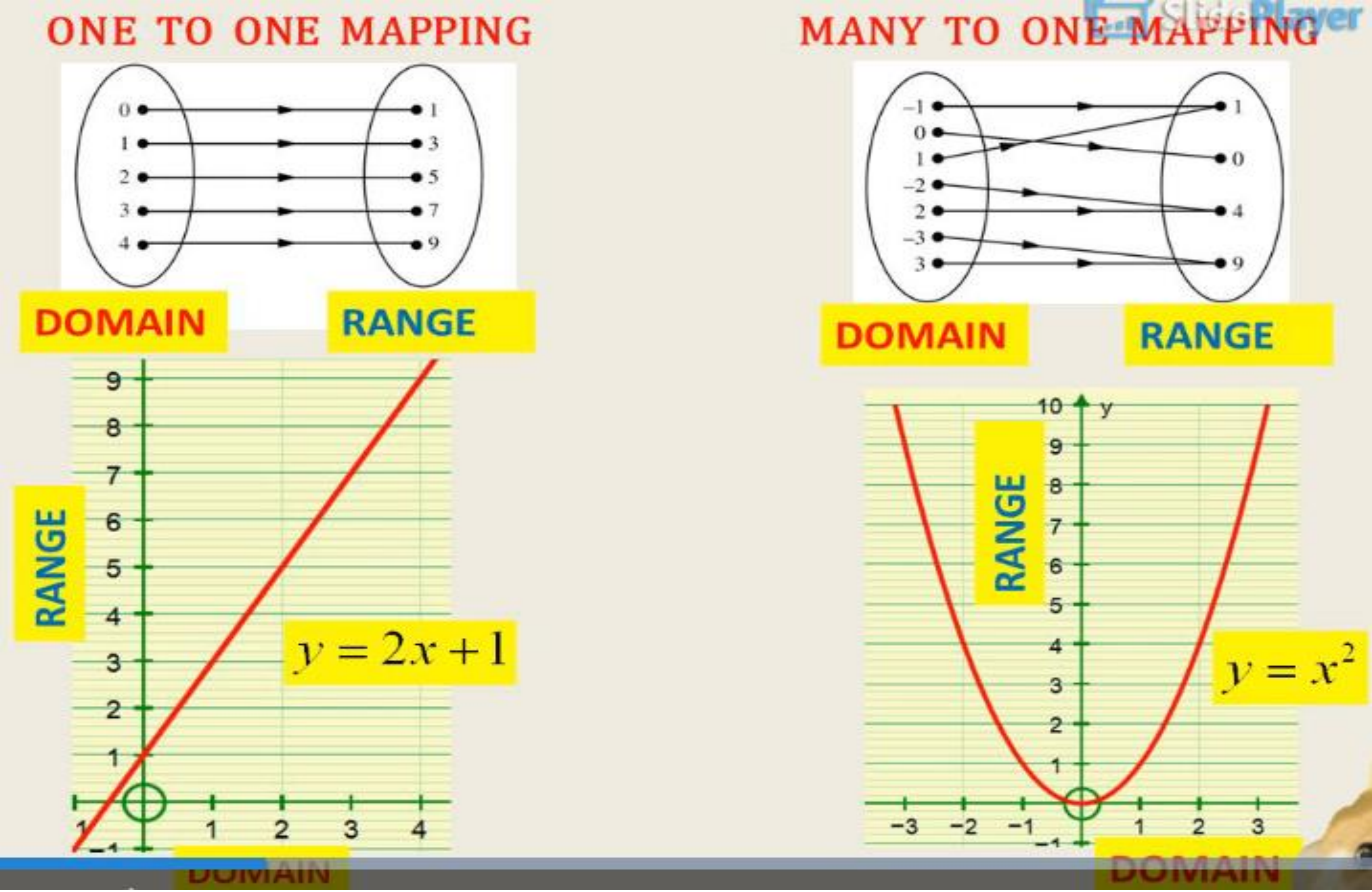

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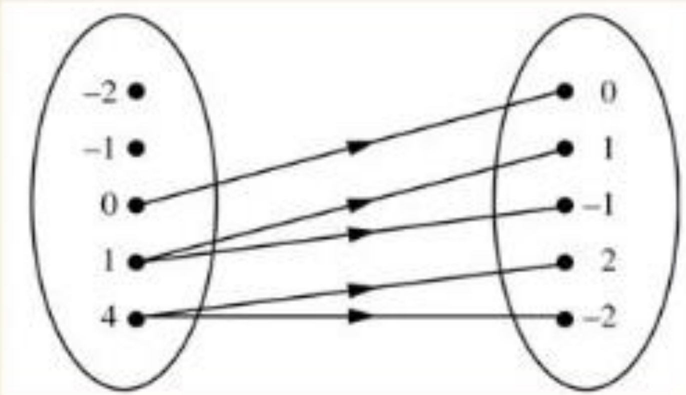
