

**PRESENTATION**

2026

**DAILY USES OF MY CURRICULUM**

**PRESENTATION BY:**

**PUNAM BARIK**

Exploring the foundations of

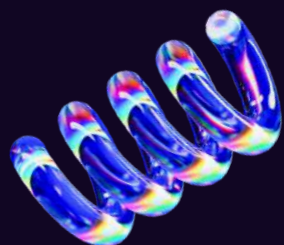
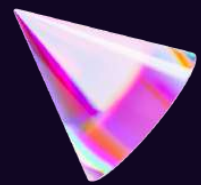
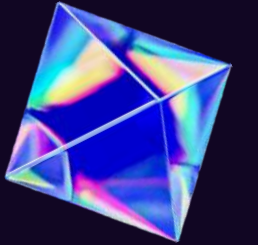
Abstract Algebra

A Journey through

isomorphism

Theorems , Group

Theory, and More



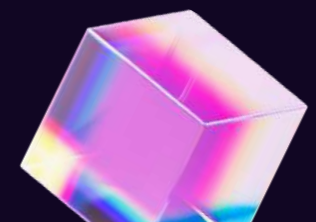
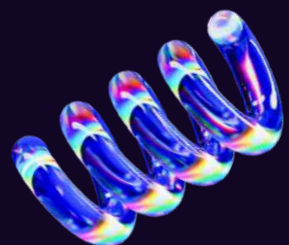
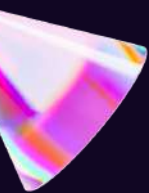
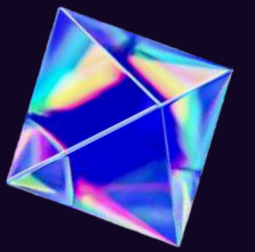
# UNDERSTANDING ISOMORPHISM THEOREMS

समरूपता प्रमेय समूह संरचनाओं को समझने में महत्वपूर्ण हैं वे समूहों और उपसमूहों के बीच संबंधों का वर्णन करते हैं यह दर्शाते हुए कि समूह उनके संचालन के संदर्भ में समतुल्य हो सकते हैं, जबकि उनके प्रतिनिधित्व में भिन्नता है, इन प्रमेयों की सेवा करते हैं

## महत्वपूर्ण अवधारणाएं

वर्गीकरण: ये प्रमेय शोधकर्ताओं को जटिल समूहों को सरल, समतुल्य संरचनाओं पर मैप करने की अनुमति देकर समूहों के अध्ययन को वर्गीकृत और सरल बनाने में मदद करते हैं।

# TRANSITIONING TO GROUP THEORY



# CYCLIC GROUPS VS. PERMUTATION GROUPS

क्रमपरिवर्तन समूहों में एक सेट के भीतर तत्वों को पुनर्व्यवस्थित करना शामिल है जो अधिक जटिलता दिखाते हैं वे सममित समूहों की संरचना के तहत काम करते हैं जो इन व्यवस्थाओं को

चक्रीय समूहों में एक एकल जनरेटर होता है जो अपनी शक्तियों के माध्यम से हर तत्व का उत्पादन कर सकता है वे समूह सिद्धांत में सीधे और महत्वपूर्ण हैं

# KEY CHARACTERISTICS OF GROUPS

01

पारस्परिक संपर्क

सदस्य नियमित रूप से संवाद और बातचीत करते हैं, चाहे आमने-सामने हों या आभासी माध्यम से।

02

संरचना

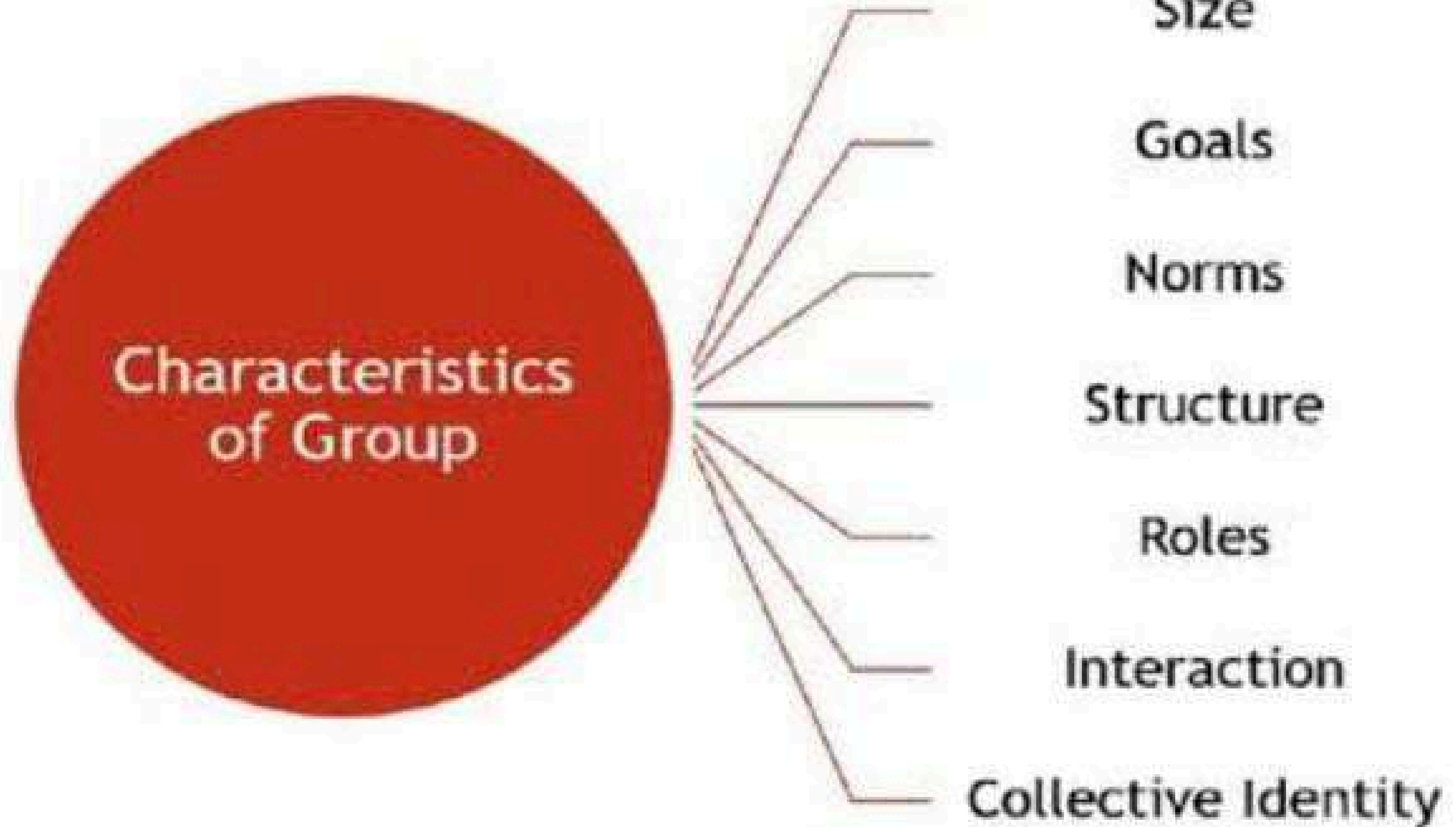
समूह अपने सदस्यों का मार्गदर्शन करने के लिए भूमिकाएँ (विशिष्ट कार्य/पद) और मानदंड (स्वीकार्य व्यवहार मानक) विकसित करते हैं।

03

एकजुटता

समूह के सदस्यों के बीच एक दूसरे के प्रति और समूह के प्रति आकर्षण की वह मात्रा, जो "पूर्णता" और अपनेपन की भावना को बढ़ावा देती है।

# Characteristics of Groups



# FUNDAMENTAL CONCEPTS OF RING THEORY

रिंग सिद्धांत अमूर्त बीजगणित की एक शाखा है जो दो द्विआधारी संक्रियाओं (जोड़ और गुणा) से सुसज्जित गणितीय समुच्चयों पर केंद्रित है।

ये संरचनाएं, जिन्हें रिंग के नाम से जाना जाता है, पूर्णांक जैसी संख्या

प्रणालियों की अवधारणाओं का सामान्यीकरण करती हैं, जहां अंकगणितीय संक्रियाएं की जाती हैं, लेकिन गुणात्मक व्युत्क्रम (भाग) की गारंटी नहीं होती है।

Fundamental Concepts  
of Mathematics 2nd edition

R.L. Goodstein

Department of Mathematics, The University, Leicester



$x$	$x + 1$	$x + 2$
$x$	$x + 1$	$x + 2$
$2x$	$2x + 2$	$2x + 1$
$2x + 1$	$1$	$x + 1$
International Series in Pure and Applied Mathematics Volume 107	$x + 2$	$2x$
$x + 1$	$2x$	$2$

# ILLUSTRATIVE EXAMPLE OF RING

एक वलय दो द्विआधारी संक्रियाओं—जोड़ और

गुणा—से सुसज्जित एक समुच्चय है

जो विशिष्ट बीजगणितीय गुणों

(सहयोगिता, जोड़ की

क्रमविनिमयता, वितरणशीलता)

को संतुष्ट करता है। इसके विशिष्ट

उदाहरणों में पूर्णांक ( $\mathbb{Z}$ ),

बहुपद  $R[x]$ , और  $n \times n$  आव्यूह शामिल हैं।

$$a^3 = 4a - 1,$$

$$a^4 = 4a^2 - a,$$

$$a^5 = -a^2 + 16a - 4,$$

$$a^6 = 16a^2 - 8a + 1,$$

$$a^7 = -8a^2 + 65a - 16,$$

$$\vdots$$

# IDEAL THEORY IN RINGS

आदर्श (Ideal) वलय सिद्धांत (Ring Theory) में एक विशेष प्रकार का उपवलय (Subring) है, जो किसी वलय (Ring) के तत्वों द्वारा गुणा किए जाने पर अवशोषण (Absorption) का गुण दर्शाता है।

यह समूह सिद्धांत (Group Theory) में सामान्य उपसमूह (Normal Subgroup) के समान भूमिका निभाता है, जिससे भागफल वलय (Quotient Ring) का निर्माण किया जाता है।

# VECTOR SPACES AND THEIR PROPERTIES

एक वेक्टर स्पेस (Vector Space), जिसे हिंदी में 'सदिश समष्टि'  
भी कहा जाता है, गणित  
(विशेषकर रैखिक  
बीजगणित/Linear Algebra)  
की एक अत्यंत  
महत्वपूर्ण संरचना है।  
सरल शब्दों में, यह सदिशों  
(vectors) का एक ऐसा संग्रह है  
जिन्हें आपस में जोड़ा जा सकता है  
और किसी संख्या (अदिश/scalar) से गुणा किया जा सकता है।

# वेक्टर स्पेस की परिभाषा

एक सेट

को एक क्षेत्र (Field)

पर वेक्टर स्पेस कहा जाता है,

यदि इसमें दो

ऑपरेशन—वेक्टर योग और अदिश

गुणन—परिभाषित हों और

वे निम्नलिखित नियमों

(स्वयंसिद्धों) का पालन करें:

# वेक्टर के गुण

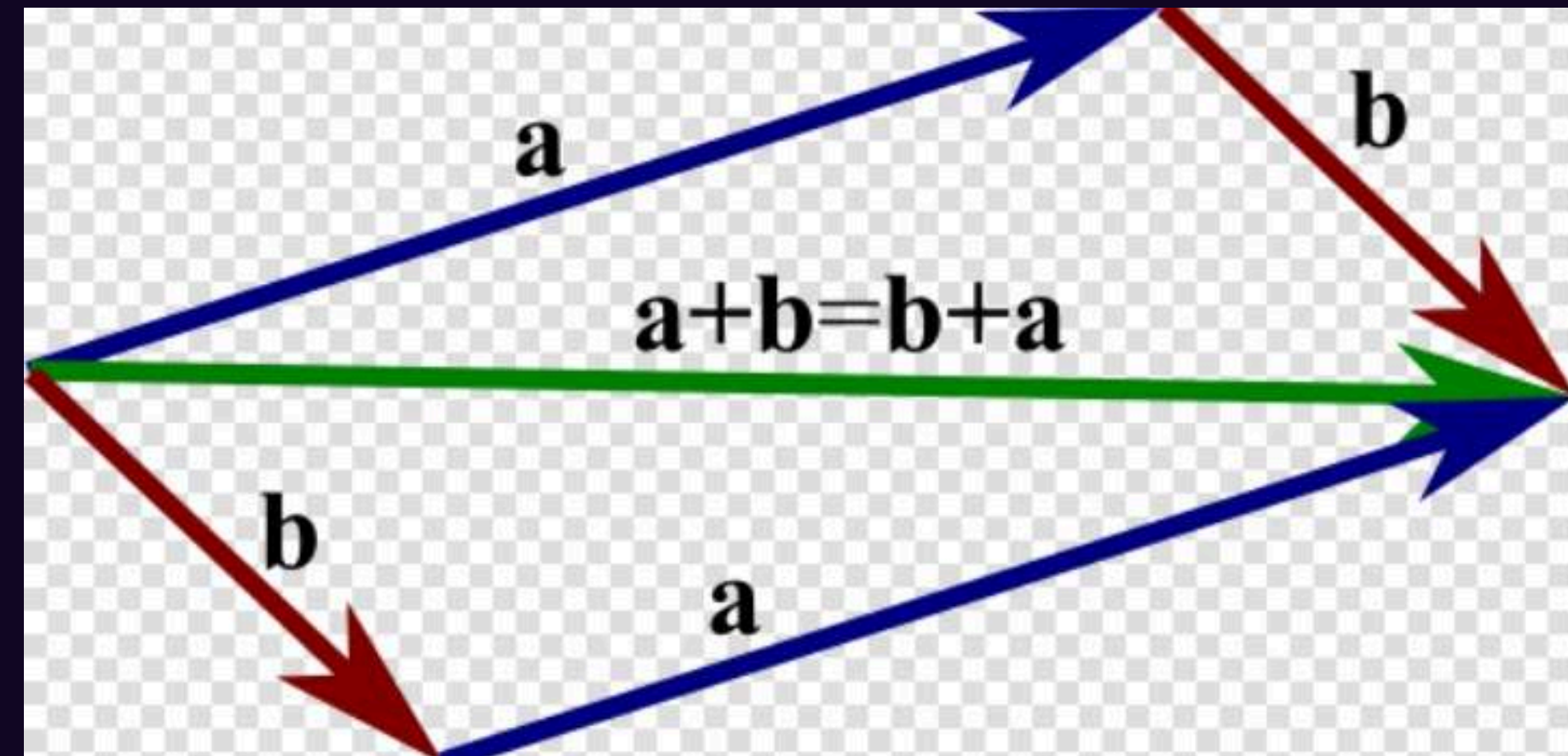
किसी सदिश का परिमाण और दिशा।

नीला तीर सदिश  $a$  को दर्शाता है।

सदिश के दो मुख्य गुण, परिमाण और दिशा

, क्रमशः लाल पट्टी

और हरे तीर द्वारा दर्शाए गए हैं।



# LINEAR TRANSFORMATIONS EXPLAINED

एक रेखीय रूपांतरण दो सदिश स्थानों के बीच एक ऐसा फलन है

जो सदिशों को नए सदिशों में रूपांतरित करता है,  
साथ ही सदिश योग और अदिश गुणन को संरक्षित रखता है,  
रेखाओं को सीधा रखता है

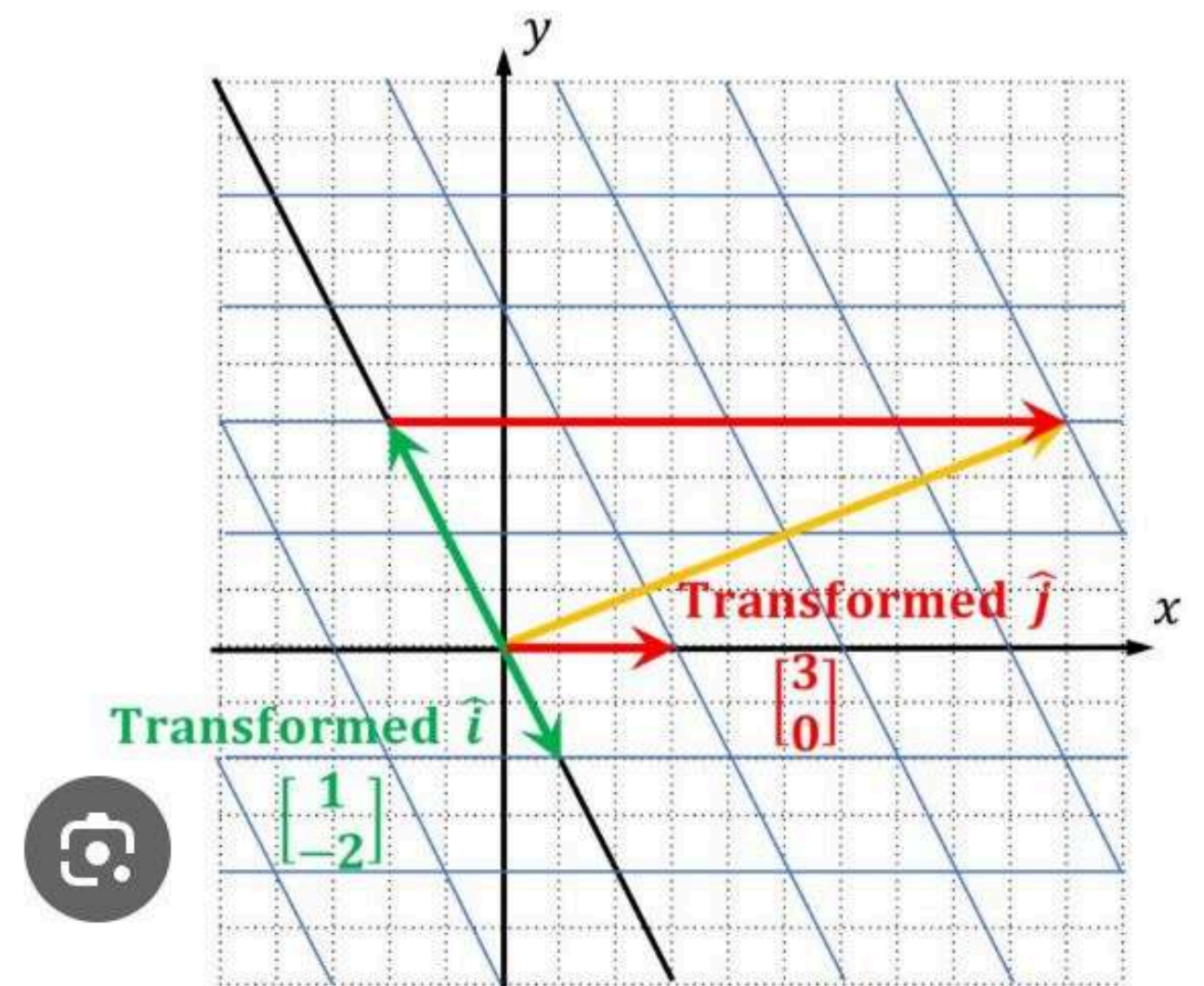
और मूल बिंदु को स्थिर रखता है।

ये रूपांतरण रेखीय बीजगणित के मूलभूत तत्व हैं,  
जिन्हें अक्सर मैट्रिक्स-सदिश गुणन के रूप में दर्शाया जाता है।

$$\vec{v} = -2\hat{i} + 4\hat{j}$$

$$\text{Transformed } \vec{v} = -2 (\text{Transformed } \hat{i}) + 4 (\text{Transformed } \hat{j})$$

$$= -2 \begin{bmatrix} 1 \\ -2 \end{bmatrix} + 4 \begin{bmatrix} 3 \\ 0 \end{bmatrix} = \begin{bmatrix} ax + by \\ cx + dy \end{bmatrix} = \begin{bmatrix} 10 \\ 4 \end{bmatrix}$$



# EXPLORING APPLICATIONS OF LINEAR TRANSFORMATIONS

रेखीय रूपांतरण गणित के मूलभूत उपकरण हैं

जो सदिशों को एक सदिश स्थान से दूसरे

सदिश स्थान में स्थानांतरित करते हैं,

साथ ही सदिश योग और अदिश गुणन को भी संरक्षित रखते हैं।

इन्हें मैट्रिक्स द्वारा दर्शाया जाता है,

जिससे ज्यामितीय वस्तुओं का हेरफेर, डेटा विश्लेषण

और जटिल समीकरणों का हल संभव हो पाता है।

# VISUALIZING ABSTRACT ALGEBRA CONCEPTS

अमूर्त बीजगणित को दृश्य रूप में प्रस्तुत करने से  
अमूर्त समूह, वलय और क्षेत्र सिद्धांतों को दृश्य उपकरणों के  
माध्यम से मूर्त और सहज  
संरचनाओं में बदला जा सकता है। प्रमुख विधियों में समूह  
संरचनाओं को देखने के लिए  
कैली ग्राफ, बहुभुज जैसी वस्तुओं की ज्यामितीय समरूपता  
और रूपांतरणों को मैप  
करने के लिए जियोजेब्रा या पास्कगैलोइस  
जैसे सॉफ्टवेयर शामिल हैं। ये दृश्य निरूपण बीजगणितीय  
अवधारणाओं को स्पष्ट, सुगम और यादगार  
संरचनाओं में रूपांतरित करते हैं।



# SUMMARY AND FUTURE INSIGHTS

गणित संरचना, स्थान और परिवर्तन की मूलभूत भाषा है,

जो विशुद्ध सैद्धांतिक तर्क से विकसित होकर तकनीकी

नवाचार और डेटा विश्लेषण का एक आवश्यक चालक बन गई है।

गणित का भविष्य कृत्रिम बुद्धिमत्ता (एआई), मशीन लर्निंग और

क्वांटम कंप्यूटिंग से गहराई से जुड़ा हुआ है, और एक ऐसे युग की ओर

अग्रसर है जहाँ मानव अंतर्दृष्टि को स्वचालित, उच्च

गति वाली गणनात्मक प्रमाण नि

र्माण द्वारा बढ़ाया जाएगा—और कभी-कभी चुनौती भी दी जाएगी।

Thank you

For watching this presentation

We hope you found this presentation on abstract algebra insightful.  
Questions and discussions are welcome!

# Lt. Raja Virendra Bahadur Singh Govt. College

CLASS – B.SC 4TH SEM | SUBJECT – MATHEMATICS



# DAILY USES OF MY CURRICULUM

This curriculum explores the real-world applications of mathematical concepts, enhancing learning through practical examples and engaging methodologies for students.

**SUBMITTED BY**  
~ KHILESH SAO

**GUIDED BY**  
~RAJKISHOR PATEL



# विषय-सूची (Contents)

## समरूपता ( **Isomorphism** )

Isomorphism Theorem helps understand how different structures can be equivalent, emphasizing the logic behind various representations and their applications.

## चक्रीय समूह ( **Cyclic Groups** )

Cyclic Groups illustrate repeating patterns in nature, such as clocks and calendars, providing insights into modular arithmetic and real-life applications.

## क्रमचय ( **PERMUTATIONS** )

Permutations relate to arrangements and orders, aiding in understanding seating combinations, passwords, and other organizational methods in everyday scenarios.

# समरूपता. (Isomorphism ) :-

समान संरचना का सिद्धांत  
समरूपता सिद्धांत बताता है कि  
कैसे अलग-अलग प्रणालियाँ  
समान संरचना रखती हैं, जैसे  
मीटर से सेंटीमीटर में रूपांतरण।

# चक्रीय समूह :- (Cyclic Groups )

दोहराए जाने वाले पैटर्न

चक्रीय समूह वास्तविक जीवन में दोहराए जाने वाले पैटर्न को दर्शाते हैं, जैसे घड़ियाँ, सप्ताह के दिन, और कैलेंडर चक्र।

# क्रमचय :- (permutation)

व्यवस्था और क्रम की समझ  
बैठने की व्यवस्था, पासवर्ड, और  
कार्ड शफलिंग जैसे उदाहरण  
वास्तविक जीवन में **संभावित**  
**व्यवस्था** को समझने में मदद  
करते हैं।

रिंग्स :-  
(Ring's)

## ALGEBRA AND COMPUTER SCIENCE

रिंग्स का उपयोग अल्जेब्रा,  
कंप्यूटर विज्ञान, और  
क्रिप्टोग्राफी में सुरक्षित डेटा और  
त्रुटि पहचान के लिए महत्वपूर्ण  
है, जिससे आधुनिक तकनीक  
को समर्थन मिलता है।

# फील्ड्स :- (Fields)

विज्ञान और इंजीनियरिंग में

Fields play a crucial role in various domains by ensuring **online security** and facilitating **accurate data transmission** in digital communication systems.

# समाकलनीय क्षेत्र :- (Integral domain)

सटीक गणना के महत्त्व

Integral domains are crucial in ensuring accurate calculations, particularly in computer science, cryptography, and engineering applications for reliable results and security.

आदर्श :-  
(Ideal)

सरल गणनाएँ और सुधार

Ideals simplify complex calculations, making them essential in error correction codes and enhancing data reliability across various applications in technology.

# सदिश स्थल :- (Vector space )

गणितीय मूल तत्व

वेक्टर स्थान का उपयोग कंप्यूटर  
ग्राफिक्स, भौतिकी,  
इंजीनियरिंग, डेटा विज्ञान, और  
संचार प्रणाली में महत्वपूर्ण  
भूमिका निभाता है, जटिल  
समस्याओं को हल करता है।

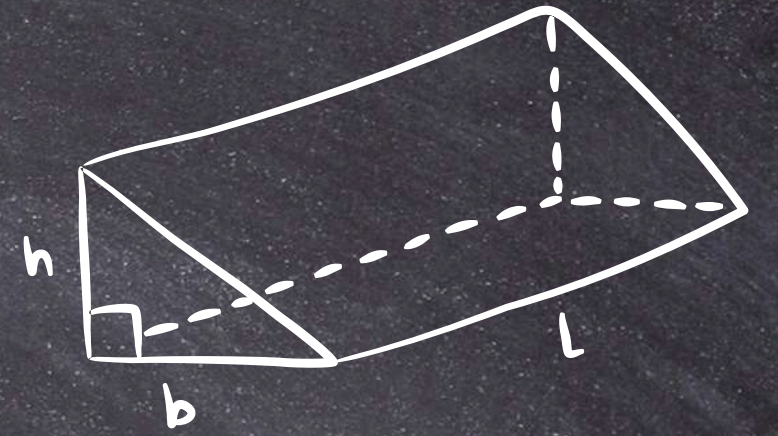
# रैखिक रूपांतरण:- (Linear Transformation)

डेटा परिवर्तन और उपयोग  
रैखिक रूपांतरण कंप्यूटर  
ग्राफिक्स, रोबोटिक्स और मशीन  
लर्निंग में **महत्वपूर्ण भूमिका**  
निभाते हैं, जैसे कि रोटेशन और  
रिसाइजिंग प्रक्रियाएं।

Thank You for Your  
Attention



$$a + 0 = a$$



$$V = \frac{1}{2} bhl$$

LATE. RAJA VIRENDRA BAHADUR  
SINGH GOVT. COLLAGE SARAI PALI



$$V = \frac{4}{3} \pi r^3$$

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NAME - AKHIL KUMAR BAGH

CLASS - BSC. 4<sup>th</sup> SEM

SUBJECT - MATHS ASSIGNMENT

TOPIC - DAILY USES OF MY CURRICULUM

$$S = \frac{d}{t}$$

Presented by - Akhil Kumar bagh

# CONTENT

> CYCLIC GROUPS

> RING HOMOMORPHISM


> FINITE-DIMENSIONAL  
VECTOR SPACE

> LINEAR TRANSFORMATION



# CYCLIC GROUP

## Cyclic Groups

- .Used in cryptography to secure digital communication.
  - . Applied in modular arithmetic such as clock calculations.
  - .Used in coding theory and error detection in computer science.
  - .Helps in understanding repeating patterns in mathematics.
- 

Cyclic groups are widely used in modern cryptography to secure digital communication and protect information.

They are also used in modular arithmetic, such as clock calculations and repeating number systems.

In computer science, cyclic groups help in coding theory and error detection techniques.

They are useful in understanding repeating patterns and structures in mathematics



# HOMOMORPHISM

Ring Homomorphism :- Used in coding theory and cryptography.  
.Helps to study relationships between different algebraic structures.

Applied in computer algebra systems for simplifying calculations.  
.Useful in abstract algebra research and mathematical modeling.

Ring homomorphisms are used to study relationships between different algebraic structures. They help mathematicians simplify complex algebraic problems by mapping one ring to another. This concept is applied in coding theory, cryptography, and computer algebra systems. It is also important in abstract algebra research and mathematical modeling.

# Vector Space

1. GPS & Mapping: Calculating your precise position, direction, and speed relative to a destination.
2. Search Engines: Converting words into "word vectors" to find relevant results based on how similar they are in meaning.
3. Computer Graphics: Rendering 3D shapes, shadows, and movement in video games and movies.
4. Streaming Recommendations: Representing your movie/music tastes as a point in a vector space to find nearby matches you might like.
5. Digital Imaging: Storing and editing photos, where each pixel's color and position are treated as vector coordinates.
6. Structural Engineering: Balancing competing forces (gravity, wind, tension) to ensure buildings and bridges remain stable.
7. AI & Facial Recognition: Mapping facial landmarks (distance between eyes, nose shape) into a coordinate system to identify individual.

# Uses of vector space



## 1. Projectile motion:

when a fruit falls from a tree or a bird dives, its motion (velocity and acceleration) is analyzed using vector component (horizontal and vertical) to determine its path.

## 2. Engineering and construction:

vectors determine the forces, torques, and stress acting on structure like bridges, enabling stable design.

## 3. Electromagnetic fields:

Earth's magnetic field is a vector quantity with components parallel and perpendicular to the surface. Electric and magnetic fields in nature are re-presented as vector spaces to calculate their force on objects.

## 4. Computer graphics and Gaming:



vectors are used to map 3D objects, define lighting, and calculate movement within virtual environments and video games.





# Linear transformation

Linear transformation is used in computer graphics to rotate, resize, and move images and objects. It is important in robotics, engineering, and physics for changing coordinates and analyzing motion. Linear transformations are also used in image processing, data science, and machine learning to transform and analyze large amounts of data.

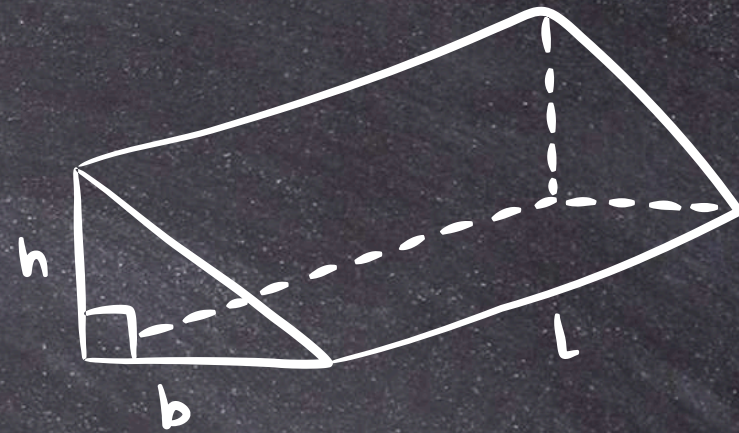


$$a + 0 = a$$

THANK  
YOU

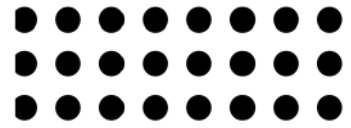


$$V = \frac{4}{3} \pi r^3$$



$$V = \frac{1}{2} bhl$$

$$S = \frac{d}{+}$$

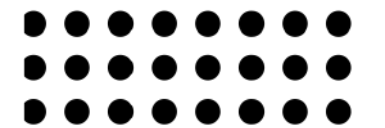


# Assignment

**Name-Babli Patel**

**Class-bsc4th semester**

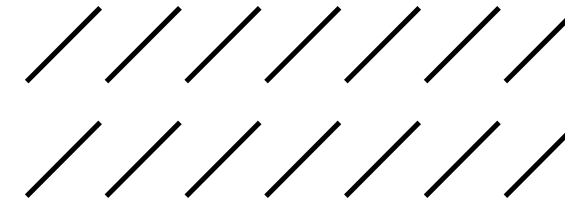
**Subject - Math**



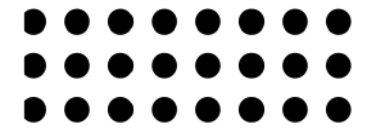
Presented by Babli Patel

# content

- .Cyclic Groups
- .Ring Homomorphism
- .Finite-dimensional vector space
- .Rank–Nullity Theorem



Presented By Babli Patel



# Cyclic Group

## Cyclic Groups

- .Used in cryptography to secure digital communication.
- . Applied in modular arithmetic such as clock calculations.
- .Used in coding theory and error detection in computer science.
- .Helps in understanding repeating patterns in mathematics.



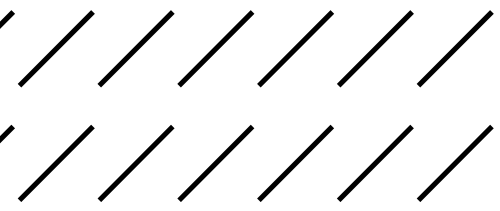
**Cyclic groups are widely used in modern cryptography to secure digital communication and protect information.**

**They are also used in modular arithmetic, such as clock calculations and repeating number systems.**

**In computer science, cyclic groups help in coding theory and error detection techniques.**

**They are useful in understanding repeating patterns and structures in mathematics.**

Presented by Babli Patel



# Homomorphism

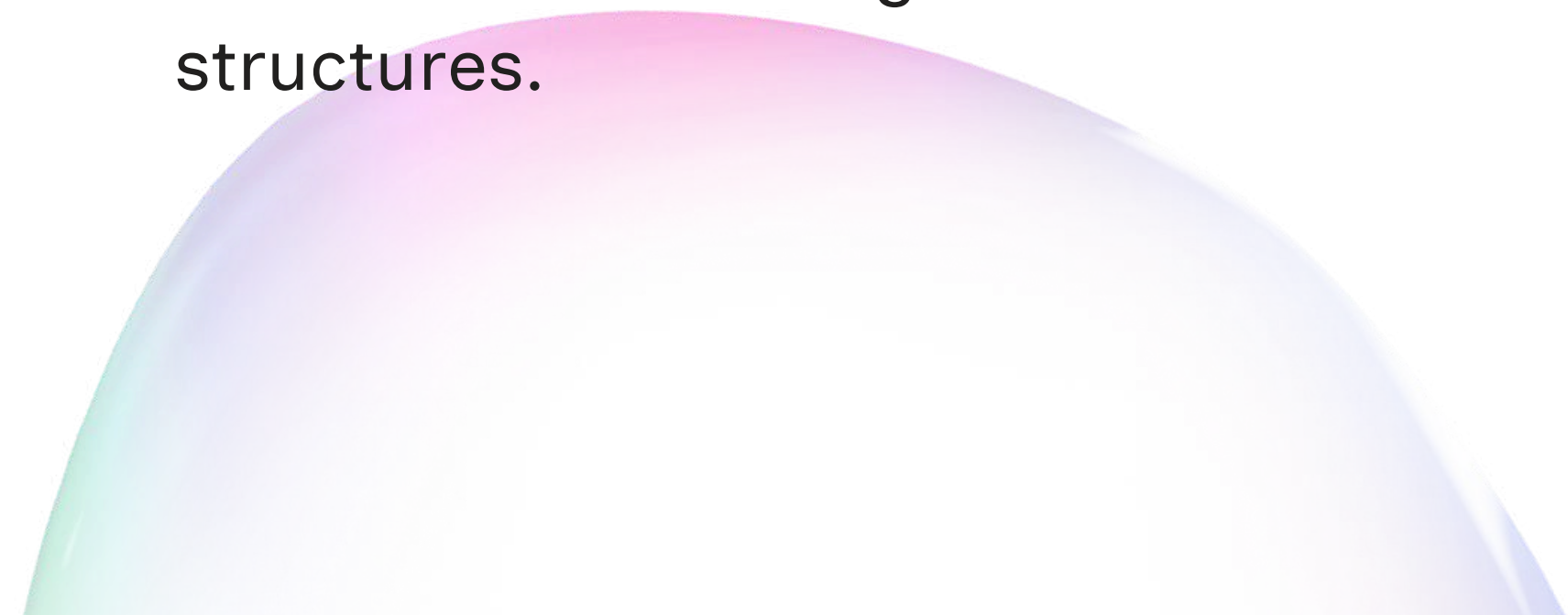


Ring Homomorphism :- Used in coding theory and cryptography.

.Helps to study relationships between different algebraic structures.

Applied in computer algebra systems for simplifying calculations.

.Useful in abstract algebra research and mathematical modeling.



**Ring homomorphisms are used to study relationships between different algebraic structures.**

**They help mathematicians simplify complex algebraic problems by mapping one ring to another.**

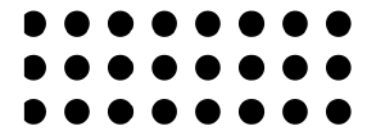
**This concept is applied in coding theory, cryptography, and computer algebra systems.**

**It is also important in abstract algebra research and mathematical modeling.**

# Vector space

Finite-dimensional vector space:-

- .Used in computer graphics and 3D modeling.
- .Applied in machine learning and data analysis.
- .Important in physics and engineering calculations.
- .Used in signal processing and image processing.



**Finite dimensional vector spaces are widely used in computer graphics and 3D modeling to represent objects and transformations.**

**They are also important in machine learning and data analysis where data is represented as vectors.**

**In physics and engineering, vector spaces are used to describe physical quantities and solve mathematical models.**

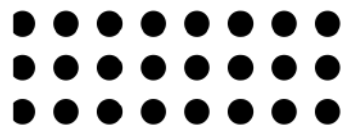
**They are also used in signal processing and image processing.**

Presented by Babli Patel

# Rank Nullity

Rank Nullity Theorem use in daily life:-

- .Help in solving systems of linear equations.
- .Used in matrix analysis and linear transformations.
- .Applied in computer graphics and data science.
- .Important in engineering and applied mathematics.

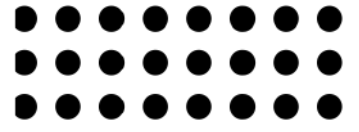


The rank–nullity theorem is used in linear algebra to understand the relationship between the rank and nullity of a linear transformation.

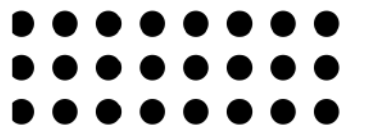
It helps in solving systems of linear equations and analyzing matrices.

This theorem is applied in computer graphics, data science, and engineering mathematics.

It is also useful in studying the structure of vector spaces and linear transformations.



**Thank You**





**LATE. RAJA VIRENDRA BAHADUR SINGH  
GOVT. COLLAGE SARAIPALI**

NAME - NARENDRA PATEL  
CLASS- BSC. 4<sup>th</sup> sem  
MATH ASSIGNMENT  
TOPIC - DAILY USES OF MY CARICULUM



# CONTENT

CYCLIC GROUPS

RING HOMOMORPHISM

VECTOR SPACE

LINEAR TRANSFORMATION



# CYCLIC GROUPS

## Cyclic Groups

.Used in cryptography to secure digital communication.

. Applied in modular arithmetic such as clock calculations.

.Used in coding theory and error detection in computer science.

.Helps in understanding repeating patterns in mathematic

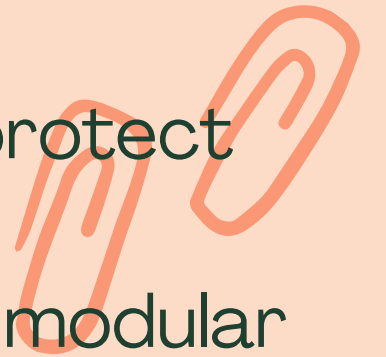


Cyclic groups are widely used in modern cryptography to secure digital communication and protect information.

They are also used in modular arithmetic, such as clock calculations and repeating number systems.

In computer science, cyclic groups help in coding theory and error detection techniques.

They are useful in understanding repeating patterns and structures in mathematic



# HOMOMORPHISM

Ring Homomorphism :- Used in coding theory and cryptography.  
.Helps to study relationships between different algebraic structures.

**APPLIED IN COMPUTER ALGEBRA  
SYSTEMS FOR SIMPLIFYING  
CALCULATIONS.  
.USEFUL IN ABSTRACT ALGEBRA  
RESEARCH  
AND MATHEMATICAL MODELING.**

**Ring homomorphisms are used to study relationships between different algebraic structures. They help mathematicians simplify complex algebraic problems by mapping one ring to another. This concept is applied in coding theory, cryptography, and computer algebra systems. It is also important in abstract algebra research and mathematical modeling.**

# VECTOR SPACE



**Fluid Flow and Water):** Meteorologists use vector fields to map wind direction and speed across the globe. Similarly, the velocity of water flowing in a pipe or river is treated as a vector field.

**Electromagnetic Fields:** Earth's magnetic field is a vector quantity with components parallel and perpendicular to the surface. Electric and magnetic fields in nature are represented as vector spaces to calculate their force on objects.

**Projectile Motion:** When a fruit falls from a tree or a bird dives, its motion (velocity and acceleration) is analyzed using vector components (horizontal and vertical) to determine its path.

**Material Strength:** The internal forces and stresses in natural materials like rock or wood under pressure can be analyzed using tensor analysis, which relies on vector space, to explain phenomena like landslides or tree snapping.

# LINEAR TRANSFORMATION

**Photo Editing:** Filters in applications like Photoshop use matrices to manipulate pixel data for rotating, flipping, resizing, or adjusting brightness.

**Dimensionality Reduction (PCA):** In data science, Principal Component Analysis (PCA) uses linear transformations to reduce the number of variables in a dataset while retaining essential information.

**Machine Learning:** Neural networks use matrix multiplication at each layer (a linear transformation) followed by an activation function to learn complex patterns.





THANK YOU

# The Hidden Math in Everyday Life

Exploring the real-world applications of Abstract and Linear Algebra

Guided by -

Mr. Rajkishor patel sir

Submitted by -

Mukesh pradhan

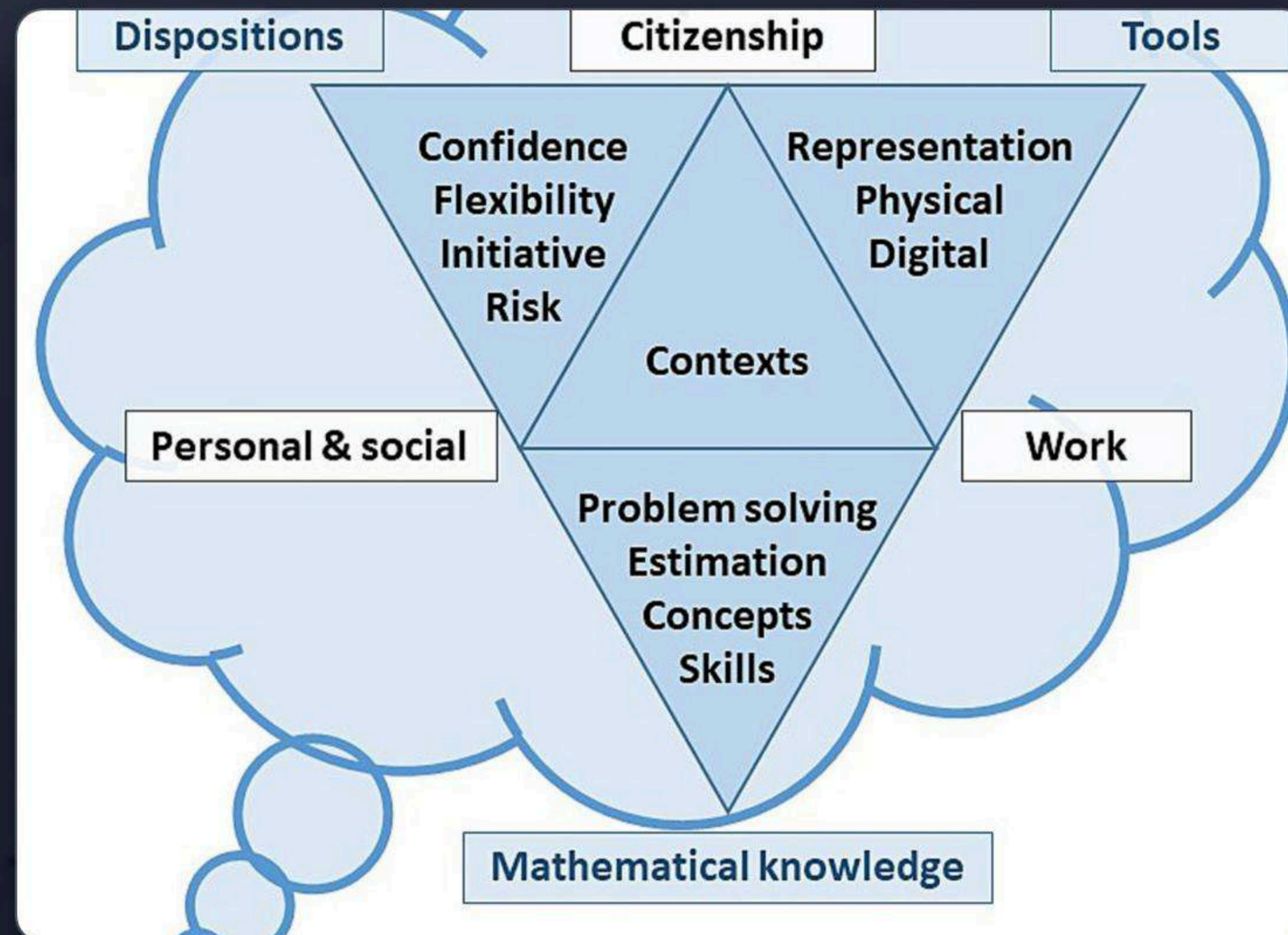
Bsc 4th sem

# Introduction: Beyond the Blackboard

Abstract and Linear Algebra might seem like theoretical concepts confined to academic textbooks, but they form the invisible framework of our modern digital world.

Every time we interact with messaging apps, video games, or secure banking websites, we are unknowingly interacting with complex algebraic structures.

**This presentation bridges the gap between the syllabus theorems and the technology you use every single day.**



# Presentation Index

## Part 1: The Foundations

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- 01.** Introduction & Purpose
- 02.** Syllabus Overview (The Theory)
- 03.** Unit I: Groups & Symmetries

## Part 2: The Applications

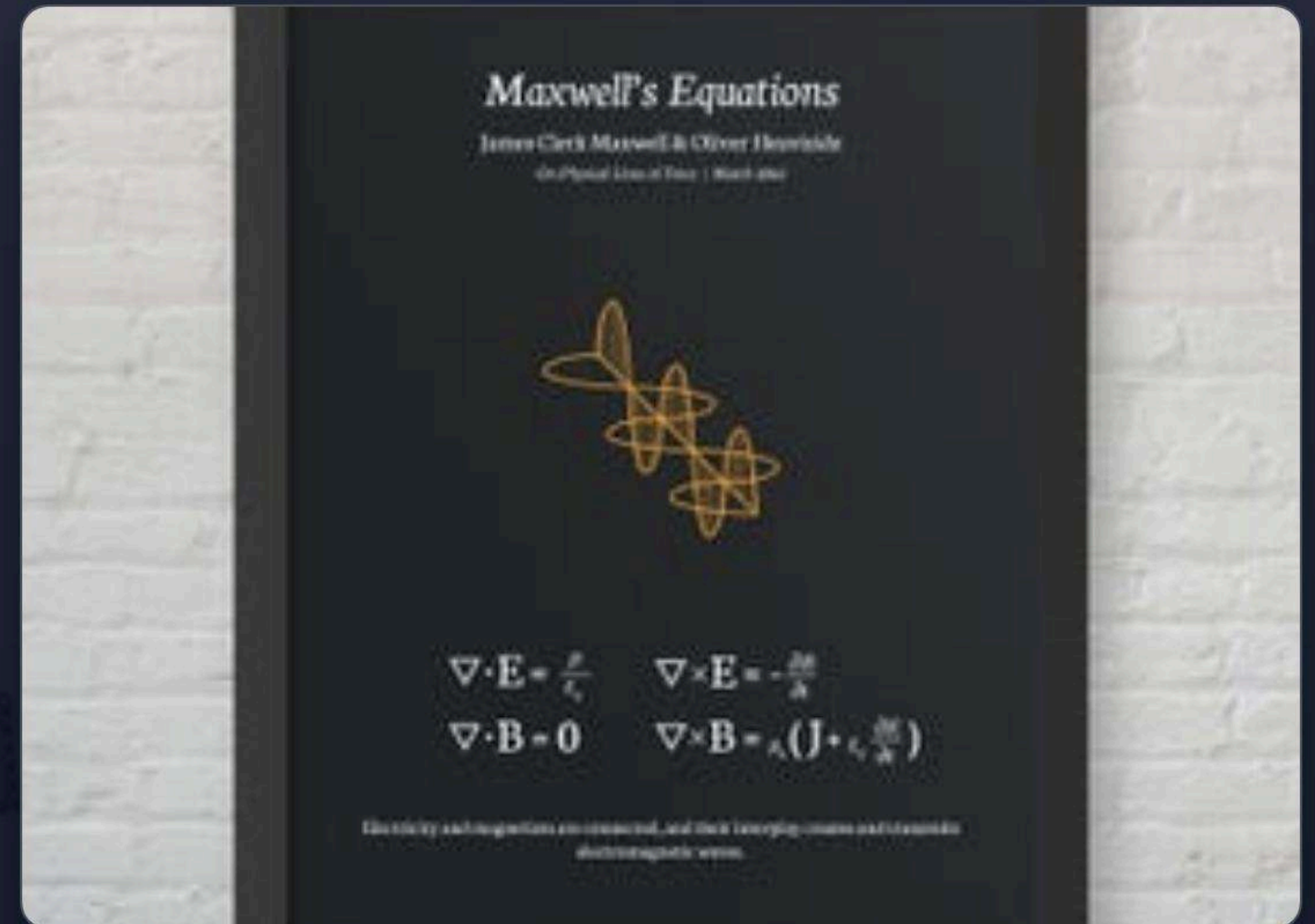
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- 04.** Digital Cryptography
- 05.** Unit II: Rings & Fields
- 06.** Error-Correcting Codes
- 07.** Units III & IV: Vectors & Matrices

# The Core Syllabus Topics

Before exploring their daily uses, here is a brief overview of the theoretical concepts established in the curriculum:

- **Groups & Rings:** Isomorphism theorems, permutation groups, cyclic groups, integral domains, and polynomials.
- **Vector Spaces:** Subspaces, basis sets, linear span, finite dimensional spaces, and dimension calculations.
- **Linear Transformations:** Matrix representations, the rank-nullity theorem, dual spaces, and natural isomorphisms.



# Unit I: Groups & Symmetries

The mathematical foundation of digital security and natural structural properties.

