

**Dr.SNS RAJALAKSHMI COLLEGE OF ARTS AND SCIENCE  
(Autonomous)**

**Accredited by NAAC – UGC with 'A+ Grade (Cycle IV)  
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Coimbatore- 49**



**DEPARTMENT OF MATHEMATICS**

**25UCU305: DISCRETE MATHEMATICS WITH PROBABILITY AND  
HYPOTHESIS TESTING**

**RELATIONS**

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## Relation

- ❑ A relation describes a connection between elements of two sets.
- ❑ If  $A$  and  $B$  are sets, a relation  $R$  from  $A$  to  $B$  is a subset of  $A \times B$ .
- ❑ Notation:  $R \subseteq A \times B$

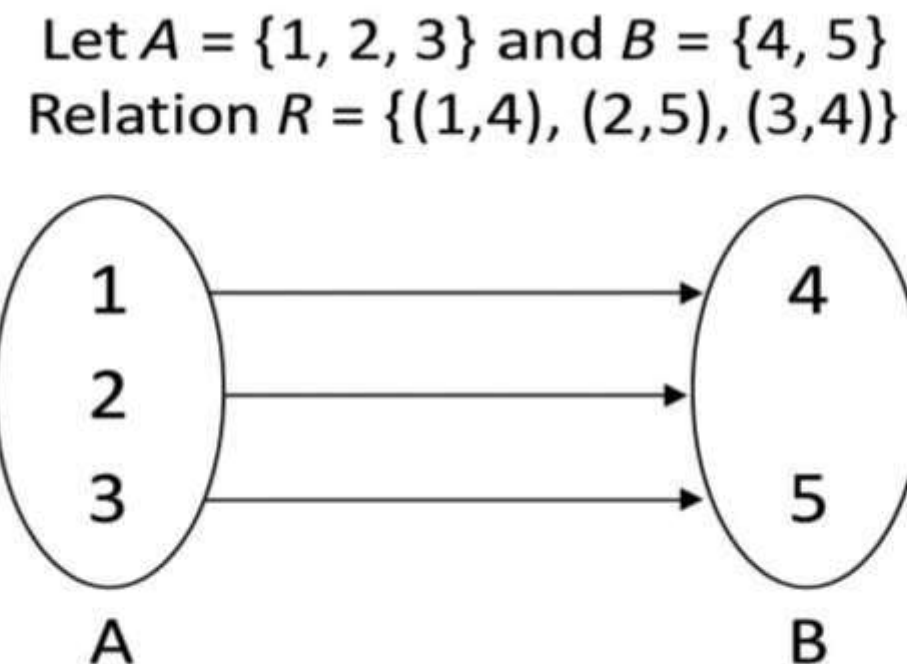


## Example of a Relation

**Let  $A = \{1, 2, 3\}$  and  $B = \{4, 5\}$**

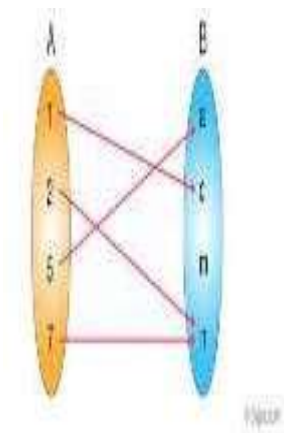
**Relation  $R = \{(1,4), (2,5), (3,4)\}$**

**Arrow diagram:  $1 \rightarrow 4, 2 \rightarrow 5, 3 \rightarrow 4$**



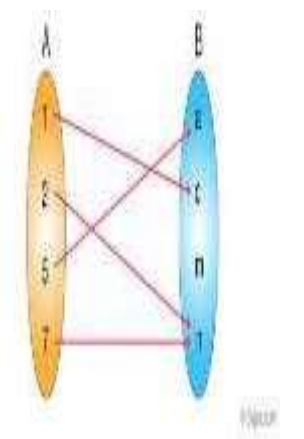
## Types of Relations

- Reflexive Relation
- Symmetric Relation
- Antisymmetric Relation
- Transitive Relation
- Equivalence Relation



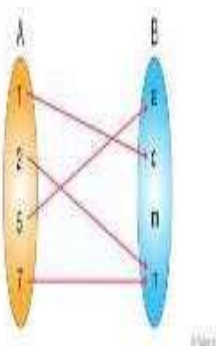
## Reflexive Relation

- **R on set A is reflexive if  $(a, a) \in R$  for all  $a \in A$ .**
- **Example:  $R = \{(1,1), (2,2), (3,3)\}$**
- **Diagram: loops on each element**