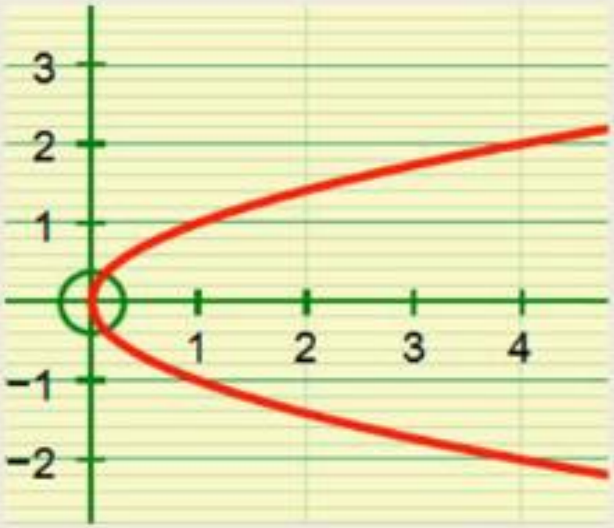
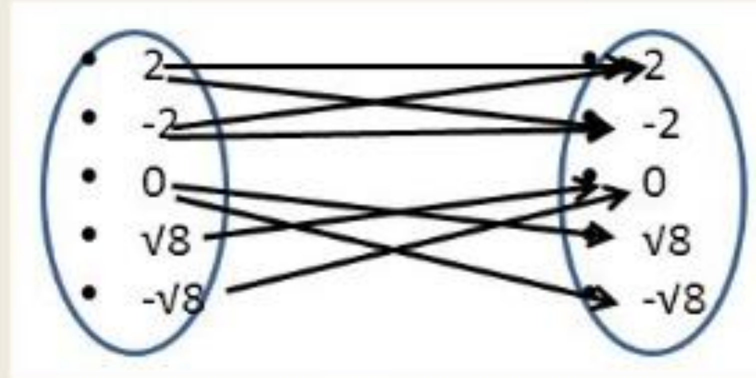
ONE TO MANY MAPPING