# Digital Security & Cryptography

- **E2E Encryption:** Messaging apps like WhatsApp rely on complex mathematical structures like Cyclic Groups and Isomorphism Theorems to secure your private data.
- **Online Banking:** RSA encryption uses properties of large prime numbers and permutation groups to ensure perfectly secure digital transactions.
- **Cryptocurrency:** The foundation of blockchain technology heavily utilizes elliptic curve cryptography, which is deeply rooted in modern group theory.



# Symmetry in the Real World



## Chemistry

Permutation groups are essential tools used to classify the symmetric properties of molecules and accurately predict behaviors in crystallography.



## Physics

Fundamental conservation laws in particle physics are directly derived from the continuous symmetries perfectly described by abstract group theory.



## Art & Design

The intricate repeating patterns found in Islamic art, tessellations, and modern architecture rely entirely on specific group structures.

# Unit II: Rings, Fields & Domains

Mathematical algorithms ensuring data integrity across the globe.

# Error-Correcting Codes

## Rescuing Corrupted Data

Have you ever scanned a slightly torn QR code? Or listened to a scratched CD without it skipping? This everyday magic is made possible by Finite Fields (often called Galois Fields).

Polynomial Rings and Field Theory allow engineers to create robust algorithms that mathematically reconstruct missing or corrupted data packets during wireless transmission.



# The Power of Data Integrity

**30%**

**Damage Tolerance**

## Reed-Solomon Codes

Using the properties of Integral Domains and Polynomial Rings, high-level QR codes can sustain up to 30% structural damage and remain perfectly readable by any device.

Without these advanced algebraic concepts, reliable digital communication over noisy channels (like Wi-Fi, 5G, and Bluetooth) would be physically impossible.

# Units III & IV: Vectors & Matrices

The geometric engines behind visual computing and artificial intelligence.

# Computer Graphics & Animation

## Vector Spaces (The Canvas)

---

In modern video games and CGI movies, every 3D object is defined by a massive set of coordinates that form a Vector Space. Even the vibrant colors displayed on your screen (RGB values) form a specific basis set within a 3-dimensional mathematical vector space.

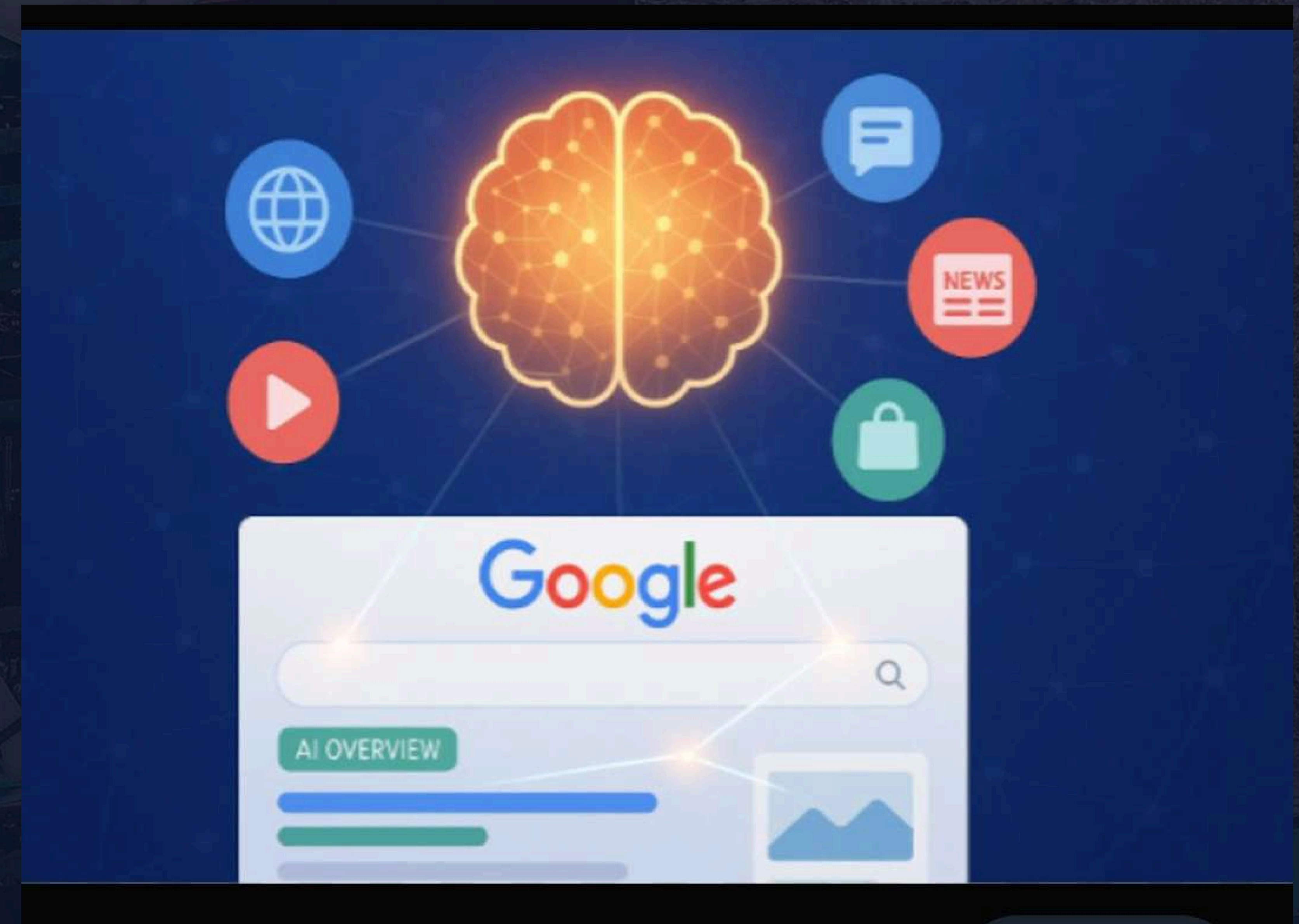
## Linear Transformations (The Action)

---

When your game character moves, the camera pans, or an object scales in size, the graphics engine is not moving physical objects—it is rapidly applying Linear Transformations (represented strictly as matrices) to millions of vectors per second.

# Artificial Intelligence & Search

- **Search Engines:** Google's PageRank algorithm models the entire internet as a massive matrix, using linear algebra to find the dominant eigenvector to rank billions of web pages.
- **Machine Learning:** Raw data is structured in multi-dimensional vector spaces. Neural network layers act as extremely complex linear transformations processing this data.
- **Eigenvalues in ML:** Core mathematical operators used in dimensionality reduction techniques, simplifying massive datasets for AI processing.



$$T(v) = \lambda v$$

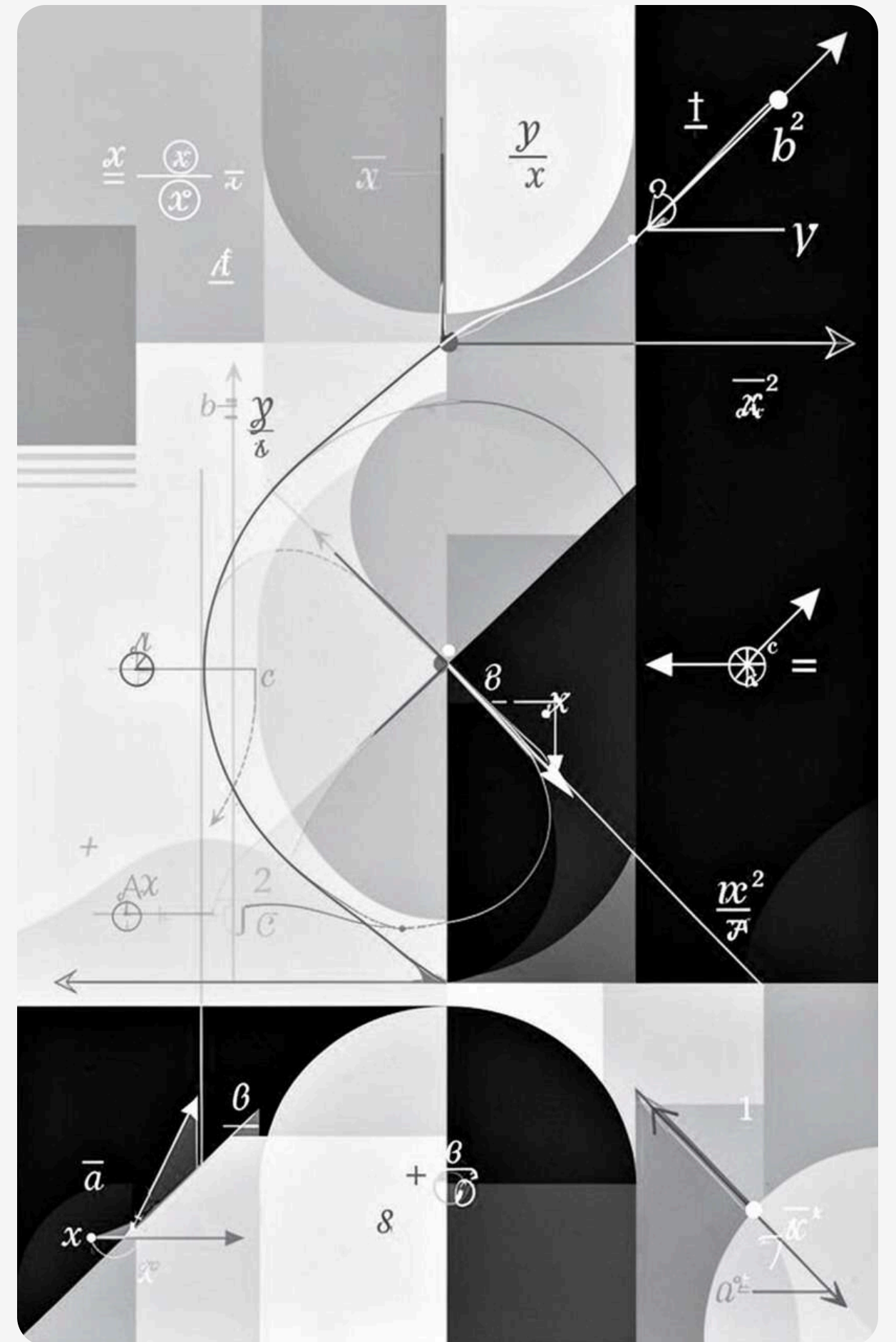


THANK YOU



# Isomorphism Theorems and Vector Spaces

Presented by Annu Choudhary  
Class Bsc 4th semester  
Guided by Raj kishor sir



# Overview of Topics

## Key concepts in algebraic structures

### Isomorphism Theorems

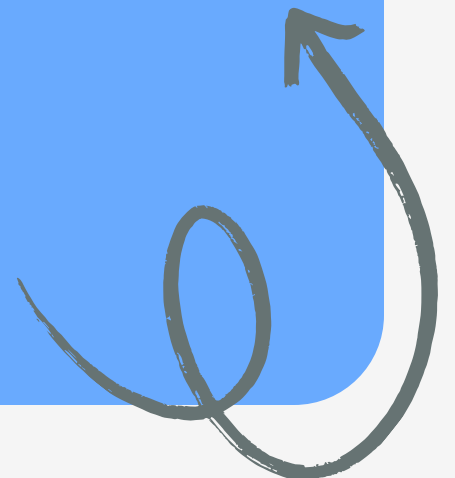
Isomorphism theorems explore structure-preserving maps, illustrating how cyclic and permutation groups relate, essential for understanding group theory and applications in mathematics.

### Ideals in Rings

Ideals are crucial subsets in rings, fields, and integral domains, acting as building blocks for understanding algebraic structures and their properties in various mathematical contexts.

### Vector Spaces

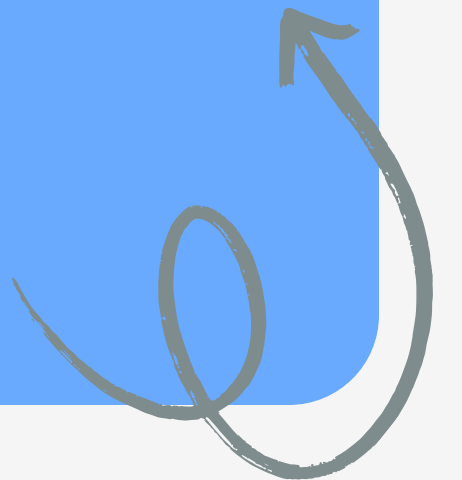
Vector spaces consist of vectors and scalars, showcasing properties like closure under addition and scalar multiplication, providing foundational concepts for linear algebra and numerous applications.



# Isomorphism Theorems Explained

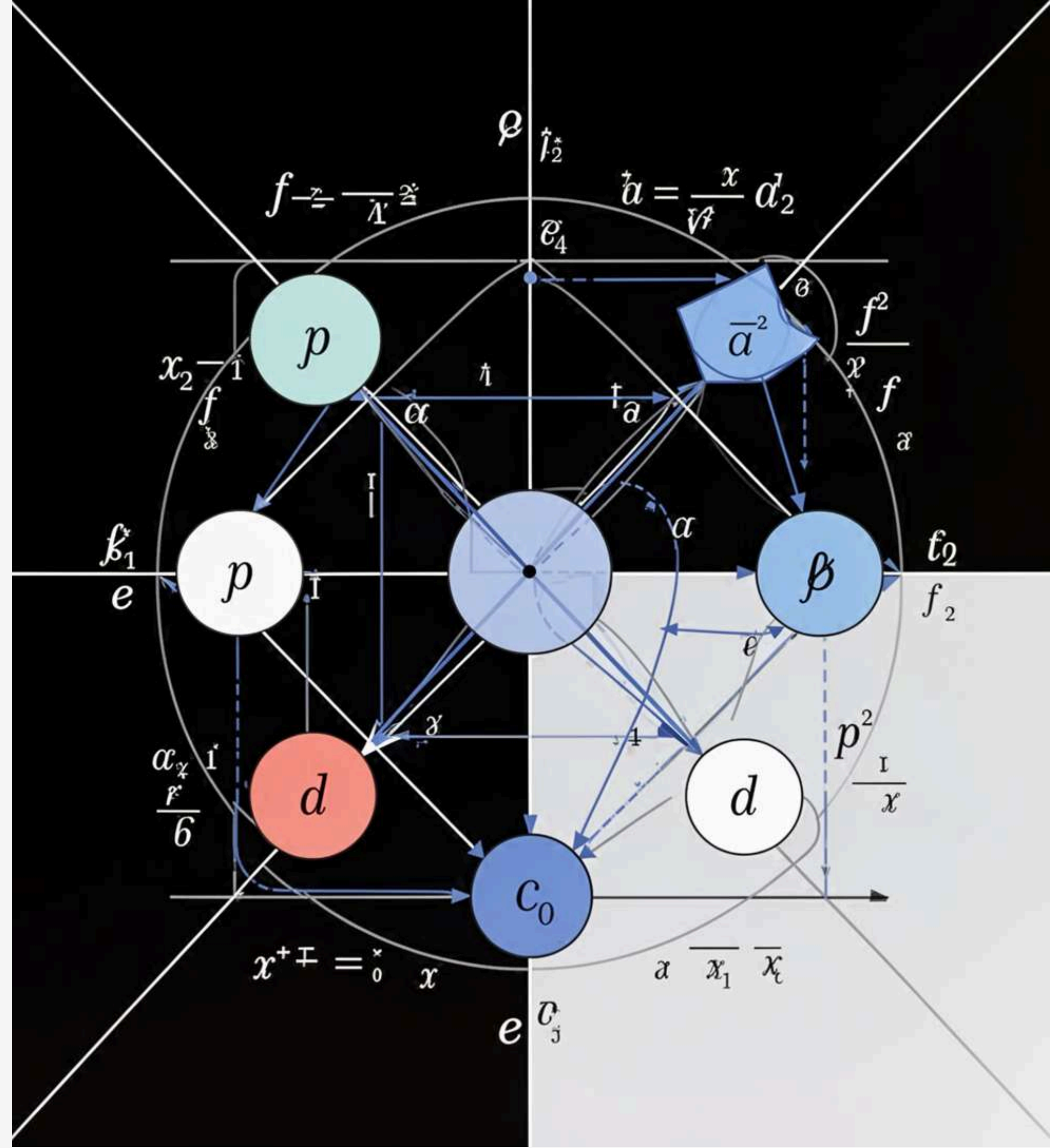
## Understanding Structure-Preserving Maps

An **isomorphism** is a structure-preserving map between groups, allowing us to understand their relationship. Studying isomorphism theorems reveals fundamental insights into the behavior of cyclic and permutation groups.



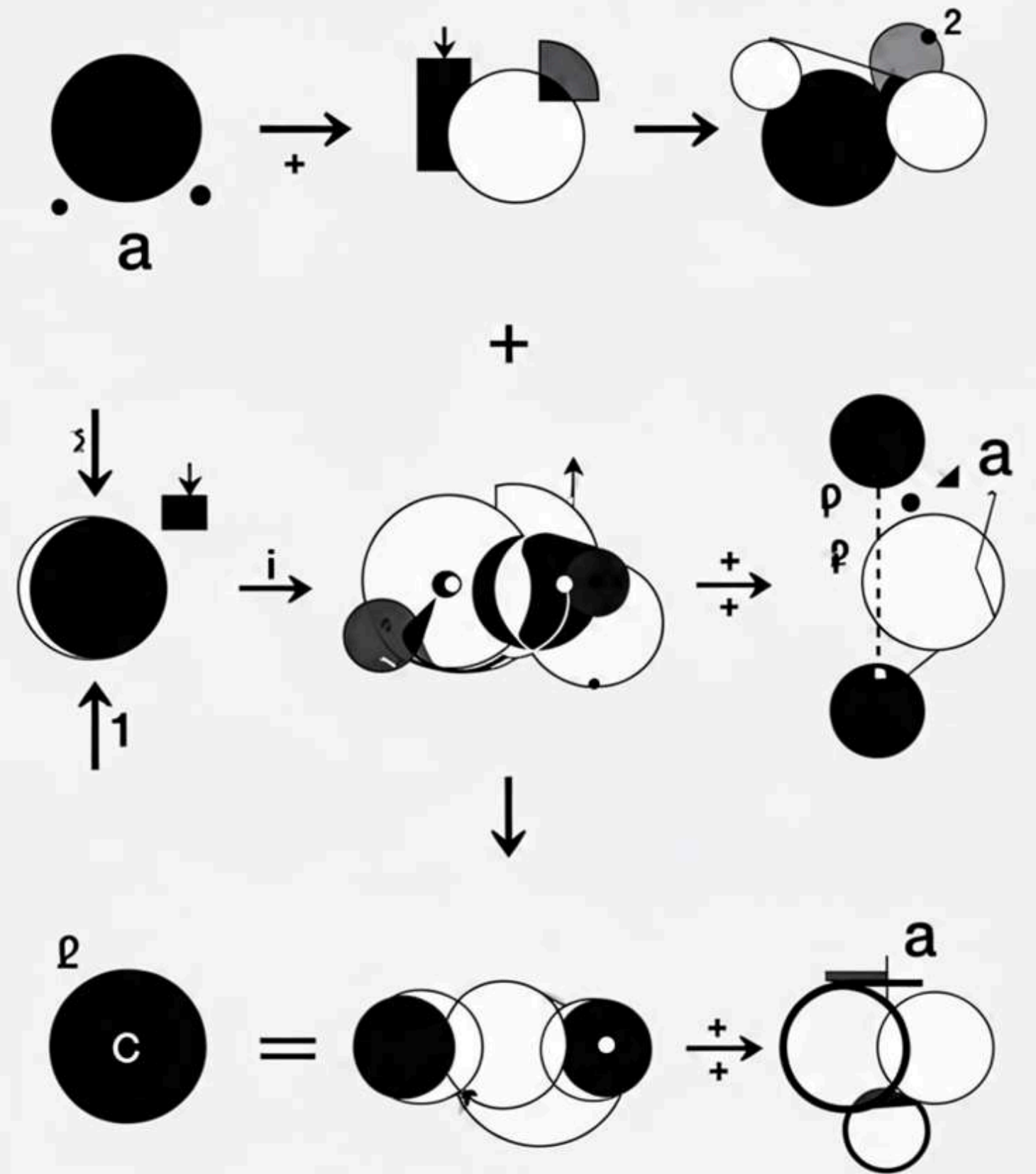
# Isomorphism Theorems Overview

- **First Isomorphism Theorem:** Relates kernel and image of a homomorphism.
- **Second Isomorphism Theorem:** Connects intersection and product of subgroups.
- **Example:** Cyclic groups are isomorphic to groups generated by rotations.



# Understanding Permutations in Groups

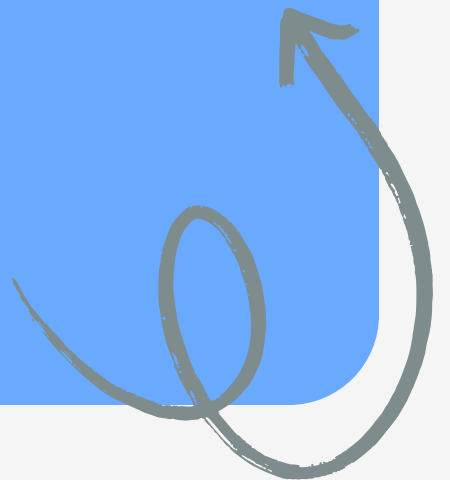
Permutations rearrange elements in a group, showcasing the essence of symmetry. This fundamental concept forms the basis for many applications in mathematics, including group actions and structure preservation.



# Ideals in Algebra

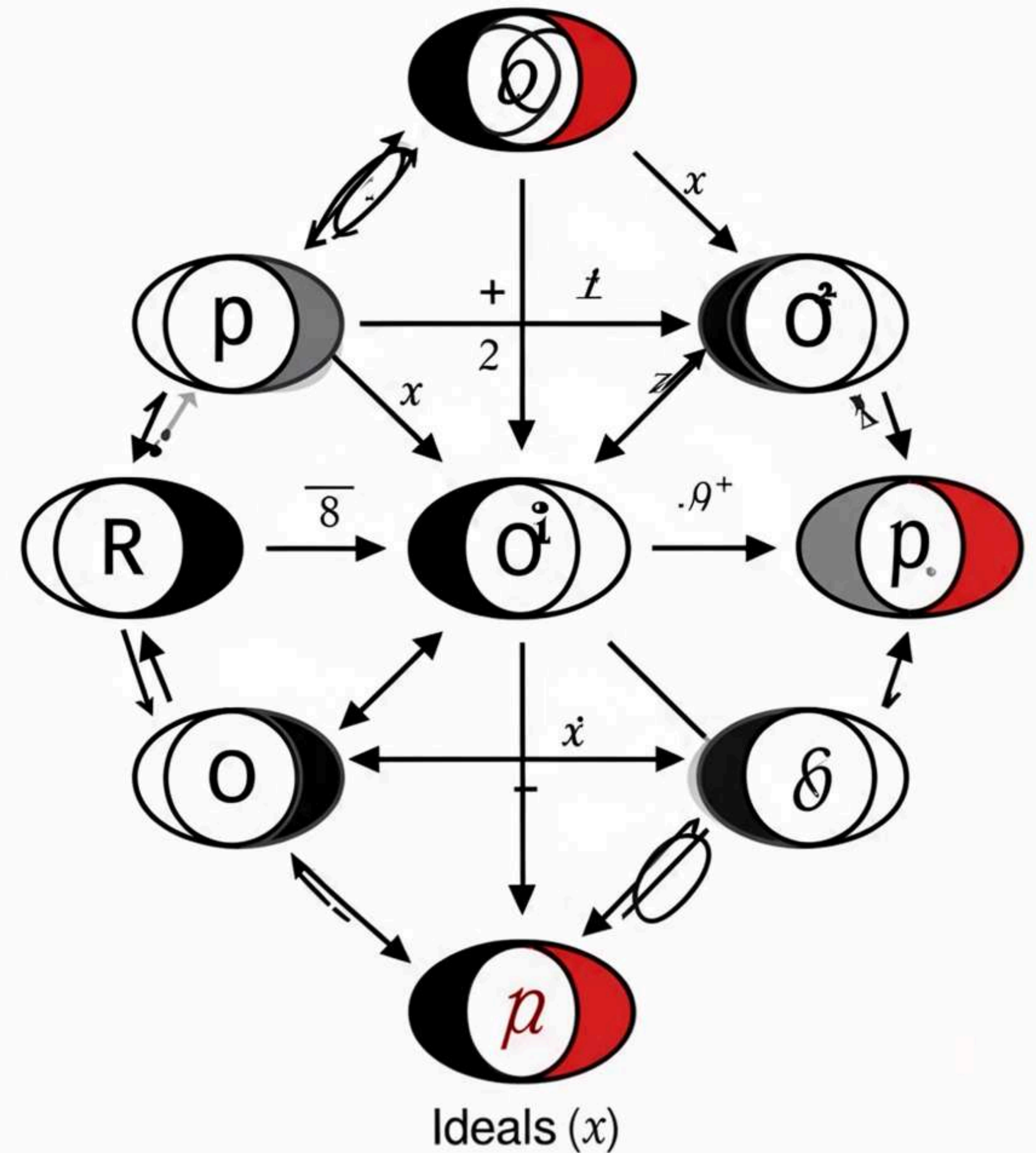
## Understanding Rings, Fields, and Domains

A ring is a set equipped with two operations, while a field has multiplicative inverses. An ideal is a special subset that absorbs products from the ring, essential for structure.



# Types of Ideals

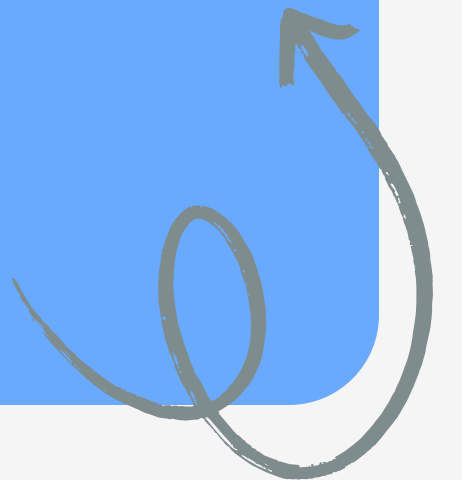
- Prime ideals are fundamental in ring theory and algebra.
- Maximal ideals lead to simple quotient structures in algebra.
- Zero ideal serves as a basic example in integral domains.



# Vector Spaces Defined

## Understanding Vectors and Scalars

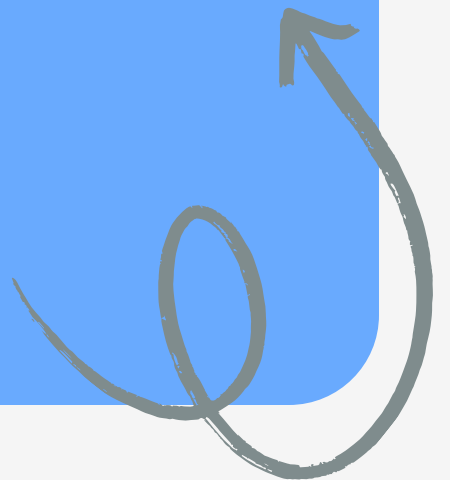
Vector spaces consist of **vectors** and **scalars**, where vectors can be added together and multiplied by scalars, ensuring closure under these operations and forming the foundation of linear algebra.



# Linear Transformations

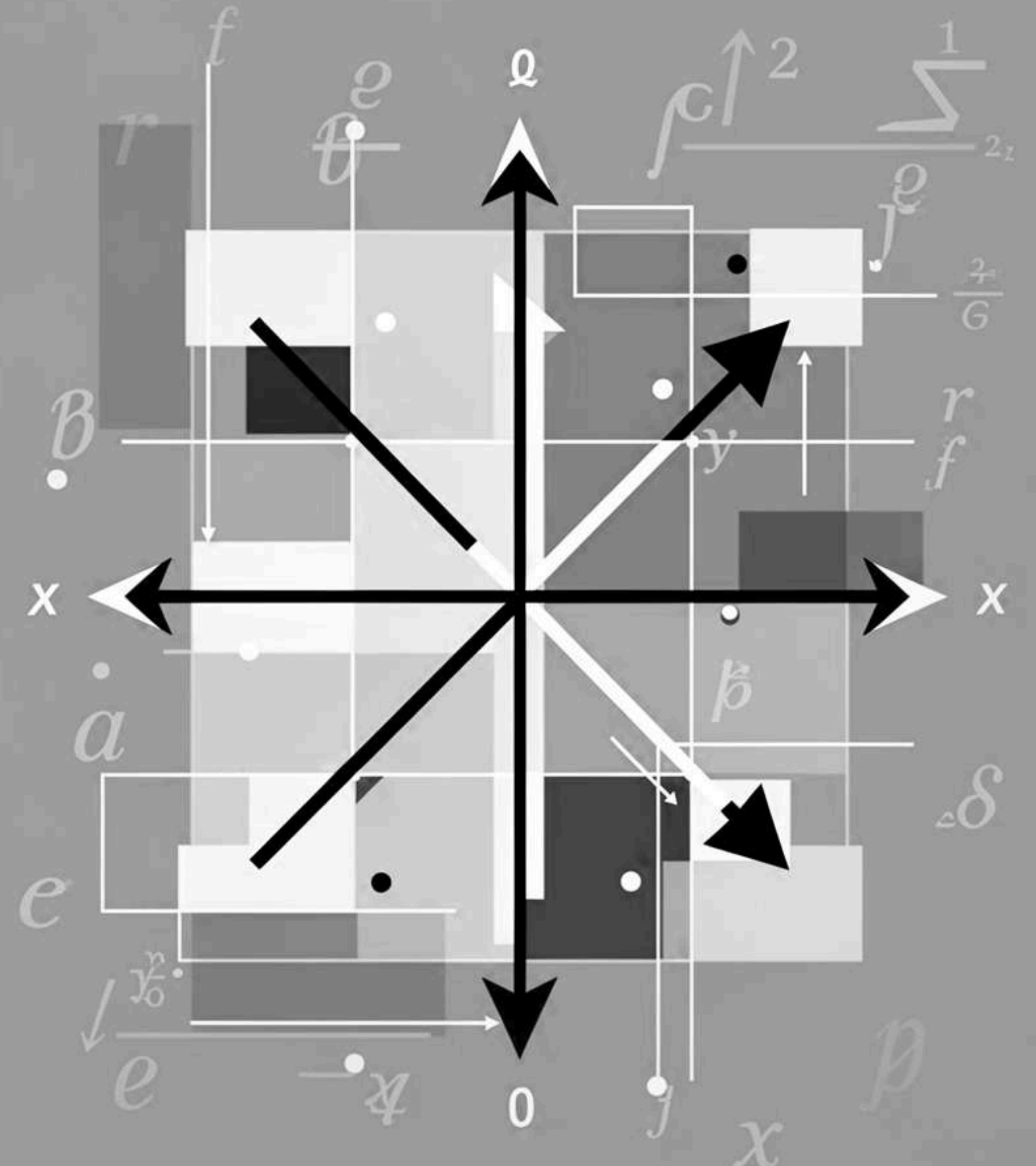
## Understanding Their Fundamental Properties

Linear transformations are crucial in mathematics, as they **preserve vector addition** and scalar multiplication, ensuring consistent structure across vector spaces through concepts like kernel and image.



# Daily Life Applications

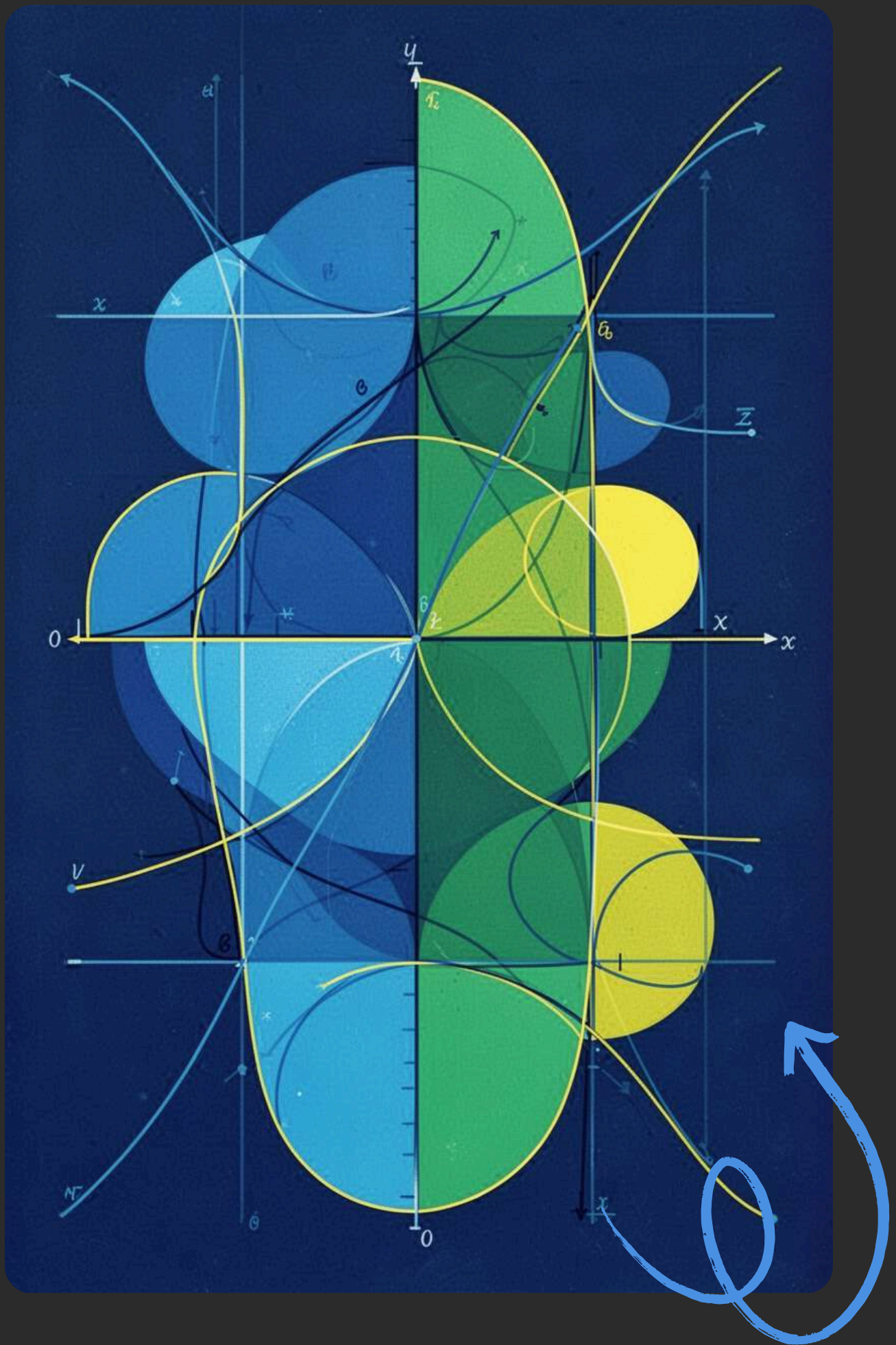
- **Computer Graphics:** Transformations enable realistic visual effects and animations.
- **Engineering:** Analyze stress and strain using mathematical modeling techniques.
- **Robotics:** Coordinate transformations facilitate robotic movement and navigation.



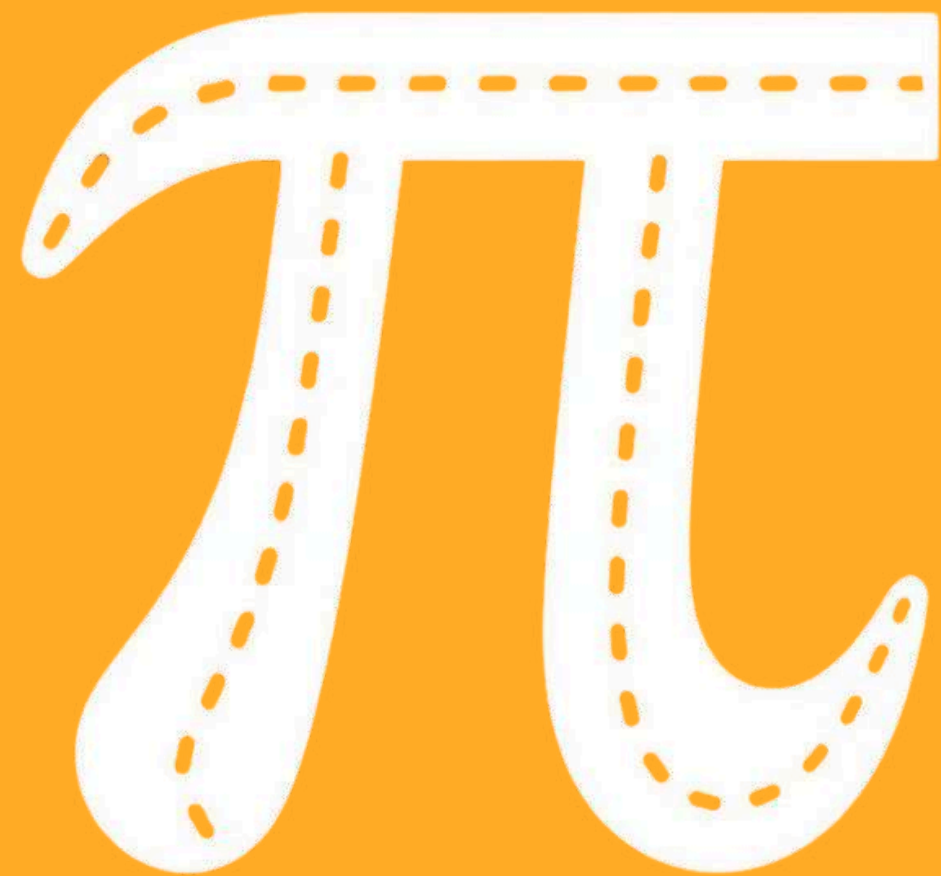
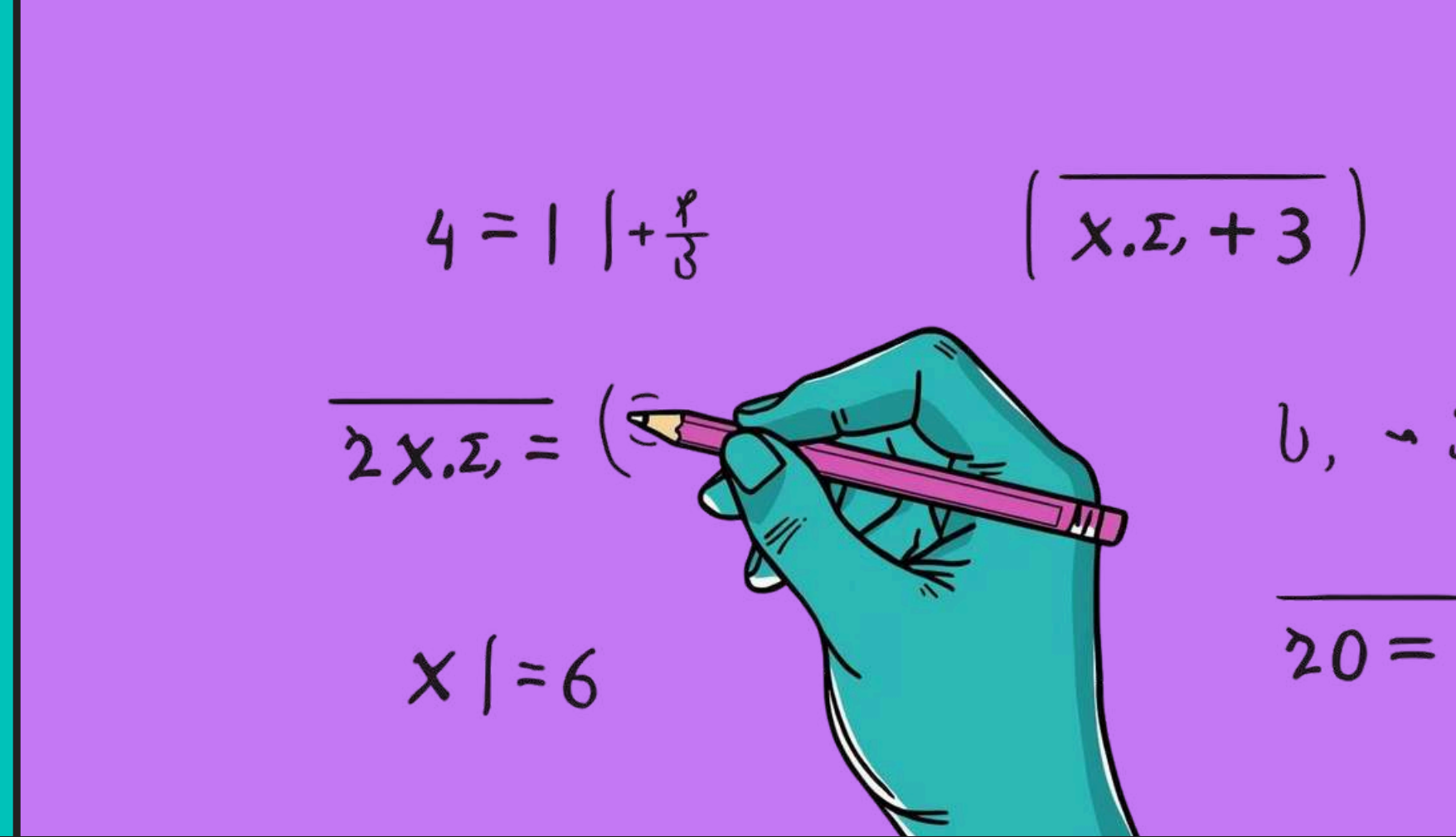


# Thank You

Exploring Mathematics in Everyday Life



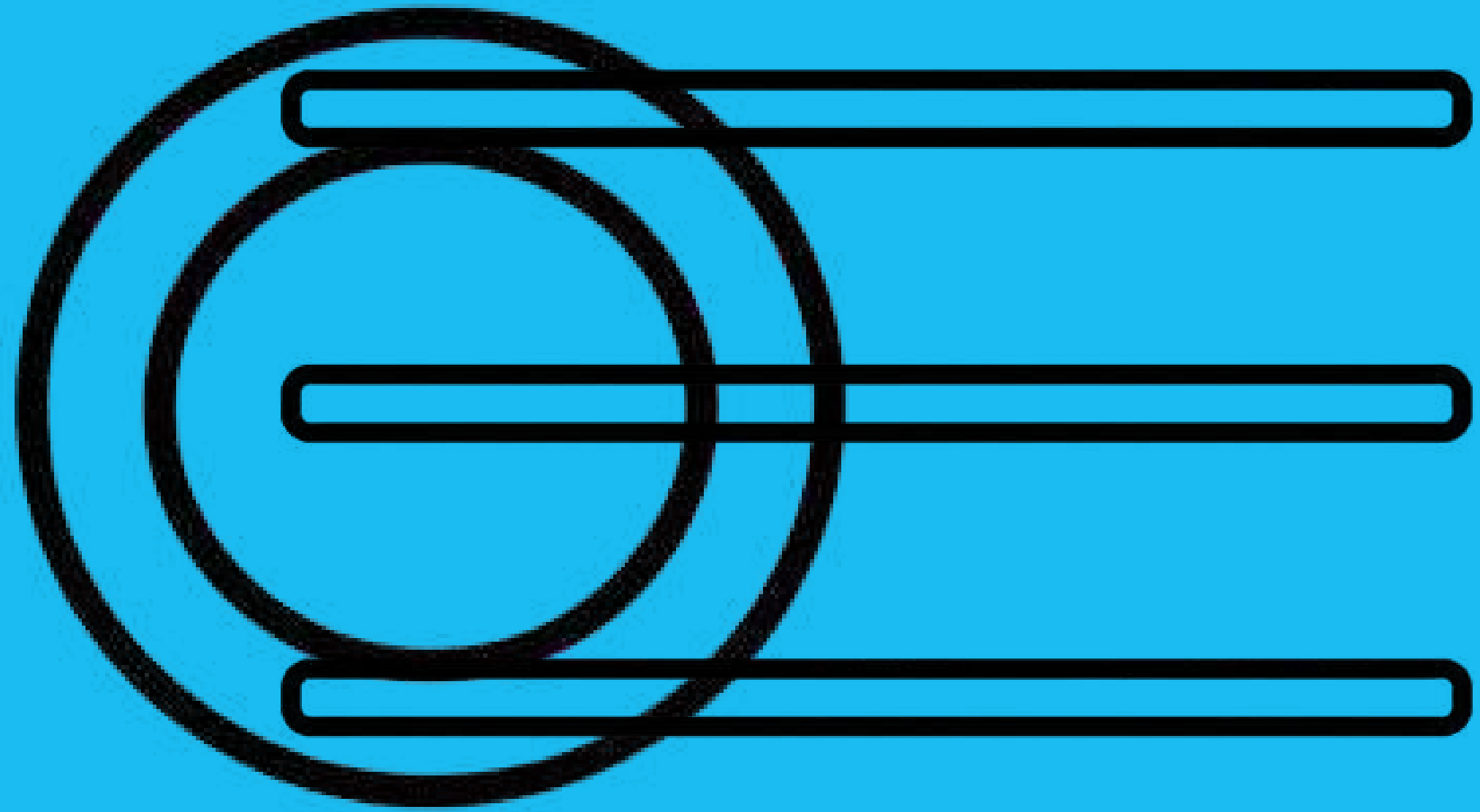
# DAILY USES OF MY CURRICULUM



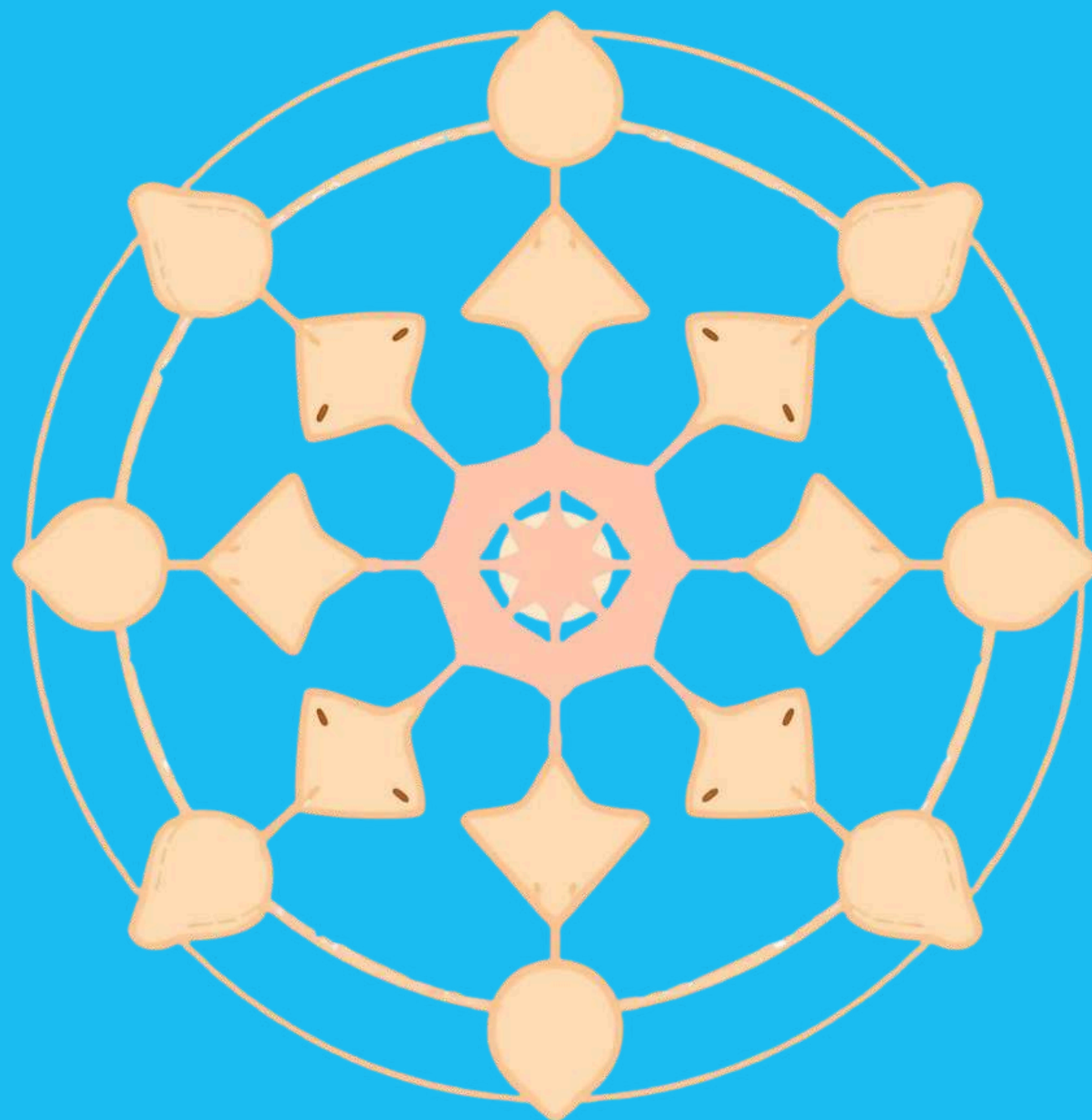
B.SC. 4TH SEMESTER



# Contents



# UNIT I - Isomorphism Theorems, Cyclic and Permutation Groups

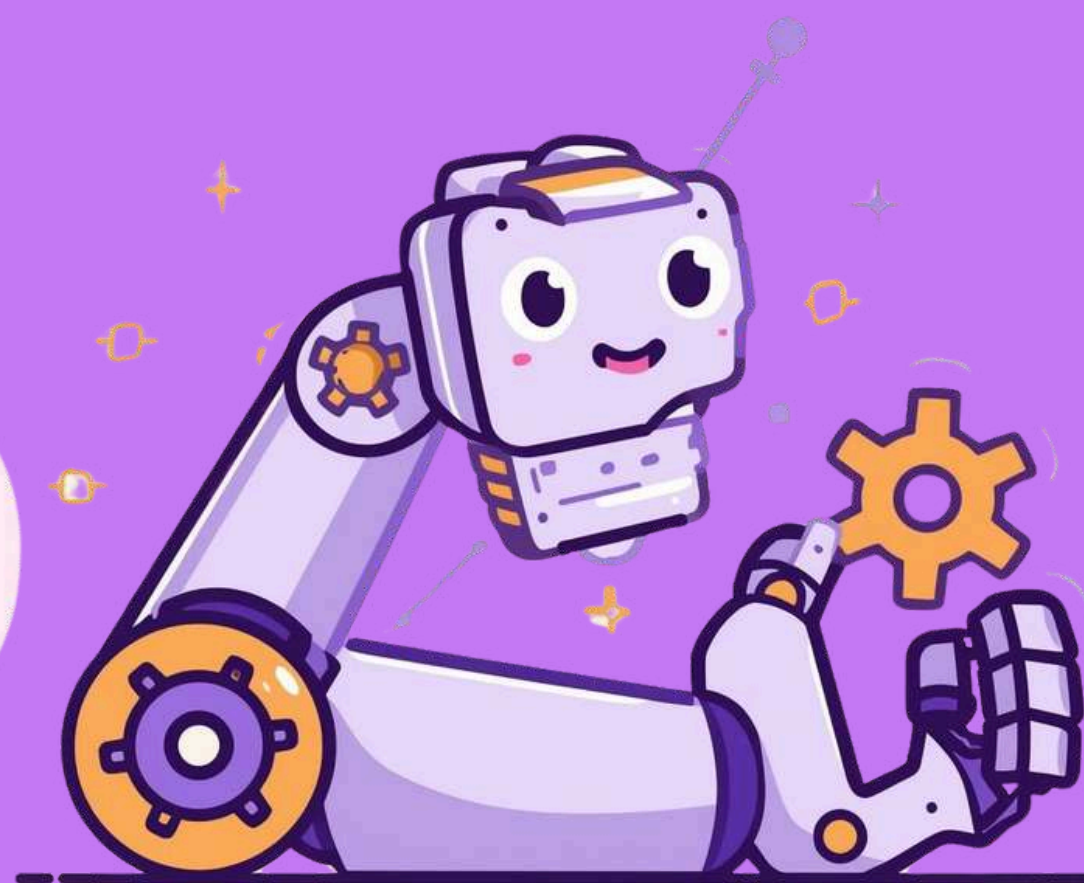


# Practical Uses of Unit 1 Concepts

Real-world applications of Isomorphism Theorems, Cyclic and Permutation Groups:



# Permutation Groups: Applications in Data Routing, Robotics & Puzzles



# UNIT 2 - Ring, Fields, Integral Domains, Ideals



$$\begin{array}{c} \mathbb{Z} \\ \downarrow \\ \mathbb{Z} + \mathbb{Z} \cdot 4x \end{array}$$

$$A = \mathbb{Z} \cdot 2x$$



$$x \cdot 4 \cdot \mathbb{Z} \cdot 2x = \mathbb{Z} \cdot (x - 2G)^3$$

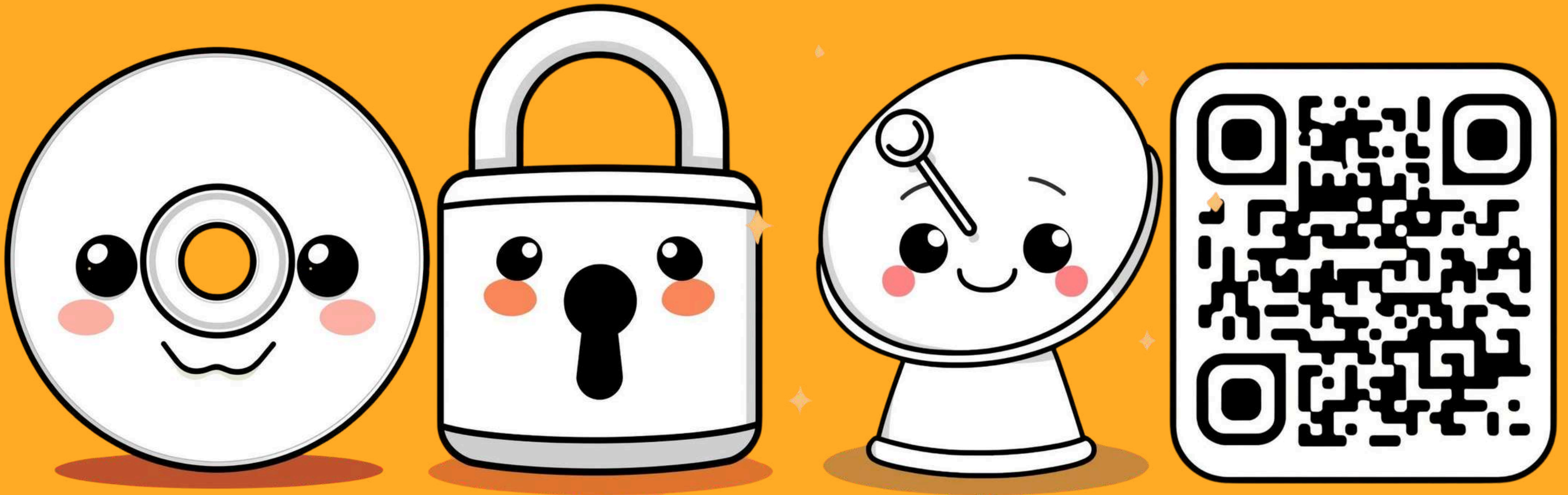
$$4 \cdot 4 = 72 \cdot 9$$

$$4 \cdot 4 = 3 \cdot 4$$

$$\langle \mathbb{Z} \cdot 2x \rangle$$

$$+ \mathbb{Z} = \mathbb{Z} + 2 \cdot x$$

# Practical Uses of Unit 2 Concepts:



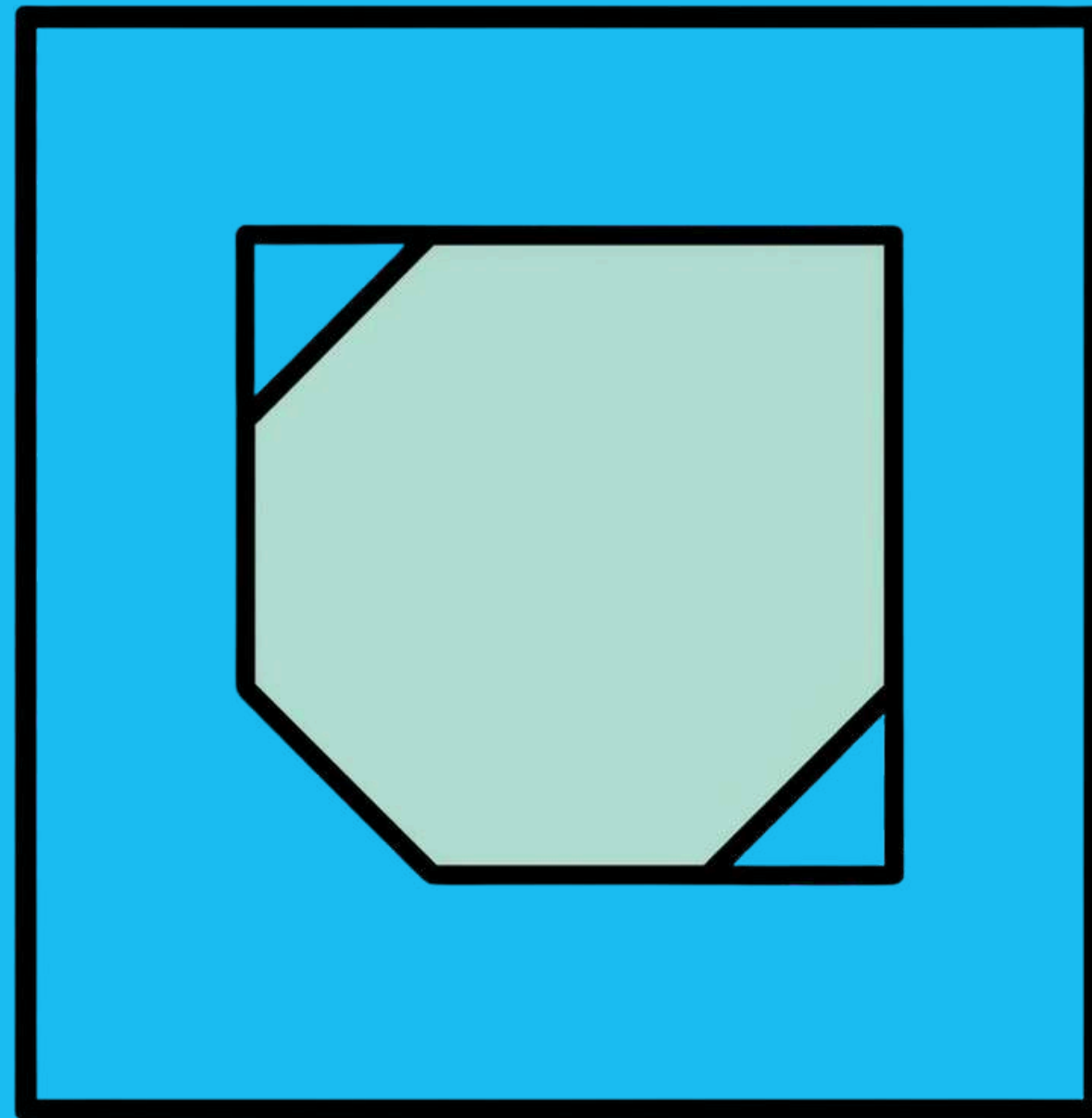
# UNIT 3 - Vector Spaces



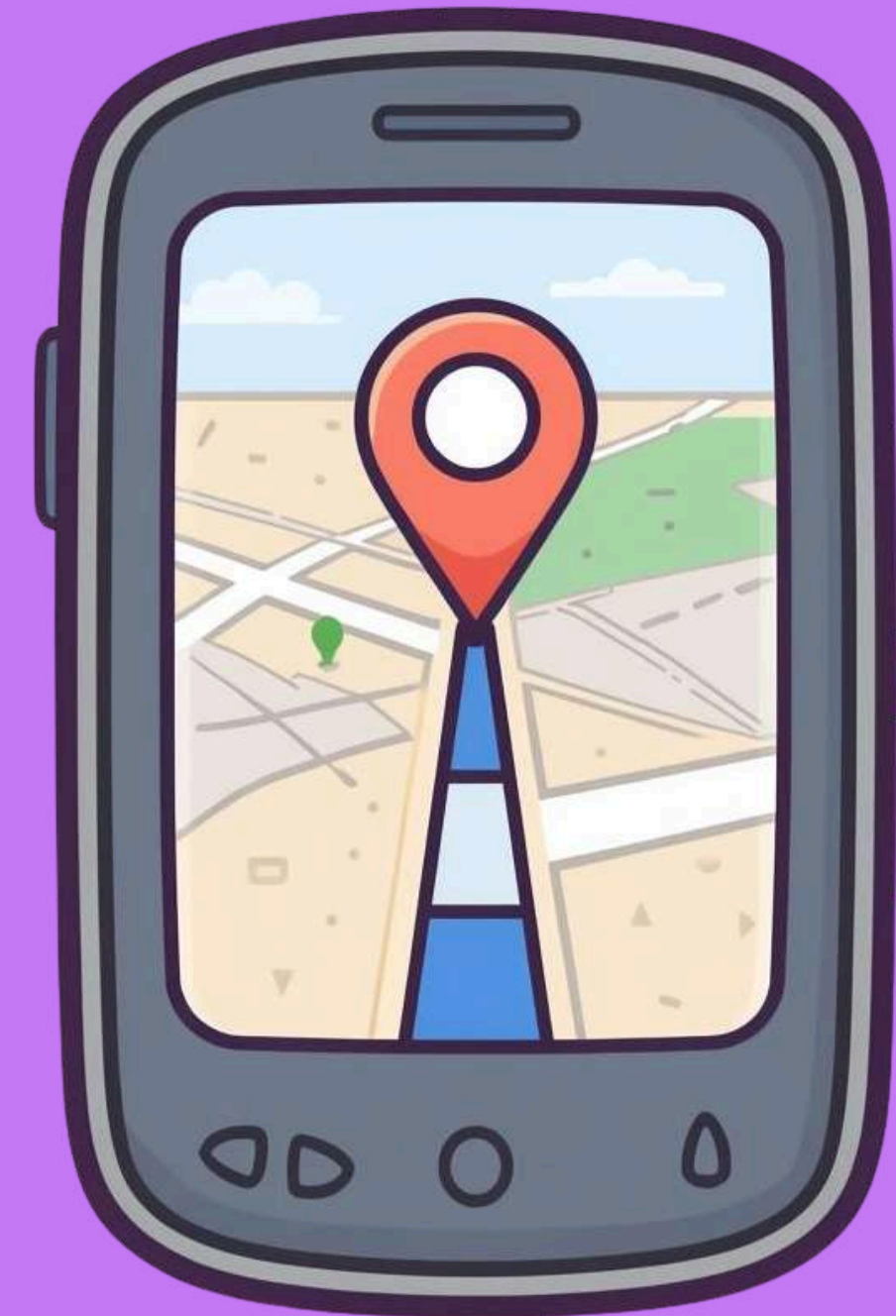
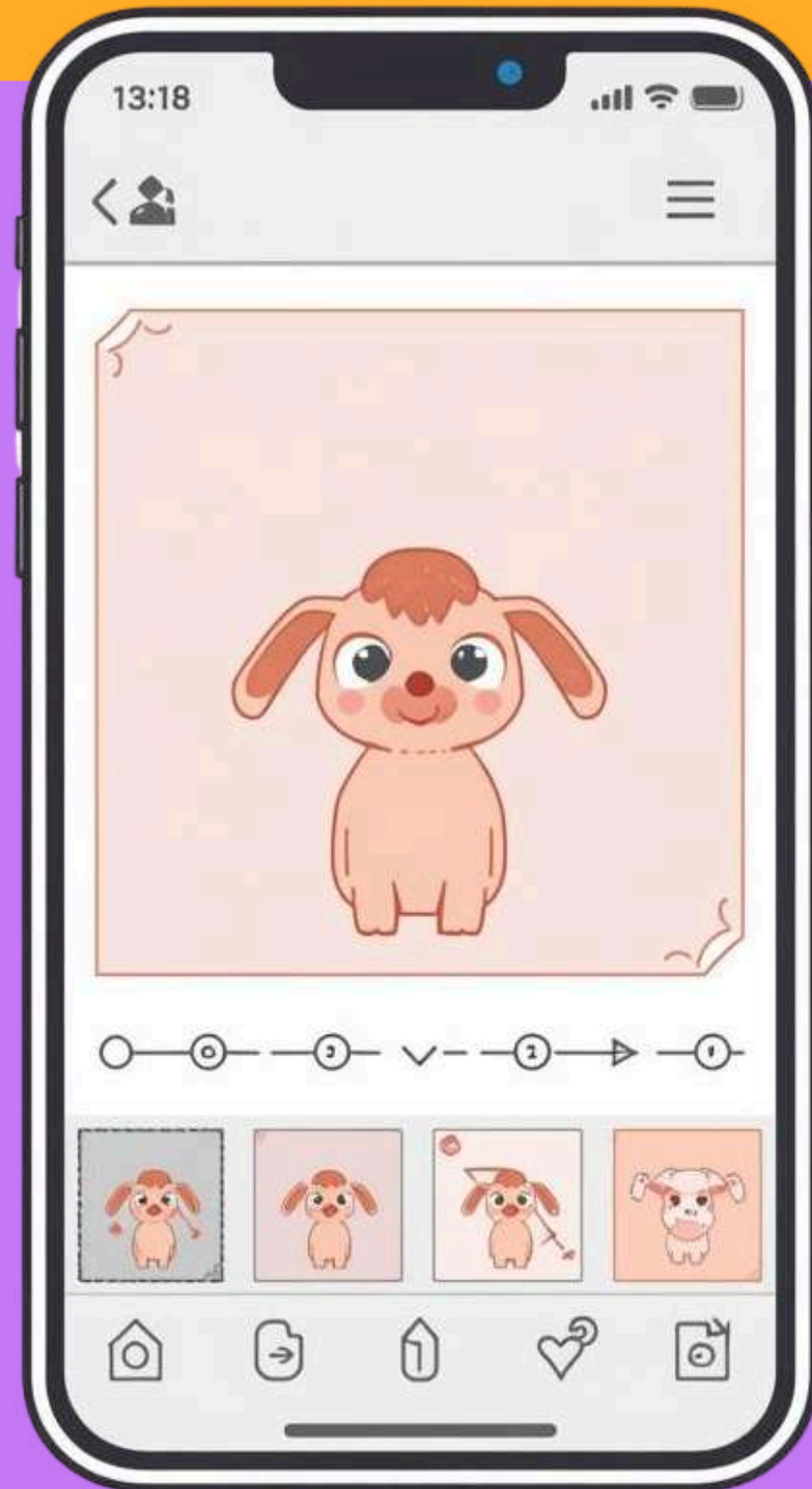
# Practical Uses of Vector Spaces



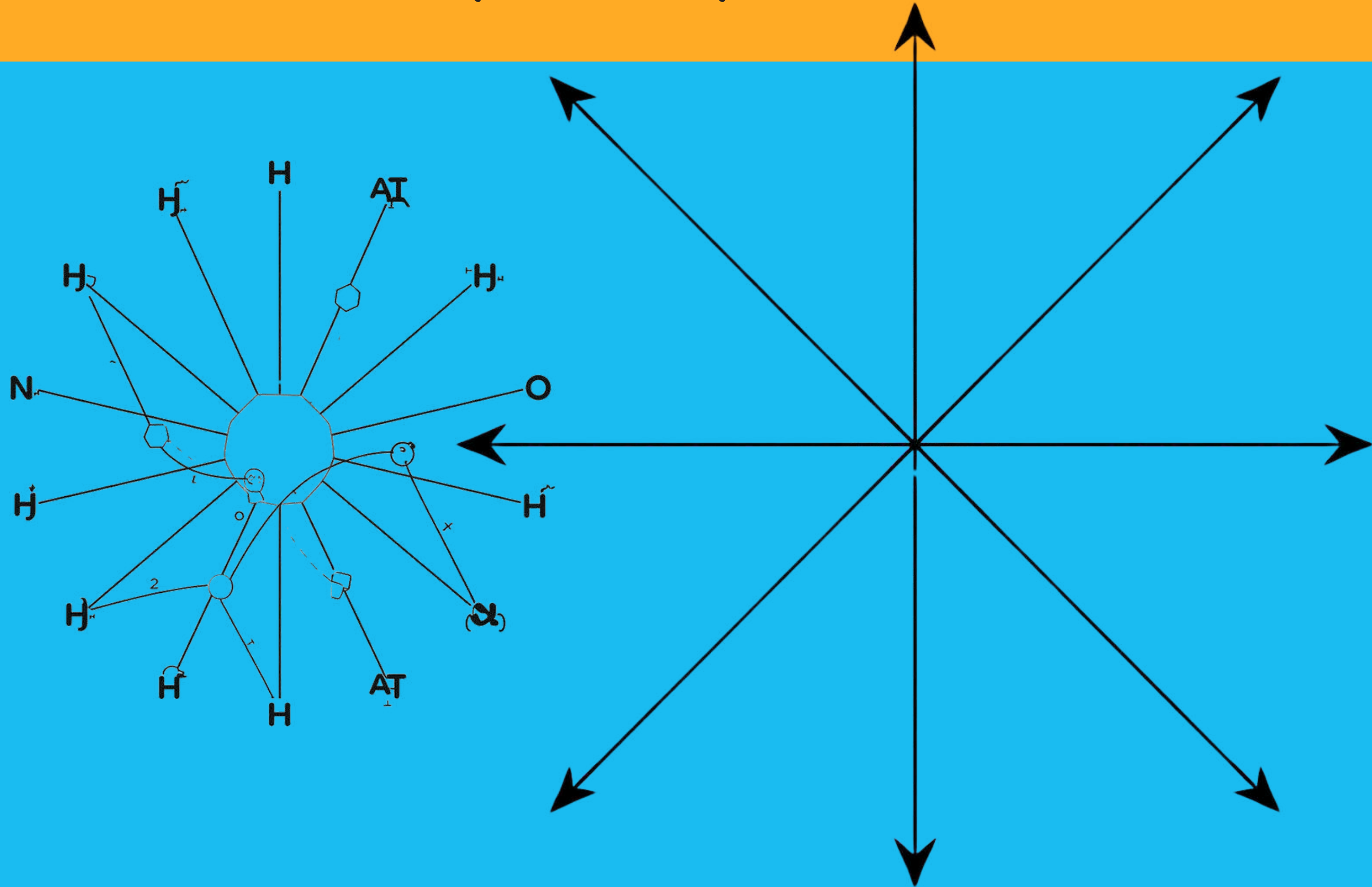
# UNIT 4: Linear Transformation



# Practical Uses of Linear Transformation:



# Summary of Key Points



**THANK YOU!**



**QUESTIONS ARE  
WELCOME!**

**ate :-Raja Virendra Bahadur Singh**  
**overnment College 'Saraipali'**  
**ist :- mahasamund ( C.G )**

**Submitted By :- Aarti**  
**Class :- bsc.4th semester**  
**Subject :- ( DSC ) mathematics**

**Submitted to :- Shri**  
**Raj Kishor Patel sir**



Name of assignment topic :-  
daily use of my curriculum

Unit 1 :- isomorphism theorems, cyclic and permutation groups

Unit 2 :- ring, field and integral domain ideals

Unit 3 :- vector space

Unit 4:- linear transformation

# Introduction :-

Mathematics is not only a theoretical subject but also has many applications in our daily life.

Concepts such as group theory, ring theory, vector space and linear transformation are very important in modern science and technology.

These mathematical structures are used in computer science, engineering, data analysis and communication systems.

They help us solve complex problems and understand real-world situations more effectively.

In this presentation, we will discuss the daily life applications of topics from our mathematics curriculum.



# Unit 1 :- isomorphism theorems ,cyclic and permutation groups

## 1. Clock system ( example of cyclic group ) :-

The 12-hour clock system is a good example of a cyclic group. Time moves from 1 to 12 and then starts again from 1. This repeating cycle continues continuously. In mathematics, such repeating patterns are called cyclic structures. Therefore, the clock system is a simple example used to explain cyclic groups.



**Cyclic Group (12-Hour Clock)**



Edit with WPS Office

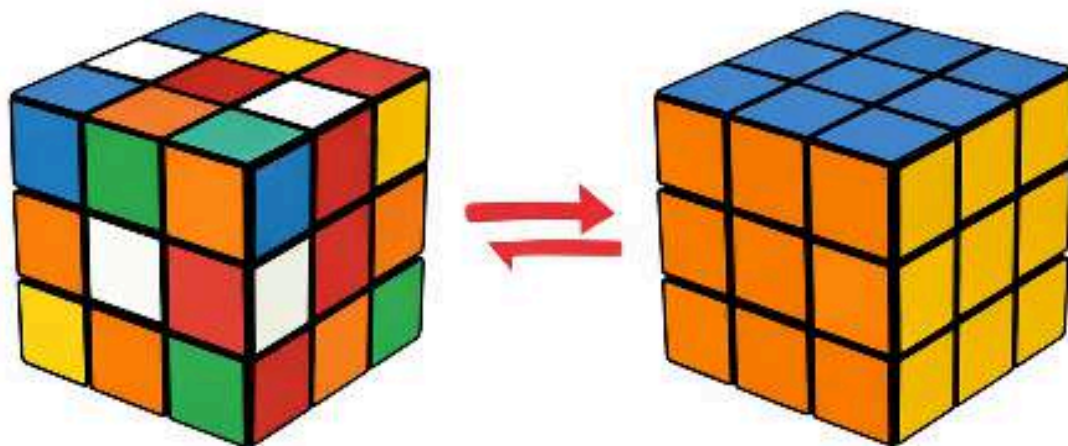
## 2 . Rubik's cube ( example of permutation groups ) :-

Solving a Rubik's Cube involves permutations. When we rotate the cube, the positions of the colored squares change. These changes in arrangement are known as permutations.

Permutation group theory helps us understand all possible arrangements. Thus, Rubik's Cube is a practical example of permutation groups.



## Permutation Group



Permutation on a Rubik's Cube



Edit with WPS Office

### 3 . Password and security system :-

Permutation and combinations are used in password and security systems. Different letters, numbers, and symbols are arranged in various orders to create strong passwords. This increases the security of the system. Cryptography also uses similar mathematical principles. Therefore, permutation groups play an important role in data security.



## इसोमोर्फिज्म थियोरम

समान मनरावन कपाटिरन



## साइकिक समूह

घड़ी जेसे दोहरावदार समूथ



## सायन्तिक समूह

घड़ी जेसे दोहरावदार समूथ



## परमीटेरान समूह

वस्तुओं के क्रम को बदलना



## 4 . Timetables scheduling :-

Permutation is also used in preparing school and college timetables. Different subjects, teachers, and classes must be arranged in a proper order. Many possible arrangements are considered before selecting the best one. Mathematics helps to analyze these arrangements efficiently. Hence, permutation is useful in scheduling systems.

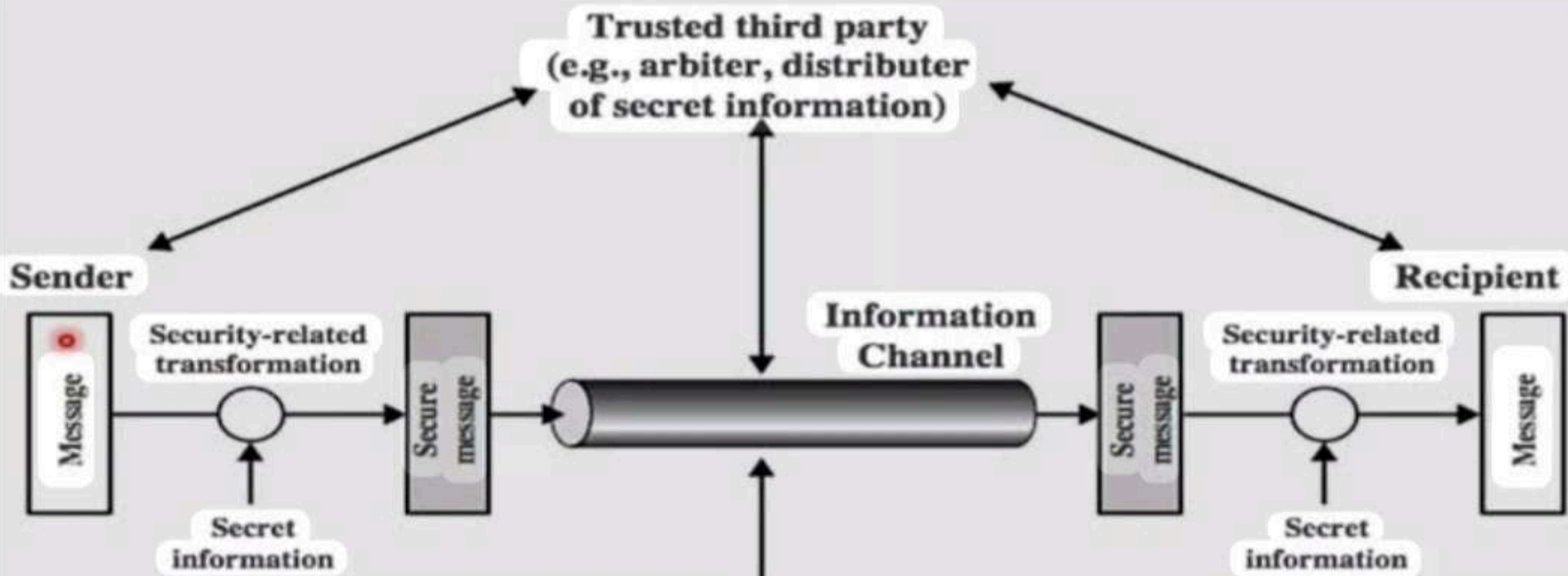


## 5 .Network structures ( example of isomorphism ):-

In computer science, different networks may have similar structures. Such networks are called isomorphic networks. Isomorphism helps to identify whether two network structures are similar or not. This makes network analysis and design easier. Therefore, isomorphism has an important role in computer science.



# Model for Network Security



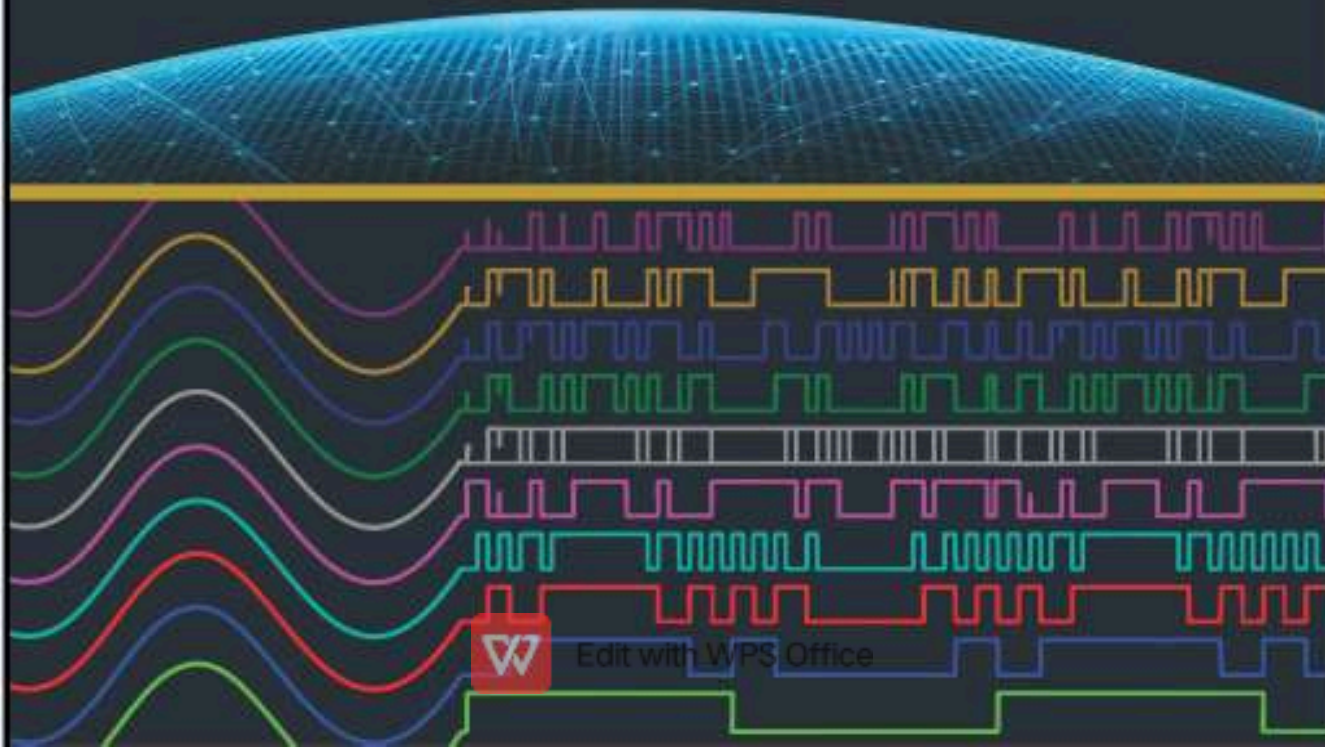
## Unit 2 :- ring , field and integral domain ideals

### 1. Digital communication :-

Ring and field structures are widely used in digital communication systems. They help in transmitting data accurately and efficiently. These mathematical structures also help in analyzing digital signals. As a result, communication technologies become more reliable. Therefore, algebraic structures play a key role in modern communication.



# Digital Communications



## 2. Error direction and error correction :-

During data transmission, errors may occur in computer systems. Coding theory is used to detect and correct these errors. Ring and field mathematics are important tools in coding theory. They help in maintaining the accuracy of transmitted data. Thus, algebra plays a crucial role in error detection systems.



### 3. Cryptography and encryption :-

Cryptography uses algebraic structures to secure information. Ring and field theory are used to design encryption algorithms. These algorithms protect sensitive data from unauthorized access. Online banking and digital transactions depend heavily on this technology. Therefore, abstract algebra is essential in modern security systems.



# CRYPTOGRAPHY

## MATHEMATICS IN CRYPTOGRAPHY

Understanding the "Role of Mathematics in  
Secure Communication".

PRESENTING BY CH CHARAN CST (23A81A0611)



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# 4. Computer algorithm :-

Many computer algorithms are based on algebraic structures. Ring and field theory help simplify complex calculations. This makes computer programs more efficient and reliable. Mathematical concepts are widely used in software development. Hence, algebra is important in computer science.

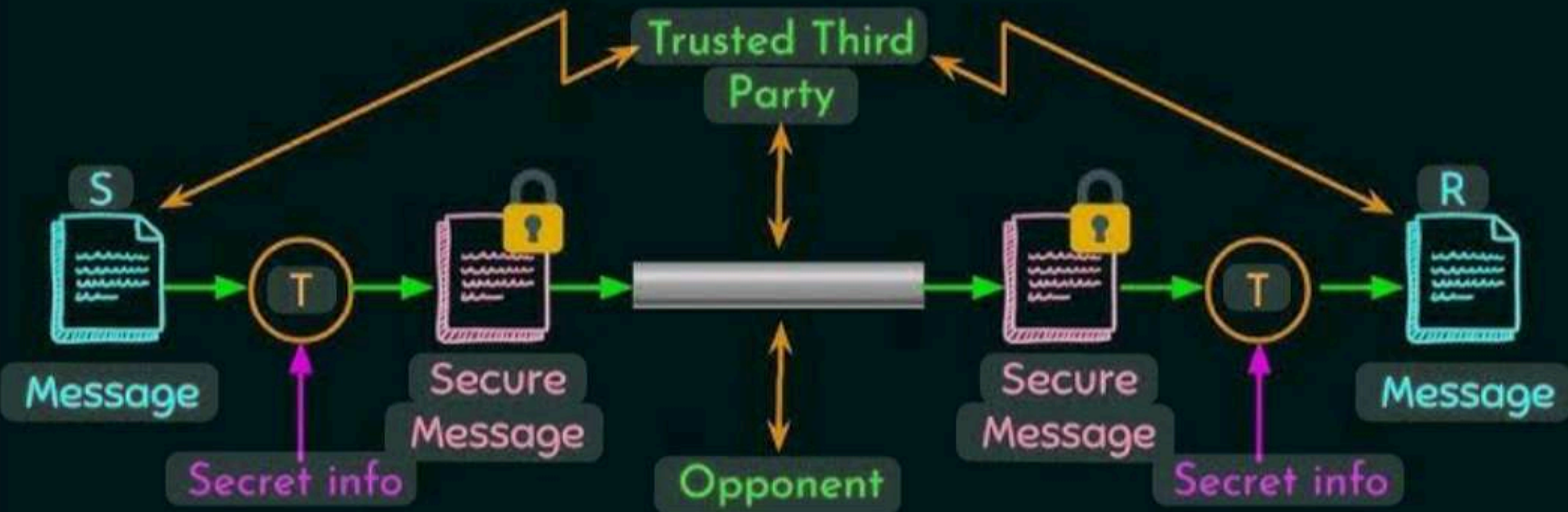


# 5. Network security :-

Network security systems use mathematical techniques to protect data. Ideals and other algebraic concepts help design secure communication systems. They prevent unauthorized access to sensitive information. As a result, systems become safer and more reliable. Therefore, abstract algebra contributes significantly to cyber security.



# Network Security Model

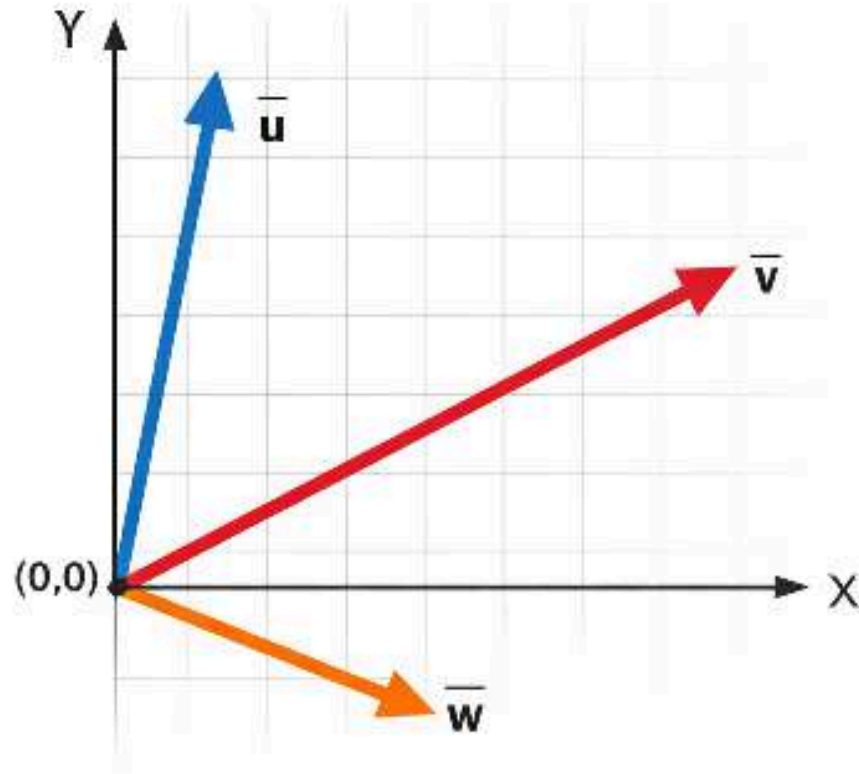


# Unit 3 :- vector space

## 1. Physics application:-

Vector spaces are widely used in physics. Quantities like force, velocity, and acceleration are represented as vectors. These quantities have both magnitude and direction. Scientists use vector mathematics to analyze motion and physical forces. Therefore, vector space plays **an** important role in physics.

# Vector Space



## Vector Representation in a Vector Space



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## 2. GPS and navigation system's :-

Navigation systems such as GPS use vectors to represent direction and distance. When traveling from one place to another, vectors help determine the shortest path. They provide accurate information about position and movement. This makes navigation systems more efficient. Hence, vectors are very useful in modern navigation technology.



### 3. Computer graphics :-

Vector space is used in computer graphics to create 2D and 3D images. Objects on the screen are represented using vectors. These vectors help move, rotate, and resize objects easily. Animation and video games also use this technology. Therefore, vector mathematics is essential in computer graphics.



# 4. Robotics :-

In robotics, vectors are used to control the movement and direction of robots. Each movement of a robot is calculated using vector mathematics. This helps the robot move accurately and efficiently. Engineers use these calculations to design robotic systems. Thus, vector space is important in robotics.



## 5. Weather forecasting :-

Meteorology uses vectors to represent wind speed and direction. Scientists analyze these vectors to study air movement. This helps them predict weather conditions. Accurate weather forecasting depends on such mathematical models. Therefore, vectors play an important role in meteorology.





# WEATHER MATH

$\frac{x-1}{x^2-2x+1}$		$\frac{4x-5}{x^2}$		$\frac{1}{x}$	
Sunny Sunday		Rain Monday		Heavy Rain Tuesday	



	$\frac{32}{x^2-25}$		
Sunny Thursday	Rain Friday	Sunny Saturday	



# Unit 4 :- linear transformation

## 1. Image processing :-

Linear transformations are used in image processing. They help rotate, resize, and improve images. Many photo editing software programs use these mathematical techniques. This helps enhance image quality and appearance. Therefore, linear transformation is important in digital imaging.



## 2. Computer animation :-

Computer animation uses linear transformations to move and transform objects. Objects can be rotated, scaled, or translated easily. This makes animations look more realistic. Movies and video games use these techniques extensively. Hence, linear transformation is essential in animation.



# Linear Transformation in Mathematics

## Daily Life Applications

Computer Graphics  
& Animation



Image Rotation  
& Scaling



Game Development



Mapping &  
GPS Navigation



Original  
Shape

Transformed  
Shape

$$y = Ax$$

Robotics & AI



Architecture  
& Design



Data  
Transformation



Engineering &  
CAD



Physics  
(Motion & Forces)



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# 3. Robotics movement:-

In robotics, linear transformations help change the position and orientation of robots. They are used to calculate accurate movements. This allows robots to perform tasks efficiently. Industrial robots use these techniques for precise operations. Therefore, linear transformation is important in robotics.



# 4. Machine learning :-

Machine learning uses linear transformations to process and analyze data. Data is transformed into different mathematical forms. This helps computers understand patterns in the data. It improves the performance of artificial intelligence systems. Hence, linear transformation is widely used in AI.



## 5. Satellite image analysis :-

Satellite images are analyzed using linear transformations. These techniques help adjust the angle and improve image quality. Scientists use them to study geographical and environmental changes. This is useful in weather forecasting and earth observation. Therefore, linear transformation is important in satellite imaging.



# Conclusion :-

Mathematics plays a very important role in our daily life. Topics such as group theory, ring theory, vector space, and linear transformation are not only theoretical concepts but also have practical applications.

These concepts are widely used in computer science, engineering, communication systems, robotics, and data analysis.

Understanding these mathematical ideas helps us solve real-life problems more effectively.

Therefore, the study of mathematics is very useful in both academic learning and practical applications.

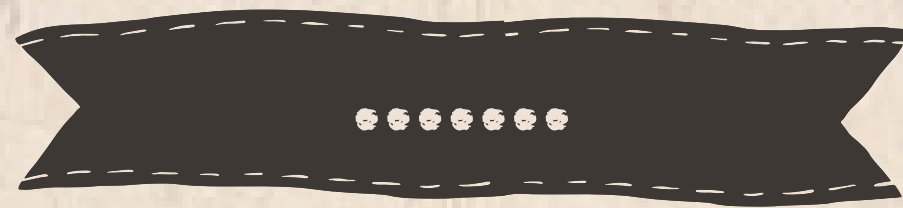


Thankyou 🙏  
.....



Edit with WPS Office

*Topic:- daily uses of my curriculum  
presented by :- Khushabu patel  
class:- bsc 4th semester*



# content

1

**Isomorphism theorem , Cyclic and permutation groups**

2

**Ring field and integral domain ideals**

3

**vector space**

4

**linear transformation**



# uses of isomorphism

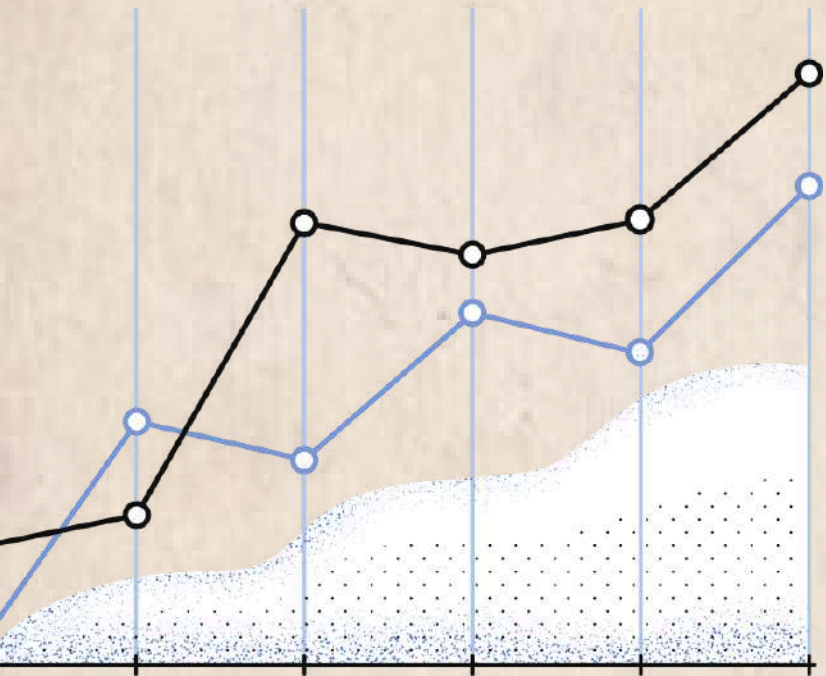
isomorphism is a way of saying two things are structurally the same even if they look different. it allows us to solve a hard problem by translating it into a simpler, isomorphic one.

## Graph / network matching:

used in computer vision and social network analysis (e.g. recognizing if two different looking graphs or network are actually the same just with different labels)

## Chemistry (molecular structure):

chemists use graph isomorphism to match chemical structures against data bases to identify compounds.

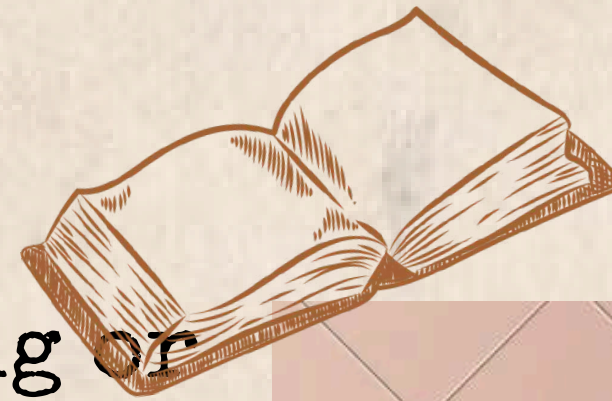


## Digital circuit verification:

in electronic design it is used to check if two different representation of a circuit are functionally equivalent.

## social media filter:

filters that change your face by rearranging or adding element (permutation) often use isomorphism to map the new image back to a structure the computer understand.



# Uses of permutation

A permutation is used when we need to arrange objects or items in a specific order. It has many practical applications in everyday life in different fields

## main uses of permutation

1. seating arrangement: used to find the number of ways people can sit in a row, around a table, or in a classroom

## 2. password and security

permutation help calculate the number of possible password or pin combination to security in phones, bank, and computer


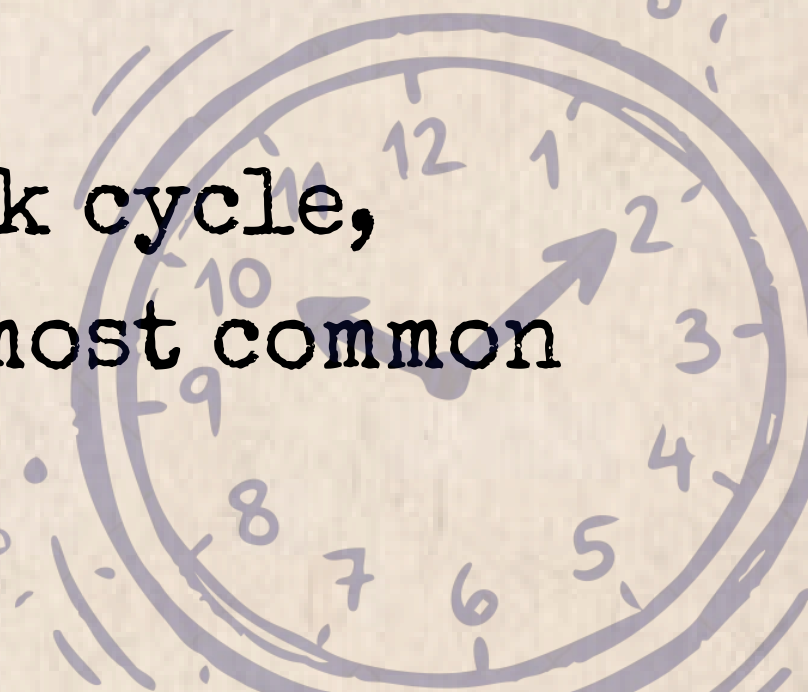
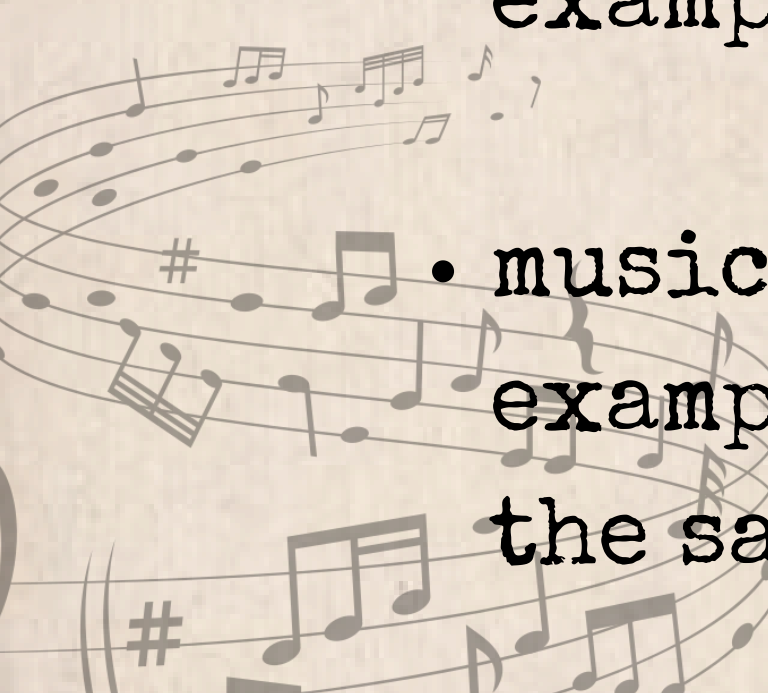
## 3. License plate number

goverrment create unique vehicle numbers using different arrangement of letters and digits

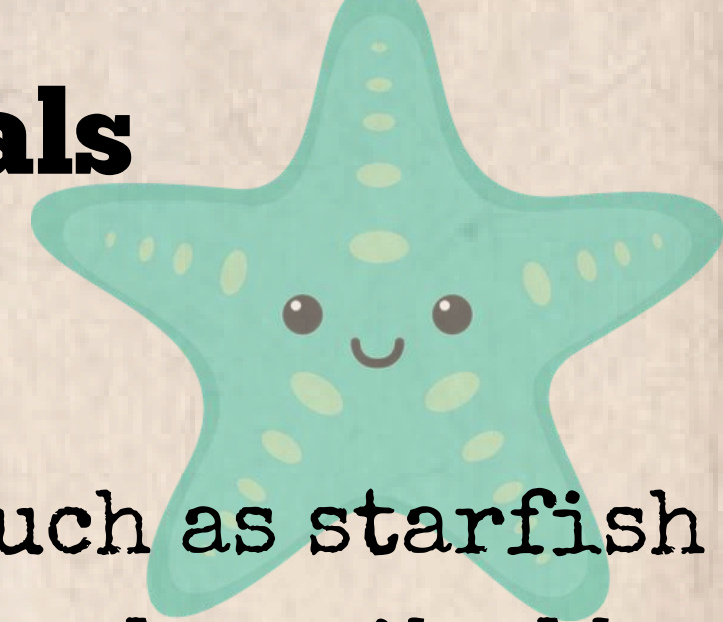


# uses of cyclic group

Cyclic groups are common in our daily life. A cyclic group is a group with an element that has an operation applied that produces the whole set

- 
- cyclic groups can be used in fun puzzles such as the Rubik's cube or in protecting sensitive information such as through cryptography
  - 12-hour clock: the numbers 0-11 (or 1-12) on a clock cycle, returning to the start after 12 hours. This is the most common example of finite cyclic groups.
  - musical octaves :- the frequency of musical notes cycles; for example, an octave doubles the frequency, and the ear hears it as the same note
- 
- 

# uses of ring, field and integral domain and ideals

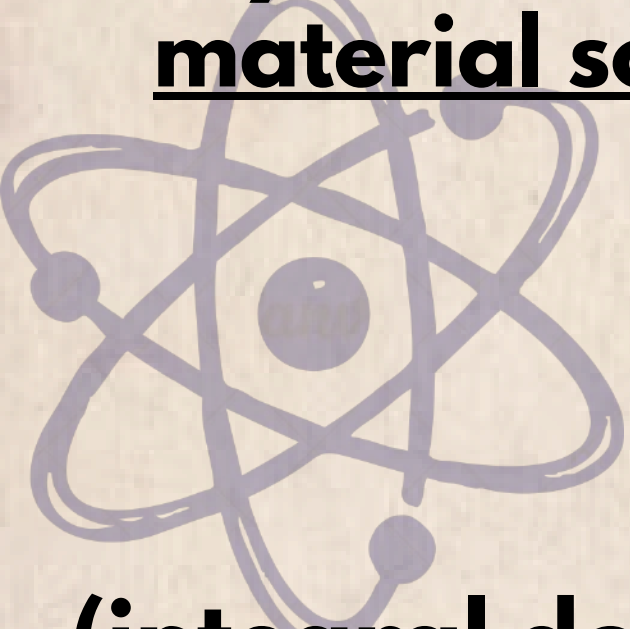


## Pattern formation (symmetry fields):

**Biology** the pattern on sea creatures (phylum echinodermata), such as starfish or sand dollars, exhibit dihedral symmetry, which can be described by algebraic group.