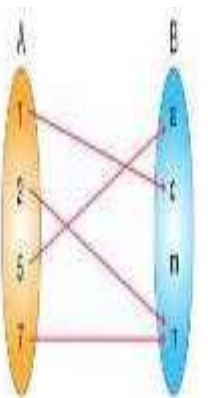
## Symmetric Relation

- **R is symmetric if  $(a, b) \in R$  implies  $(b, a) \in R$ .**
- **Example:  $R = \{(1,2), (2,1)\}$**
- **Diagram:  $1 \leftrightarrow 2$**



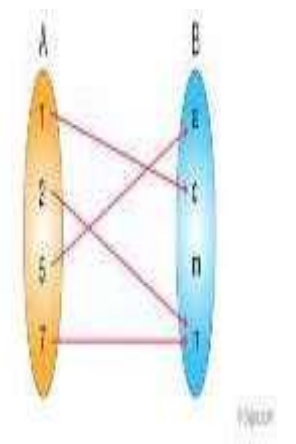
## Antisymmetric Relation

- If  $(a, b)$  and  $(b, a) \in R \Rightarrow a = b$ .
- Example:  $R = \{(1,1), (2,2), (1,2)\}$
- Diagram: one-way arrow unless  $a=b$



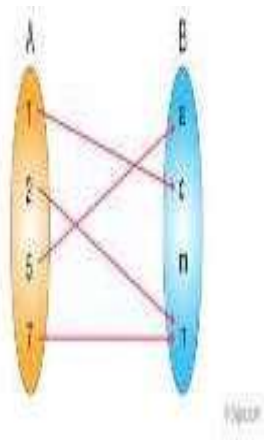
## Transitive Relation

- **If  $(a, b) \in R$  and  $(b, c) \in R \Rightarrow (a, c) \in R$ .**
- **Example:  $R = \{(1,2), (2,3), (1,3)\}$**
- **Diagram:  $1 \rightarrow 2 \rightarrow 3$  and  $1 \rightarrow 3$**



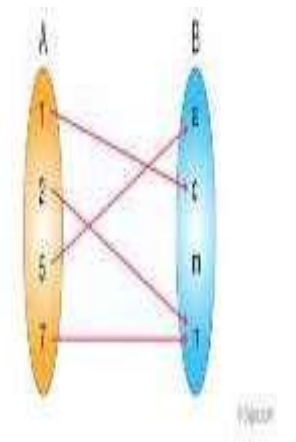
## Equivalence Relation

- A relation that is reflexive, symmetric, and transitive.
- Example: Same remainder when divided by 3
- Equivalence classes:  $[0]=\{3,6,9\}$ ,  $[1]=\{1,4,7\}$ ,  $[2]=\{2,5,8\}$



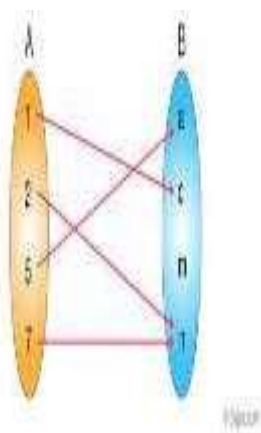
## Real-Life Examples

- “Is friend of”  $\rightarrow$  symmetric
- “Is equal to”  $\rightarrow$  equivalence relation
- “Is subset of”  $\rightarrow$  reflexive, antisymmetric, transitive



## Conclusion

- **Relations describe connections between elements of sets.**
- **Understanding relation properties helps classify relations.**
- **Used in algebra, computer science, graph theory, etc.**



## Exercise Problems:

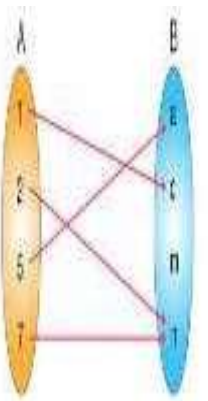
### 1. List the elements of $A \times B$

Let  $A = \{1, 2\}$ ,  $B = \{3, 4\}$ . Find  $A \times B$ .

### 2. Identify the Relation

Given  $A = \{1, 2, 3\}$  and  $R = \{(1, 3), (2, 2), (3, 1)\}$

Is  $R$  a relation from  $A$  to  $A$ ? (Yes / No — explain)



THANK YOU