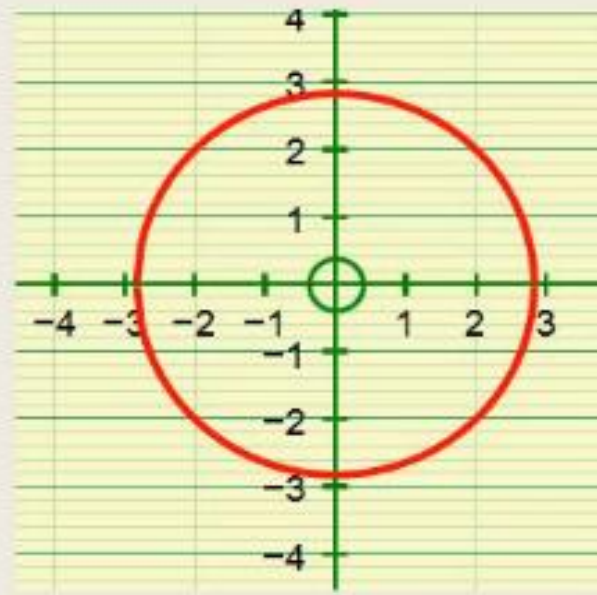




$$y = \pm\sqrt{x}$$

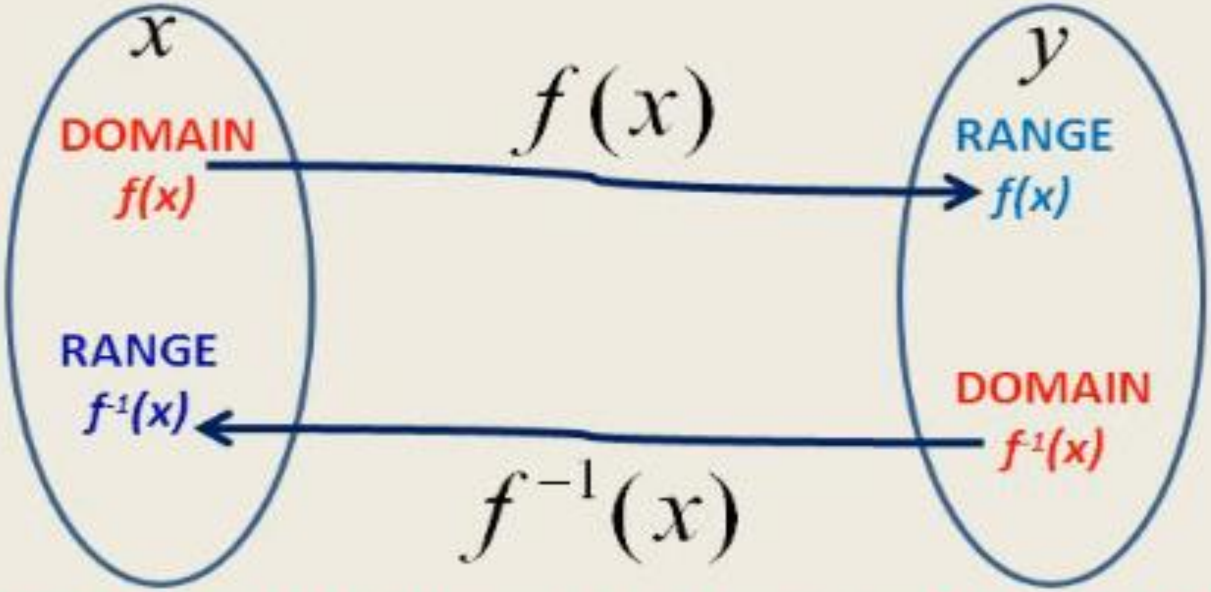
MANY TO MANY MAPPING





$$x^2 + y^2 = 8$$

Finding the INVERSE FUNCTION $f^{-1}(x)$



For an INVERSE to EXIST the original function MUST BE ONE TO ONE

DOMAIN *f(x)* is EQUAL TO RANGE *$f^{-1}(x)$*

RANGE *f(x)* is EQUAL TO DOMAIN *$f^{-1}(x)$*

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EXAMPLE

A function is defined as

$$f(x) = \sqrt{x-2} \qquad x \geq 2$$

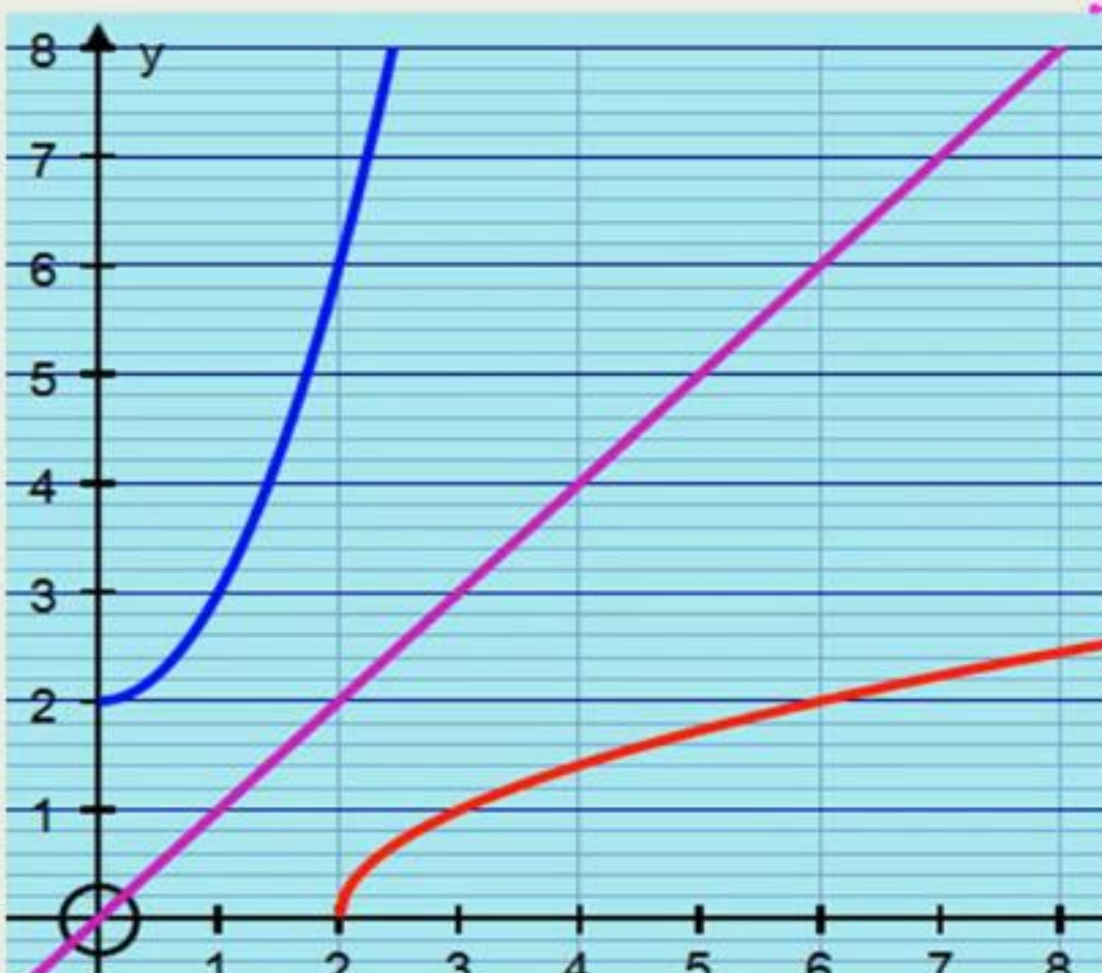
(a)Find the inverse function $f^{-1}(x)$

(b) Find the domain and Range of $f^{-1}(x)$

(c) sketch the graphs of $f(x)$ and $f^{-1}(x)$ on the same pair of axes.

$$f^{-1}(x) = x^2 + 2$$

$$y = x$$



We see that the graph of the inverse function is **the reflection in the line y=x** of the graph of the function. VICA VERSA

$$f(x) = \sqrt{x-2}$$

Practice Question:

1. Prove that the composite of two bijections is a bijection.

2. Consider a set A = {a, b, c, d, e, f,} and a relation R defined on A given by R{(a,a),(a,b),(b,a),(b,b),(c,c),(d,d),(d,e),(d,f),(e,d)(e,e),(e,f),(f,d),(f,e),(f,f)}.Write the matrix representation M_R of the relation and hence prove that it is an equivalence relation.

3. Given A={1,2,3,4}and R=(1,1),(1,3),(1,4),(3,2),(4,2),(4,4) represent relation by using diagram.

4. Enlist properties of functions.

5. Elements of the poset {{2,4 ,5, 10, 12, 20, 25},/} are maximal and which are minimal. Also draw Hass diagram.

6. Let A= {1,2,3,4} and let R={(1,2),(2,3),(3,4),(2,1)} be a relation on A. Find the transitive closure of R using Warshall's algorithm.

Suggested links from NPTEL & other Platforms:

1. https://nptel.ac.in/courses/111/106/111106086/
2. https://nptel.ac.in/courses/111/107/111107058/
3. https://nptel.ac.in/courses/106/106/106106183/#

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Thank you!

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