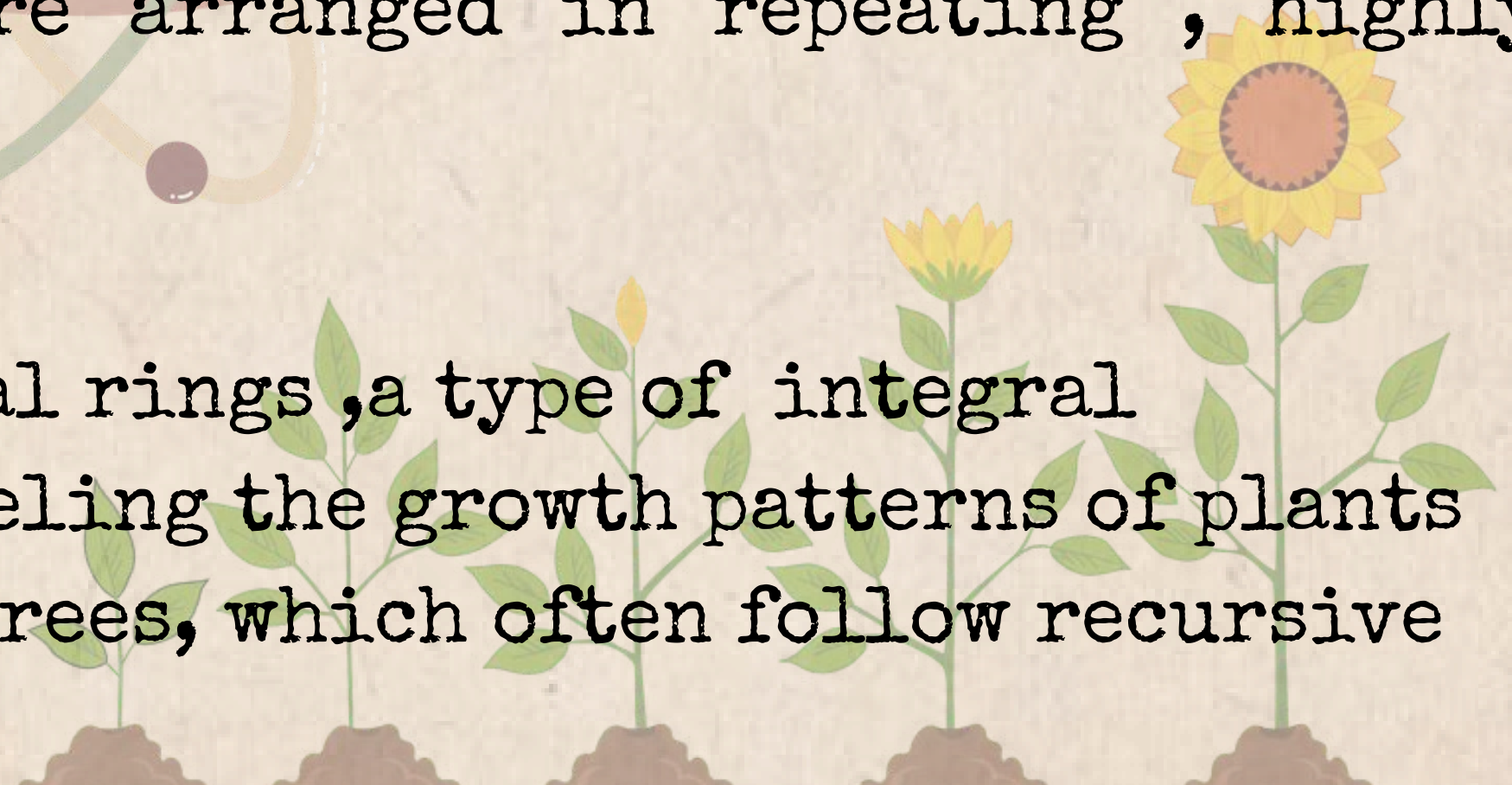
## crystalline structure (Rings):

**material science:** the atomic structure of crystal can be modeled using ring theory to predict how they interact with light or x-rays, as atoms are arranged in repeating, highly symmetric patterns.



## (integral domains):

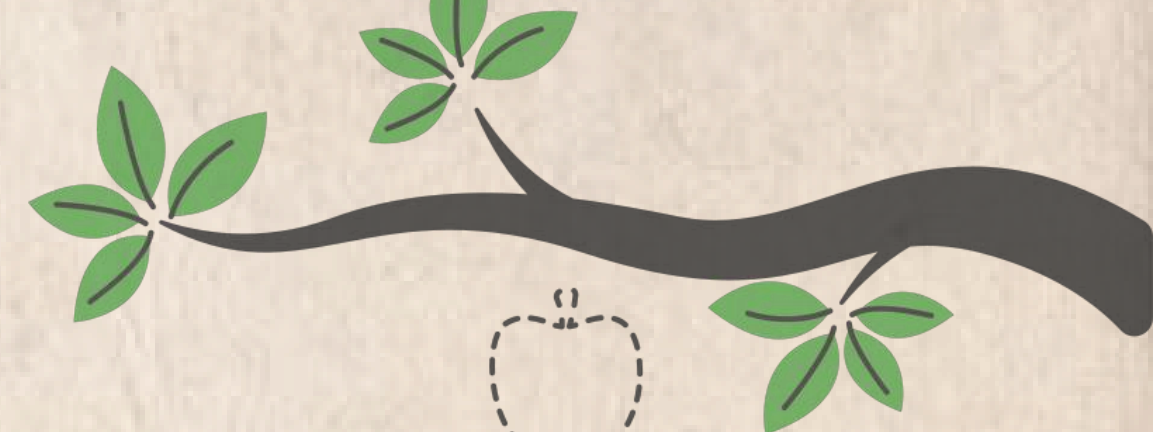
**natural growth:** the study of polynomial rings, a type of integral domain, is used in modeling the growth patterns of plants and the branching of trees, which often follow recursive algebraic rules



# uses of vector space

## 1. Projectile motion:

when a fruit falls from a tree or a bird dives, its motion (velocity and acceleration) is analyzed using vector component (horizontal and vertical) to determine its path.



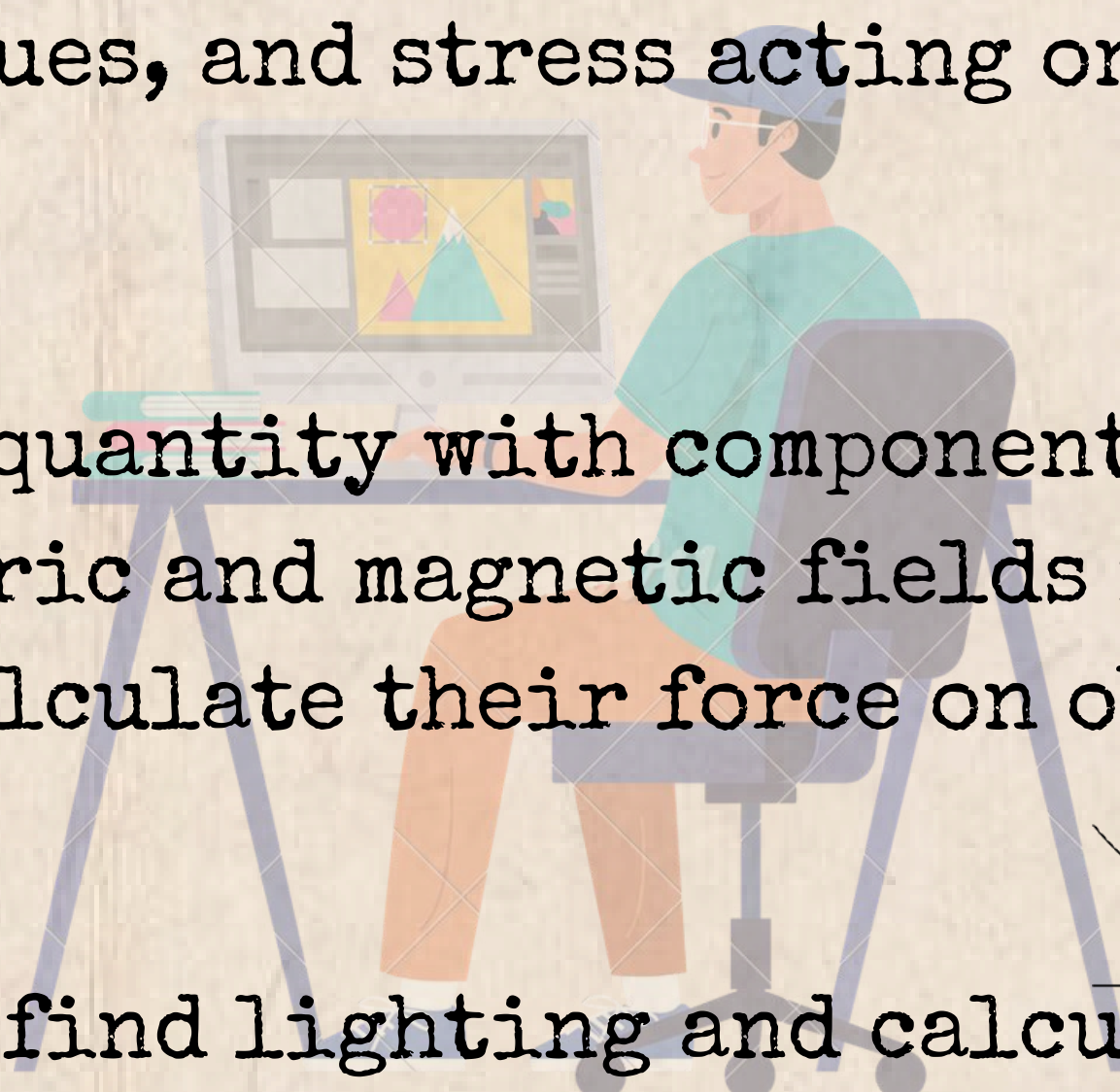
## 2. Engineering and construction:

vectors determine the forces, torques, and stress acting on structure like bridges, enabling stable design.



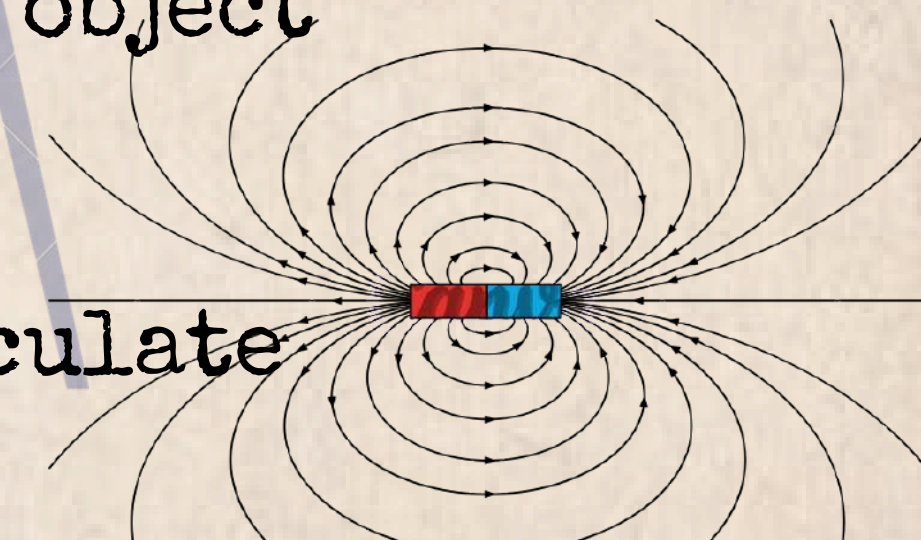
## 3. Electromagnetic fields:

Earth's magnetic field is a vector quantity with components parallel and perpendicular to the surface. Electric and magnetic fields in nature are re-presented as vector spaces to calculate their force on objects.

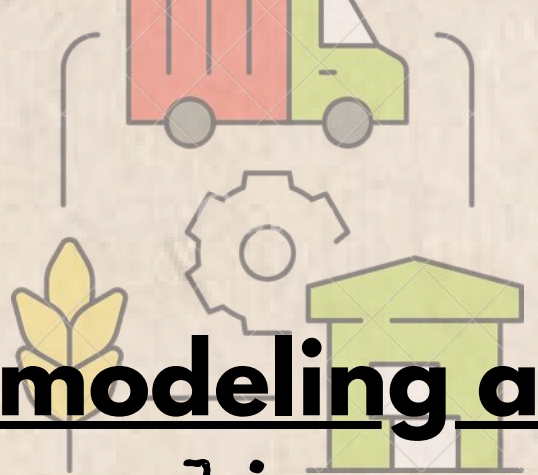


## 4. Computer graphics and Gaming:

vectors are used to map 3D objects, define lighting, and calculate movement within virtual environments and video games.



# linear Transformation



## 1. Economic modeling and supply chain

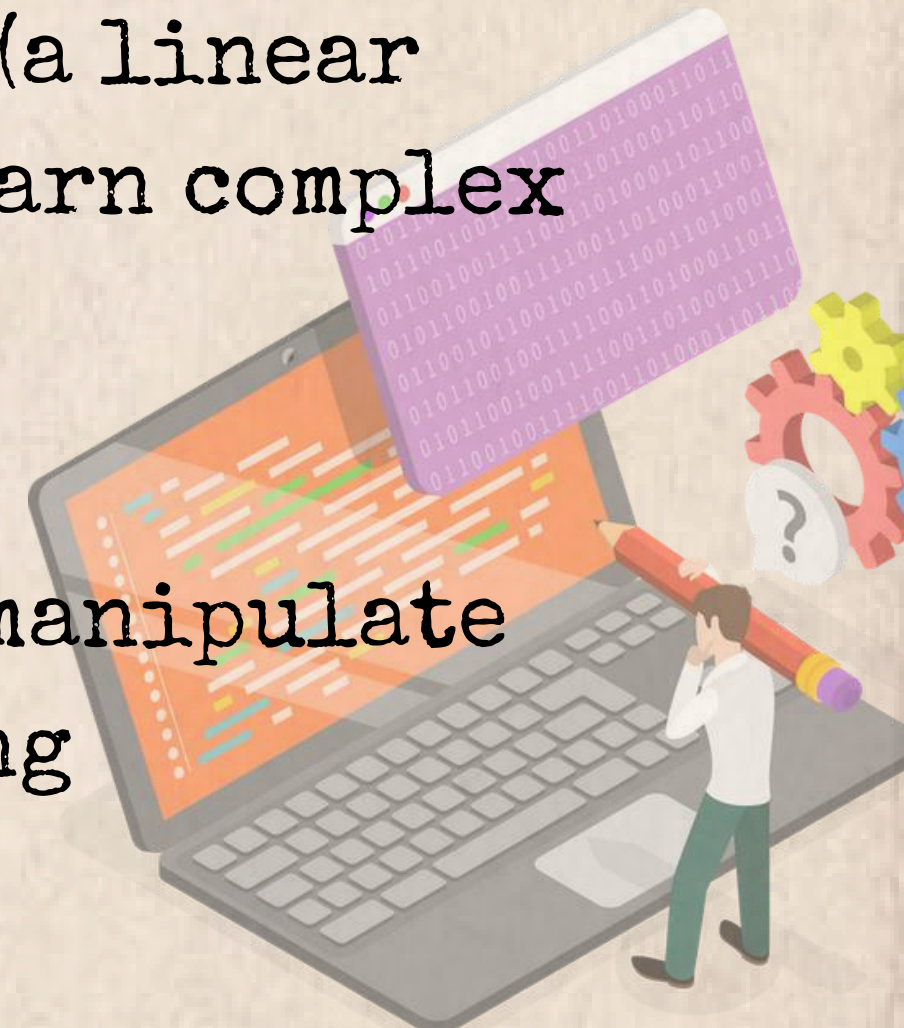
businesses use linear transformation to manage resources . if a bakery makes bread and cakes, and each requires a specific amount of flour and sugar , the relationship between “product made” and “ingredients used” is a linear transformation.

## 2. Machine learning:

neural networks use matrix multiplication at each layer (a linear transformation ) followed by an activation function to learn complex patterns

## 3. Photo Editing

filters in applications like photoshop use matrices to manipulate pixel data for rotating , flipping, resizing ,or adjusting brightness.



**THANK YOU**

Clancia Alves



# Uses of Abstract Algebra our daily life

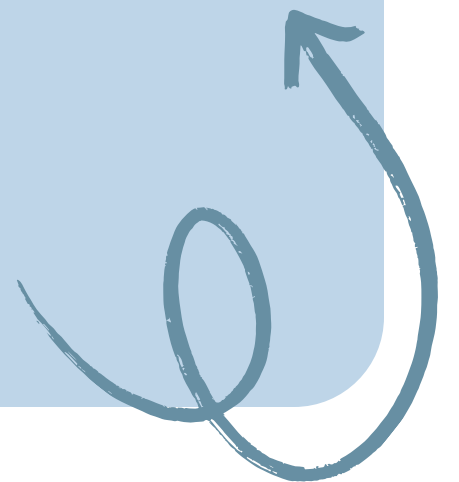
Guided by ~Raj Kishore Sir  
Submitted by ~Gagan Sahu,  
Mathematics B.Sc. 4th Sem



# Overview

## Key Concepts in Abstract Algebra

This presentation covers essential topics in abstract algebra, including isomorphism theorems, cyclic and permutation groups, rings, fields, integral domains, vector spaces, and linear transformations.

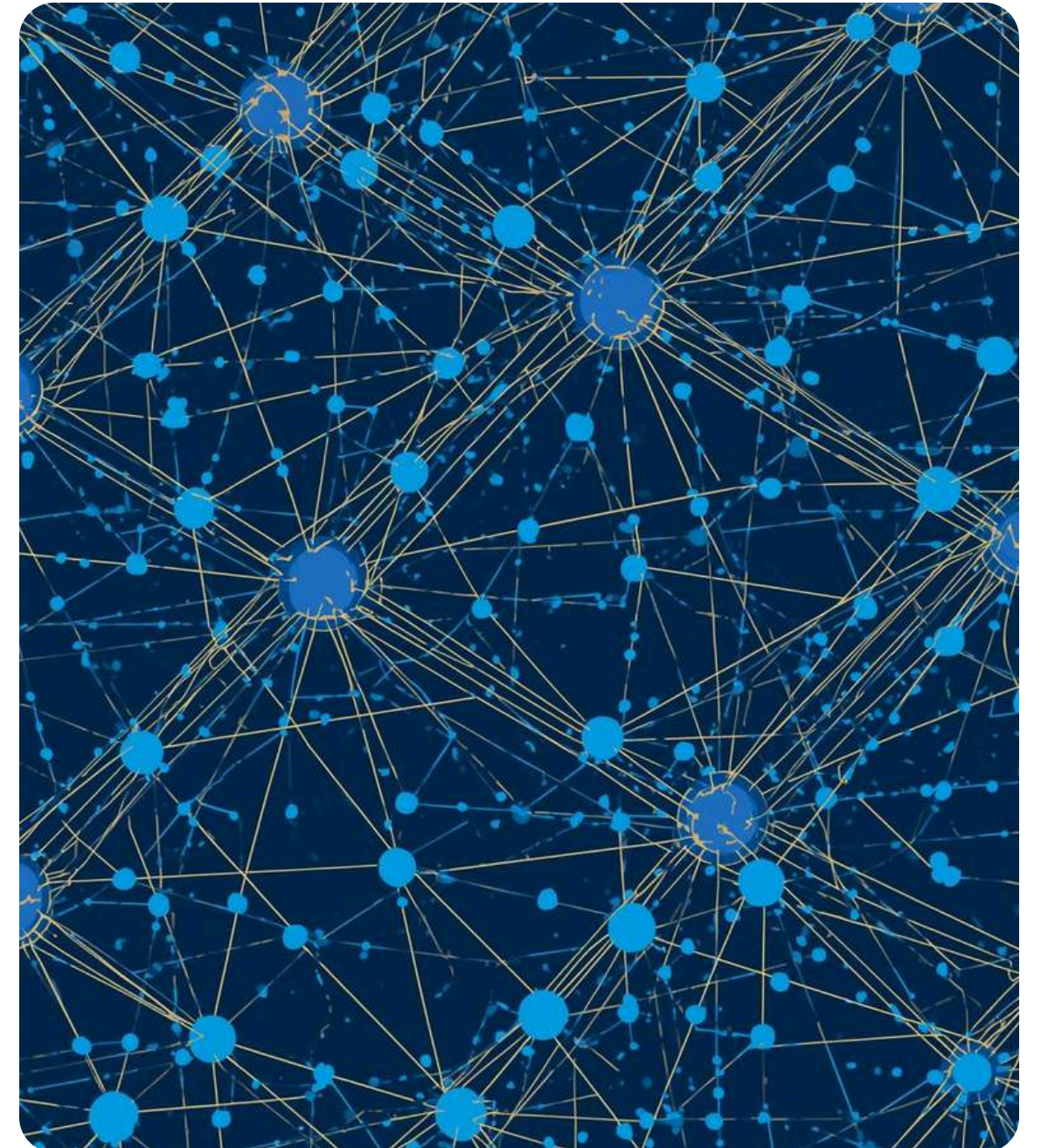


# Unit 1- Isomorphism Theorems

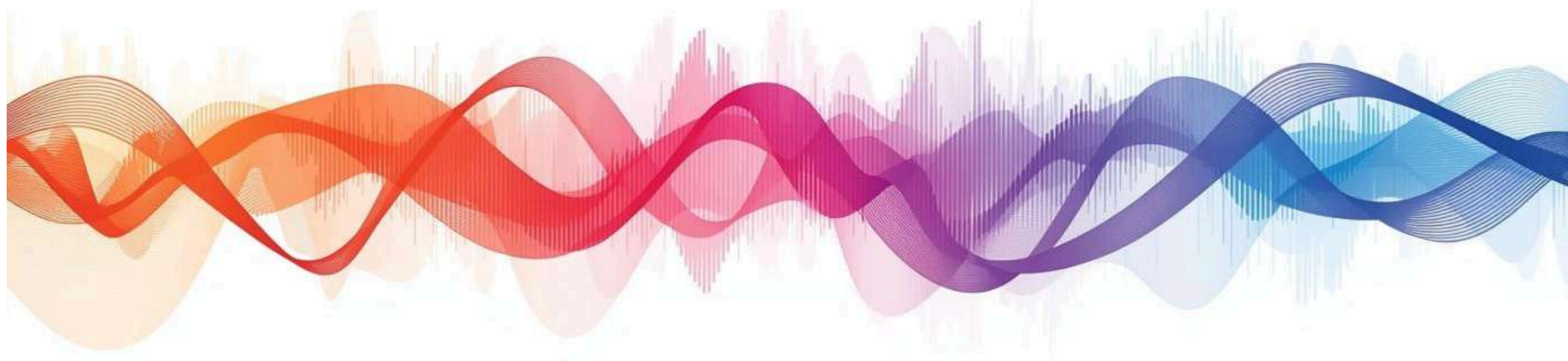
Functional programming languages like Haskell and Scala leverage isomorphisms to establish code **equivalence proofs**, enhancing software reliability and enabling more efficient algorithm design through structured abstractions.



# Applications of Cyclic Groups

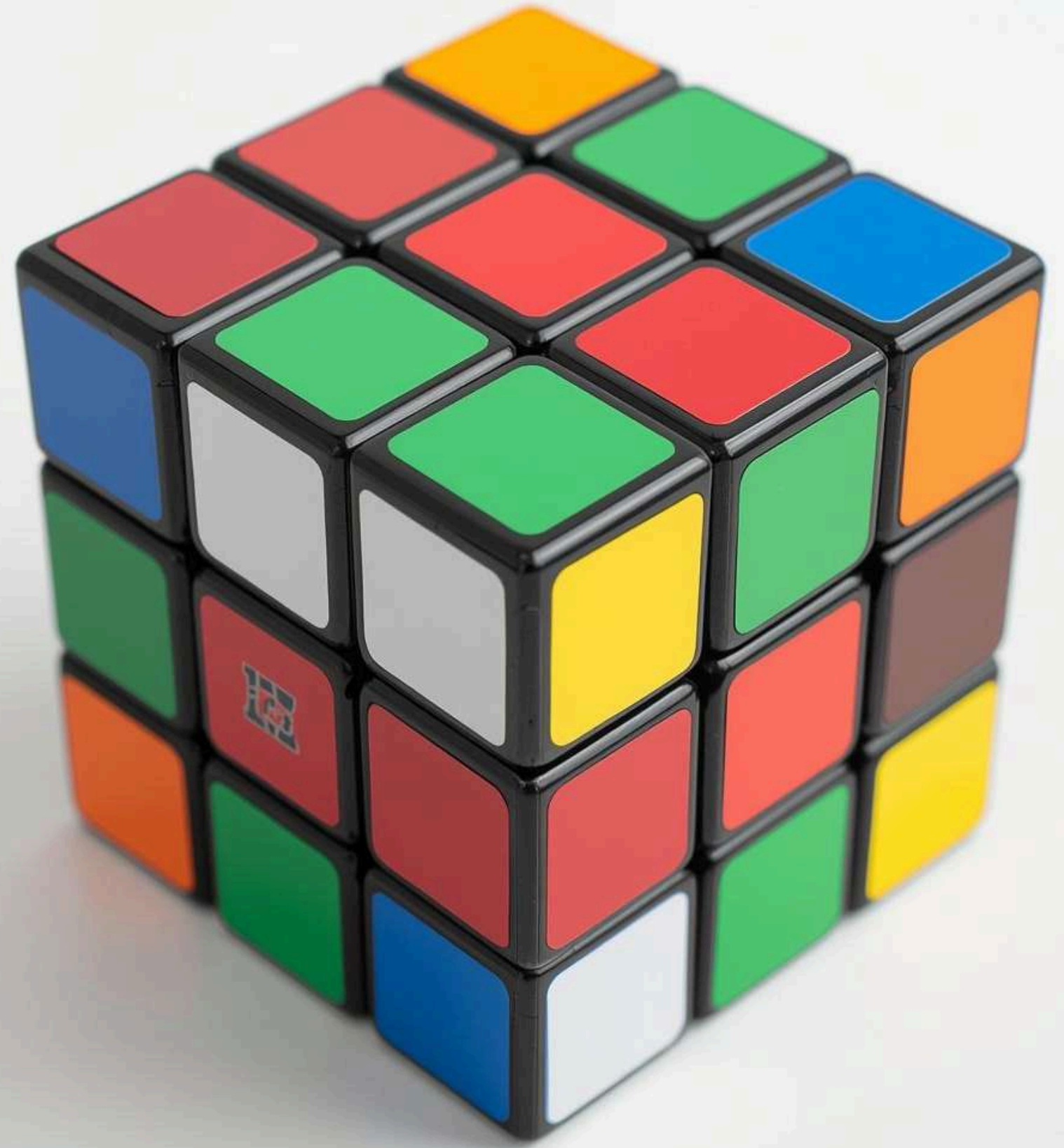


# Cyclic Groups — Broader Applications



# Applications of Permutation Groups

The states of a Rubik's Cube can be represented as a **permutation group**, showcasing the mathematical relationships between its positions. Understanding these groups aids in solving and optimizing cube configurations effectively.

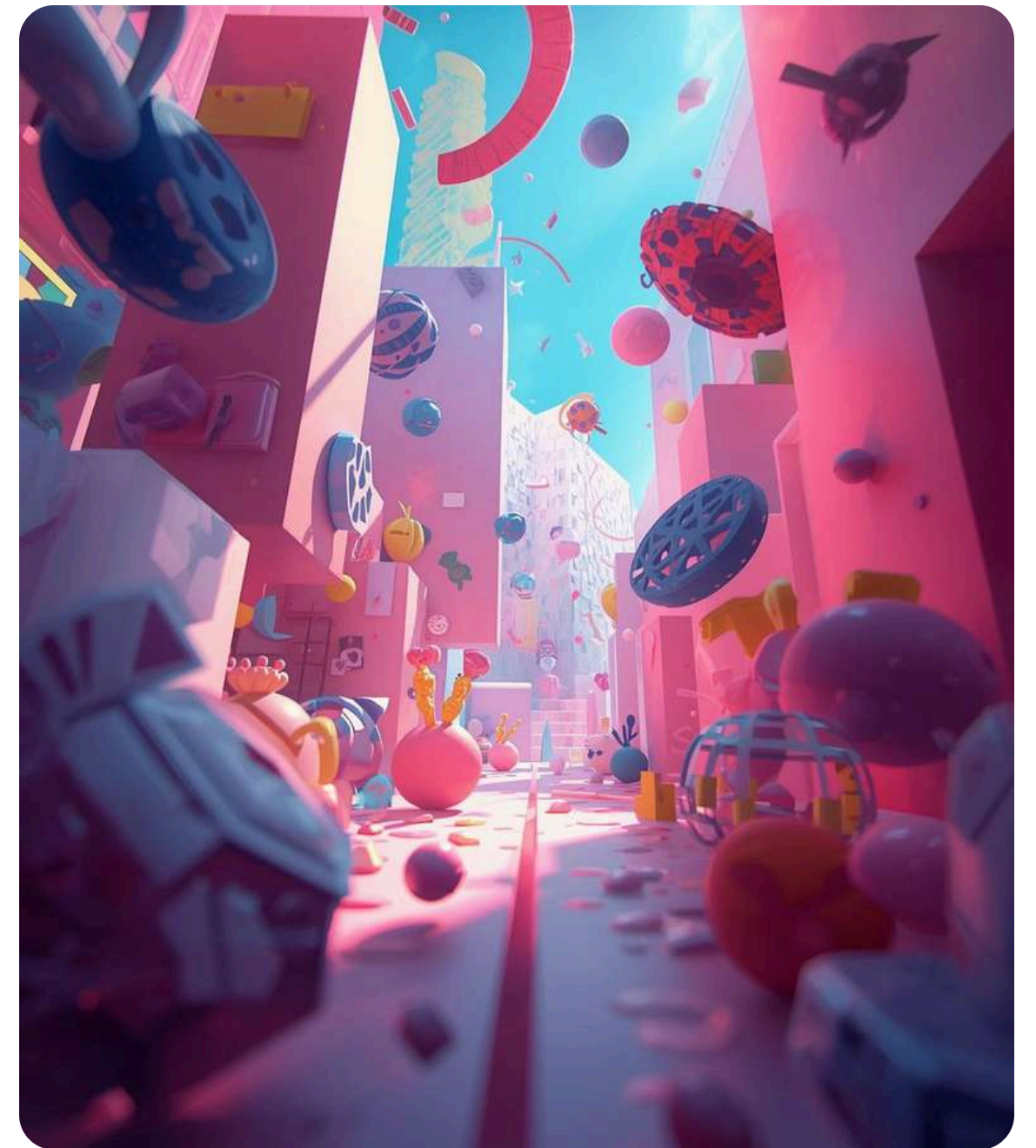
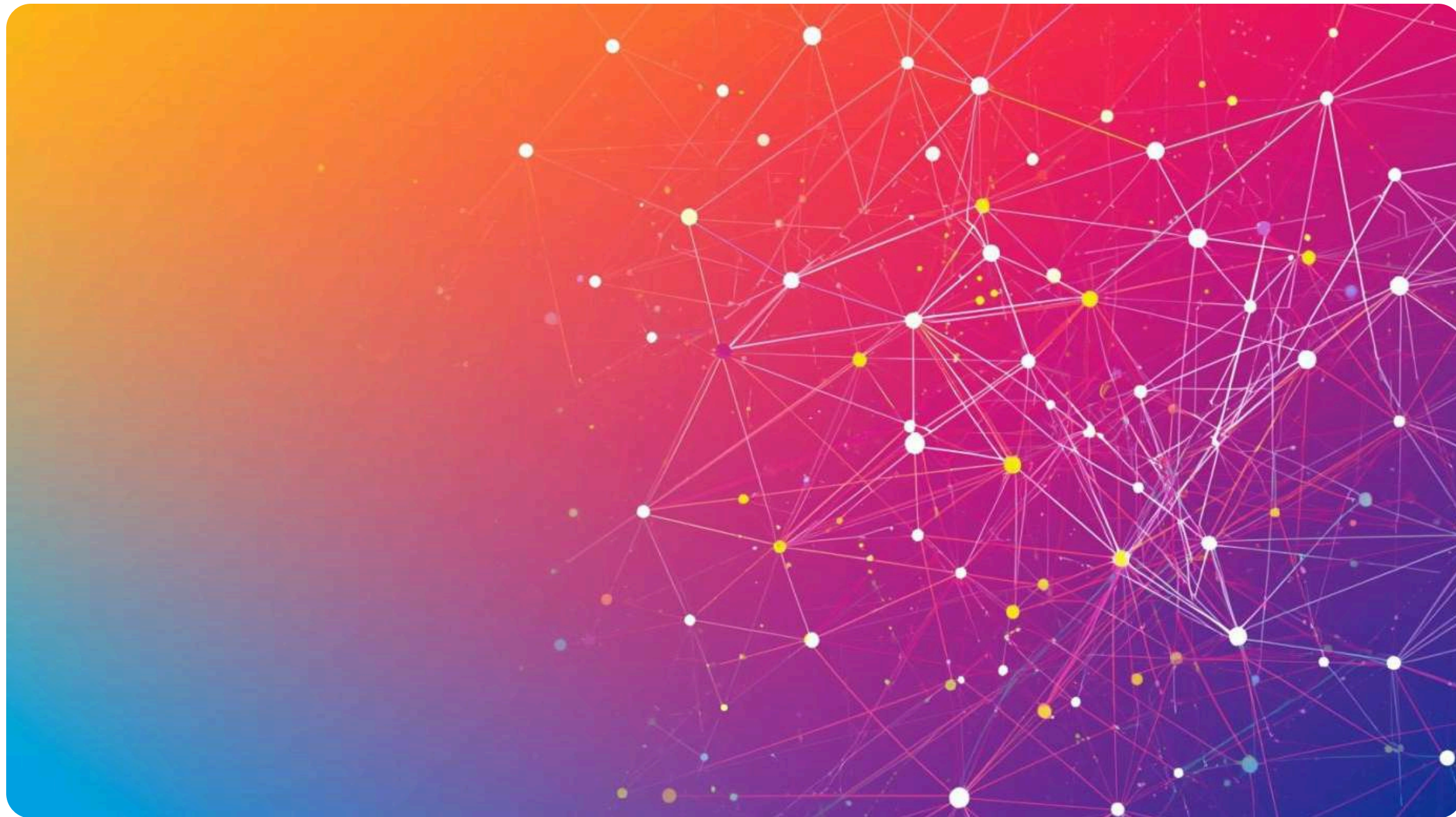


# Unit 2 - Rings, Fields & Integral Domains

Rings play a vital role in **cryptography**, CPU arithmetic, CRC checks, and image filters, providing a mathematical foundation for secure communications, data integrity, and efficient computational processes across various technologies.

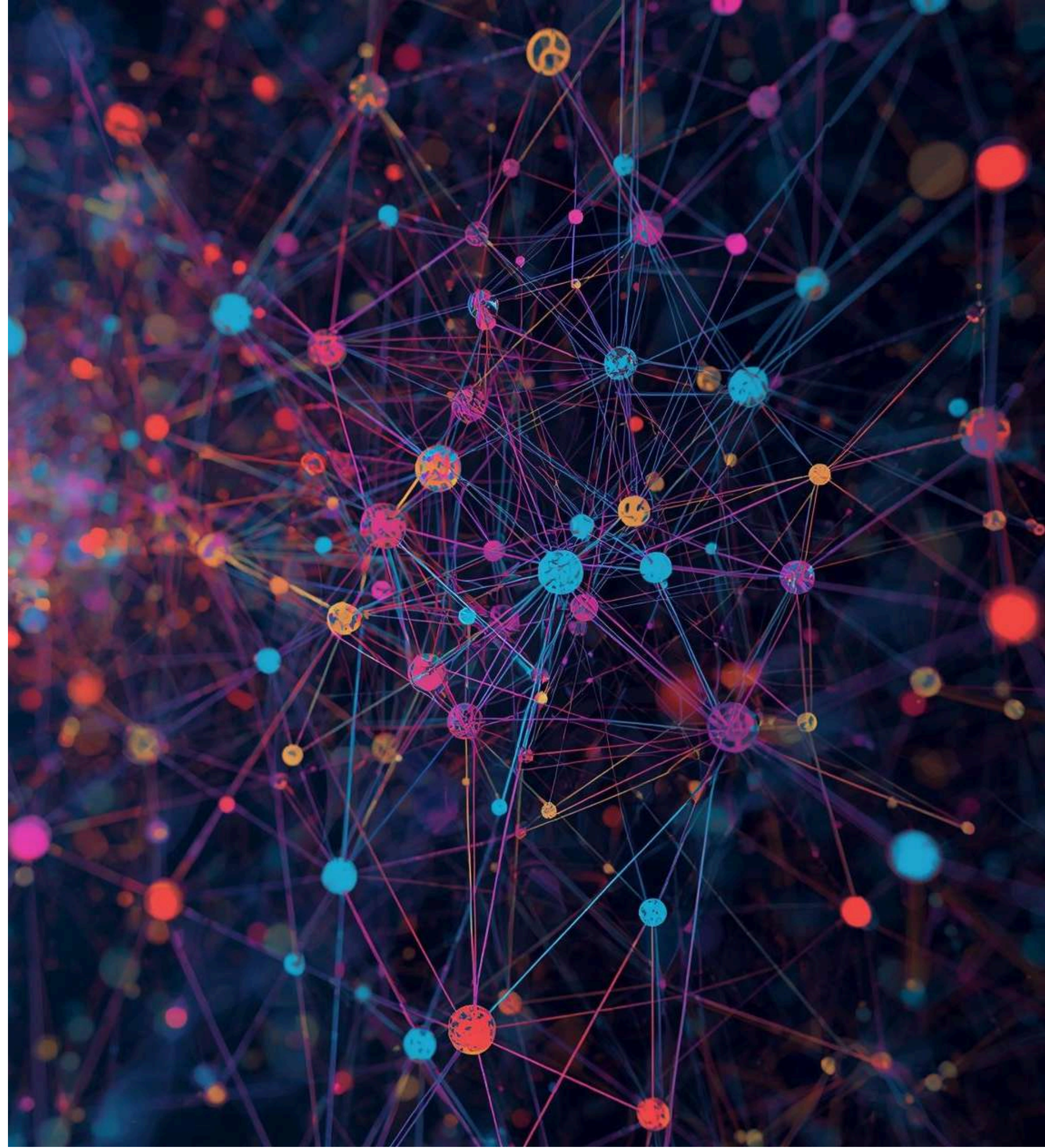


# Unit 3 - Vector Spaces



# Unit 4- Linear Transformations

Linear transformations are crucial in **AI and deep learning**. They utilize weight matrices to adjust inputs, enabling models like transformers to understand and process complex data effectively and efficiently.



# Abstract Algebra in Action

Abstract algebra is essential in modern technology, influencing encryption, artificial intelligence, and scientific modeling. It provides a framework for understanding complex systems while connecting theoretical concepts to practical applications.





# Thank You

Questions and reflections welcome

Lt. Raja Virendra Bahadur Singh  
Govt. College Saraipali

Pt. Ravishankar Shukla University Raipur  
(Session - 2025-26)

Presentation on  
Daily uses of my curriculum



Guided By  
Mr. R.K Patel Sir  
Assistant Professor  
Mathematics

Presented by  
Pratap Prasanna Dash  
B.sc 4th Sem.

# CONTENT'S :-

Daily Uses Of My Curriculum

1. Isomorphism Theorems Cyclic and Permutation Groups (Unit- 01)
2. Ring , Field and Integral Domain Ideals (Unit-02)
3. Vector Spaces ( Unit -03)
4. Linear Transformation (Unit -04)

# Isomorphism Theorems

These theorems are the ultimate data compression and simplification tools. They tell us when two seemingly different systems are actually identical in structure.

- System Design: Engineers use them to swap a complex system for a simpler “equivalent” one without losing functionality.
- Error Correction: In digital communication (like 5G or satellite signals), they help map data to “check-sums” to ensure your Netflix stream doesn’t glitch

# Isomorphism

The Isomorphism Theorem tells us that two mathematical systems can look different but have the same structure and rules. In daily life, this idea appears when we convert units like meters to centimeters or rupees to paise numbers change, but the relationship stays the same. It is also seen in time formats, such as 12-hour and 24-hour clocks, which represent the same time differently. When we simplify equations in mathematics, the form changes but the meaning remains the same. This concept helps us understand that different representations can still follow the same structure and logic.

# Cyclic Group

A cyclic group is something that repeats in a fixed pattern. In daily life, we see this in clocks — after 12, it starts again from 1. Days of the week repeat every 7 days, and months repeat every year. This repeating system follows cyclic rules. Cyclic patterns are also used in modular arithmetic, like finding remainders (for example, time calculations such as “3 hours after 10 PM”). Calendar planning, shift rotations, and timetable scheduling also follow cyclic patterns. So, cyclic group ideas help us understand repetition, rotation, and periodic systems in everyday life.



# Permutation Group

- These handle shuffling and rearrangement.

Data Routing: Every time you send a request over the internet, permutation groups help determine the most efficient path for data packets to travel through routers.

- Robotics & Molecules: In chemistry, they describe how atoms can rotate in a molecule. In robotics, they define the “configuration space”—~~basically, all the ways a robotic arm can move without hitting itself.~~

- Puzzles: The Rubik’s Cube is the most famous physical example of a permutation group; every move is a permutation of the cube’s facets.



# Ring

In algebra, a ring is an important mathematical structure used in many fields. It helps in solving polynomial equations and studying number properties. The concept of rings is also used in computer science, cryptography, and coding theory to secure data and detect errors in digital communication systems used in daily technology.

- 
- In daily life, rings from abstract algebra work behind the scenes to keep digital data secure and functional. The most common application is in cryptography, where ring theory (specifically polynomial rings and modular arithmetic) is the encryption that secures your online banking and private messages.

# Field

- Finite fields are essential for RSA encryption, which secures online banking and browsing. They are also used in error correcting codes (e.g., CRC codes in file downloads, QR codes, and satellite communication), allowing devices to detect and fix data errors, say Quora users.

A field in algebra is useful in many daily technologies. It helps in making correct calculations in science, engineering, and computers. Fields are also used to protect information on the internet, like online banking and passwords. They help in sending and receiving data correctly in mobile phones, computers, and digital communication.

# Integral Domain

- As a generalization of integers, these are used to study divisibility and in polynomial rings. They form the backbone of constructing fields, crucial for structured data analysis, explains a ScienceDirect topic.

An integral domain in algebra helps in doing accurate calculations without errors in multiplication. It is useful in computer science, coding theory, and cryptography. These concepts help protect digital information and improve data transmission. Integral domains are also used in mathematics, engineering, and computer systems to solve problems and design reliable technologies.

# Ideals

In algebra, ideals help in simplifying complex calculations and solving equations. Their concept is used in computer science, coding theory, and cryptography to protect digital information. Ideals also help in designing error-correcting codes used in mobile communication, computers, and data storage systems to make data transmission more accurate and reliable.

- Algebraic Structure Analysis: Prime and maximal ideals are used to form quotient rings, which are foundational for creating new, smaller fields and rings in number theory and coding.
- Polynomial Manipulation: In computational algebra, ideals help manage sets of polynomials in polynomial rings.

# Vector Spaces

- Vector spaces are the silent engines behind much of our modern technology. In digital imaging, photos are treated as vectors where each pixel's color value is a coordinate, allowing software to resize or filter images without losing data integrity. Search engines and streaming services use vector spaces to power recommendation algorithms; by representing your interests as points in a high-dimensional space, they can mathematically calculate which movies or websites are “closest” to your preferences. Additionally, in signal processing, vector spaces allow your phone to isolate your voice from background noise by treating sound waves as vectors and subtracting the unwanted frequencies.

Vector space is used in many areas of daily life and modern technology. It helps in computer graphics to create images and animations, in physics to describe forces and motion, and in engineering for designing machines and structures. Vector spaces are also used in data science, signal processing, and communication systems.

# Linear Transformation

Linear transformation is used in computer graphics to rotate, resize, and move images and objects. It is important in robotics, engineering, and physics for changing coordinates and analyzing motion. Linear transformations are also used in image processing, data science, and machine learning to transform and analyze large amounts of data.



Linear transformations are everywhere in our daily digital interactions, primarily through computer graphics and image processing. When you resize a photo, rotate a video, or apply a filter on social media, the software uses matrices to map original pixel coordinates to new ones, ensuring the image scales or shifts accurately. They also power recommendation engines like those on Netflix or Spotify, which project your preferences into a multi-dimensional space to find “nearby” content you might like. Even the ~~GPS~~ on your phone relies on these transformations to translate satellite signals into your specific location on a 2D map.



# Reference

01. Source Internet
  02. [www.Reddit.com](http://www.Reddit.com)
  03. [www.scrubs.com](http://www.scrubs.com)
  04. [www.brilliant.org](http://www.brilliant.org)
-

A night view of Earth from space, showing city lights and a yellow horizontal line.

— Thank You

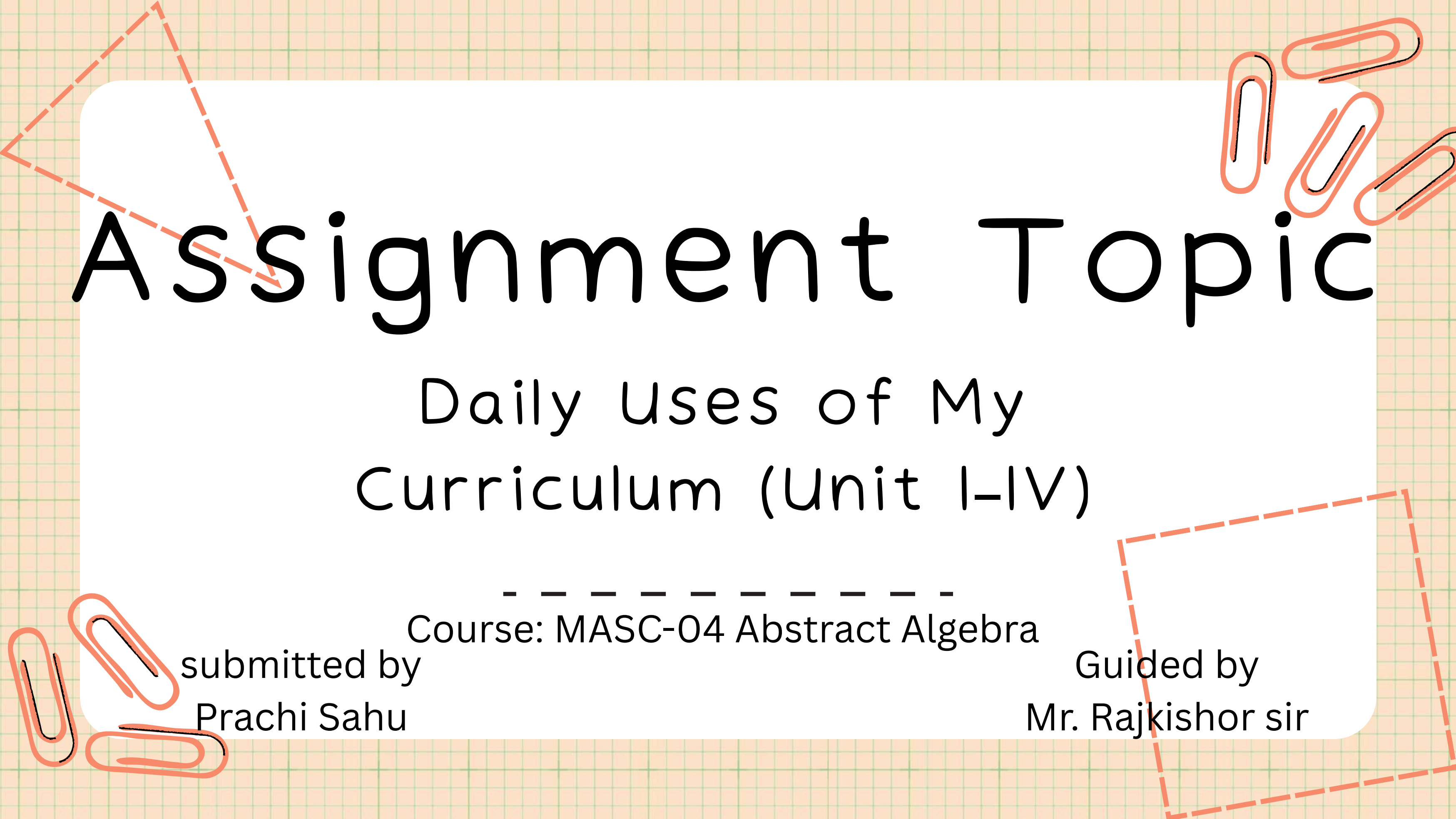


Zoho Show

# Pratap Prasanna Maths.pdf

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# Assignment Topic

Daily Uses of My  
Curriculum (Unit I-IV)

-----  
Course: MASC-04 Abstract Algebra

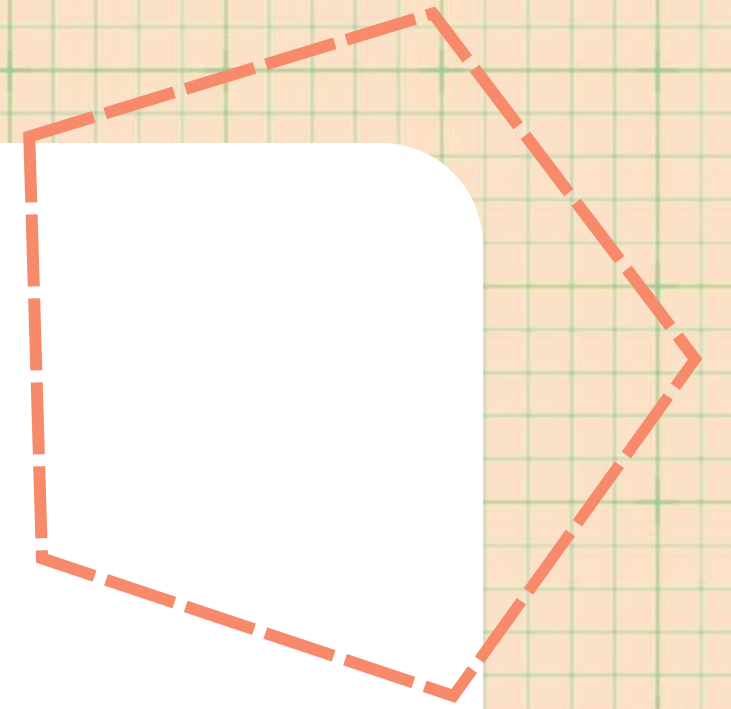
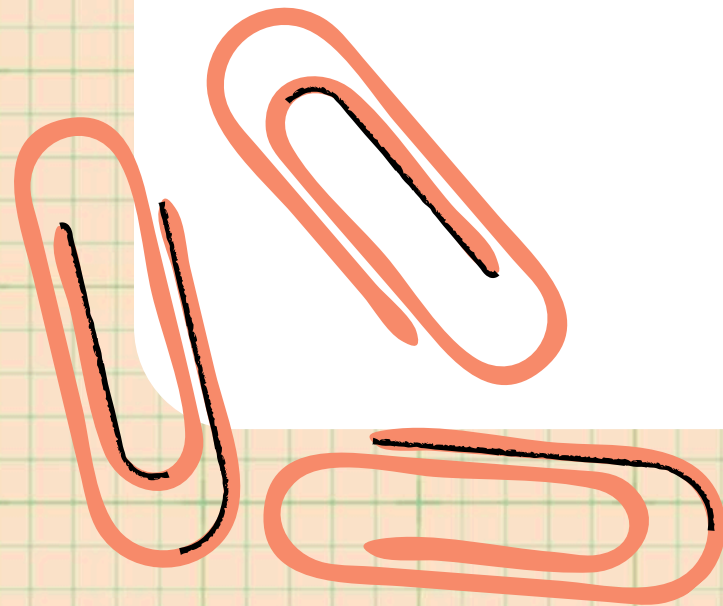
submitted by  
Prachi Sahu

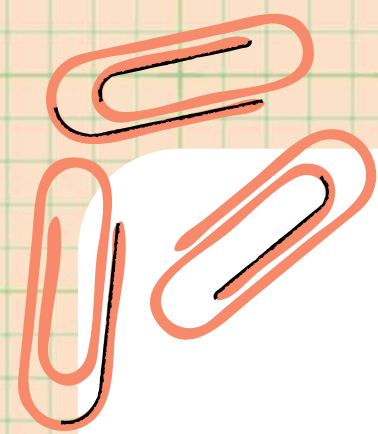
Guided by  
Mr. Rajkishor sir

# Assignment format

- Introduction
- unit 01 - uses
- unit 02 - uses
- unit03 - uses
- unit 04 - uses
- conclusion

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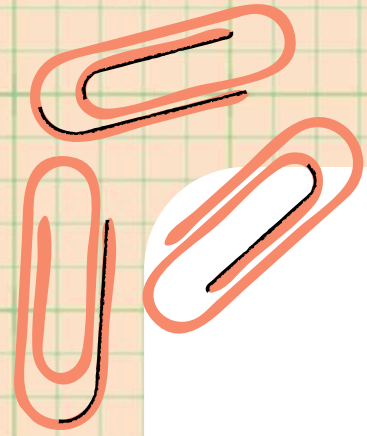




# Introduction (परिचय)

-----

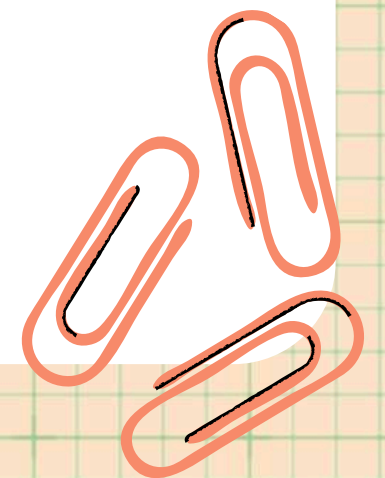
Mathematics केवल theoretical subject नहीं है बल्कि इसका उपयोग हमारे दैनिक जीवन और आधुनिक तकनीक में भी होता है। Abstract Algebra के concepts जैसे groups, rings, vector spaces और linear transformations का उपयोग computer science, cryptography, engineering और physics में किया जाता है। इस assignment में Unit I से Unit IV तक पढ़े गए topics के practical uses को समझाया गया है।

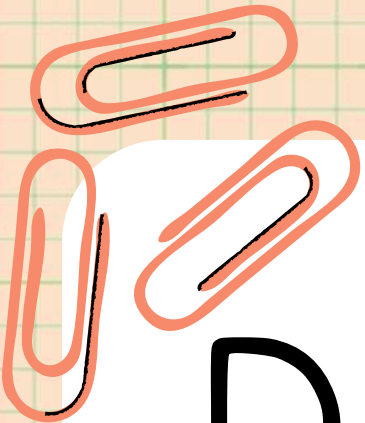


# Unit 1 – Groups and Isomorphism

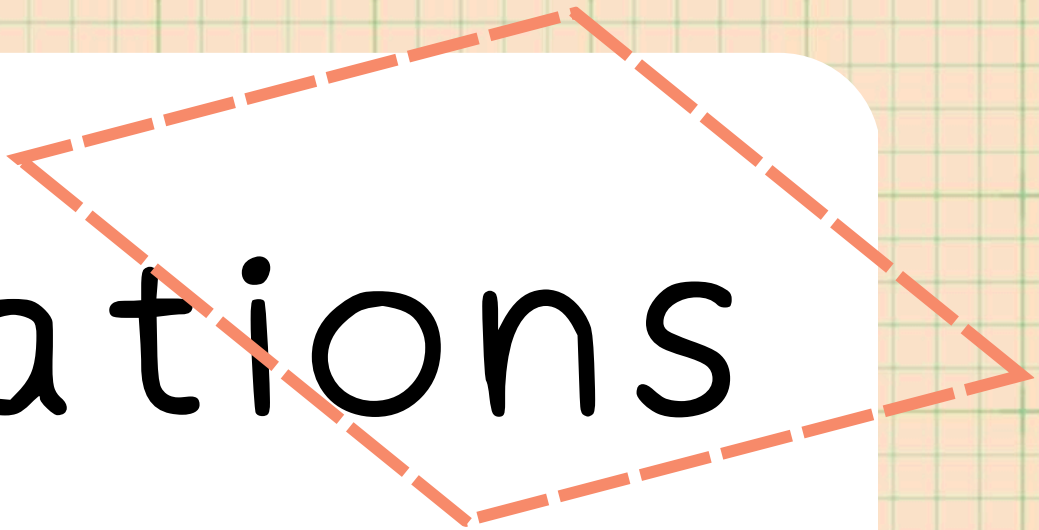
## **Definition**

Group एक algebraic structure है जिसमें एक set और एक binary operation होता है जो closure, associativity, identity और inverse properties को satisfy करता है।





# Daily Life Applications



- 
- Cryptography (Data Security)

Online banking और password encryption में group theory का उपयोग होता है।

- Rubik's Cube Solving

Rubik's cube को solve करने में permutation group का उपयोग होता है।

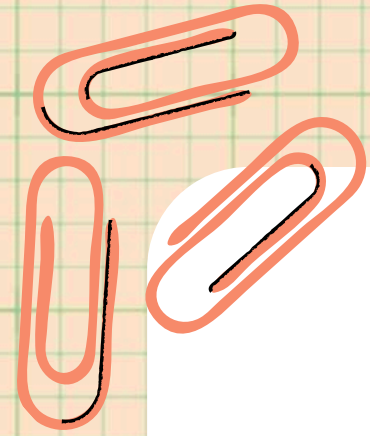
- Symmetry in Design

Architecture और art में symmetry group का प्रयोग किया जाता है।

- Computer Algorithms

कई algorithms group theory के principles पर आधारित होते हैं।

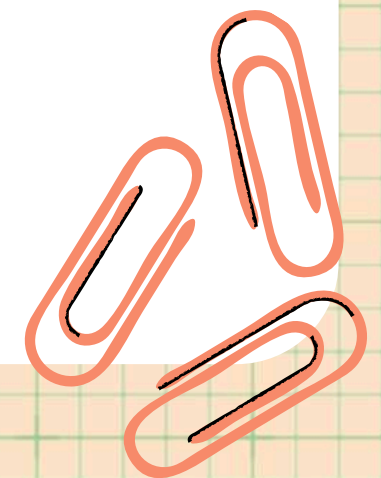




# Unit II – Rings, Fields and Integral Domains

## **Definition**

Ring एक algebraic structure है जिसमें addition और multiplication operations defined होते हैं।



# Daily Life Applications

- Coding Theory

Error detection और correction codes rings और fields पर आधारित होते हैं।

- Cryptography

RSA encryption algorithm fields और modular arithmetic का उपयोग करता है।

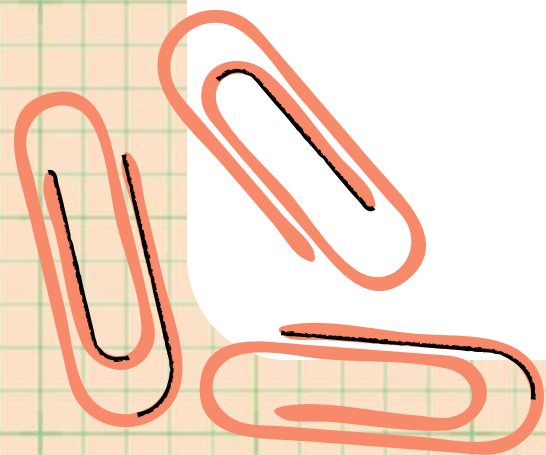
- Computer Arithmetic

Computer calculations modular arithmetic और ring theory पर आधारित होती हैं।

- Digital Communication

Data transmission में polynomial rings का उपयोग किया जाता है।

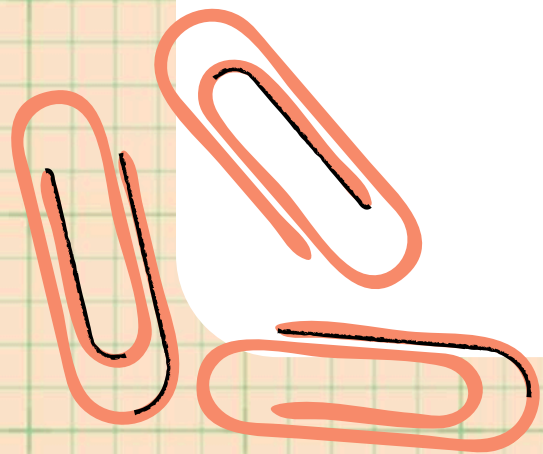
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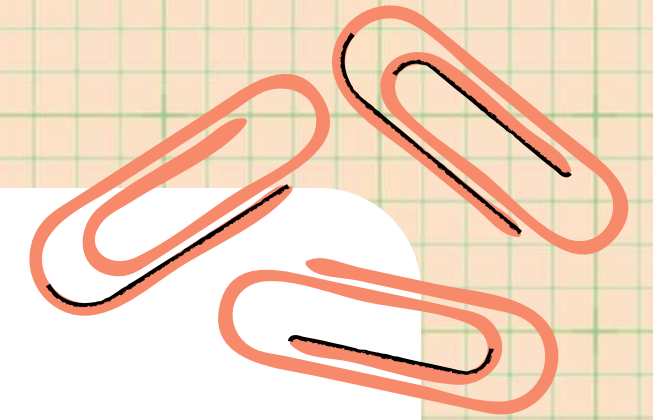
# Unit III – Vector Spaces

## Definition

Vector space वह mathematical structure है जिसमें vectors और scalars के बीच operations defined होते हैं।



# Daily Life Applications



- Computer Graphics

3D animation और video games में vector spaces का उपयोग होता है।

- Physics

Force, velocity और displacement vectors से represent किए जाते हैं।

- Machine Learning

Data को vector form में represent करके analysis किया जाता है।

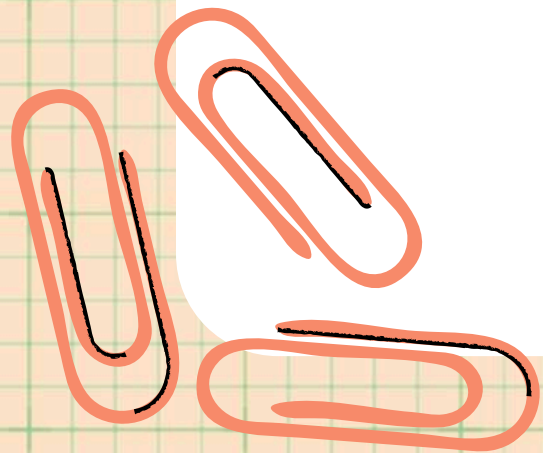
- Navigation Systems

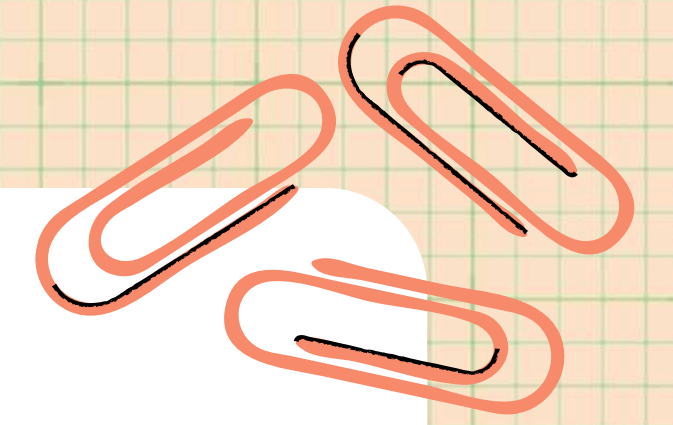
GPS technology vectors का उपयोग करती है।

# Unit IV - Linear Transformations

## Definition

Linear transformation एक function है जो एक vector space से दूसरे vector space में vectors को map करता है।





# Daily Life Applications

- Image Processing

Image rotation, scaling और reflection linear transformations से होती है।

- Computer Graphics

3D objects को move और rotate करने में matrix transformations का उपयोग होता है।

- Engineering Simulations

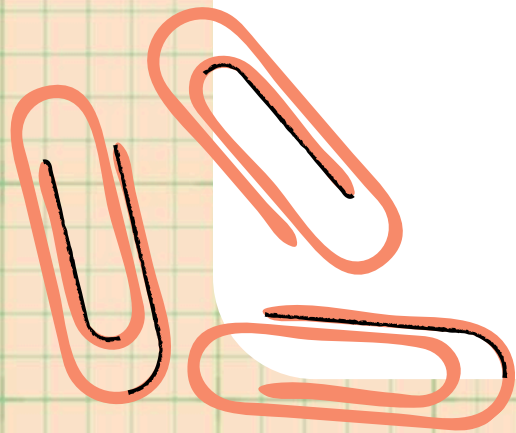
Mechanical systems के analysis में linear transformations उपयोगी हैं।

- Robotics

Robot arms की movement coordinate transformations से control होती है।

# Importance of Abstract Algebra in Modern life

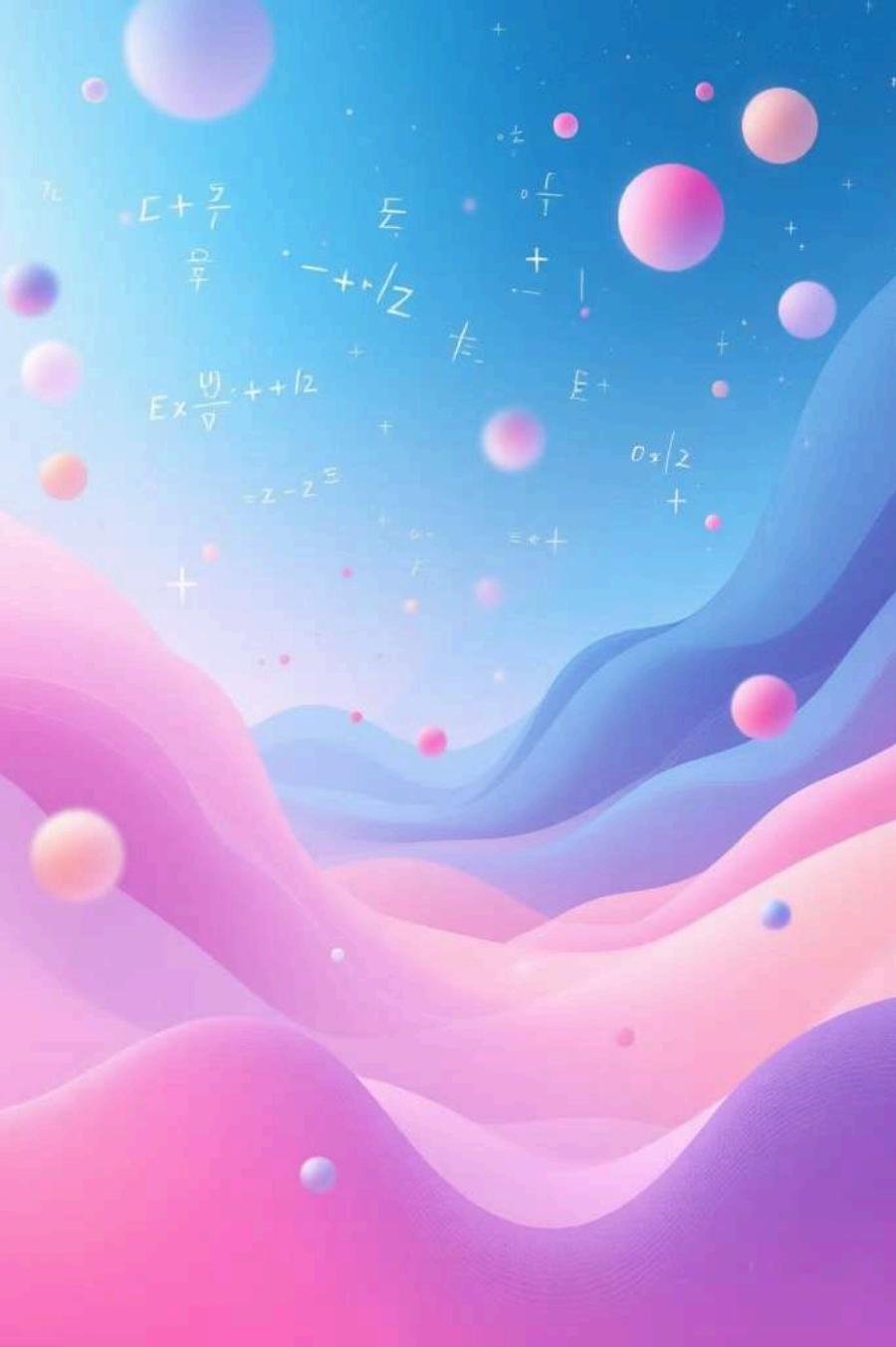
- Cyber security
- Computer science
- Artificial intelligence
- Engineering design
- Data science



# Conclusion (निष्कर्ष)

Abstract Algebra के concepts जैसे groups, rings, vector spaces और linear transformations आधुनिक विज्ञान और तकनीक में महत्वपूर्ण भूमिका निभाते हैं। ये concepts केवल mathematical theory तक सीमित नहीं हैं बल्कि real-life applications में भी उपयोगी हैं।

THANKYOU



# Real-World Mathematics: Applications of Semester IV Curriculum

Exploring how abstract algebra, linear algebra, and mathematical structures power our everyday digital world

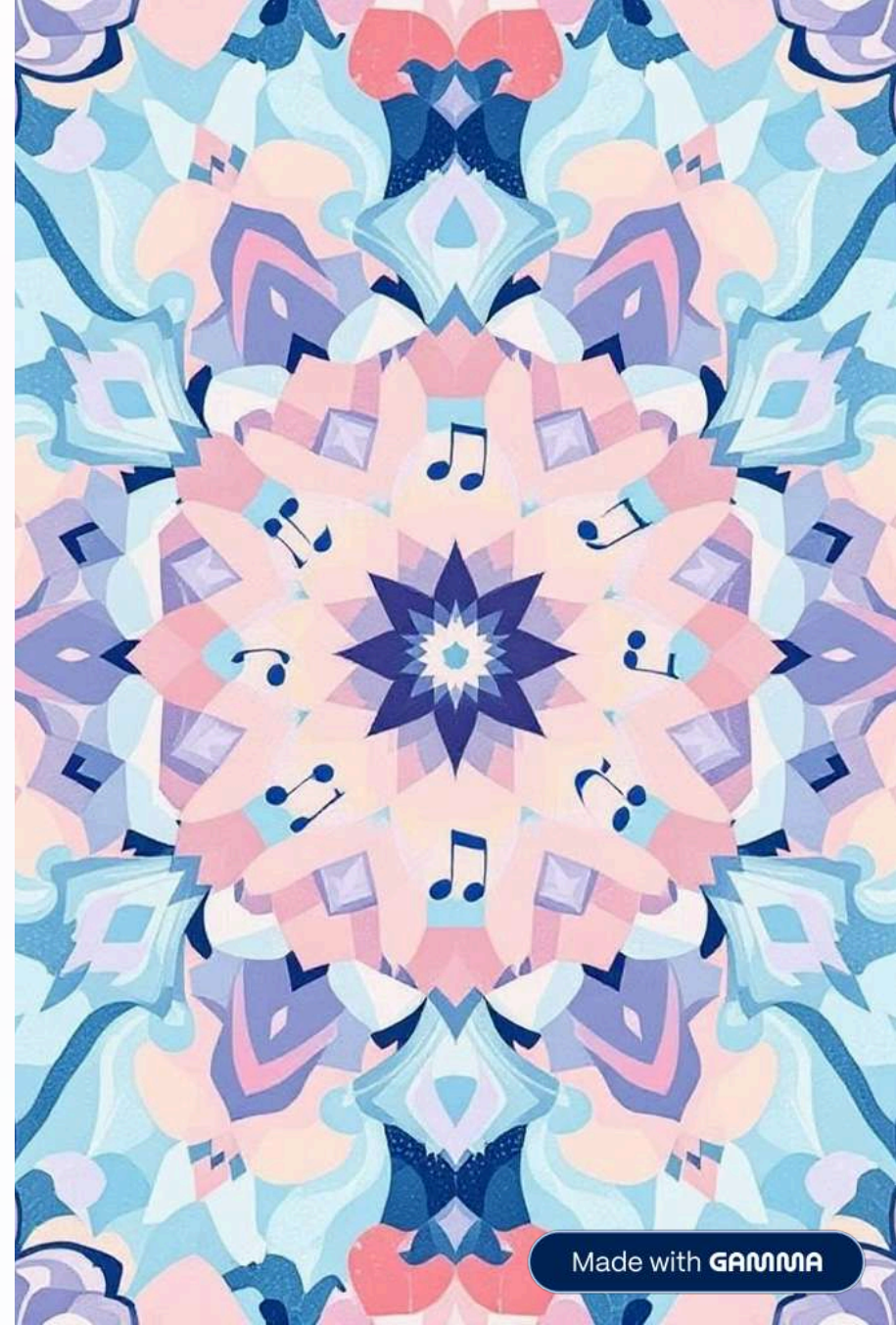
**Guided by:** Raj Kishore Patel **Submitted by:** Arti Kar

# Unit 1: Groups & Isomorphisms

## Symmetry in Art and Music

Group theory reveals the mathematical beauty underlying artistic patterns and musical compositions. Rotational symmetries in mandalas, frieze patterns in architecture, and even chord progressions in music all obey group axioms.

Isomorphisms connect seemingly different structures, showing that a Bach fugue and an Islamic geometric pattern share identical underlying mathematical relationships.



# Unit 1: Groups & Isomorphisms

## Error Correction in Digital Data

01

---

### Data Encoding

Messages transformed using group operations into redundant codewords

03

---

### Syndrome Calculation

Group theory identifies error patterns using parity checks

02

---

### Transmission

Data sent through noisy channels with potential bit flips

04

---

### Correction

Original message reconstructed using group inverse operations

From QR codes to satellite communications, group theory ensures reliable data transmission across billions of devices daily.

# Unit 2: Rings & Fields

## Cryptography and Secure Communication

### Modular Arithmetic

Finite fields form the foundation of RSA encryption, enabling secure online banking and e-commerce transactions.

### Elliptic Curves

Ring structures enable modern cryptography with smaller keys providing stronger security for cryptocurrencies and digital signatures.



# Unit 2: Rings & Fields

## Building Computer Processors



### Logic Gates

Boolean rings model AND, OR, NOT operations at the hardware level



### Binary Arithmetic

Finite fields enable efficient addition, multiplication, and division circuits



### ALU Design

Arithmetic logic units built using ring homomorphisms and field properties

Every CPU in smartphones, laptops, and servers relies on ring and field theory to perform billions of calculations per second.



# Unit 3: Vector Spaces

## 3D Graphics and Computer Vision

1

### Model Space

3D objects represented as vectors in  $\mathbb{R}^3$

2

### Transformations

Rotation, scaling, translation using linear maps

3

### Projection

Perspective mapping to 2D screen coordinates

Video games, CGI films, and augmented reality all depend on vector space operations to create immersive visual experiences.

# Unit 3: Vector Spaces

## Data Analysis and Machine Learning

### Feature Vectors

Datasets mapped to high-dimensional spaces where each dimension represents a measurable attribute

Netflix recommendations, medical diagnostics, and fraud detection systems all leverage vector space mathematics to extract meaningful insights from massive datasets.

### Principal Component Analysis

Dimensionality reduction using vector space projections to identify patterns and correlations



# Unit 4: Linear Transformations

## Image Processing and Filters

1

**Original Image**

Pixels as vectors in colour space

2

**Convolution Kernel**

Linear transformation matrix applied

3

**Filtered Output**

Enhanced edges or blurred effects

Smartphone cameras, medical imaging, and photo editing software use linear transformations for sharpening, blurring, edge detection, and noise reduction in real-time.

# Unit 4: Linear Transformations

## Engineering Design and Simulations



### Finite Element Analysis

Structural stress simulations transform complex geometries into solvable matrix equations for aerospace and automotive design



### Weather Forecasting

Atmospheric models use linear transformations to predict pressure, temperature, and wind patterns across millions of grid points



### Civil Engineering

Bridge and building designs analysed using transformation matrices to calculate load distributions and structural integrity

# The Ubiquitous Power of Advanced Mathematics

**100%**

## Connected Devices

Use group theory for error correction

**99.9%**

## Data Security

Enabled by ring-based cryptography

**3D**

## Graphics Pipeline

Relies on vector space transformations

From the smartphone in your pocket to global financial systems, the abstract mathematics of Semester IV underpins the technological infrastructure of modern civilization. What seems theoretical in the classroom becomes indispensable in the real world.

## Questions & Discussion





# MATHEMATICS PRESENTATION

Uses Of Abstract Algebra  
In Our Daily Life

Submitted By -  
Nandini Rana





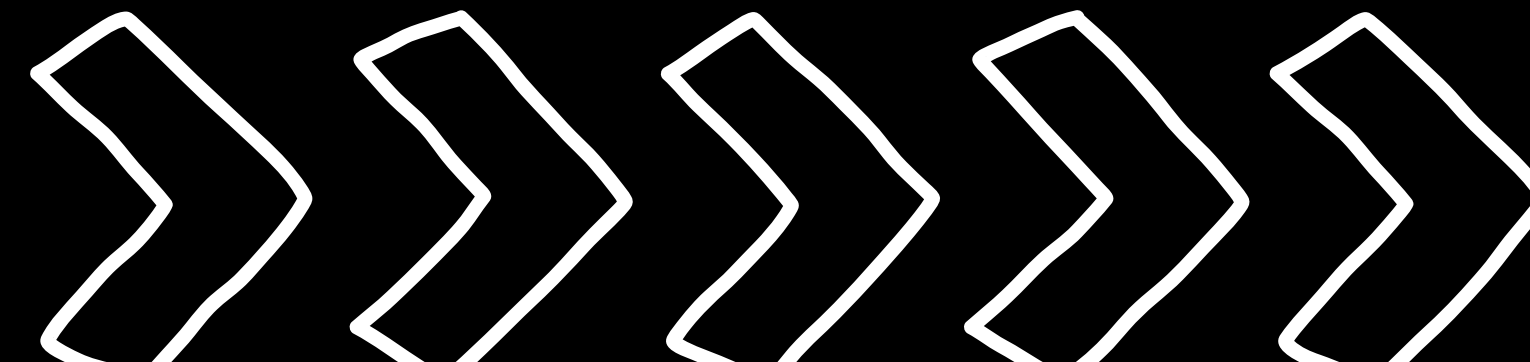
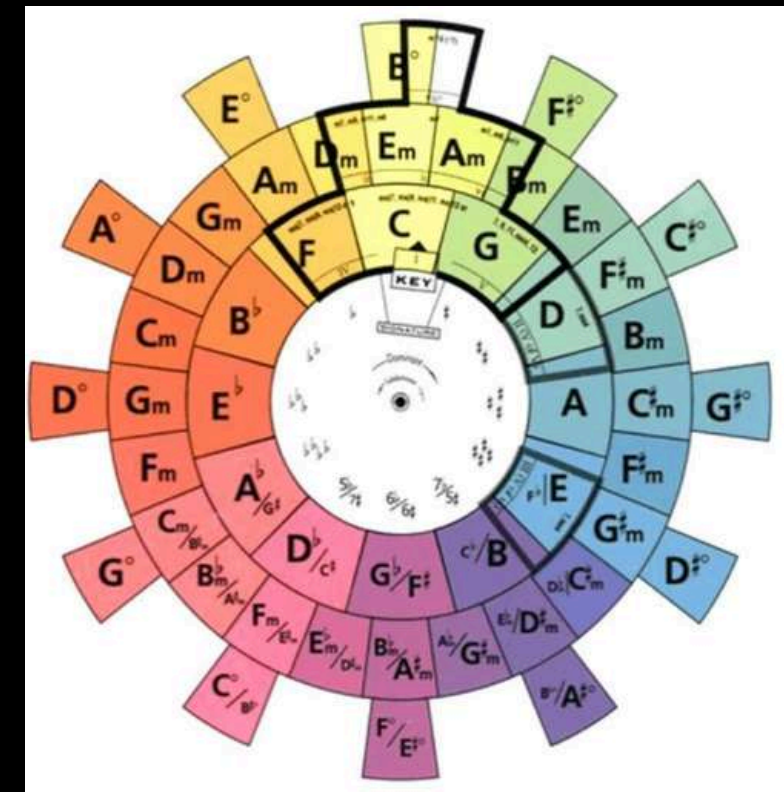
# CONTENT

- Isomorphism Theorem, Cyclic And Permutation groups
- Ring Field And Integral Domain Ideals
- Vector Space
  - Linear Transformation



## Uses of Isomorphism in our daily life

Isomorphism—meaning structural similarity—allows us to simplify complex problems by treating different systems with the same rules as equivalent. Common examples include using maps to navigate, blueprints for buildings, recognizing that different chess sets have the same rules, or applying the same strategies to similar games



# Navigation and maps:

A subway map is an isomorphic representation of the physical tracks, focusing on connectivity (station order) rather than exact distance.

# Language and Transport:

A phrase in English and its direct translation in Spanish are isomorphic; they share a different structure (words) but hold identical meaning.

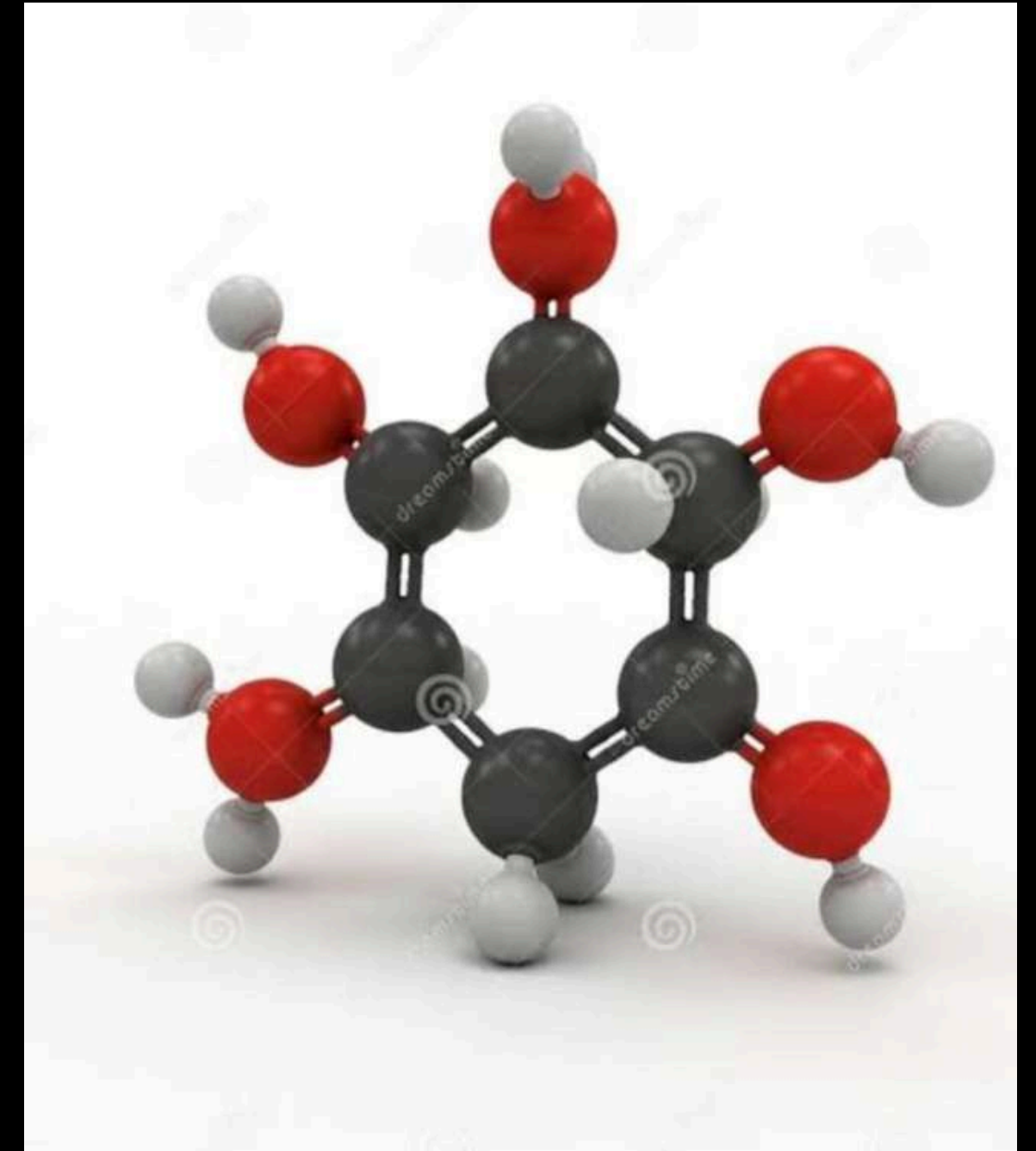
# Digital Interfaces :

A digital clock app is isomorphic to a physical clocks .

The user interface differs, but both display the same underlying temporal structure.

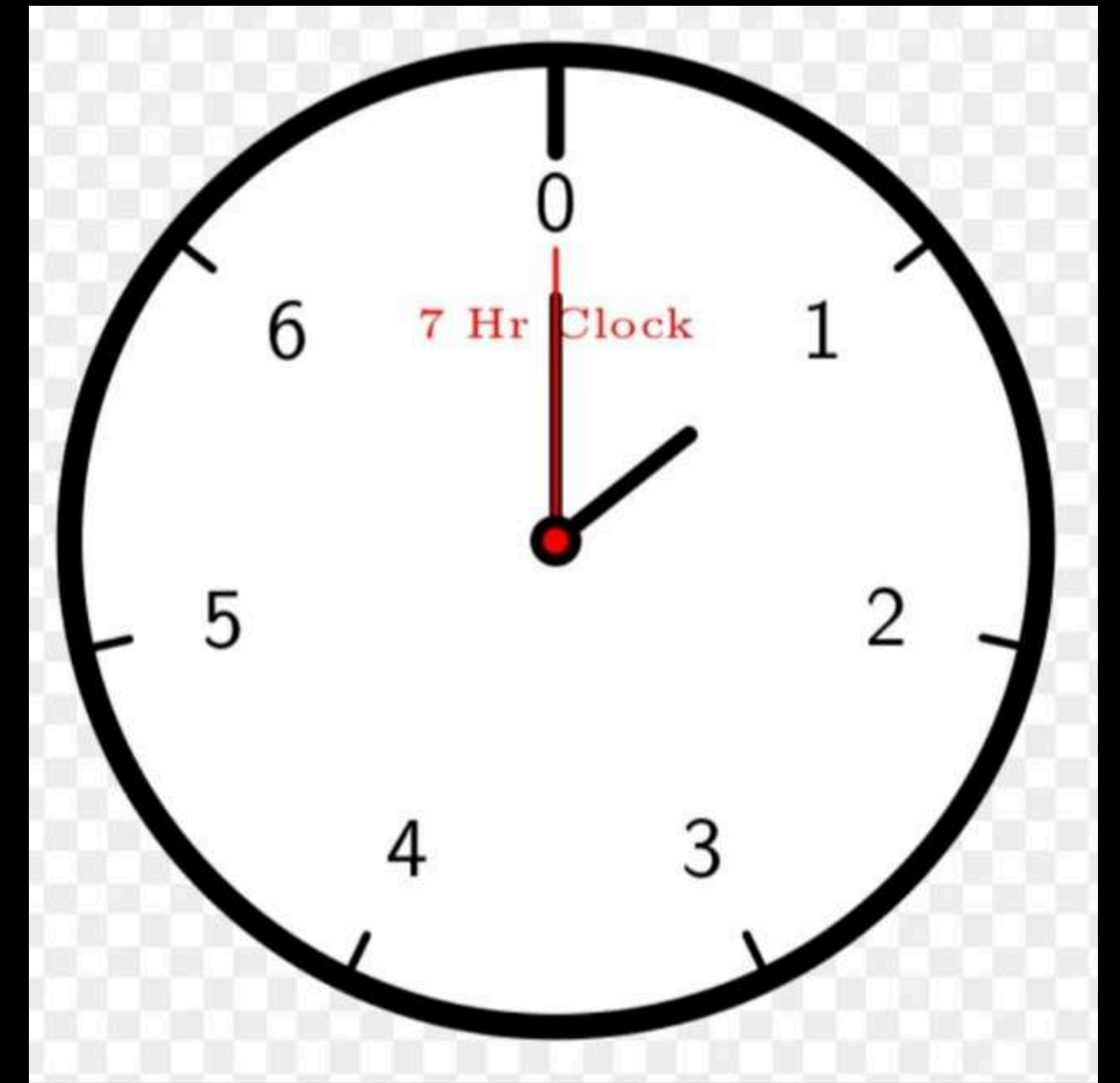
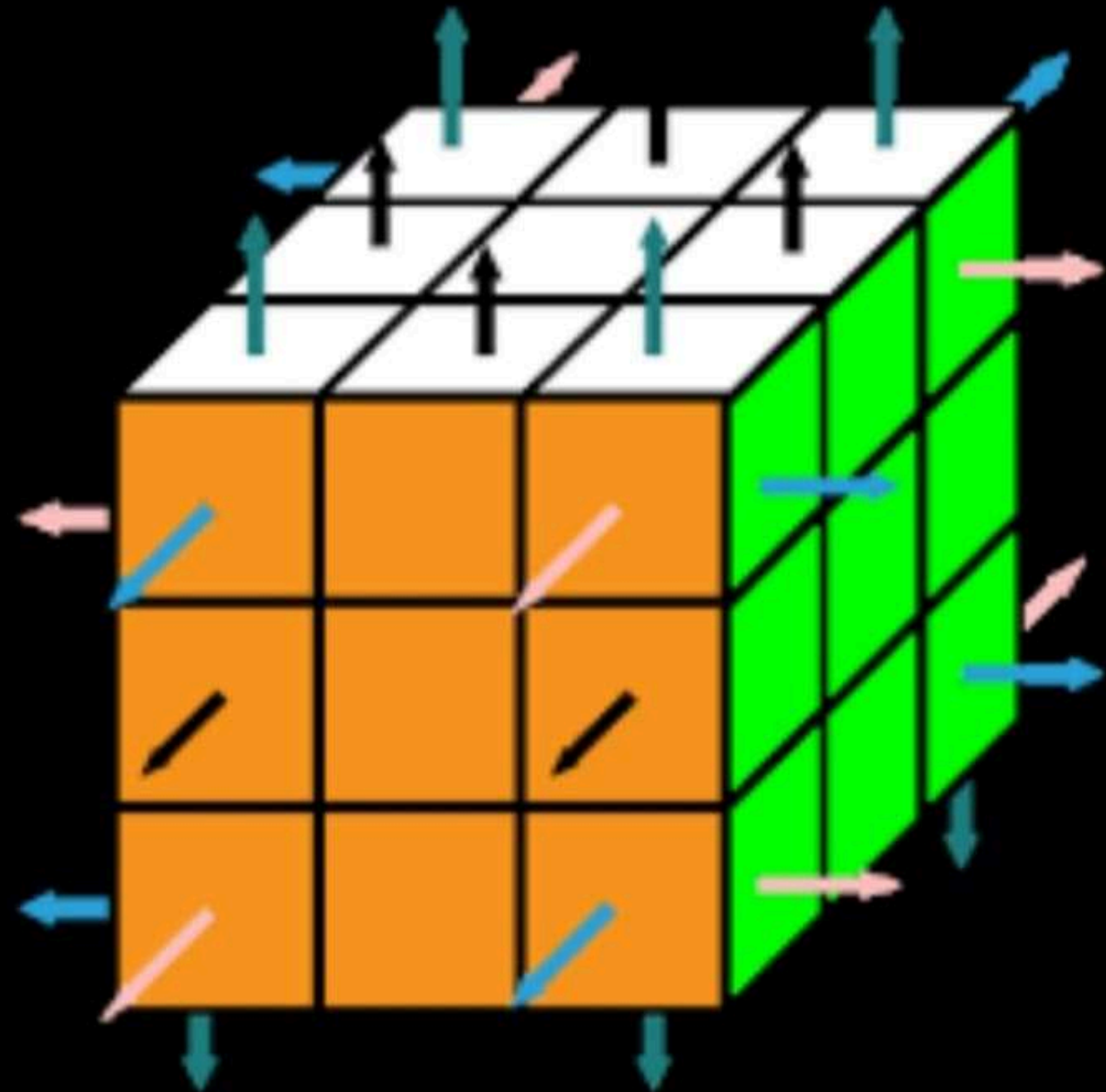
# Game Mechanics:

Many board games or puzzles are identical in strategy despite having different themes, such as various card games.



# Real life uses Of Cyclic groups

**Bell Ringing:** "Method ringing" is a way of ringing church bells in specific, repeating sequences that cycle through all permutations, utilizing a cyclic structure for the performance.



**12-Hour Clock System:** A 12-hour clock operates as a cyclic group (  $\mathbb{Z}_{12}$  ), where hours (1–12) act as elements and addition is defined modulo 12.

# • Ring Field And Integral Domain Ideals

## 1. Fields: The Foundation of Reliable Data

A Field is a set where you can add, subtract, multiply, and divide (except by zero).

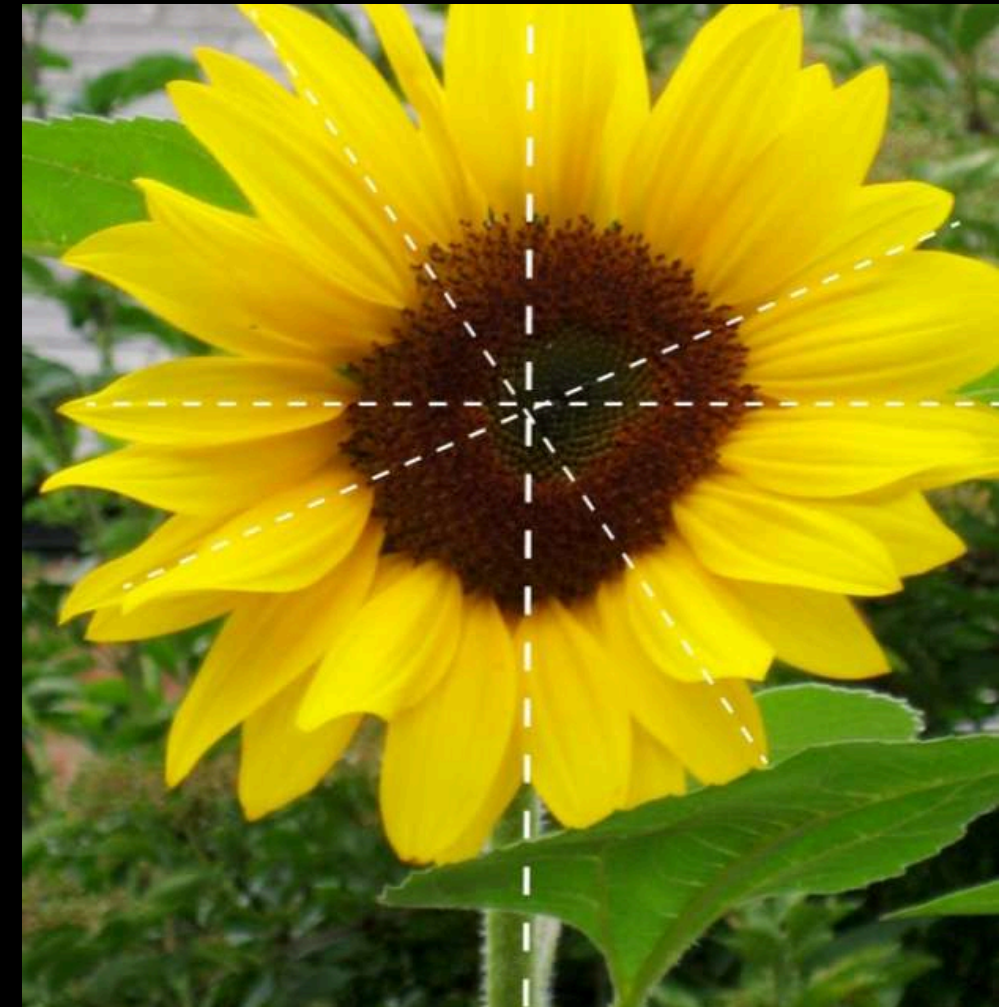
## 2. Rings: Dealing with Clockwork and Integers

A Ring is a bit looser than a field .

Clock Arithmetic (Modular Arithmetic): The most common ring is . Every time a computer calculates a hash function (like for a digital signature) or a checksum, it is operating within a ring.

## 3. Integral Domains: Keeping Data Unique

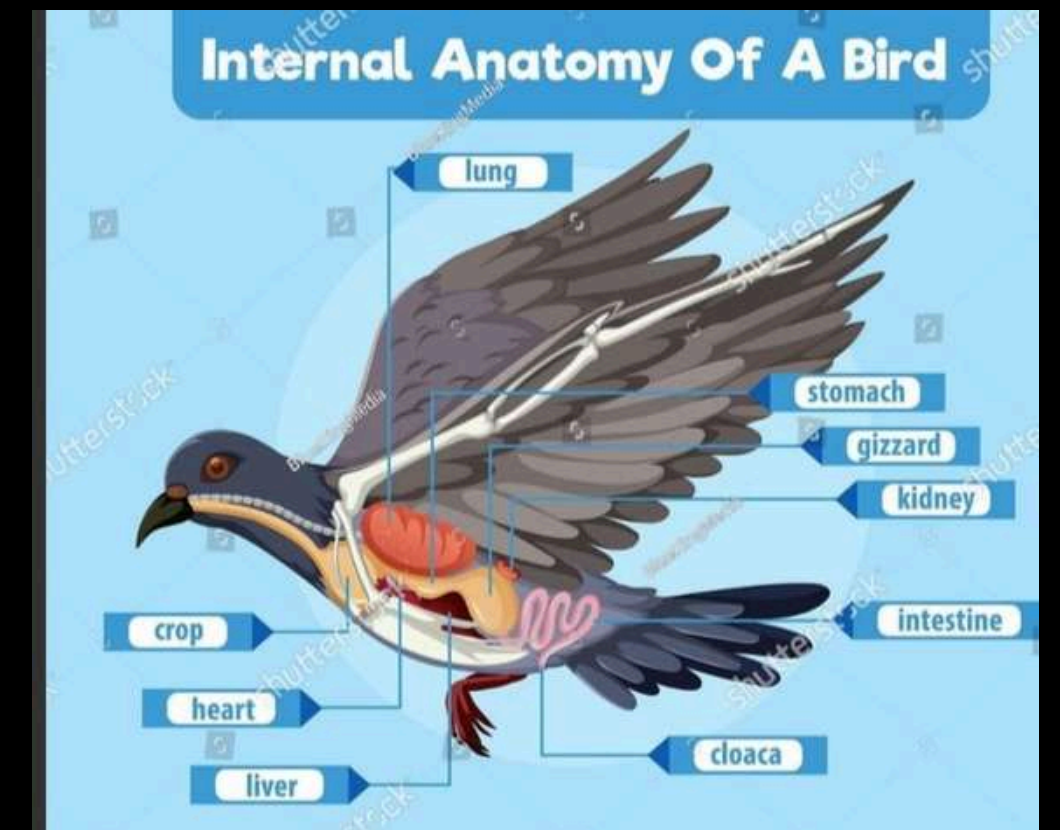
An Integral Domain is a ring where you can't multiply two non-zero things and get zero (no "zero divisors").Add a subheading



# Vector Space uses in our daily life



Vector spaces are the language of linear combinations. Any time you blend different "ingredients" (data, colors, forces) to get a specific result, you are using a vector space.



**Pixels as Vectors:** Each pixel is a vector in a 3D space (Red, Green, Blue). A 12-megapixel photo is just a single vector in a 36-million-dimensional space.

**Structural Analysis:** Engineers treat forces (gravity, wind, weight) as vectors. To ensure a building stands, the vector sum of all forces at every joint must be zero (equilibrium).

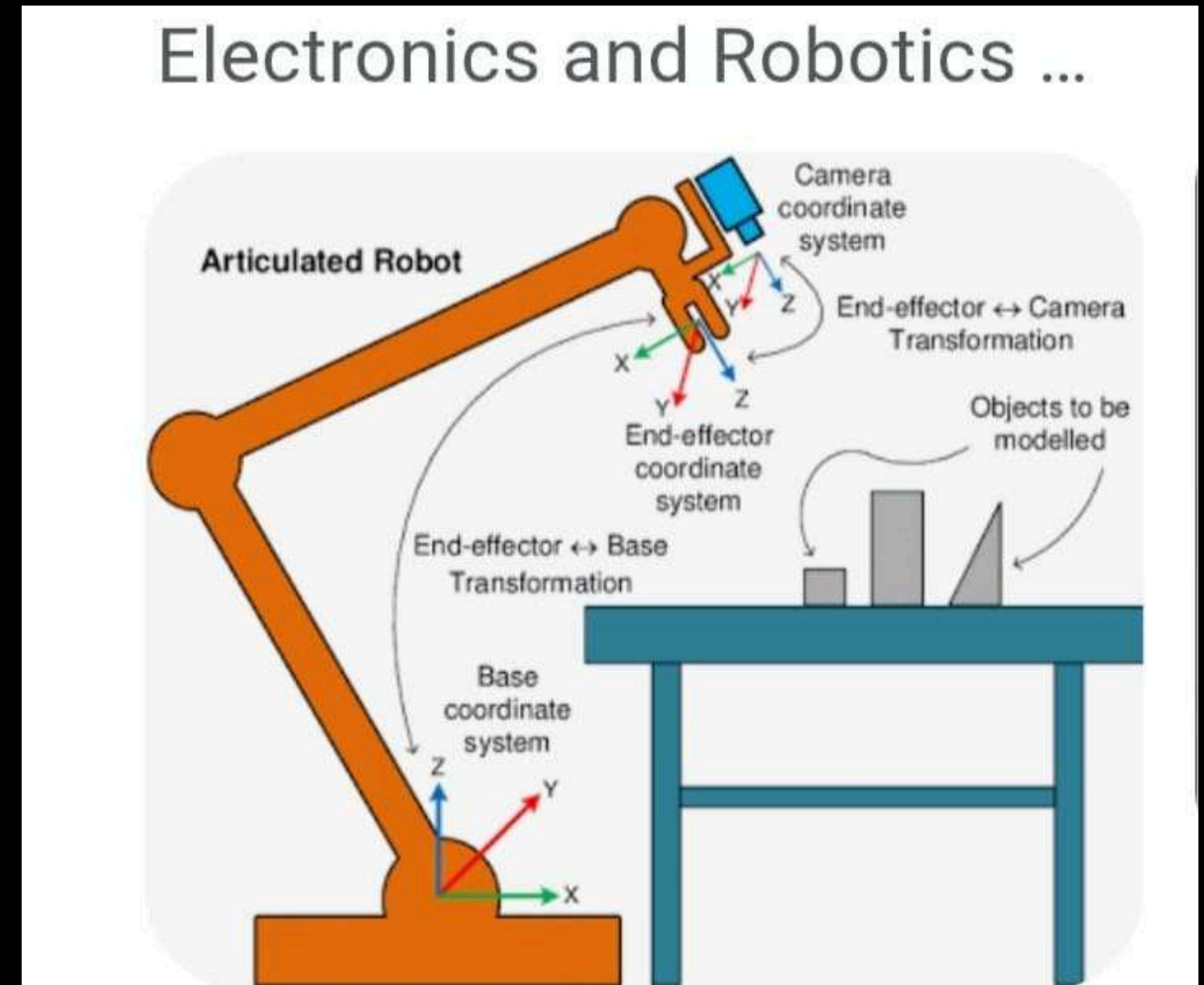
# Linear Transformation uses in our daily life

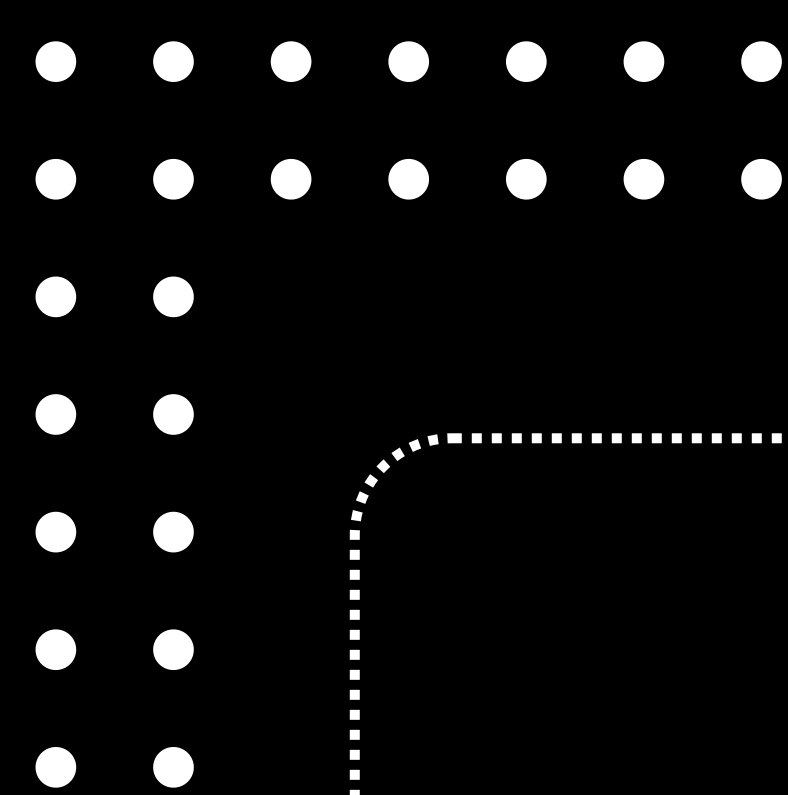
Linear transformations are essentially "rules" for moving or changing data while keeping its internal relationships (like straight lines and proportional distances) intact. In practice, if you can represent a problem as a matrix, you are likely using a linear

**Geometric Editing:** Every time you rotate a photo, zoom in (scaling), or tilt it (shearing) in an app like Instagram or Canva, you are applying a transformation matrix to the pixels.

## A Robotic Arm Picking up a Cup

Imagine a robot in a factory. To pick up a cup, it has to deal with three different "points of view" (called Coordinate Frames):





THANK YOU



# **ASSIGNMENT**

## **Abstract Algebra**

**Daily uses of my curriculum**

Submitted By - prinsu sahu

# Daily uses of isomorphism theorems

Isomorphism theorems (First, Second, Third, and Fourth) are foundational tools in algebra used to simplify complex structures by showing they are essentially the same (isomorphic) as simpler quotient structures. They are used daily to identify, analyze, and compute with groups, rings, and modules.

# Daily uses of permutation groups

- 1 Passwords & PINs:** Calculating the number of possible codes and strengthening security by increasing the number of possible arrangements.  
**License Plates & Phone Numbers:** Generating unique identification numbers by permuting letters and digits.
- 2 Scheduling:** Organizing race results, tournament brackets, or tasks in a specific order.  
**Computer Sorting Algorithms:** Used for organizing data sets efficiently.

# Daily uses of cyclic theorems

**Clock Arithmetic:** 12-hour clocks are a standard cyclic system where 12, 1, 2...11, 12, 1... repeat indefinitely.

**Jewelry/Craft Design:** Creating unique necklaces or bracelets with beads, where flipping the necklace over means the same, or rotating the necklace is the same.

**Round Table Seating:** Arranging guests at a round table or arranging items on a carousel.

**Data Structure/Coding:** Using cyclic shifts in computer algorithms (e.g., Fisher–Yates shuffle) for generating random sequences.

# Daily uses of cyclic and permutation groups

**Rubik's Cube & Puzzles:** Each turn on a Rubik's cube is a permutation of the colored squares. The overall goal of returning to the original state involves finding a cycle.

**Network Routing:** In communication networks, data is often routed using permutations to optimize speed and security.

# Real life uses of vector spaces

Vector spaces are fundamental in modeling and solving problems across science, engineering, and technology by representing data as  $n$ -dimensional vectors. Key applications include computer graphics (3D modeling), machine learning (data representation, PCA), quantum mechanics, signal processing, and engineering (structural analysis, circuit design).

# Daily uses of linear transformation

Linear transformations are used daily in computer graphics (rotating/scaling images on screens), data science (reducing dimensionality with PCA), and machine learning (neural network layers) to efficiently process and transform data points. They allow for geometric operations like rotation, scaling, and shearing.

# Daily uses of field and integral domain

Fields and integral domains are foundational algebraic structures used daily in computer science, cryptography, and engineering. Fields (e.g., real numbers, complex numbers) enable division, essential for solving linear equations. Integral domains (e.g., integers, polynomial rings) support factoring and canceling without division, fundamental to number theory and coding.

# Real life uses of ideals and ring

- Ring ideals are foundational to modern technology and mathematics, serving as specialized subsets of rings (like integers or polynomials) that enable structured operations. They are used daily in coding theory for error detection, cryptography for secure communication, and in digital image segmentation algorithms to process pixels. They also generalize prime numbers and factorization, allowing unique factorization in algebraic number theory.

# CONCLUSION

Abstract algebra is fundamental to modern daily technology, powering secure communications, data storage, and digital signal processing through concepts like groups, rings, and fields. It enables daily tasks by securing online transactions (cryptography) and correcting data errors in digital storage like CDs, hard drives, and streaming.



THANK YOU

# LATE RAJA VIRENDRA BAHADUR SINGH GOVT COLLEGE (SARAIPALI)



**GUIDED BY:-**

**Rajkishor Patel Sir**

**SUBMITTED BY:-**

**Ankita Dadsena**





# INDEX

- ▶ Isomorphism theorem, Cyclic and permutation groups
- ▶ Ring, Field and Integral Domain ideas
- ▶ Vector space
- ▶ Linear transformation

# UNIT 1:- Uses of theorems

## Isomorphism theorem- uses

- ▶ Help in understanding when two algebraic structures are essentially the same.
- ▶ Used to simplify complex groups into easier forms.
- ▶ Used in coding theory for error detection and correction.

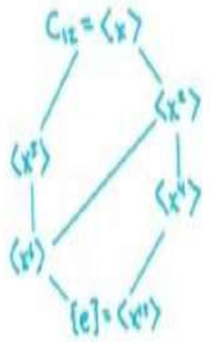
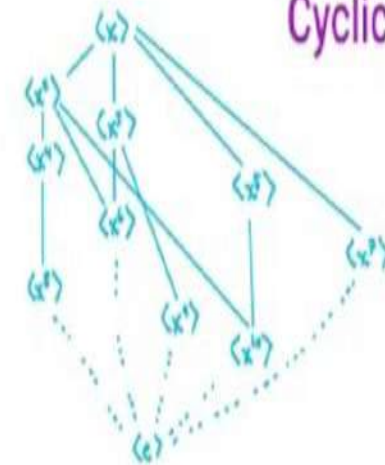
LEGENDS :	
	Sub-group
	Normal Sub-group
	Quotient
	Isomorphic

## Cyclic groups - uses

- ▶ Used in modular arithmetic.
- ▶ Helps in studying periodic phenomena.
- ▶ Used in computer science for designing algorithms.

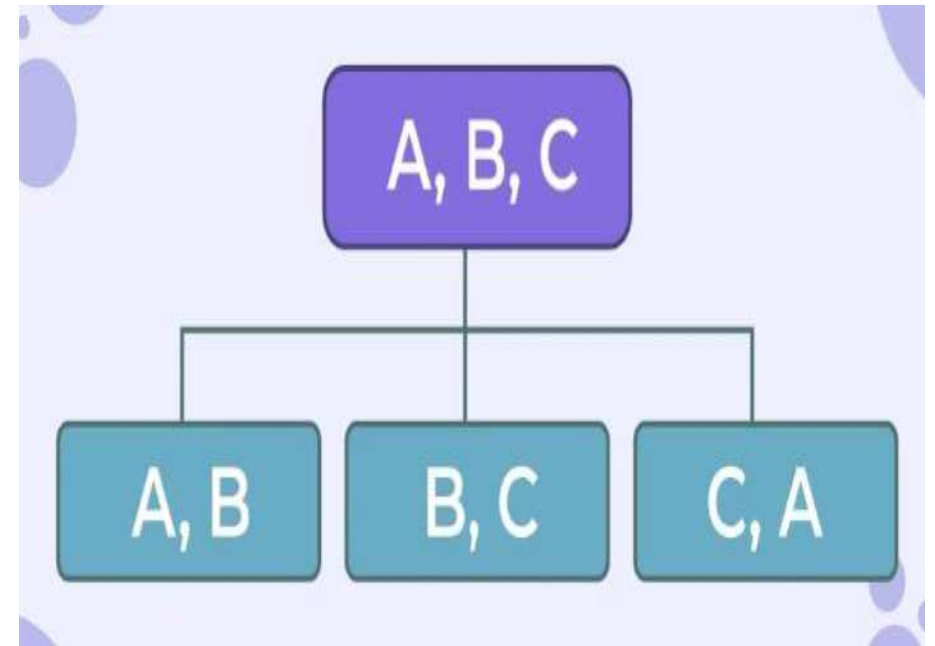
Abstract Algebra

Cyclic groups



## Permutation groups – uses:-

- ▶ Used to study arrangements.
- ▶ Applied in Rubik's cube and puzzle solving.
- ▶ Used in cryptography and coding theory.



## UNIT 2:- Ring, field and integral domain

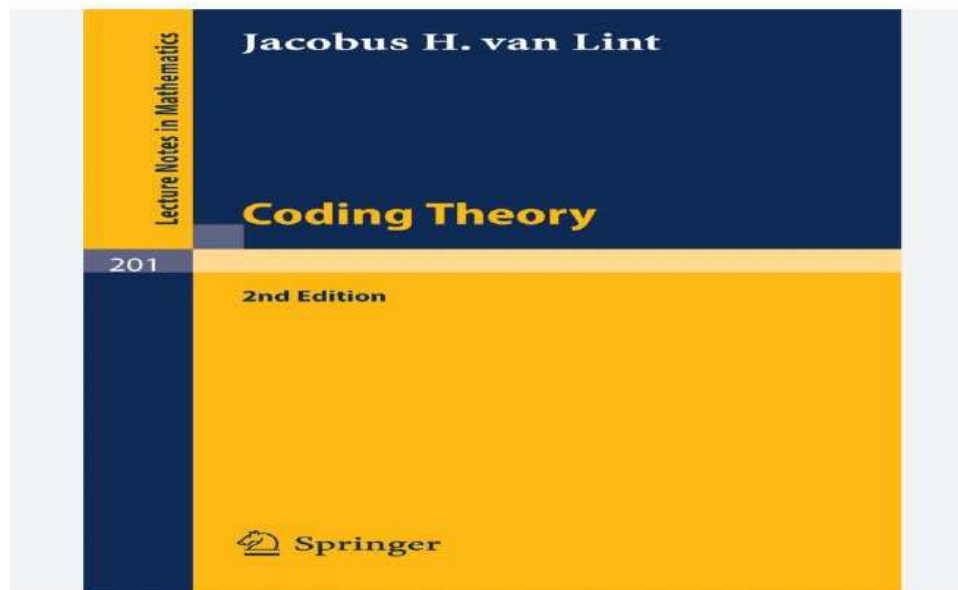
### Basic idea (Concept) :-

- ▶ A ring is a set with addition and multiplication operation.
- ▶ A field is a ring where division is possible.
- ▶ An integral domain is a ring with no zero divisors.

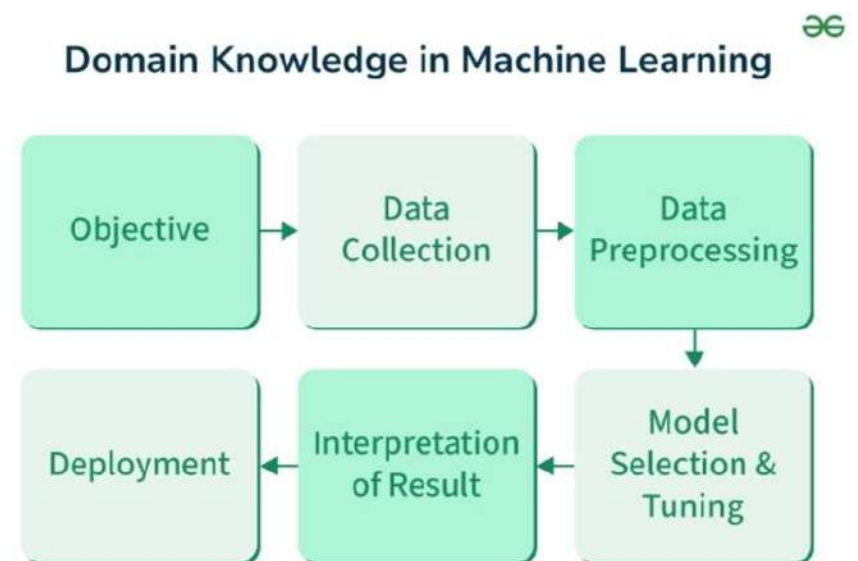
## Uses of ring, field and integral domain:-

- ▶ Coding theory
- ▶ Computer science
- ▶ Number theory
- ▶ Digital communication
- ▶ Physics and engineering
- ▶ Algebraic geometry

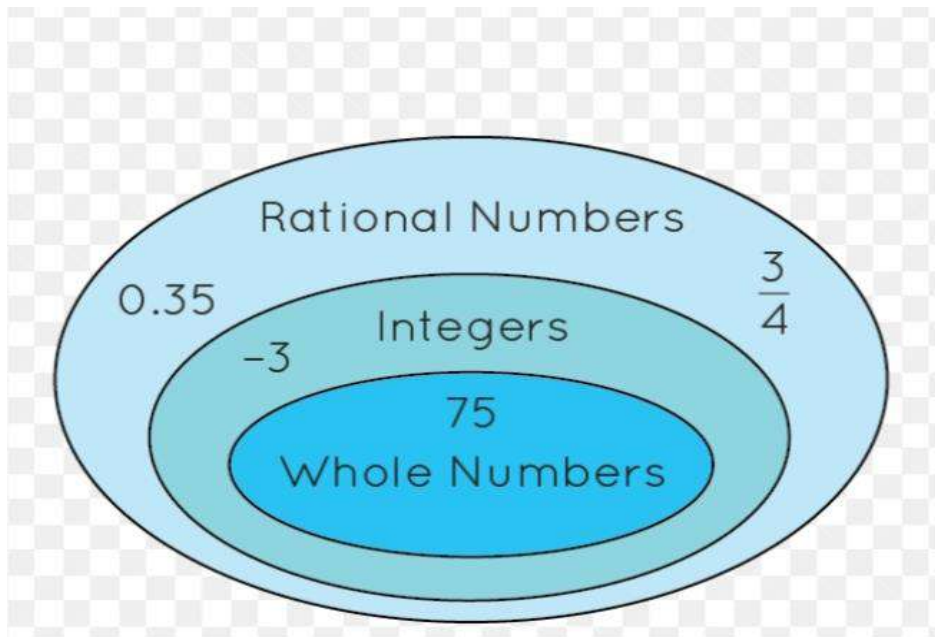
## Coding theory:-



## Computer science:-



## Number theory:-



## Digital communication:-

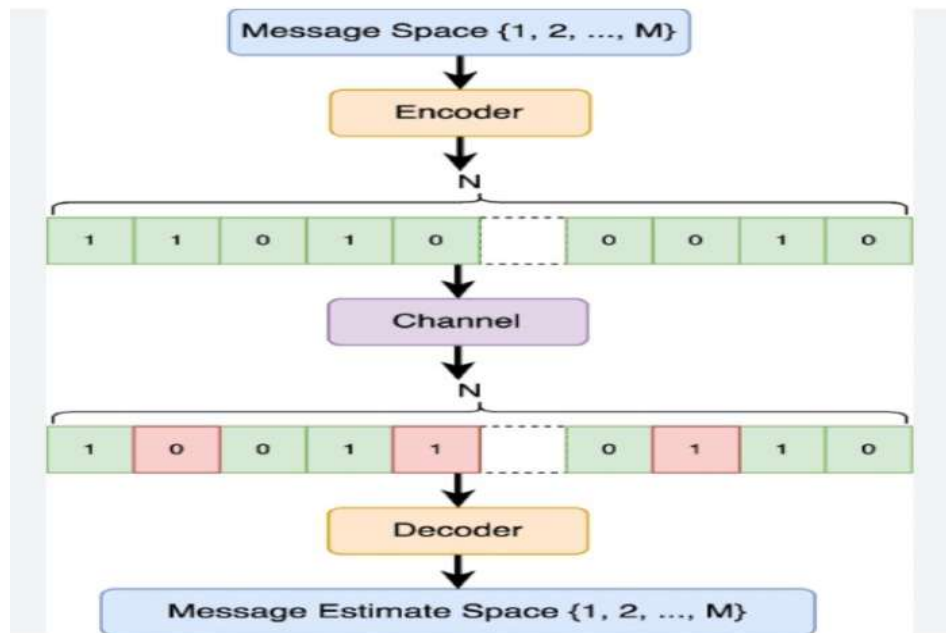


# Unit 3:- Vector space

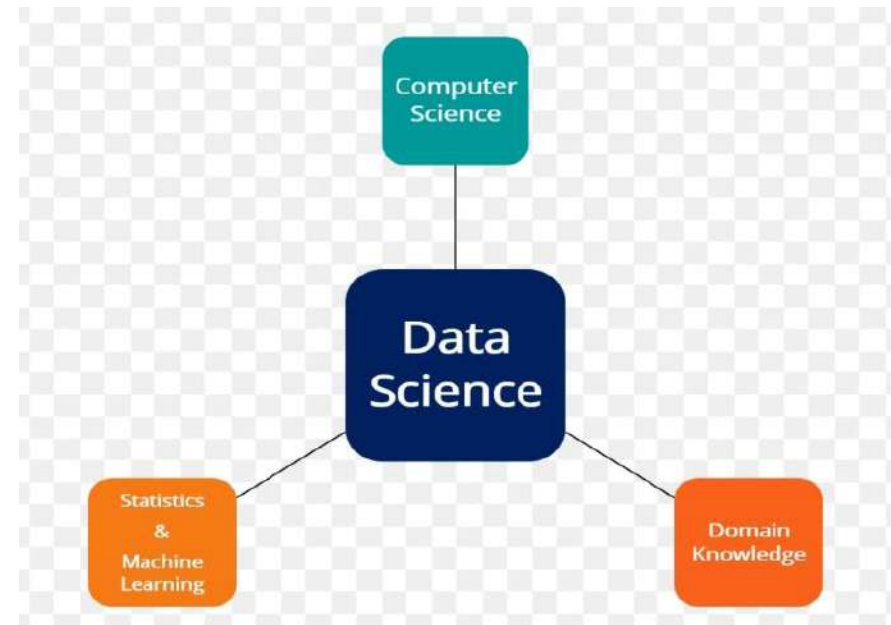
## Uses of vector space:-

- ▶ Computer graphics
- ▶ Data science
- ▶ Quantum mechanics
- ▶ Engineering problems
- ▶ Economics

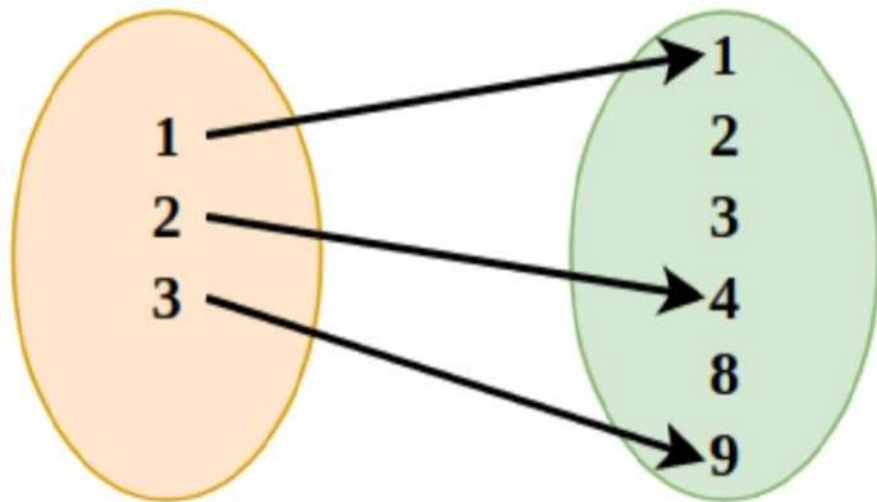
## Computer graphics:-



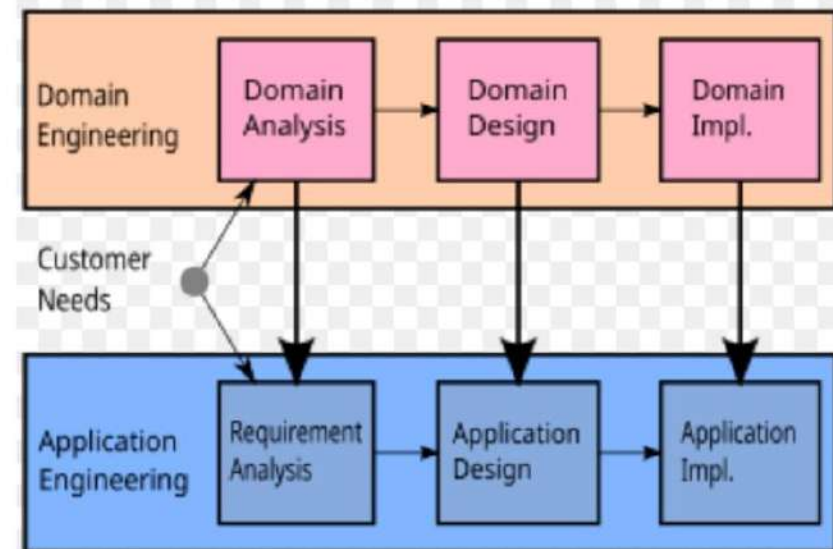
## Data science:-



## Quantum mechanics:-



## Engineering problems:-



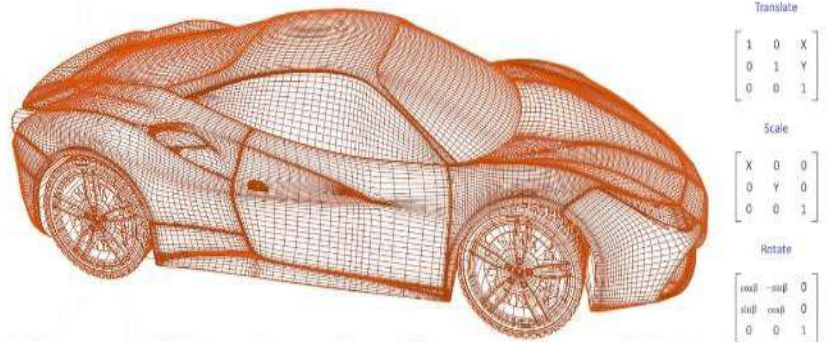
# Unit 4:- Linear transformation

## Uses of linear transformation:-

- ▶ Computer graphics
- ▶ Image processing
- ▶ Machine learning
- ▶ Physics and engineering
- ▶ Cryptography

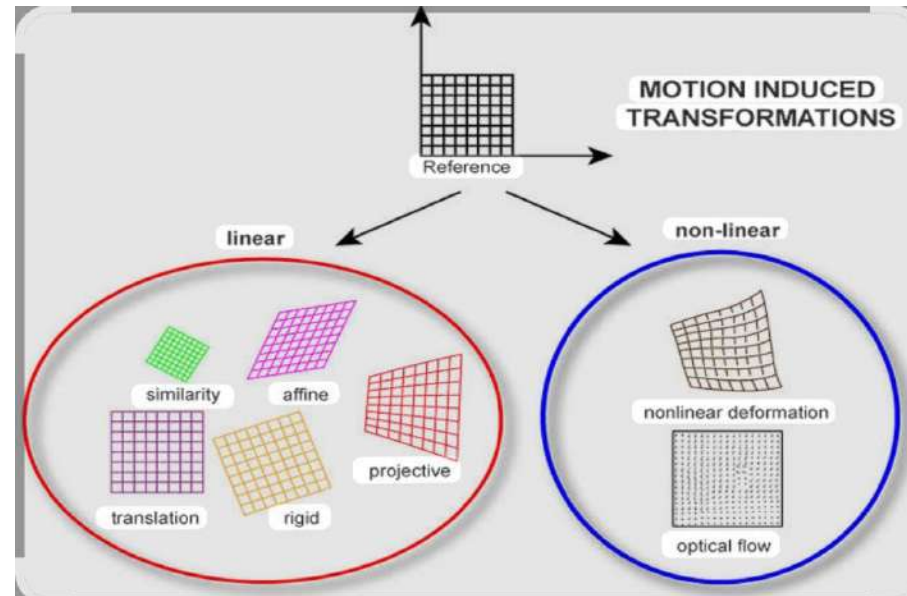
Computer graphics:-

## Transformation Matrices

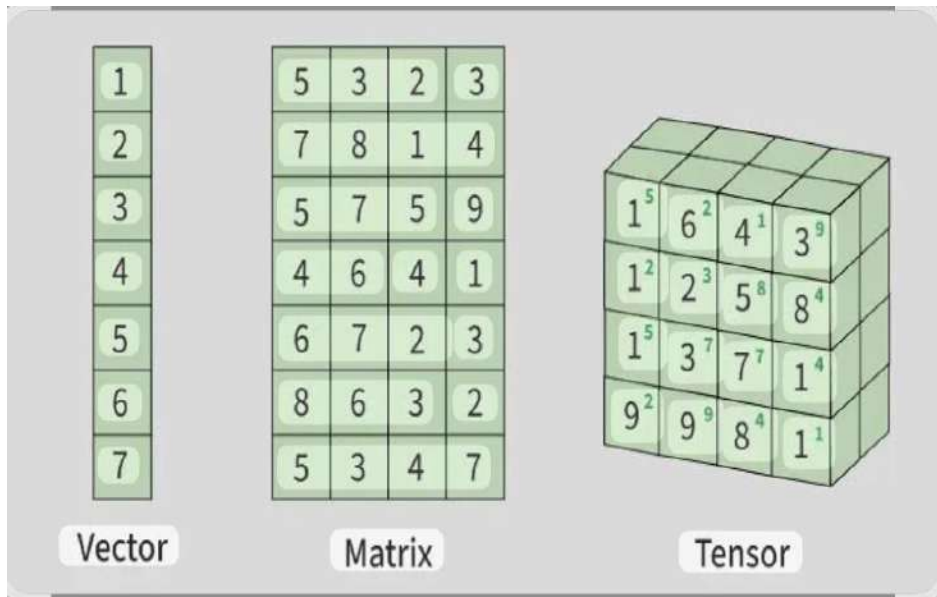


Linear Algebra for Computer Scientists

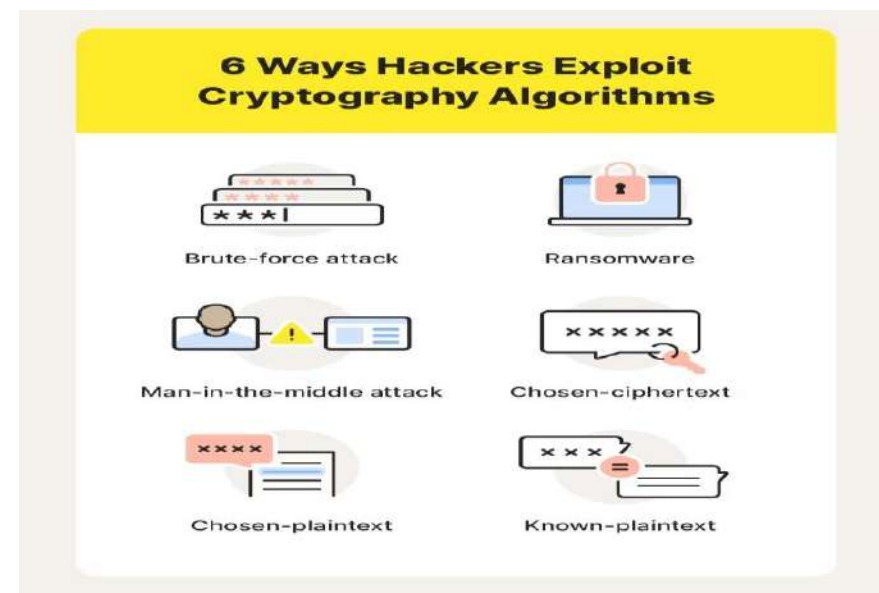
Image processing:-



## Machine learning:-



## Cryptography:-





**THANK**

**YOU !**



# Late Raja Virendra Bahadur Government college saraipali

SUBMITTED BY:- ALKA KUMHAR

SUBMITTED TO:- RAJKISHOR PATEL SIR








CLASS :- BSC 4 TH SEM









SUBJECT:- MATHS (DSC)








# Abstract algebra in daily life









- ▶ Abstract Algebra क्या है? (परिभाषा)
- ▶ 👉 English:
  - ▶ Abstract Algebra is a branch of mathematics that studies algebraic structures like groups, rings, and fields.
- ▶ 👉 Hindi में:
  - ▶ अमूर्त बीजगणित गणित की वह शाखा है जिसमें समूह (Group), वलय (Ring), और क्षेत्र (Field) जैसी संरचनाओं का अध्ययन किया जाता है।

# Unit:-1 isomorphic theorems cyclic and permutations group









- ▶  1. Cyclic Group (चक्रीय समूह) का उपयोग
- ▶  Idea: Repeat होने वाली चीजें
- ▶  Examples:
- ▶  Clock system
- ▶ 12 के बाद फिर 1 → cycle बनता है
- ▶  Days of week
- ▶ Monday → Sunday → फिर Monday
- ▶  Traffic signal
- ▶ Red → Yellow → Green → repeat
- ▶  Conclusion:
- ▶ जहाँ भी कोई चीज repeat (cycle) होती है, वहाँ cyclic group use होता है








- ▶  2. Permutation Group (परिवर्तन समूह) का उपयोग
- ▶  Idea: Arrangement / order change
- ▶  Examples:
- ▶  Class seating arrangement
- ▶  Playing cards shuffle
- ▶  Password / PIN combinations
- ▶  Competition ranking (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>)
- ▶  Conclusion:
- ▶ जहाँ भी arrangement या order change होता है, वहाँ permutation group use होता है








- ▶  3. Isomorphism (समरूपता) का उपयोग
- ▶  Idea: Same structure in different forms
- ▶  Examples:
- ▶  Clock (mod 12) और numbers (mod 12)
- ▶  Different systems but same pattern
- ▶  Computer data structures mapping
- ▶  Conclusion:
- ▶ यह हमें बताता है कि अलग-अलग चीजों में same structure हो सकता है








- ▶  4. Isomorphism Theorems का उपयोग
- ▶  Idea: Complex system को simple बनाना
- ▶  Examples:
- ▶  Data compression
- ▶  Encryption systems (security)
- ▶  Coding theory (error detection)
- ▶  Computer algorithms simplify करना
- ▶  Conclusion:
- ▶ यह theorems हमें complex problems को आसान बनाने में मदद करते हैं

# Unit :- 2 Ring field and Integral domain ideals










- ▶  Unit-2 का Daily Life में उपयोग
- ▶  1. Ring (वलय) का उपयोग
- ▶  Idea: Addition + Multiplication दोनों होते हैं
- ▶  Examples:
- ▶  Banking system  
(जमा + ब्याज calculation)
- ▶  Computer arithmetic  
(binary operations: +, ×)
- ▶  Accounting system  
(profit-loss calculations)
- ▶  Conclusion:
- ▶ जहाँ दो operations (जोड़ और गुणा) होते हैं, वहाँ ring concept use होता है

- ▶  2. Field (क्षेत्र) का उपयोग
- ▶  Idea: हर non-zero element का inverse होता है (division possible)
- ▶  Examples:
- ▶  Engineering calculations
- ▶  Computer graphics & coding
- ▶  Cryptography (encryption/decryption)
- ▶  Conclusion:
- ▶ जहाँ division जरूरी होता है, वहाँ field use होता है








- ▶  3. Integral Domain (समाकलन क्षेत्र)
- ▶  Idea: No zero divisors
- ▶  Examples:
- ▶  Accurate calculations
- ▶ (जहाँ गलती avoid करनी हो)
- ▶  Data integrity systems
- ▶  Secure computations
- ▶  Conclusion:
- ▶ जहाँ error-free calculation चाहिए, वहाँ integral domain useful है









- ▶  4. Ideals (आदर्श) का उपयोग
- ▶  Idea: Substructure जो ring के अंदर special property रखता है
- ▶  Examples:
- ▶  Coding theory
- ▶ (error detection & correction)
- ▶  Cryptography systems
- ▶  Signal processing
- ▶  Conclusion:
- ▶ Ideals का use system को simplify करने और security बढ़ाने में होता है








# Unit:- 3 vector space







- ▶  Vector Space का Daily Life में उपयोग
- ▶  1. Physics (भौतिकी) 
- ▶  Idea: Direction + magnitude
- ▶  Examples:
- ▶  Velocity (वेग)
- ▶  Force (बल)
- ▶  Wind direction
- ▶  ये सब vectors हैं → इसलिए vector space use होता है





- ▶  2. Computer Graphics 
- ▶  Idea: 2D/3D objects बनाना
- ▶  Examples:
- ▶  Video games
- ▶  Animation movies
- ▶  Mobile graphics
- ▶  Screen पर जो images दिखती हैं, वो vectors से बनती हैं

- ▶  3. Navigation (दिशा निर्धारण) 
- ▶  Examples:
- ▶  Airplane direction
- ▶  Ship navigation
- ▶  Google Maps
- ▶  Location और direction vector की मदद से find होते हैं





- ▶  4. Data Science & AI 
- ▶  Idea: Data = vectors
- ▶  Examples:
- ▶  Machine learning
- ▶  Recommendation systems (YouTube, Instagram)
- ▶  AI models
- ▶  हर data point vector की तरह treat होता है





- ▶  5. Engineering 
- ▶  Examples:
- ▶  Bridge design
- ▶  Machine forces
- ▶  Structure analysis
- ▶  Engineers forces और motion को vectors से solve करते हैं





- ▶  6. Signal Processing 📡
- ▶  Examples:
- ▶  Mobile signals
- ▶  Audio processing
- ▶  TV signals
- ▶  Signals को vectors की तरह represent किया जाता है





- ▶  7. Economics & Statistics 
- ▶  Examples:
- ▶ Income, cost, profit data
- ▶ Graphs और analysis
- ▶  Multiple values को vector form में represent किया जाता है





# Unit:-4 linear transformatio



- ▶  Linear Transformation का Daily Life में उपयोग
- ▶  1. Computer Graphics 
- ▶  Idea: Image को change करना (transform करना)
- ▶  Examples:
- ▶  Rotation (घुमाना)
- ▶  Scaling (छोटा-बड़ा करना)
- ▶  Reflection (mirror image)
- ▶  Video games, animation, mobile apps में यही use होता है





- ▶  2. Image Processing 
- ▶  Examples:
- ▶ Photo edit करना
- ▶ Brightness/contrast change करना
- ▶ Filters लगाना
- ▶  ये सब linear transformations से होते हैं

- ▶  3. Engineering 
- ▶  Examples:
- ▶ Structure design
- ▶ मशीनों का motion analysis
- ▶ Signal conversion
- ▶  Input को output में बदलना → transformation

- ▶  4. Physics 
- ▶  Examples:
- ▶ Coordinate system change करना
- ▶ Motion को different axes में देखना
- ▶ Force transformation
- ▶  Vector को नए form में convert किया जाता है

- ▶  5. Data Science & AI 
- ▶  Examples:
- ▶ Data transformation
- ▶ Feature scaling
- ▶ Machine learning models
- ▶  Data को एक form से दूसरे form में बदलना

- ▶  6. Robotics 
- ▶  Examples:
- ▶ Robot arm movement
- ▶ Direction change
- ▶ Position control
- ▶  हर movement एक transformation होता है

- ▶  7. Economics & Statistics 
- ▶  Examples:
- ▶ Graph transformation
- ▶ Data normalization
- ▶ Trend analysis
- ▶  Data को समझने के लिए transform किया जाता है

**Thank you**

✿ LATE RAJA VIRENDRA BAHADUR SINGH COLLAGE

# MATHS ASSIGNMENT



SUBMITTED BY  
SHEKH IMROZ

GUIDED BY  
MR RAJKISHOR PATEL

# »»» INDEX

1. Group theorem
2. Finite fields
3. Vector space
4. Basic & dimensions
5. Linear transformation

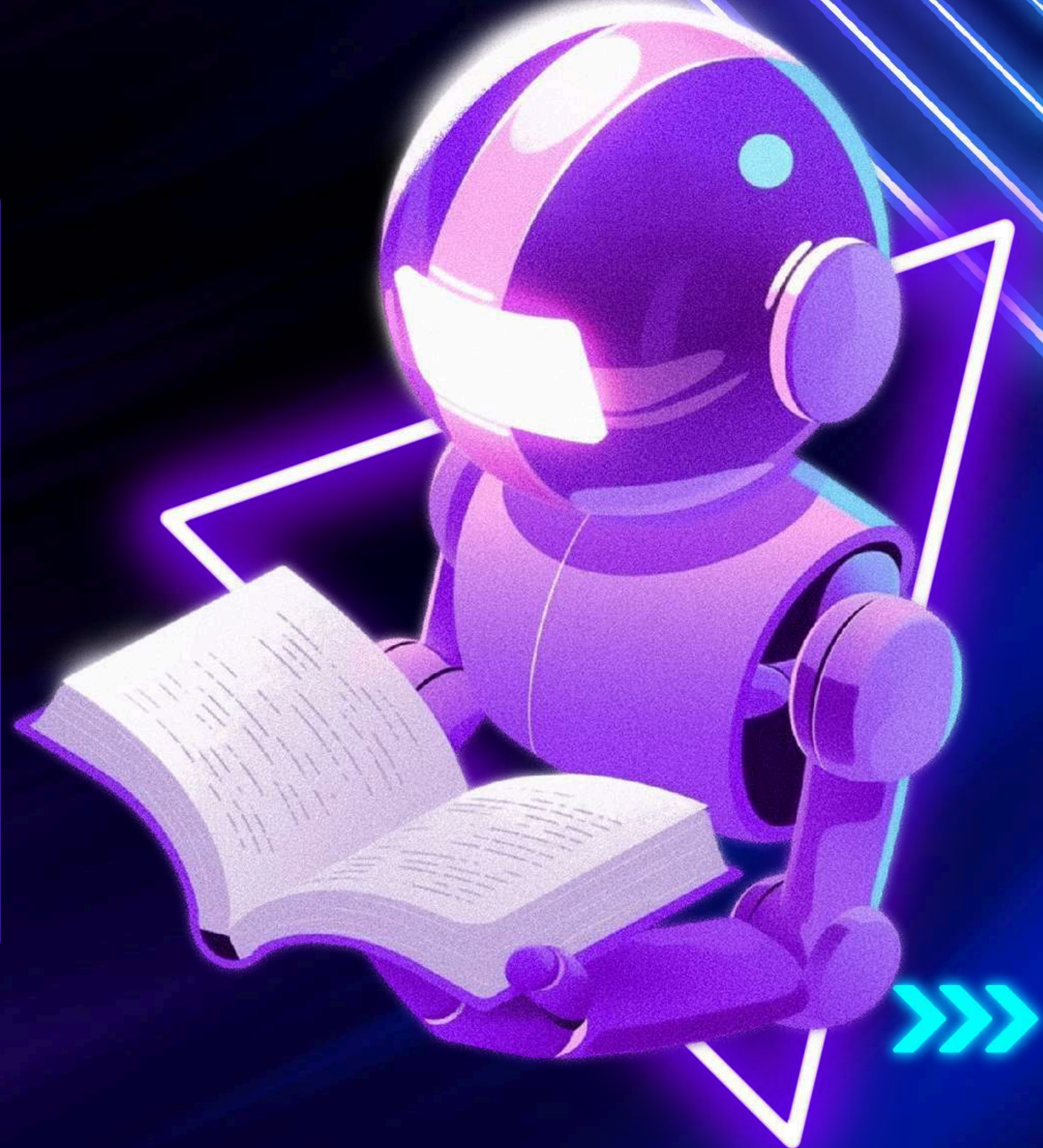


# UNIT 1

## Cryptography (Group Theory)

**Use 1: End-to-End Encryption:** WhatsApp messages ko secure karne ke liye Cyclic Groups aur Isomorphism ka use hota hai.

**Use 2: Digital Signatures:** Online banking mein password security ke liye Group Homomorphism mandatory hai.



## ➤ **Robotics & Symmetry (Permutation Groups)**

Use 1: Robot Movements: Robot ke joints aur movements ko Permutation Groups ke sequence se control kiya jata hai.

Use 2: Molecular Symmetry: Chemistry mein naye medicines banane ke liye molecules ki symmetry ko Group Theory se study karte hain.



# UNIT 2

## ► Data Recovery (Finite Fields)

Use 1: Error Correction: QR Codes aur scratched CDs se data recover karne ke liye Galois Fields ka math use hota hai.

Use 2: Satellite Communication: Space se aane wale signals mein "noise" hatane ke liye Field theory algorithms use hote hain.



# ➤ BLOCKCHAIN & CODING (RINGS & IDEALS)

Use 1: Cryptocurrency: Bitcoin aur Ethereum ki security Ring Theory aur Polynomial Rings par based hoti hai.

Use 2: Checksum Verification: Jab koi file download hoti hai, toh Quotient Rings verify karti hain ki data sahi hai ya corrupt.



# UNIT 3

## Image Processing (Vector Spaces)

Use 1: JPEG Compression: Hamari photos ka size kam karne ke liye unhe ek Vector Space se lower dimension mein transform kiya jata hai.

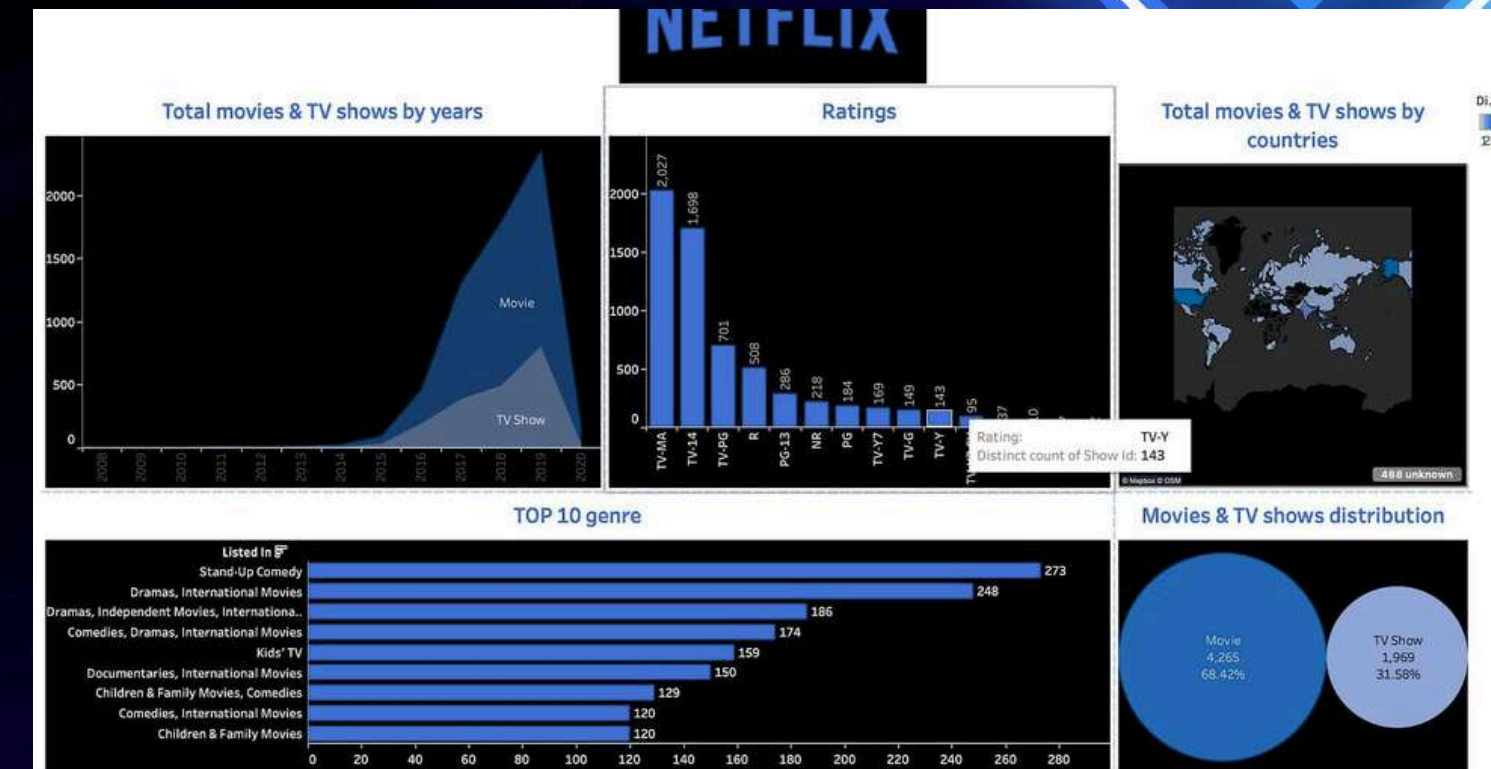
Use 2: Instagram Filters: Filters pixels ko Basis Vectors ki tarah treat karke unka color aur brightness change karte hain.



# SEARCH ENGINES (BASIS & DIMENSION)

Use 1: Google PageRank: Google internet ke billions of pages ko ek vishal Vector Space mein rank karta hai.

Use 2: Recommendation Engines: YouTube aur Netflix aapke interest ko vectors ki tarah calculate karke "Suggested Videos" dikhate hain.



# UNIT 4

## Gaming & CGI (Linear Transformation)

Use 1: 3D Game Physics: Characters ka move hona ya rotate hona Matrix Multiplication aur Linear Transformation hai.

Use 2: Movie Visual Effects: Marvel ya Avatar jaisi movies mein CGI characters ko real dikhane ke liye matrices ka use hota hai.



# AI & MEDICAL IMAGING (RANK-NULLITY)

Use 1: Face Recognition: Mobile face-unlock features images ka Rank calculate karke face identify karte hain.

Use 2: MRI/CT Scans: Doctors jab scan dekhte hain, toh computer raw data ko Linear Maps ke through image mein badalta hai.





**THANK  
YOU**



**LATE. RAJA VIRENDRA BAHADUR SINGH GOVT.  
COLLEGE, SARAIPALI**



**2025-26  
CLASS- B.Sc. 4<sup>th</sup> Sem  
SUBJECT:- MATHEMATICS**

**Guided by :-**

**Raj Kishor Patel sir**

**SUBMITTED BY:-  
CHITRA**

# Index

- 1) Isomorphism Theorem, Cyclic and Permutation groups.
- 2) Ring, Field and Integral Domain ,Ideals.
- 3) Vector Spaces.
- 4) Linear Transformation.

# Unit:-1 Isomorphism Theorems uses

## 1. प्रोग्रामिंग भाषा और टाइप थ्योरी

प्रथम आइसोमॉर्फिज्म प्रमेय यह दर्शाता है कि फंक्शन इनपुट को आउटपुट में कैसे मैप करते हैं; “कर्नेल” को अनदेखा किया जाता है, “इमेज” ही मायने रखती है। इसका उपयोग कार्यात्मक प्रोग्रामिंग भाषाओं (हास्केल, स्काला) में यह साबित करने के लिए किया जाता है कि दो अलग-अलग कोड संरचनाएं समान रूप से व्यवहार करती हैं।

## 2 इंजीनियरिंग में प्रणाली समतुल्यता

दो विद्युत परिपथ जो एक समान व्यवहार करते हैं, समरूपी कहलाते हैं - इंजीनियर इसका उपयोग जटिल परिपथों को सरल समतुल्य परिपथों से बदलने के लिए करते हैं।



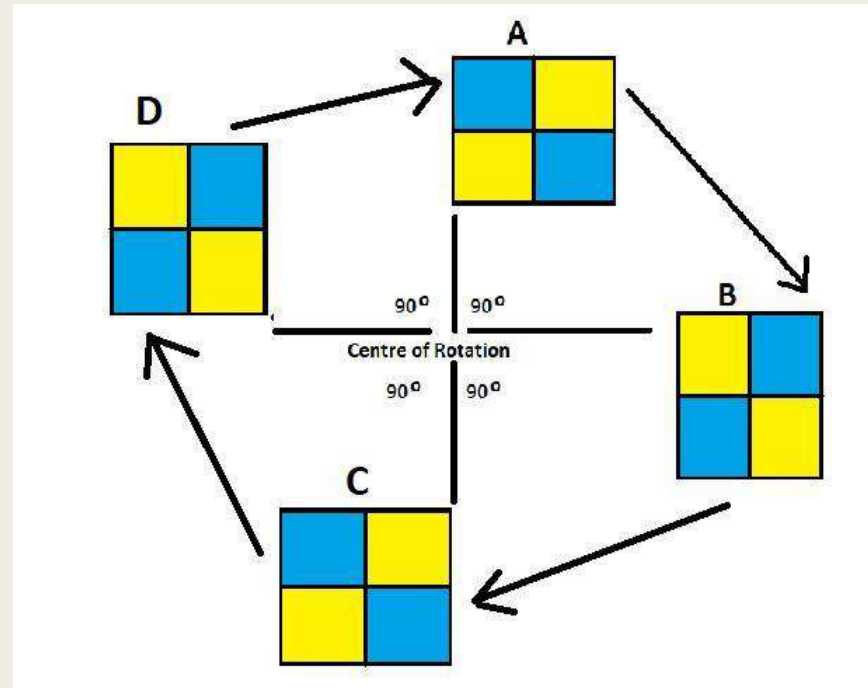
## 3. संरचनात्मक इंजीनियरिंग

द्वितीय समरूपता प्रमेय इमारतों और पुलों के जटिल समरूपता समूहों को प्रबंधनीय उपसमूहों में विभाजित करने में मदद करता है।


# चक्रीय समूह - वास्तविक जीवन में उपयोग

- घड़ी का समय (Clock Arithmetic/Modular System):  
12-घंटे या 24-घंटे की घड़ी एक फाइनाइट (finite) चक्रीय समूह का सबसे अच्छा उदाहरण है।  
उपयोग: समय की गणना करने में (जैसे- 10 बजे के 5 घंटे बाद 3 बजना:  $(10+5) \pmod{12}=3$ )।
- डिजिटल सुरक्षा और क्रिप्टोग्राफी (Cryptography):
- आधुनिक एन्क्रिप्शन तकनीकें, जैसे Diffie-Hellman Key Exchange, डेटा को सुरक्षित रखने के लिए चक्रीय समूहों का उपयोग करती हैं।
- ये समूह “डिस्क्रीट लॉग रिदम समस्या” (discrete logarithm problem) पर आधारित होते हैं, जिसे सुलझाना बहुत कठिन है, जिससे यह सुरक्षित हो जाता है।

- पैटर्न और घूर्णन (Patterns and Rotations)
- समरूपता (Symmetry): किसी भी वस्तु, जैसे कि एक पंखे की पंखड़ी या एक वर्ग, को एक निश्चित कोण पर घुमाने पर वह वापस अपनी मूल स्थिति में आ जाती है।
- बेल रिंगिंग (Bell Ringing): घंटियों को बजाने के पैटर्न जो बार-बार दोहराए जाते हैं, चक्रीय समूहों के क्रमपरिवर्तन (permutations) का उपयोग करते हैं।



# क्रमचय समूहों के वास्तविक जीवन में उपयोग

-  **पासवर्ड (Password) और सुरक्षा:** साइबर सुरक्षा और एन्क्रिप्शन में, पासवर्ड या पिन (PIN) का चयन अक्षरों और संख्याओं के विशिष्ट क्रमचय होते हैं। यह सुनिश्चित करता है कि डेटा सुरक्षित रहे।



- **पहेली और खेल (Puzzles & Games):** रूबिक क्यूब (Rubik's Cube) को हल करने के लिए क्रमचय समूहों के एल्गोरिदम का उपयोग किया जाता है।



- **संगीत (Music Theory):** संगीत के सुरों (scales) और रागों (chords) की व्यवस्था में समरूपता (symmetry) का अध्ययन।

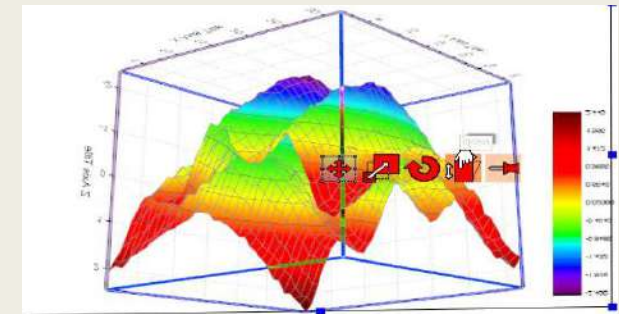
# Unit:-2 Ring, Field and Integral Domain, Ideals

- रिंग (Ring Theory) के उपयोग:
- डेटा सुरक्षा (Data Security): कंप्यूटर 0 और 1 (binary) पर काम करते हैं। रिंग थ्योरी का उपयोग बाइनरी स्ट्रिंग्स (binary strings) के साथ काम करने के लिए किया जाता है, जो डिजिटल संचार में डेटा को सुरक्षित रखने में मदद करता है।
- फील्ड (Field Theory) के उपयोग:
- क्रिप्टोग्राफी (Cryptography - सांकेतिक भाषा): जब आप इंटरनेट पर पासवर्ड डालते हैं या WhatsApp पर सुरक्षित संदेश भेजते हैं, तो एलिप्टिक कर्व क्रिप्टोग्राफी (Elliptic Curve Cryptography) और RSA जैसे एल्गोरिदम, फील्ड थ्योरी (विशेष रूप से फाइनाइट फील्ड्स) का उपयोग करते हैं।

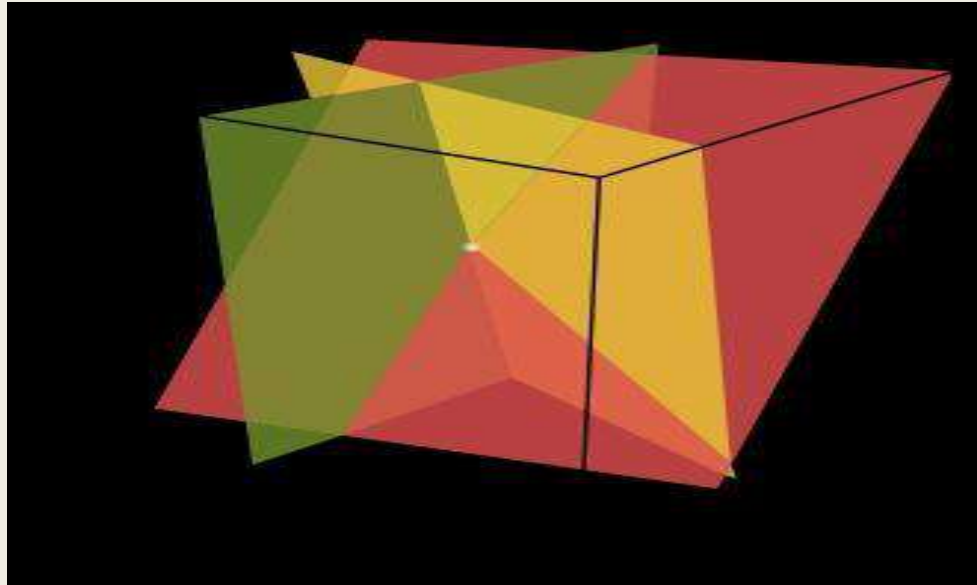
- इंटिग्रल डोमेन (Integral Domain) के उपयोग:
- संख्या सिद्धांत (Number Theory): इनका उपयोग पूर्णांकों (Integers) के गुणों का विश्लेषण करने के लिए किया जाता है, जो डिजिटल सिग्नेचर और ऑथेंटिकेशन (Authentication) में महत्वपूर्ण हैं।
- आइडियल्स (Ideals) के उपयोग:
- भागफल रिंग (Quotient Rings): आइडियल्स की मदद से बड़ी रिंग्स को छोटी, प्रबंधनीय रिंग्स (Quotient Rings) में तोड़ा जाता है, जो जटिल डेटा संरचनाओं को सरल बनाता है।

# Unit:-3 Vector Spaces uses

- भौतिकी (Physics) में: वेग (velocity), त्वरण (acceleration), विस्थापन (displacement), और बल (force) जैसी राशियों को दर्शाने के लिए, जिनमें परिमाण और दिशा दोनों होते हैं, सदिश स्थान का उपयोग किया जाता है [Source: Unacademy, Quora]।
- कंप्यूटर ग्राफिक्स और गेम्स: 3डी ऑब्जेक्ट, पोजीशन और ट्रांसफॉर्मेशन (रोटेशन, ट्रांसलेशन, स्केलिंग) की गणना वेक्टर स्पेस ऑपरेशंस का उपयोग करके की जाती है, अक्सर स्क्रिब्ड लीनियर ऑपरेटर तकनीकों के माध्यम से।

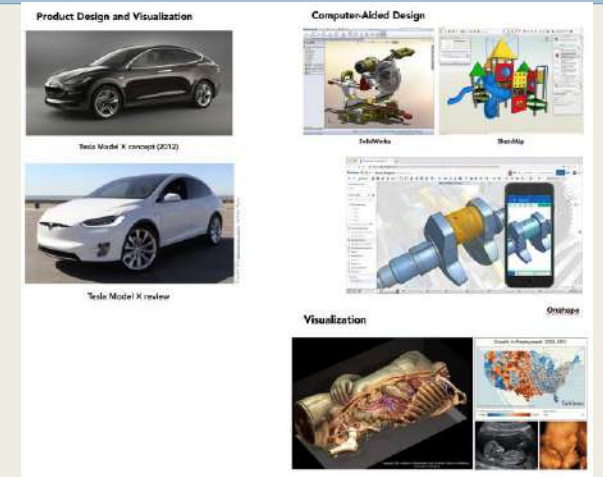


- रैखिक समीकरणों को हल करना: सदिश स्थान समीकरणों की प्रणालियों ( ) के समाधान खोजने के लिए ढांचा प्रदान करते हैं
- , जो समरूप समाधानों के लिए उप-स्थानों को परिभाषित करते हैं।

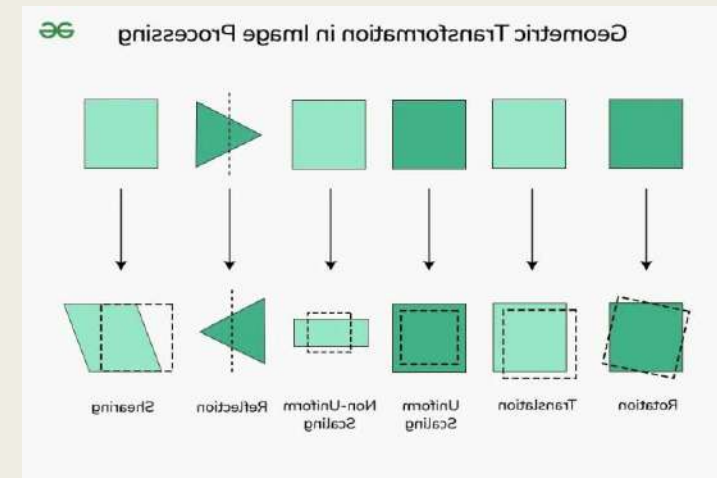


# Unit:-4 Linear Transformation uses

■ कंप्यूटर ग्राफिक्स और इमेज प्रोसेसिंग: इनका उपयोग 3D मॉडल को घुमाने, स्केल करने, शियर करने और 2D स्क्रीन पर प्रोजेक्ट करने के लिए किया जाता है।



■ ज्यामितीय रूपांतरण: 2D या 3D अंतरिक्ष में परावर्तन, अपरूपण और घूर्णन जैसी क्रियाओं का करना, जहां सीधी रेखाएं सीधी रहती हैं और मूल बिंदु स्थिर रहता है।



- डेटा विश्लेषण और मशीन लर्निंग: प्रिंसिपल कंपोनेंट एनालिसिस (पीसीए) डेटा की विमा को कम करने के लिए रैखिक रूपांतरणों पर निर्भर करता है।
- कर्नेल और छवि: मैट्रिक्स के शून्य स्थान (कर्नेल) और स्तंभ स्थान (छवि) का विश्लेषण यह निर्धारित करने में मदद करता है कि रूपांतरण स्थान को कैसे संपीड़ित या मैप करता है।
- सिस्टम मॉडलिंग: भौतिक व्यवहार को मॉडल करने के लिए डिफरेंशियल समीकरणों और नियंत्रण प्रणालियों में रैखिक ऑपरेटरों का उपयोग किया जाता है।

“Thank You”



Chandani Chouhan B.Sc 4rth semester

Guided by - Rajkishor Patel sir

**Bridging the gap  
between theory and  
technology**



# CONTENTS

01 Introduction to  
abstract algebra

02. Isomorphism  
theorem

03 cyclic group

04 Permutations

05 Vector Space



# Introduction to Abstract Algebra

- Beyond Arithmetic: Moving from solving for  $x$  to studying underlying structures.
- The Study of Sets and Operations: Defining the "rules of the game" for any system.
- The Power of Abstraction: Stripping away specific numbers to reveal universal patterns.





## Isomorphism Theorems (The Science of Mapping)

- Concept: Identifying when two seemingly different systems are structurally identical.

- Daily Use: Data Compression & File Formats.

- When you zip a file or convert a .wav to an .mp3, the Isomorphism

Theorems provide the framework to ensure the "essence" of the data

remains intact even if the "form" changes.

- Analogy: It's like translating a book into another language:



## Cyclic Groups (The Math of Repetition)

Concept: Groups generated by a single element that repeats in a fixed cycle.

- Application :-

- Digital Clocks: Timekeeping operates on "Modular Arithmetic,

" a fundamental cyclic group .

- Cryptography: The security of many "Public Key" systems relies on the difficulty of finding the generator in a large cyclic group.

- Music Theory: The Circle of Fifths is a perfect representation of a cyclic group



## Permutation Groups (The Math of Arrangement)



- Application :-
- Data Sorting: Sorting algorithms in your computer use permutation theory to organize files.
- Quantum Chemistry: Predicting the arrangement of electrons in atoms based on symmetry groups.
- Logistics: Optimizing delivery routes and assembly line sequences.



## Vector Spaces (The Math of Direction)

- Concept: Systems that allow for scaling and combining "arrows" or "data points."
- Application :
- Computer Vision: Facial recognition software treats your face as a collection of vectors in a high-dimensional space.
- Economic Modeling: Predicting market trends by treating different variables as dimensions in a vector space.

**Thank you**



# The Mathematics of Everyday Life

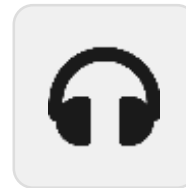
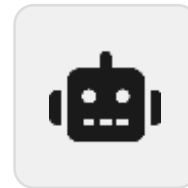
Real-World Applications of Semester IV Curriculum (Units I–IV)

---

**Presented by : Roshan Barik**

Guided by : Raj Kishor Patel Sir

Course : MASC-04 | Abstract Algebra | Semester IV



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Step 1

**Introduction**



Step 2

**Unit 01 — Groups & Isomorphisms**



Step 3

**Unit 02 — Rings & Fields**



Step 4

**Unit 03 — Vector Spaces**



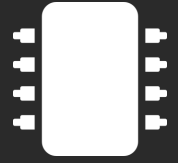
Step 5

**Unit 04 — Linear Transformations**

01

# Introduction

*Math Beyond The Blackboard*



# Mathematics: The Invisible Architecture of Daily Life

---

## The Common Misconception



Students often think topics like Isomorphisms or Vector Spaces are only for textbooks. They feel it has no use in real life.

## A Daily Experience



Face unlock (Linear Algebra), WhatsApp message (Group Theory), YouTube search (Vector Spaces) — all use Semester IV math.

## The Reality



This math is the engine behind WhatsApp encryption, Google Search, Spotify songs and robot arms in factories.

## The Goal of This Presentation



To show exactly where each unit of our syllabus appears in real daily life — from clocks to computer chips.

# 02

## UNIT - 01

*Groups & Isomorphisms — The Science of Symmetry*

---



Modern Cryptography



The Math Clock

# Modern Cryptography: WhatsApp & Banking

## Topic

### Cyclic Groups and Finite Groups

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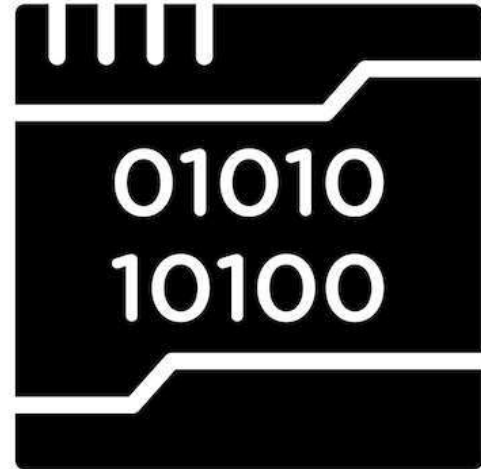
## Application

### End-to-End Encryption

---

## Explanation

When you send a message on WhatsApp, it gets locked using group theory. It creates a 'one-way' math function — easy to lock, very hard to break. Only the receiver can open it. Your UPI payment and net banking also use the same idea.



# The Math Clock: Modular Arithmetic

Topic

**Cosets and Lagrange's Theorem**

Application

**Timekeeping and Scheduling**

Explanation

Our 12-hour clock is a cyclic group. After 12, it starts from 1 again — that is group theory. If today is Monday and your exam is after 10 days, you can find the day using the same 'clock math'. Even train and bus schedules work this way.



# 03

## UNIT - 02

*Rings & Fields — The Science of Data Integrity*

---



QR Codes & Scratched CDs



Computer Hardware & Logic Gates

# QR Codes & Scratched CDs

## Topic

### Polynomial Rings — Reed-Solomon Codes

---

## Application

### Error Correction in QR Codes and CDs

---

## Explanation

When a QR code is dirty or partly torn, it still works. Polynomial rings are used to fill in the missing data. The same math helps a scratched CD still play music without skipping — the missing sound is calculated and filled in automatically.



# Computer Hardware & Logic Gates

Topic

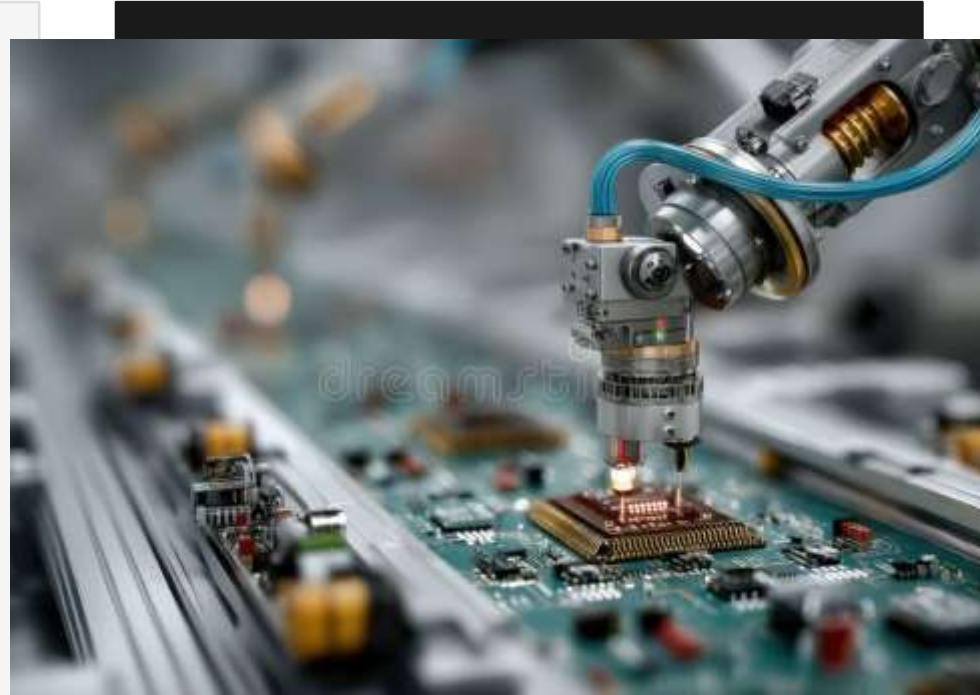
**Fields — Binary Field  $\{0, 1\}$**

Application

**Microchip Design**

Explanation

Every computer chip — phone, laptop, calculator — works on just two values: 0 and 1. This is the simplest field in mathematics. AND, OR, NOT gates are all field operations. Without ring and field theory, no computer chip could be designed.



*Microchip Design*

# 04

## UNIT - 03

*Vector Spaces — The Science of Data Representation*

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Google Search & Digital Imaging



Spotify & Noise-Cancelling Headphones

# Google Search & Digital Imaging

## Topic

### **Basis, Dimension and Subspaces**

---

## Application

### **Search Engines and Screen Colors**

---

## Explanation

Google stores every webpage as a vector. When you search something, it finds the 'closest' vector to your query. Also, every color on your screen is made by mixing Red, Green and Blue — three basis vectors of color space. That is why it is called RGB.



*Search Engines and Screen Colors*

# Spotify & Noise-Cancelling Headphones

## Topic

### Vector Subspaces and Linear Span

---

## Application

### Music Recommendation and Sound Cancellation

---

## Explanation

Spotify saves your music taste as a vector. It then finds songs that are 'mathematically close' to your taste in a Song Space. Noise-cancelling headphones detect outside sound as a vector and create an opposite vector to cancel it. This is all vector space math.



*Music Recommendation and Sound Cancellation*

05

# UNIT - 04

*Linear Transformations — The Science of Motion*

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Computer Animation



Robotics & Automated Factories

# Computer Animation: 3D Games & Movies

## Topic

### Linear Transformations and Matrices

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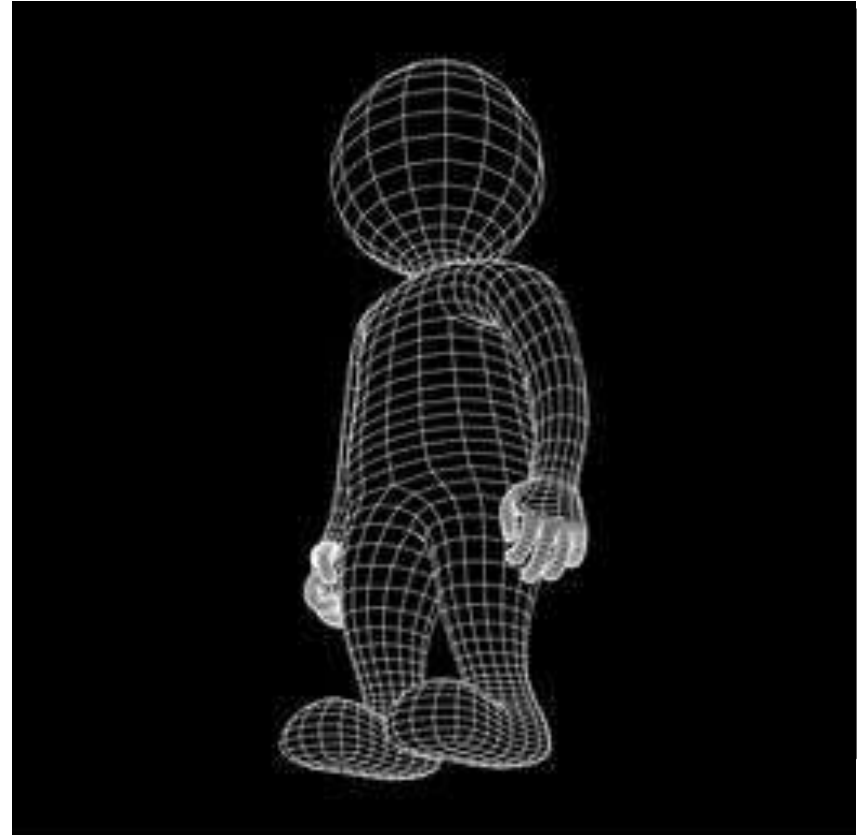
## Application

### 3D Character Movement

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## Explanation

In games like BGMI or Free Fire, when your character runs, jumps or turns — all of that movement is done by linear transformations. The character's position is a vector, and the transformation moves it to a new position. Pixar and Disney movies also use the same math.



# Robotics & Automated Factories

Topic

**Rank-Nullity Theorem and Transformation Matrices**

Application

**Robotic Arm Precision**

Explanation

In car factories, robot arms weld and paint exactly without any human help. To move the arm to the right spot, the computer solves a system of linear transformations. Even the camera in your phone adjusts its angle using linear transformation math.



# Thank You

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*"Pure Mathematics is, in its way, the poetry of logical ideas."*

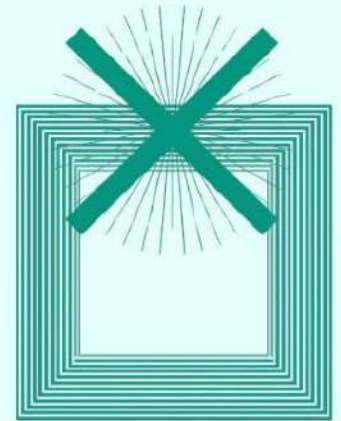
— Albert Einstein

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# DAILY LIFE USES OF

1. Isomerism theorems cyclic and permutation groups
2. Rings field integral domain ideas
3. Vector spaces
4. Linear transformation



---

Presented by : SAKSHI KHUTIYA.  
guided by : RAJ KISHOR SIR.

# INTRODUCTION TO KEY MATHEMATICAL IDEAS

This presentation explores powerful abstract mathematical structures that quietly shape our daily lives:

- Isomerism Theorems: Explain how molecules with identical formulas can have different arrangements and properties
- Cyclic & Permutation Groups: Describe symmetry operations and ordered arrangements fundamental to patterns
- Rings, Fields & Integral Domains: Algebraic structures enabling consistent arithmetic operations in technology
- Vector Spaces: Collections of objects that can be scaled and combined, essential for graphics
- Linear Transformations: Functions preserving structure while mapping between spaces

These concepts matter because they provide the mathematical foundation for pharmaceuticals, cryptography, computer graphics, AI, and communication systems we use every day.



# ISOMERISM THEOREMS IN DAILY LIFE

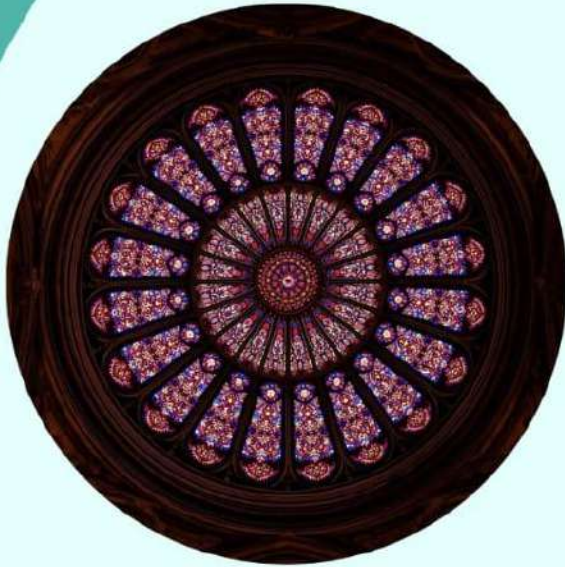
Isomerism in chemistry refers to molecules sharing the same molecular formula but arranged differently in space. This seemingly subtle distinction has profound real-world implications.

In pharmaceuticals, isomers can produce dramatically different effects. Thalidomide's tragic history illustrates this: one isomer treated morning sickness while its mirror image caused birth defects.

Food chemistry relies on isomerism too. The difference between natural and artificial sweeteners often comes down to molecular arrangement. Understanding isomerism helps chemists design safer, more effective compounds for medicine and nutrition.



# CYCLIC AND PERMUTATION GROUPS AROUND US



- Symmetry in Art & Architecture: Cyclic groups describe rotational symmetry in mandalas, rose windows, and geometric tile patterns found in buildings worldwide.
- Cryptography & Security: Permutation groups form the mathematical backbone of encryption algorithms that protect your passwords and online transactions.
- Task Organization: Permutation patterns help optimize scheduling, from arranging work shifts to planning efficient delivery routes.


# RINGS, FIELDS, AND INTEGRAL DOMAINS IN TECHNOLOGY

These algebraic structures form the backbone of modern digital technology. Rings and fields are essential in coding theory, enabling error correction codes that ensure your text messages and streaming videos arrive intact. Integral domains guarantee unique factorization, crucial for cryptographic algorithms protecting online banking. Fields underpin Reed-Solomon codes used in CDs, DVDs, and QR codes. Every time you scan a barcode or send an email, these abstract mathematical structures work invisibly to maintain data integrity and secure communications.






## VECTOR SPACES IN EVERYDAY TECHNOLOGY



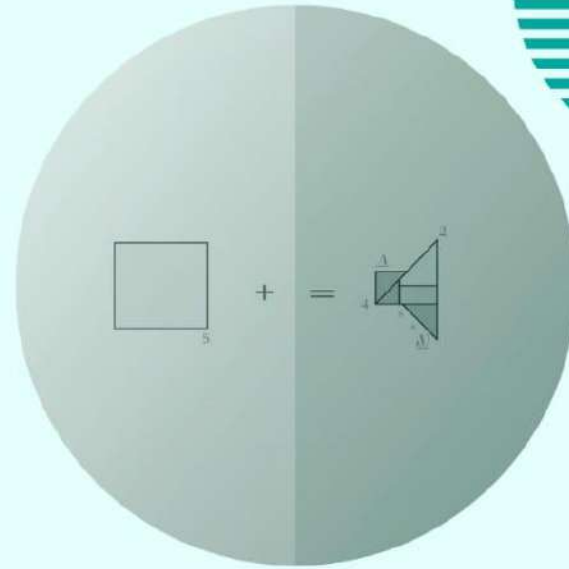
Vector spaces form the mathematical foundation of the digital worlds we interact with daily. In computer graphics, vectors define positions, directions, and transformations that render 3D objects on screen. Animation studios use vector space operations to create smooth character movements and realistic physics simulations. Video games rely on vector calculations for everything from camera angles to collision detection. Every pixel you see in a rendered image is the result of vector space mathematics working behind the scenes.



# LINEAR TRANSFORMATIONS SIMPLIFY COMPLEX PROBLEMS

Linear transformations are the mathematical backbone of modern image processing and data compression. When you compress a photo, stream video, or apply filters to images, linear transformations work behind the scenes to efficiently manipulate data while preserving essential information.

These operations transform complex visual data into manageable forms, enabling faster transmission and storage without significant quality loss. From JPEG compression to real-time video encoding, linear algebra makes our digital world possible.





## APPLYING LINEAR ALGEBRA

- Facial Recognition: Eigenfaces use linear transformations to identify unique facial features, enabling secure device unlocking and photo organization
- GPS Navigation: Vector calculations determine precise positions and optimal routes, guiding millions of travelers daily
- Robotics & Motion Control: Linear algebra powers robotic arm movements, autonomous vehicles, and industrial automation systems

# COMPARING ABSTRACT MATH CONCEPTS AND THEIR DAILY ROLES



Isomerism → Pharmaceuticals & Food Science

Different molecular arrangements create distinct drug effects and flavors.

Group Theory → Symmetry & Security

Cyclic groups define artistic patterns; permutations protect passwords.

Rings & Fields → Communication Technology

Error correction codes ensure reliable digital transmission.

Vector Spaces → Computer Graphics

Enable 3D modeling, animation, and virtual world creation.

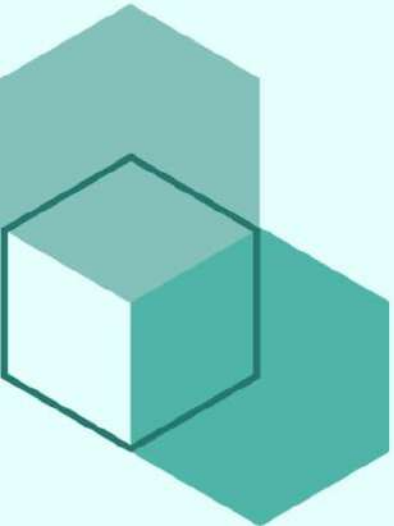
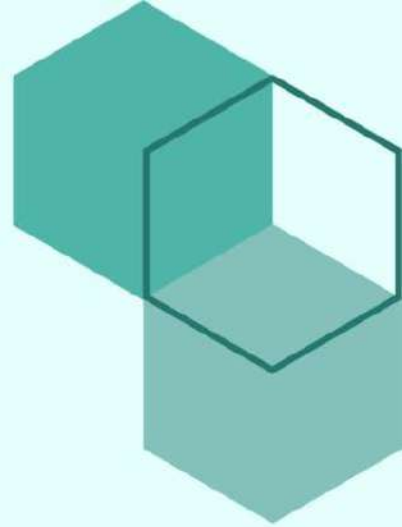
Linear Transformations → AI & Image Processing

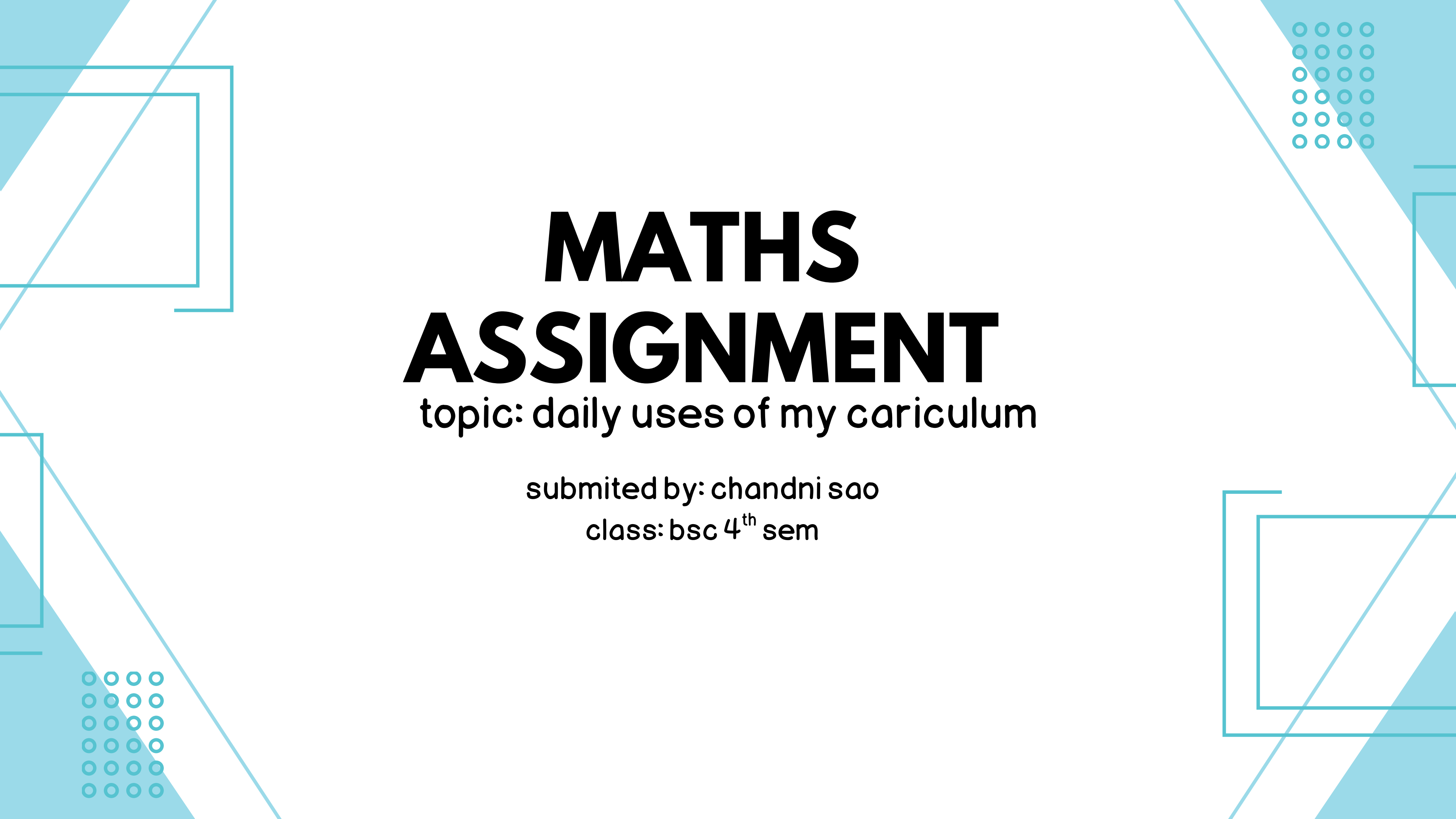
Power facial recognition, data compression, and machine learning.





THANK  
YOU





# **MATHS**

# **ASSIGNMENT**

topic: daily uses of my cariculum

submitted by: chandni sao  
class: bsc 4<sup>th</sup> sem

# CONTENT

1. isomorphism theorem ,cyclic and permutation group
2. ring,field and integral domain , idea:
3. vector space
4. linear transformatin

# USE OF ISOMORPHISM

- **Data compression & Encryption**: Mapping complex data into simpler structure without losing information.
- **pattern matching**: used in computer vision to recognize that two different -looking shapes are structurally the same.
- **chemical databases**: identifying identical molecular structure regardless of how they are drawn

# USES OF CYCLIC GROUP

- **Timekeeping**: the 12 - hour clock and 7-day week reset to 1 after reaching their limit (modular arithmetic)
- **Music** : the 12- tone scale (octaves) where notes repeat in a fixed , circular patterns.
- **power grids** : three phase electric power cycles through phases to maintain a steady flow of energy.

# PERMUTATION GROUP

- **Digital security**: password and PINs, where the specific order of the same characters creates a unique identity.
- **Scheduling**: Organizing flight paths or delivery routes to find the most efficient sequence.
- **Gaming** : Shuffling cards or solving a rubics cube , which are essentially exercises in manipulating permutation groups.

# RING, FIELAD

- **Cryptography**: modern encryption (like AES) treats data as elements of a ring to scramble sensitive info.
- **3D Graphic**: matrix ring allows computers to calculate rotations and lighting in video game and movies.
- **Qr codes**: use “finite fields” to build in error correction, allowing the code to be read even if it’s dirty or torn.
- **satellite TV**: corrects “noise” in he signal during storms using reed.

# USES OF VECTOR SPACE

- **GPS & Mapping**: calculating your precise position , direction, and speed relative to a destination.
- **structural engineering**:balancing competing forces (gravity,wind , tension) to ensure buildings and bridges remain stable.
- **AI & Facial Recognition** : mapping facial landmarks (distance between eyes, nose shape ) in to a coordinate system to identify individuals.

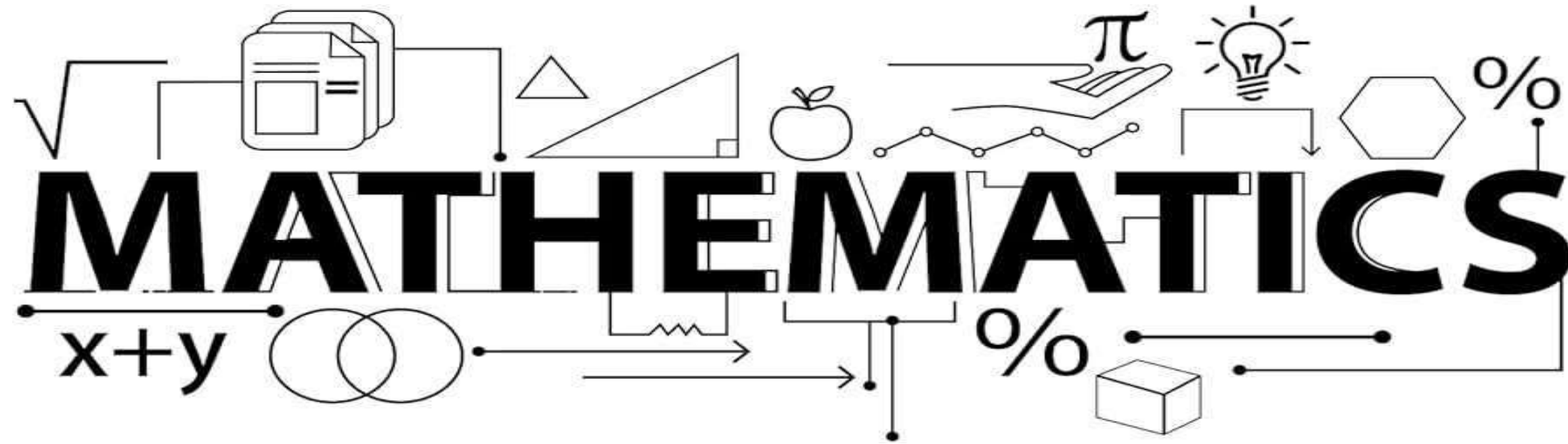
# LINEAR TRANSFORMATION

- **Digital photos** : scaling (resizing), rotating , and flipping images .
- **Search engines**: organizing and ranking web pages based on relevance using vector - based algorithms.
- **Audio processing** : adjusting volume or applying equalizers to music files.
- **Social media filters**: applying effects that distort or adjust facial features in real time

**THANK YOU**

# ABSTRACT ALGEBRA

Daily Uses of My Curriculum: Units I to IV



SUBMITTED BY : ARMAN SINGH

GUIDED BY: Mr. RAJ KISHORE PATEL SIR

B.Sc 4TH SEMESTER - DSC - MATHS

# Unit I

## – Daily Uses of Isomorphism Theorems and Groups

### Daily life uses of isomorphism theorems

#### 🖥️ 1. Data Representation

Same data can be written in binary, decimal, or hexadecimal

Structure and operations remain the same

Helps in easy conversion and processing in computers

#### 💰 2. Currency Systems

Different currencies follow same arithmetic rules

Exchange rates map one system to another

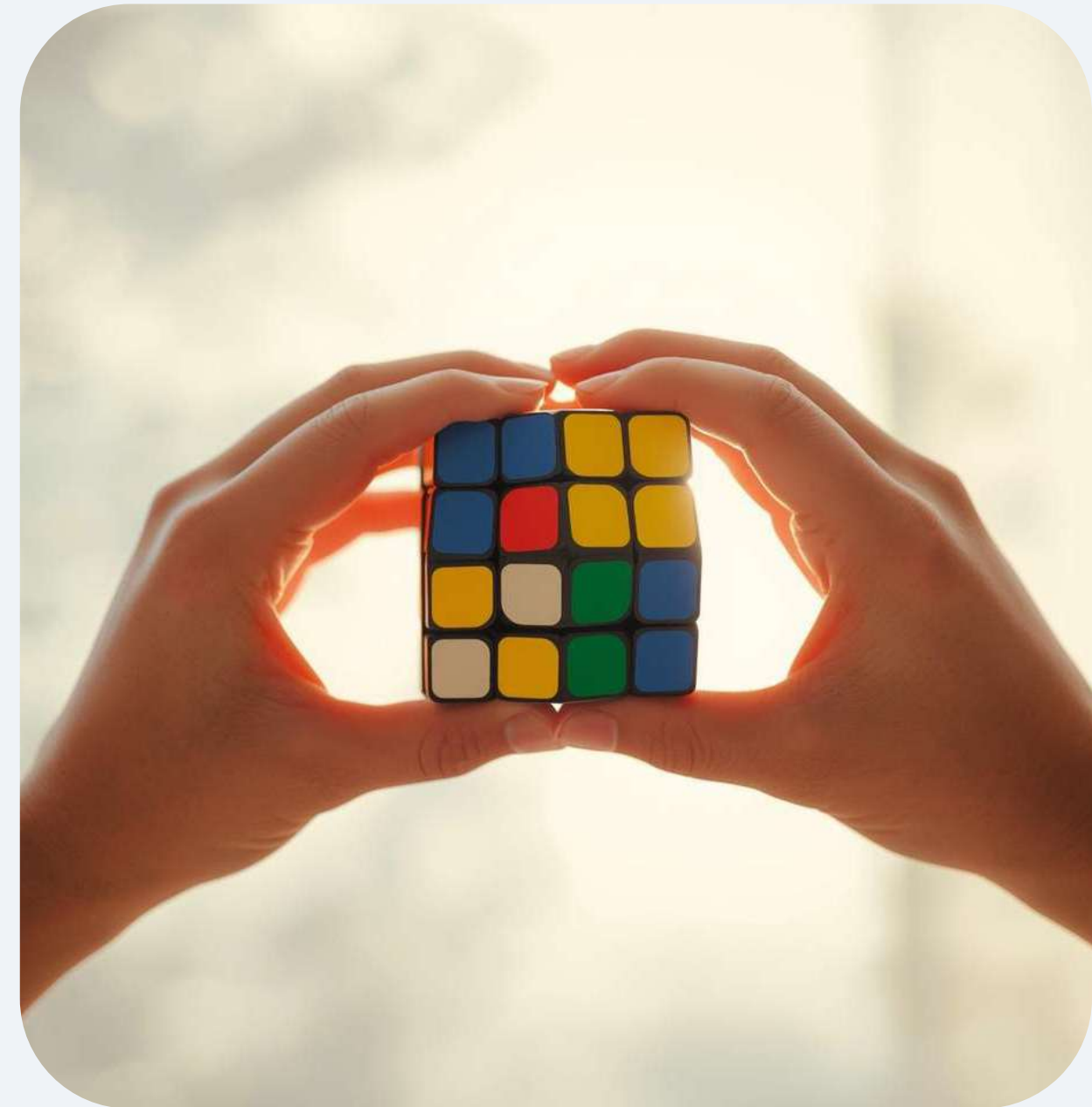
Makes international trade and comparison easier

#### 📍 3. Maps and Navigation

Maps preserve structure of real-world locations

Distances and connections remain consistent

Helps in accurate GPS navigation



# Unit I

## – Daily life uses Isomorphism Theorems and Groups

### Topic:- Daily life uses of group theory

Our 12-hour and 24-hour clocks are "Additive Groups" modulo Even planning weekly schedule is an application of Group Theory.

### Clock System

Time follows a cycle (mod 12 or 24) After 12  $\rightarrow$  comes back to 1  
☞ Used in: Watches Time calculations 📅 Weekly Routine  
Days repeat every 7 days Your study, gym,

### Topic: Cyclic Groups and Finite Groups.

### Application: End-to-end encryption.

Every arrangement of digits is a permutation Security depends on number of permutations

☞ Example:

1. 4-digit PIN  $\rightarrow 10^4$  combinations
2. Seating Arrangements ?
3. Shuffling Cards 🃏
4. Sorting Algorithms 🖥️



# Unit II

## – Daily Uses of Rings, Fields, and Integral Domains



### Daily Life Uses of Rings:

#### 1. Digital Systems & Computers

Integers used in computers form a ring  
Operations like addition and multiplication follow ring rules

☞ Example:

Memory calculations

Address computations

#### 2. Modular Arithmetic (Remainder system)

Used in clocks, coding, and calculations

Example: mod 10 (digits), mod 12 (clock)

☞ Used in:

OTP systems

Cyclic counters

# Unit II

## – Daily Uses of Rings, Fields, and Integral Domains

### Daily Life Uses of Fields:

#### 1. Finance & Calculations 💰

Real numbers (a field) used in:

Interest calculation

Profit/loss

Investments

👉 Without division, finance wouldn't work properly

#### 2. Physics & Engineering ⚙️

Measurements (speed, force, voltage) use real numbers

Calculations require division

#### 3. Computer Graphics 🎮

2D/3D graphics use fields (real numbers)

Used in:

Animation

Game physics

Rendering



# Unit III

## – Daily Uses of Vector Spaces

### 📍 1. Navigation & Maps

Direction + distance = vector

GPS uses vectors to track movement

👉 Example:

“Go 5 km north, then 3 km east”

= vector addition

### ✈️ 2. Airplanes & Wind Direction

Plane direction + wind direction = final path

👉 Pilots use vector addition to adjust routes

### 🎧 3. Sound & Music Processing

Audio signals are vectors

Used in:

Noise reduction

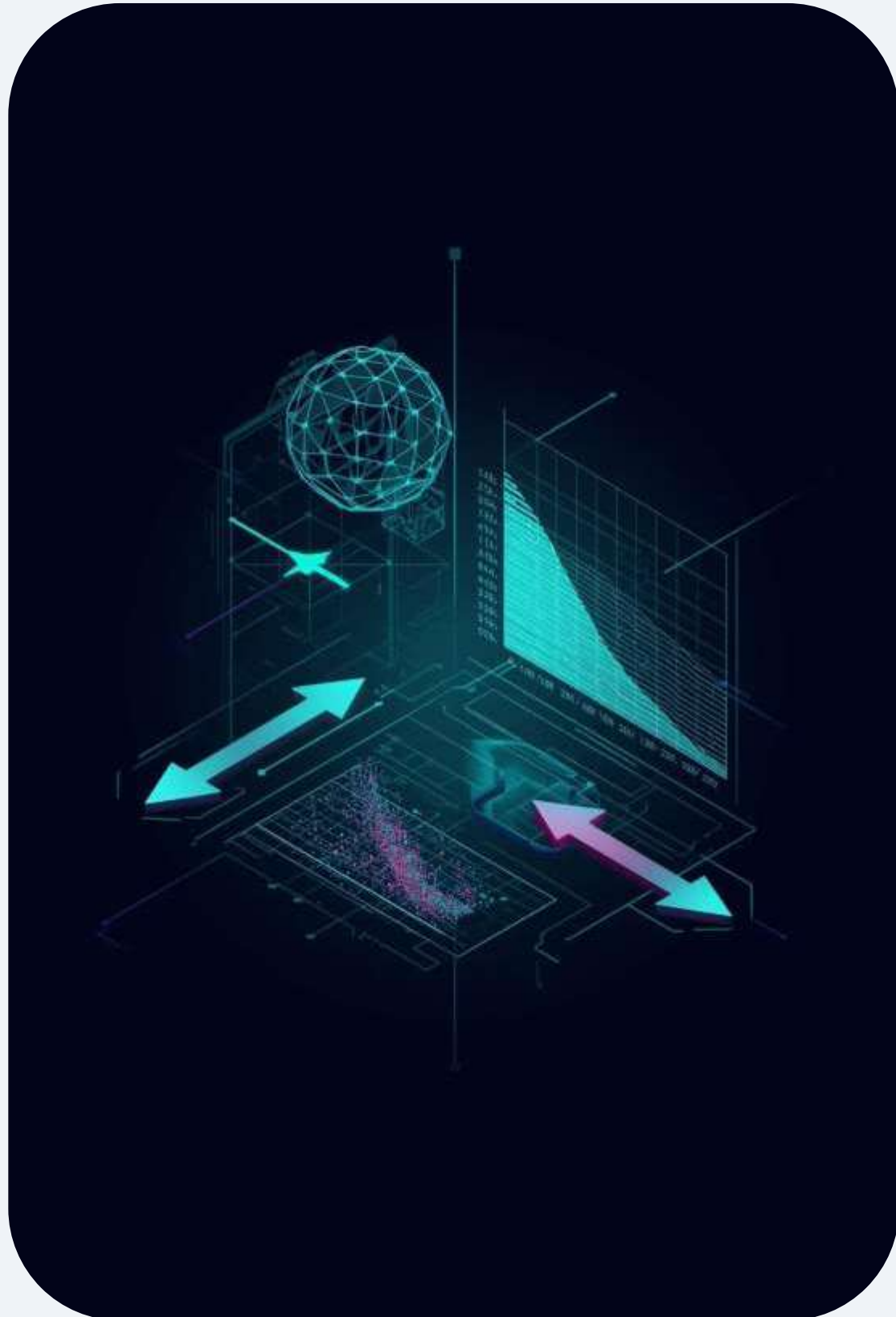
Equalizers

👉 Your earphones improve sound using vector math



# Unit III

## – Daily Uses of Vector Spaces



### 4. Electricity & Physics

Voltage, force, velocity = vectors

Engineers use vector spaces to solve circuits

### 5. Data & Statistics

Each data point = vector

Used in:

Graphs

Predictions

Analysis

### 6. Driving & Motion

Speed + direction = velocity vector

Turning = changing vector direction

# Unit IV

## – Daily Uses of Linear Transformations

### 1. Games & Animation

Objects are moved, rotated, scaled using transformations

 Used for:

Character movement

Camera rotation

Zoom in/out

 Example:

Rotating a character = rotation transformation

Increasing size = scaling

### 2. Image Editing & Filters

Images are transformed using matrices

 Used in apps like:

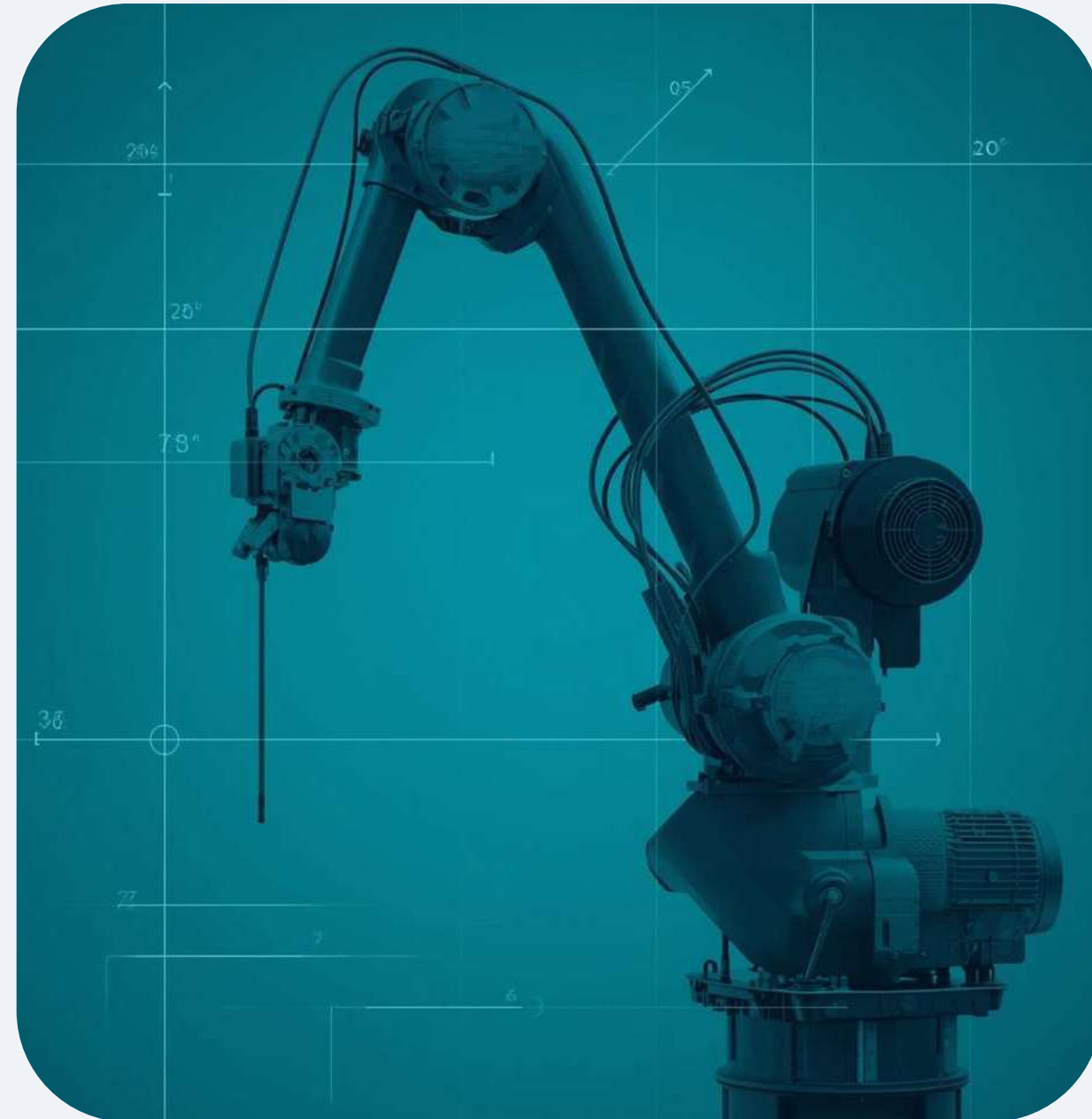
Photoshop

Snapchat



# Unit IV

## – Daily Uses of Linear Transformations



### 3. Maps & GPS Systems

Real-world locations → map coordinates

☞ Transformations help:

Convert 3D Earth → 2D map

Adjust scale and orientation

### 4. Machine Learning & AI

Data is transformed to extract features

☞ Used in:

Face recognition

Recommendation systems

### 5. Sound & Signal Processing

Audio signals transformed for clarity

☞ Used in:

Noise reduction

Equalizers

Voice enhancement

# Summary of Daily Uses Across Units I-IV

## GROUP THEORY

Symmetry in art and architecture, encryption for secure communication, and scheduling problems using permutation groups.

## RING & FIELD THEORY

Digital error detection and correction, encryption for mobile and internet security, and reliable banking transactions.

## VECTOR SPACES

Modeling physical forces and velocities, data science representations, and audio signal processing applications.

## LINEAR TRANSFORMATIONS

Image manipulation in computer graphics, robotics coordinate systems, and machine learning feature transformations.

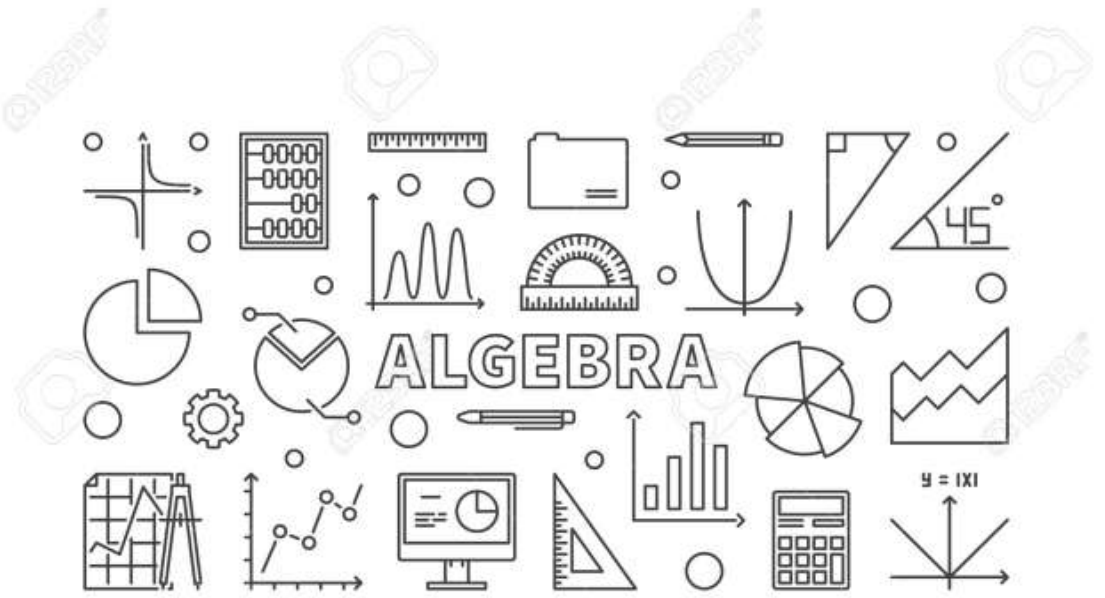
# Thank --- You

SUBMITTED BY : ARMAN SINGH



# Bridging the Gap Between Theory and Technology

## Applications of Abstract Algebra



Name - Vijay Patel

Class:- BSC 4th Semester

Guided by:- Raj Kishor Patel Sir

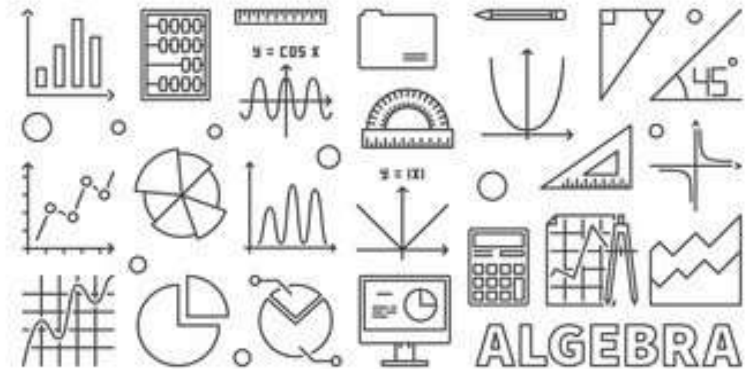
# Contents

01	Introduction to abstract algebra	05	Rings
02	Isomorphism theorem	06	Fields
03	Cyclic group	07	Vector Space
04	Permutations group	08	Linear Transformation



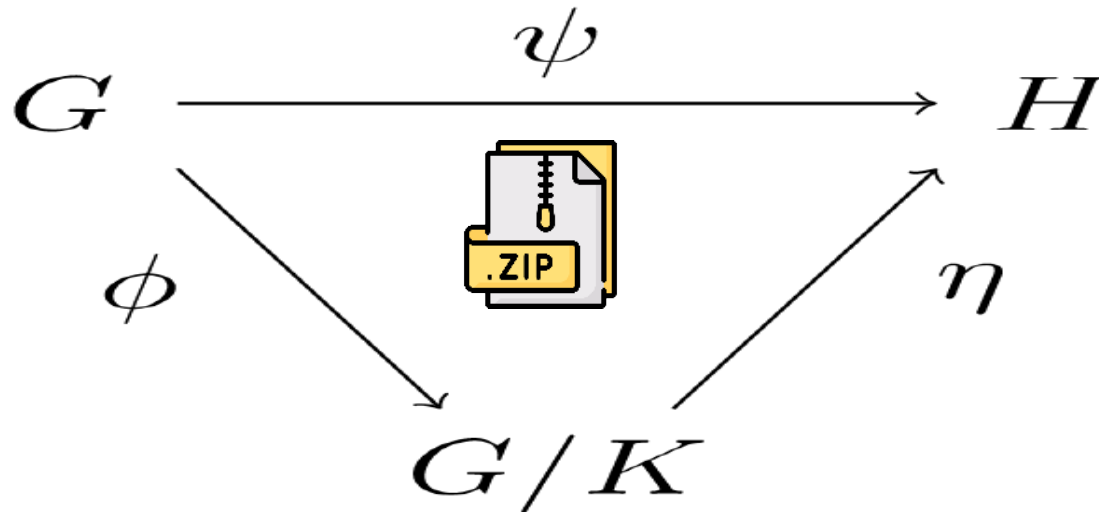
# Introduction to Abstract Algebra

- Beyond Arithmetic: Moving from solving for  $x$  to studying underlying structures.
- The Study of Sets and Operations: Defining the "rules of the game" for any system.
- The Power of Abstraction: Stripping away specific numbers to reveal universal patterns.
- The Blueprint of Science: Providing the mathematical language for physics, chemistry, and computing.



# 1) Isomorphism Theorems (The Science of Mapping)

- Concept: Identifying when two seemingly different systems are structurally identical.
- Daily Use: Data Compression & File Formats.



- When you zip a file or convert a .wav to an .mp3, the Isomorphism Theorems provide the framework to ensure the "essence" of the data remains intact even if the "form" changes.
- Analogy: It's like translating a book into another language; the words change, but the story (the structure) remains exactly the same.

## 2) Cyclic Groups (The Math of Repetition)

---

- Concept: Groups generated by a single element that repeats in a fixed cycle.

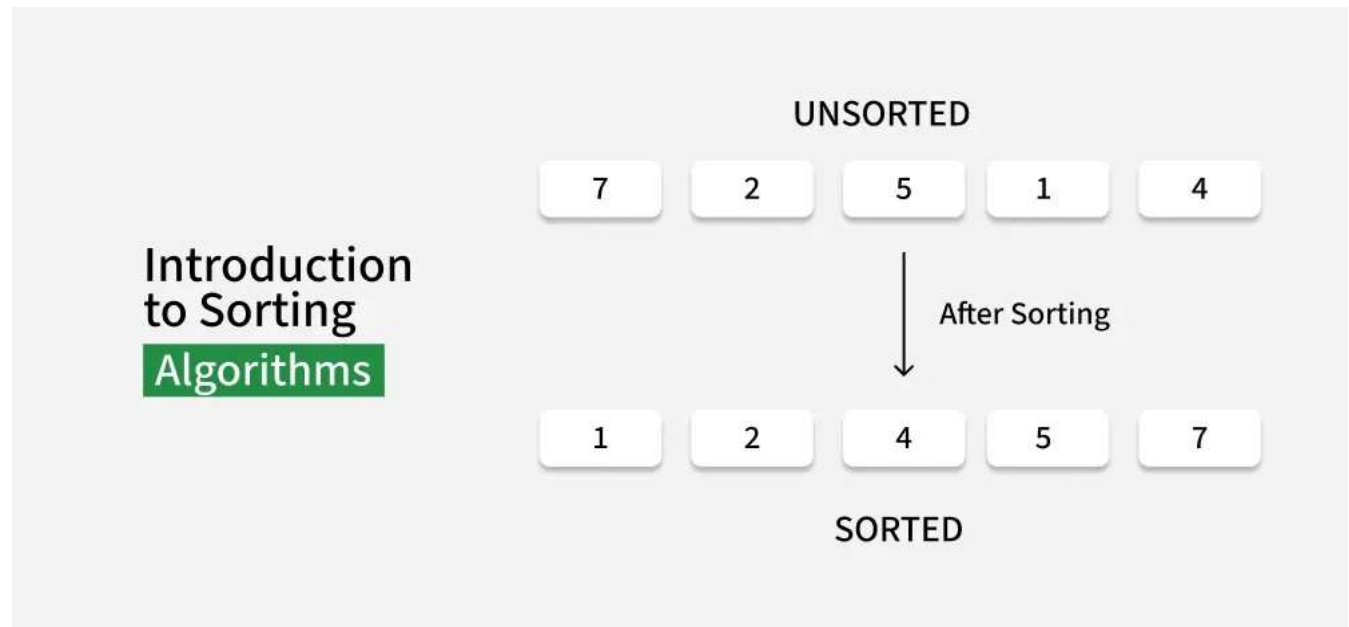


- Application :-
- Digital Clocks: Timekeeping operates on "Modular Arithmetic," a fundamental cyclic group .
- Cryptography: The security of many "Public Key" systems relies on the difficulty of finding the generator in a large cyclic group.
- Music Theory: The Circle of Fifths is a perfect representation of a cyclic group

# 3) Permutation Groups (The Math of Arrangement)

---

- Concept: Focused on the different ways to rearrange a set of objects.



- Application :-
- Data Sorting: Sorting algorithms in your computer use permutation theory to organize files.
- Quantum Chemistry: Predicting the arrangement of electrons in atoms based on symmetry groups.
- Logistics: Optimizing delivery routes and assembly line sequences.

## 4) Rings (The Math of Arithmetic)

- Concept: Structures that allow both addition and multiplication (like the set of Integers).
- Application:-
- Polynomials in Coding: Polynomial rings are used to create the error-correction codes in your Wi-Fi signal.
- Digital Signal Processing: Filtering out background noise in phone calls using ring-based algorithms.
- Rings allow us to perform "algebra" on objects that aren't just simple numbers.

## 5) Fields (The Math of Precision)

- Concept: A ring where every non-zero element has a multiplicative inverse (allowing for division).
- Application :Finite Fields (Galois Fields): The backbone of the AES (Advanced Encryption Standard) that protects your passwords.
- QR Codes: Uses Field theory to ensure the code can be read even if 30% of it is damaged.

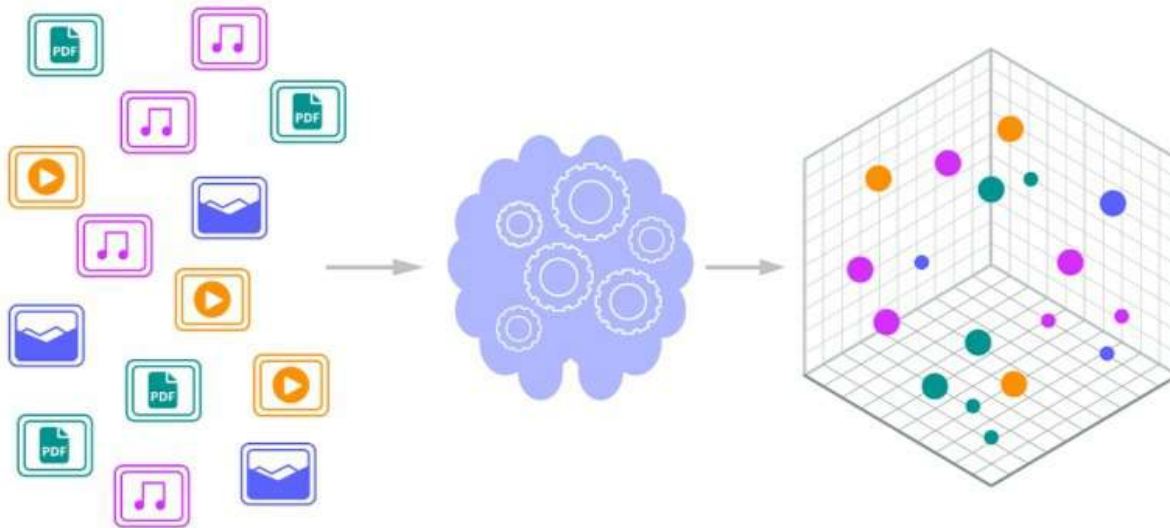


- Real-World Impact: Without Fields, secure online shopping would be impossible.

# 6) Vector Spaces (The Math of Direction)

---

- Concept: Systems that allow for scaling and combining "arrows" or "data points."
- Application :
- Computer Vision: Facial recognition software treats your face as a collection of vectors in a high-dimensional space.
- Economic Modeling: Predicting market trends by treating different variables as dimensions in a vector space.
- Physics: Calculating the forces on a bridge or the flight path of an airplane.



## 7) Linear Transformations (The Logic of Change)

---

- Concept: Functions that move vectors from one space to another while keeping lines straight.
- Application :
- Image Editing (Instagram Filters)
- When you brighten a photo or change its hue, you are applying a linear transformation to the pixel vectors.
- Facial Recognition. Your face is mapped as a set of vectors; the computer "rotates" and "scales" that map to match it against a database.

# Abstract Algebra is not "Abstract"

It is the concrete foundation of  
our digital lives.

Thank  
you



This presentation outline  
bridge the gap between  
abstract algebra and the  
real world.

Name:- Babli Behera

Class:- BSC 4<sup>th</sup> Semester

Guided by:- Raj Kishor Patel Sir

## Introduction:-

The Big Idea:- Abstract Algebra isn't just symbols on a chalkboard, it is the "logic of structure" that governs our digital and physical world.

### Core concepts

- Symmetry (group)
- Data encoding (rings)
- Space and movement (vector space)
- Linear transformations

# Unit:-1

## Cyclic Groups:- The math of cycle

**Definition:-**A group generated by a single element where operation eventually repeat.

**Daily lifes Uses:-**

- 1. Time keeping:-** Clock operate on modular arithmetic (a cyclic groups).
- 2. Music:-** The 12-tone scale in western music is a cyclic groups. Shifting a song to a different key is essentially a group operation.
- 3. Scheduling:-** Employee shift rotations and round-robin tournament brackets.

# Group homomorphism and isomorphism:-

**The concept:-**

**Homomorphism:-**A structure preserving map between two groups.

**Isomorphism:-** A perfect 1 to 1 correspondence where two different looking system are actually identical in behaviour.

## Daily life uses of group homomorphism and isomorphism

- **Digital Audio:-** When you press a key on a digital piano, the physical movement is mapped to a digital frequency.
- **Encryption:-** Converting a plain text message into a scrambled code. If the decryption works perfectly, the relationship between the message and the code is isomorphic.
- **Architectural models:-** A scale model is a "homomorphism" of the real building it preserve the structural relationship at different scale.

# Permutation Group:-

**Definition:-** A group whose elements are bijection from a set to itself under the operation of functions composition.

- **Symmetric group:-**  $S_n$  Donotes the group of all the permutations of  $n$  elements.
- **Key operation:-** cycles, transposition and parity.

## Daily uses of permutations group

- **Puzzle solving:-** The mechanics of a “Rubik cube” are entirely governed by the group  $S_{54}$ .
- **Chemistry:-** Studying the symmetry of molecules and isomers.
- **Scheduling:-** Round robin tournament scheduling and task allocation.
- **Data science:-** Ranking algorithms and sorting process.

## Unit:-2

### Ring homomorphism subring

**Definition:-** Ring homomorphism and subring are the invisible mathematical engine behind data security, digital communication and even simple arithmetic shortcuts.

**Daily uses:-**

- 1. Protecting credit card information**
- 2. Error free communication**
- 3. Arithmetic shortcuts (divisibility rules)**
- 4. Digital image processing**

## Polynomial rings:-

**Definition:-** A set of the polynomial where you can add, subtract and multiply.

**Daily life uses:**

- **Error correction:-** Your netflix stream doesn't "glitch" because of reed solomon codes(based on polynomial rings). They "fill in" missing data packets.
- **QR code:-** Those square you scan use polynomial division to ensure the link open even if the code is slightly smedged.
- **Cryptography:-** Modern security relies on operation within finite fields of polynomial.

**Unit:-3**  
**Vector space :-**  
**The math of**  
**dimensions**

**Definition:-** A collection of object (vector) that can be scaled or added together.

**Daily life uses:-**

- **Colour grading:-** Every colour on your phone screen is a vector in an RGB vector space (R,C,B).
- **Search engines:-** Google views a webpage as a “vector” of keywords. When you search, it finds the vector closest to your query
- **Physics:-** Calculating the force of the wind on a bridge or the flight path of an airplane.

- **Graphic and Gaming:-** Imagine designing a video game characters vector space helps moves rotate and scale them in 2D/3D space. Game like Fortnite use these concepts for smooth animation and realistic movement.
- **Data Analysis and ML:-** vector space making handling huge data easier like, Netflix uses them to recommend shows based on your watch history. Principal component analysis is another example reducing data dimensions while keeping hey info.

# Unit:-4 linear transform- ation

**Definition:-** A mapping between vector space that preserve the operation of addition and scaling.

**Daily life uses:-**

- **Computer graphics:-** Every time you “zoom”, “rotate” or “skew” a photo on Instagram, you are applying a linear transformation .
- **3D Animation:-** Pixar movie are essentially billion of linear transformation per second to move character in 3D space.
- **Ai and Machine:-** Neural network use linear transformation to turn input data into a prediction.

# Rank and nullity of a linear transformation

- Rank represent the useful information or the output we actually achieved.
- Nullity represent the redundancy or the lost / hidden parts of a system.
- **Daily life uses:-**
- **Search engines:-**

**Rank:-** The Rank of the matrix helps determine the importance of a Webpage. If a matrix has a high rank, it means there is a lot of unique, non redundant information linking different sites together.

**Nullity:-** Help filter out noise or circular links that don't add value to your search history.

## Summary table :-

Concepts	Key application	Benefits to you
Cyclic groups	Clock/calendar	Organization of time
Isomorphism	Data encryption	Secure online banking
Polynomial rings	Error correction	Smooth video streaming
Vector space	Colour/Imaging	High-quality digital photos
Linear transformation	CGI/AI	Modern entertainment and technology

## Conclusion:-

- **Final thought:-** Abstract Algebra is the “invisible architecture” of the 21<sup>st</sup> century.
- **Take away:-** Every time you send a text, watch a movie or check the time ,you are using the power of groups, rings and spaces.

# “ DAILY USES OF MY CURRICULUM ”

CLASS – BSC 4<sup>TH</sup> SEMESTER

SUBJECT – MATHS

Submitted by

Twinkle Sahu

Guided by

Raj Kishor Patel sir

# CONTENTS

- **Uses of isomorphism theorems , cyclic and permutations groups.**
- **Uses of ring , field and integral domain , ideals.**
- **Uses of vector spaces.**
- **Uses of linear transformation.**

# UNIT 1

## 1. ISOMORPHISM THEOREMS

- **These theorems are the ultimate data compression and simplification tools. They tell us when two seemingly different systems are actually identical in structure.**
- **System Design: Engineers use them to swap a complex system for a simpler “equivalent” one without losing functionality.**
- **Error Correction: In digital communication (like 5G or satellite signals), they help map data to “check-sums” to ensure your Netflix stream doesn’t glitch.**

## 2. CYCLIC GROUP

- These represent repetition and circularity.
- **Cryptography (The “Lock”):** Most secure websites (HTTPS) use cyclic groups. The difficulty of solving the “Discrete Logarithm Problem” within a large cyclic group is what keeps your credit card info safe from hackers.
- **Scheduling:** Anything that resets—clock time, days of the week, or “round-robin” tournament scheduling—is managed by cyclic group logic

### 3. PERMUTATION GROUPS

- **These handle shuffling and rearrangement.**
- **Data Routing:** Every time you send a request over the internet, permutation groups help determine the most efficient path for data packets to travel through routers.
- **Robotics & Molecules:** In chemistry, they describe how atoms can rotate in a molecule. In robotics, they define the “configuration space” — basically, all the ways a robotic arm can move without hitting itself.
- **Puzzles:** The Rubik’s Cube is the most famous physical example of a permutation group; every move is a permutation of the cube’s facets.

# UNIT 2

## 1. RING

- **In daily life, rings from abstract algebra work behind the scenes to keep digital data secure and functional. The most common application is in cryptography, where ring theory (specifically polynomial rings and modular arithmetic) enables the encryption that secures your online banking and private messages. Beyond security, rings are essential for error-correction codes used in CDs, DVDs, and satellite communications to fix data corrupted during transmission. Even the digital signals in your smartphone rely on ring structures to process audio and video efficiently.**

## 2. FIELDS

- **Finite fields are essential for RSA encryption, which secures online banking and browsing. They are also used in error-correcting codes (e.g., CRC codes in file downloads, QR codes, and satellite communication), allowing devices to detect and fix data errors, say Quora users.**

### 3. INTEGRAL DOMAINS

- **As a generalization of integers, these are used to study divisibility and in polynomial rings. They form the backbone of constructing fields, crucial for structured data analysis, explains a ScienceDirect topic.**

## 4. IDEALS

- **Algebraic Structure Analysis:** Prime and maximal ideals are used to form quotient rings, which are foundational for creating new, smaller fields and rings in number theory and coding.
- **Polynomial Manipulation:** In computational algebra, ideals help manage sets of polynomials in polynomial rings.

# UNIT 3

## 1. VECTOR SPACES

- **Vector spaces are the silent engines behind much of our modern technology. In digital imaging, photos are treated as vectors where each pixel's color value is a coordinate, allowing software to resize or filter images without losing data integrity. Search engines and streaming services use vector spaces to power recommendation algorithms; by representing your interests as points in a high-dimensional space, they can mathematically calculate which movies or websites are “closest” to your preferences. Additionally, in signal processing, vector spaces allow your phone to isolate your voice from background noise by treating sound waves as vectors and subtracting the unwanted frequencies.**

# UNIT 4

## 1. LINEAR TRANSFORMATION

- **Linear transformations are everywhere in our daily digital interactions, primarily through computer graphics and image processing. When you resize a photo, rotate a video, or apply a filter on social media, the software uses matrices to map original pixel coordinates to new ones, ensuring the image scales or shifts accurately. They also power recommendation engines like those on Netflix or Spotify, which project your preferences into a multi-dimensional space to find “nearby” content you might like. Even the GPS on your phone relies on these transformations to translate satellite signals into your specific location on a 2D map.**



**THANK YOU**

# ***Mathematics Assignment***

Name – Panisha Chouhan

Class – BSC 4<sup>th</sup> semester

# Content

1. Isomorphism & Groups
2. Rings & Fields
3. Vector spaces
4. Linear Transformations

# 1. Isomorphism & Group:-

Isomorphism and Group theory are used in everyday life Primarily in symmetry rotation , solving puzzles (such as the Rubik's Cube) , and encrypting data . They simplify problems by explaining the behaviour of seemingly different objects through mathematical structure.

## Use in daily life

- **Rubik's cube:-** All possible ways to Rotate a Rubik's cube from a group . Algorithms for solving The puzzle are created using the Principles Of this group.
- **Symmetry:-** Group theory is used to explain why mirrors , tile patterns, Or objects look the same when rotated.
- **Computer graphics:-** Graph isomorphism is used to rotate or scale 3D objects revealing that two different graphs or shapes have the same structure.

- Data encryption ( Cryptography) :- In modern security system (such as bank transactions) information is encrypted using group theory.
- Understanding isomorphism :- if you understand two different systems with the same structure ( e.g., The way a gear rotates), a solution for one may also apply to the other.

## 2. Rings & Field

Ring and fields are fundamental Concepts of abstract algebra that are used in everyday life in digital security, data transmission, and coding theory Fields are used to secure data in Cryptography ( such as RSA encryption), while rings are used to design error- correcting codes, which are used in CD/DVD and satellite communication.

### ***Major uses of rings and fields in everyday Life :-***

- Cryptography and data security:- Modern encryption, such as the RSA algorithm, which protects banking and personal information on the internet relies on finite fields.

- Error correction:- When you are CDs/DVDs or receive signals from satellites, error- correcting codes(such as reed- Solomon codes, which use rings / fields) detect and correct error in the data .
- Digital Communication :- Finite fields are used to handle error in scanning QR codes and barcodes.
- Signal Processing (Fourier Analysis):- The discrete Fourier transform uses abelian group and ring properties, which is important in audio / image processing.
- Computer programing:- The principles of rings and fields are used to define data types and their operations, such as the integer or real types.

# 3. Vector space

Vector spaces are fundamental mathematical structures used daily to model, analyse, and manipulate data by defining rules for adding vectors and scaling them. Key applications include computer graphics (transforming 3D objects), GPS navigation (calculating distance/vectors), machine learning (representing data), and engineering (analyzing structural forces).

Here are key examples of vector space use for a mathematics assessment:

**..Navigation and Location:** -Vectors define locations and movement. A navigation system uses vectors to calculate the quickest path, such as “3 miles North and 2 miles East,” representing a vector space of positions.

**.Computer Graphics and Video Games:** -3D graphics represent objects using vectors to define shape and position, using matrix transformations to rotate, scale, or move images on a screen.

.Data Analysis and AI: -Recommendation systems, such as Netflix, use high-dimensional vector spaces to map user preferences, where "thought vectors" represent similarities between movies or products.

.Engineering and Physics:-Engineers use vectors to map physical forces. For example, calculating how a bridge sustains weight involves calculating forces that operate within a vector space.

.Image Filtering:-Photo editing apps use linear transformations within a vector space to rotate, shear, or filter image

## 4. Linear transformation

Linear transformations are used in everyday life primarily in computer graphics (e.g., rotating or resizing objects in gaming or animation), image processing, data analysis, and engineering calculations. Quora and Mankar college, Scribd.

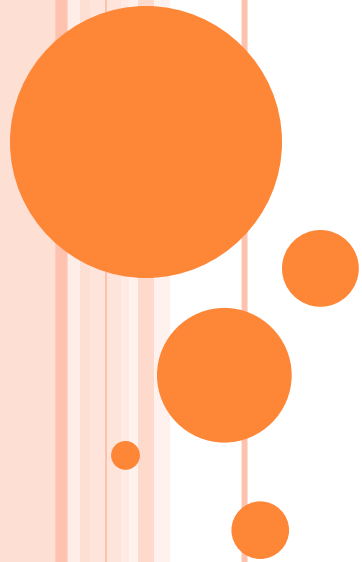
### **Examples of Daily life of Linear transformations:-**

- **Computer Graphics and Animation:-** In Video games or movies, when a character is rotated, scaled, or mirrored, a linear transformation matrix is used for all these transformations.
- **Image Processing :-** Rotating , zooming, or stretching the pixels of a digital photo are examples of linear transformations.

- **Temperature/unit converter** :- For example  $F=9/5c+32$ , using a temperature converter to convert Celsius to Fahrenheit, or kilometres to Miles, this is a linear mapping.
- **Engineering & Modelling**:- In structural engineering, linear transformations are used to understand the deformation of bridges or building. When they are subjected to loads .
- **Data Science/ Graphics**:- Rotation and projection are used to visualise large sets of data, which is based on linear mapping.

**Thank you**

# **USES OF ABSTRACT ALGEBRA IN OUR DAILY LIFE**



**Submitted by-  
Blessyranikhesh**

# TOPICS:-

❏ **Isomorphism Theorems ,Cyclic and Permutation Group:**

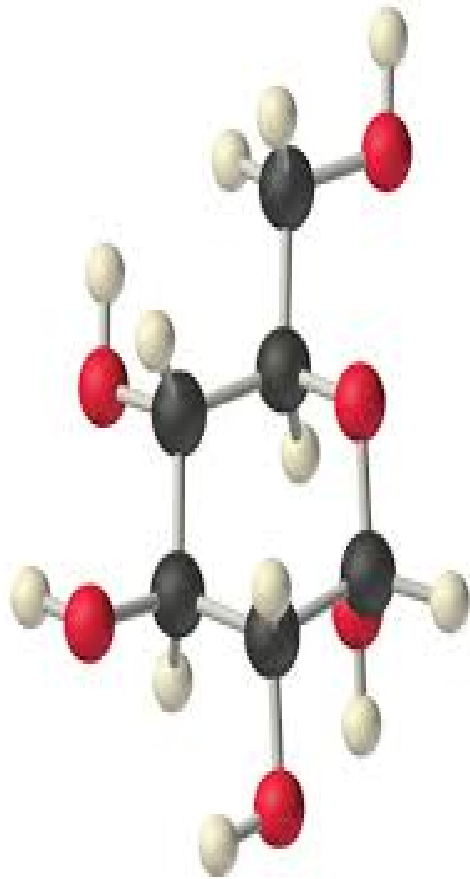
❏ **Ring, field and integral Domain ,Idea:**

❏ **Vector spaces:**

❏ **Linear Transformation:**



# Uses of isomorphism in day today life



D-Glucose

Isomorphism is a way of saying two things are "structurally the same" even if they look different. It allows us to solve a hard problem by translating it into a simpler, isomorphic one.

**Graph/Network Matching:** Used in computer vision and social network analysis (e.g., recognizing if two different-looking graphs or networks are actually the same, just with different labels).

**Chemistry (Molecular Structure):** Chemists use graph isomorphism to match chemical structures against databases to identify compounds.

**Digital Circuit Verification:** In electronic design, it is used to check if two different representations of a circuit are functionally equivalent.

**Social Media Filters:** Filters that change your face, by rearranging or adding elements (permutations), often use isomorphism to map the new image back to a structure the computer understands.

# Uses of permutation in our day today life



Permutations deal with situations where the order of elements matters, such as arrangements, sequencing, and.

**Arrangements:** Scheduling tasks, planning travel itineraries (arranging stops), and organizing seating charts (e.g., weddings, conferences) use permutations to determine the best sequence.

**Sports Team Line-ups:** Managers use permutations to determine the batting order in baseball or the sequence of shooters in soccer.

**Digital Data Processing:** Computers use permutation algorithms in sorting and searching databases, as well as in encryption techniques like Fast Fourier Transforms.

**Cooking Recipes:** The specific order of adding ingredients (permuting the steps) ensures the correct taste and texture.

# Uses of cyclic groups in our day today life



Cyclic groups involve patterns that repeat or rotate, returning to their original position. WordPress.com +1

**12-Hour Clocks:** The numbers 0-11 (or 1-12) on a clock cycle, returning to the start after 12 hours. This is the most common example of finite cyclic groups.

**Bell Ringing:** "Method ringing" or scientific bell ringing uses permutations, but the overall structure of the sequence is cyclic, returning to the original pattern.

**Musical Octaves:** The frequency of musical notes cycles; for example, an octave doubles the frequency, and the ear hears it as the same note.

**Symmetry in Nature:** Many natural objects, such as jellyfish, sea urchins, flowers, and snowflakes, exhibit radial symmetry, which is modeled using cyclic groups.

# Uses of ring , field and integral domain and ideals



**Chemistry:** Chemists classify molecules based on their symmetry using group theory, which is a key component of ring theory. The symmetry of molecules determines their behavior in chemical reactions.

## **Pattern Formation (Symmetry Fields):**

**Biology:** The patterns on sea creatures (phylum Echinodermata), such as starfish or sand dollars, exhibit dihedral symmetry, which can be described by algebraic group .

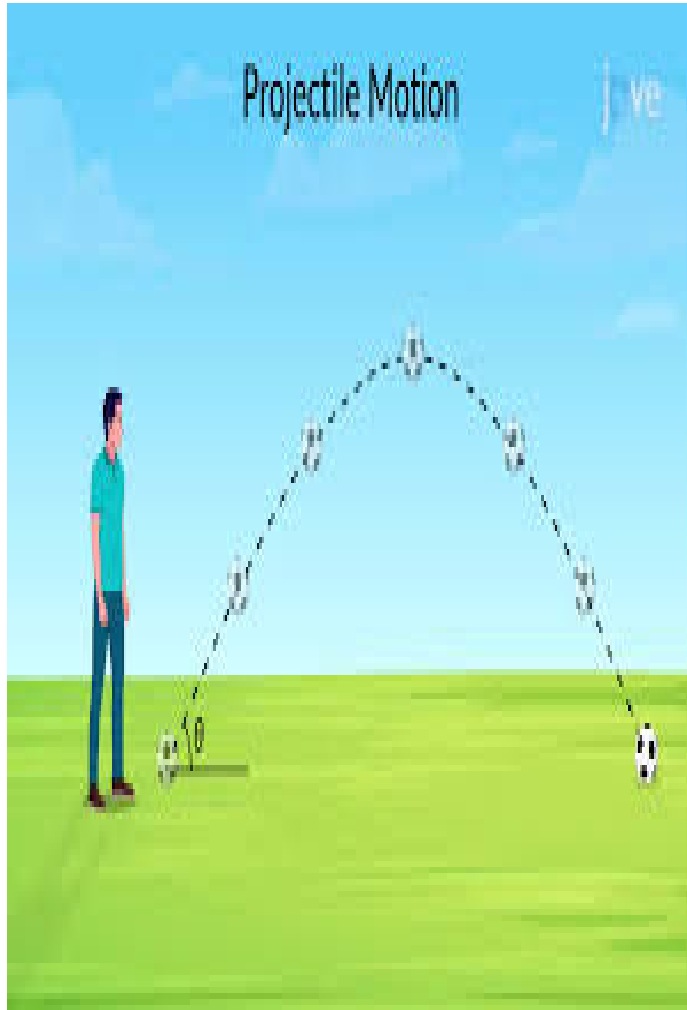
## **Crystalline Structure (Rings):**

**Material Science:** The atomic structure of crystals can be modeled using ring theory to predict how they interact with light or x-rays, as atoms are arranged in repeating, highly symmetric patterns.

## **(Integral Domains):**

**Natural Growth:** The study of polynomial rings, a type of integral domain, is used in modeling the growth patterns of plants and the branching of trees, which often follow recursive algebraic rules.

# Uses of vector spaces



**Fluid Flow and Water):** Meteorologists use vector fields to map wind direction and speed across the globe. Similarly, the velocity of water flowing in a pipe or river is treated as a vector field.

**Electromagnetic Fields:** Earth's magnetic field is a vector quantity with components parallel and perpendicular to the surface. Electric and magnetic fields in nature are represented as vector spaces to calculate their force on objects.

**Projectile Motion:** When a fruit falls from a tree or a bird dives, its motion (velocity and acceleration) is analyzed using vector components (horizontal and vertical) to determine its path.

**Material Strength:** The internal forces and stresses in natural materials like rock or wood under pressure can be analyzed using tensor analysis, which relies on vector space, to explain phenomena like landslides or tree snapping.



What is abstract algebra ?

Abstract algebra is a branch of mathematics studying algebraic structures like groups, rings, and fields rather than specific number calculations.

**Cryptography & Security:** Modern cryptographic systems (like RSA) rely on number theory and group theory to encrypt sensitive data, ensuring secure internet transactions.

**Coding Theory (Error Correction):** Algebraic coding theory uses finite fields to detect and fix errors in digital storage (CDs, hard drives) and telecommunications.

**Chemistry & Physics (Symmetry):** Group theory classifies molecular structures, analyzes molecular vibrations, and helps predict physical properties.

**Computer Science & Algorithms:** Abstract algebra is used in algorithm design, such as in Fast Fourier Transforms (FFT) for signal processing and 3D computer graphics.

**Physical Puzzles:** The movements of a Rubik's Cube can be modeled and solved using permutation groups.

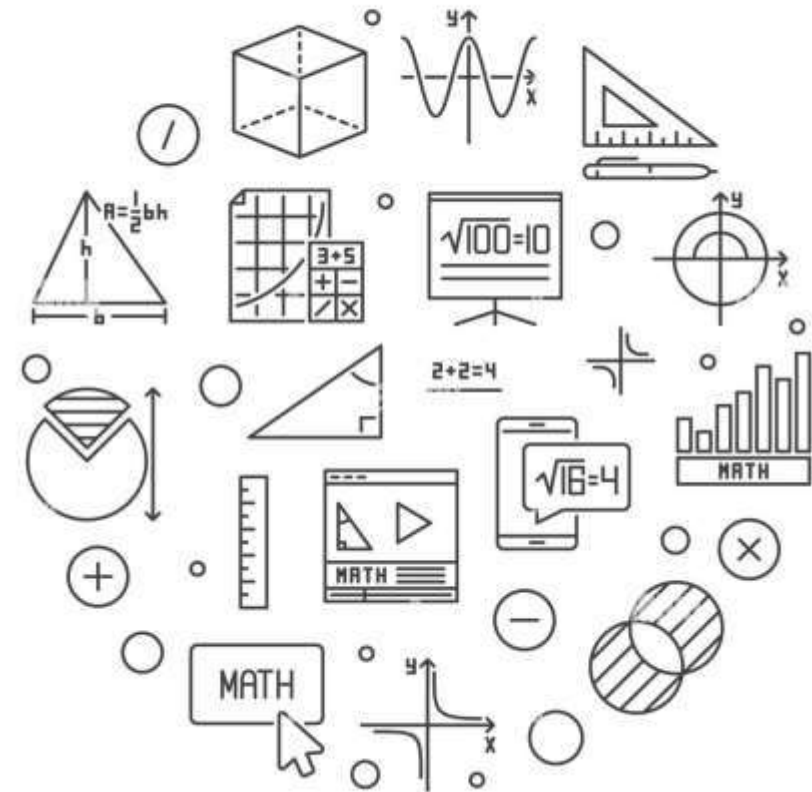


Thank  
you!

**Topic:-**

# **The Mathematics of Everyday Life**

Real-World Applications of Semester IV  
Curriculum (Units I–IV)



Presentated by :- Durgesh Kumar  
sahu



- ◇ INTRODUCTION
- ◇ Modern cryptography
- ◇ The math clock
- ◇ QR Codes & Scratched CDs
- ◇ Computer Hardware & logical Gate
- ◇ Google search & Digital Imaging
- ◇ Artificial Intelligence
- ◇ Computer animation
- ◇ Robotics & Automated Factoriesic

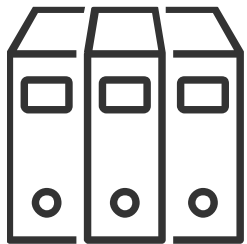
# Introduction

## Math Beyond The Blackboard

Mathematics is the "Operating System" of the modern world. It is the language of patterns, structures, and logical relationships

To peel back the layers of abstract theory and reveal the mathematical engines driving our daily technology, nature, and art.





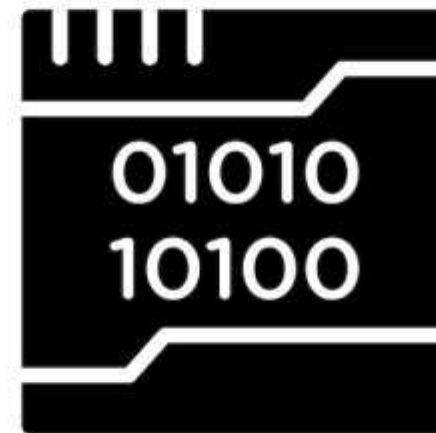
# **Modern Cryptography:** Whatsapp & Banking

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**Topic:** Cyclic Groups and Finite Groups.

**Application:** End-to-end encryption.

**Explanation:** Group theory allows us to create "one-way" mathematical functions. Your messages are locked using group operations that only the receiver can reverse.





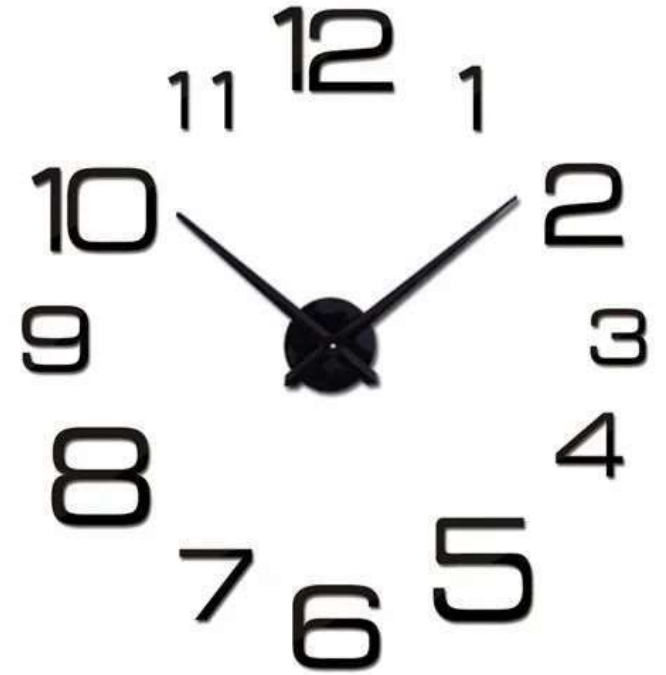
# The Math clock : Moduler Arithmetic

---

**Topic:** Cosets and Lagrange's Theorem.

**Application:** Timekeeping and Scheduling.

**Explanation:** Our 12-hour and 24-hour clocks are "Additive Groups" modulo 12 and 24 respectively. Even planning weekly schedule is an application of Group Theory.





# QR Codes & Scratched CDs

---

## QR Codes & Scratched CDs

**Application:** Reed-Solomon Error Correction.

**Explanation:** When a QR code is dirty, math fills in the gaps. Polynomial rings allow the scanner to "calculate" the missing data.





# Computer Hardware & Logical Gate

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## Computer Hardware & Logical Gate

**Application:** Microchip Design.

**Explanation:** Every computer chip runs on "High" or "Low" voltage, which corresponds to the Field  $\{0, 1\}$ . Ring theory helps optimize these circuits.



# Google Search & Digital Imaging

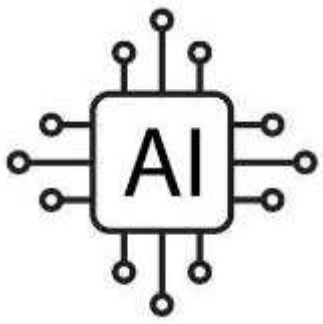
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## Google Search & Digital Imaging

**Explanation:** Google treats every webpage as a vector in a massive "Web Space." Your search query is a vector, and math find the "Closest Basis" to give you results.

Every color on your screen is a "Linear Combination" of three basis vectors: Red, Green, and Blue.





# Artificial Intelligence

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## Artificial Intelligence

**Explanation:** Your music taste is a vector in a "Song Space." Spotify finds a "Subspace" of songs that are mathematically closest to your taste. Sound waves are vectors.

Noise-canceling headphones create a "negative vector" to cancel out the background noise vector.

## Designing an Exceptional User Experience: Unveiling the Secrets of the Spotify App

Spotify





# Computer Animation

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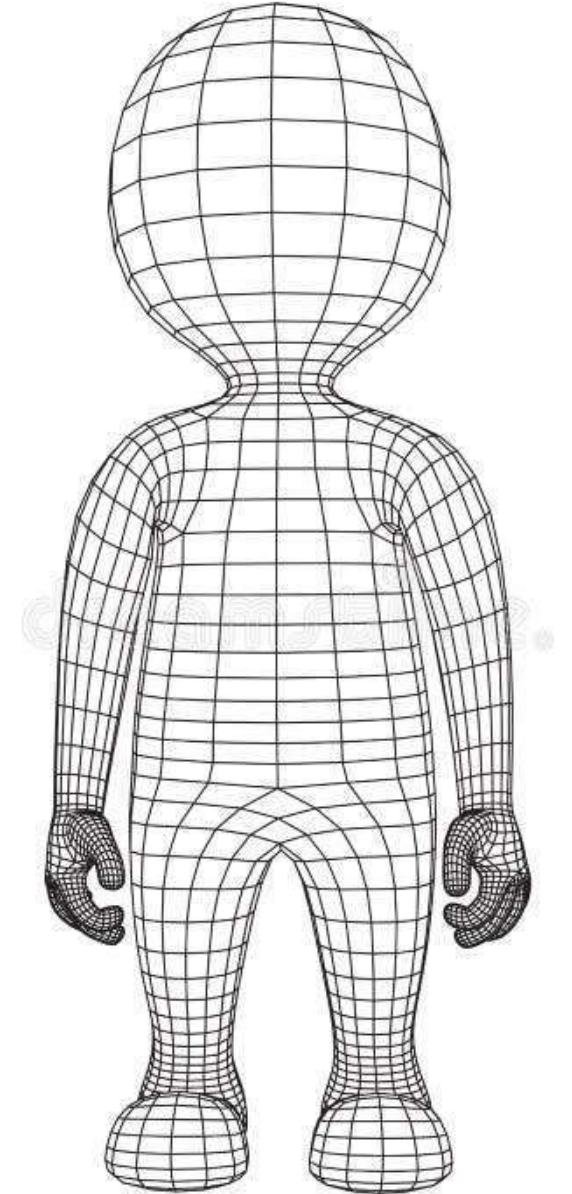
Application: 3D Character Movement.

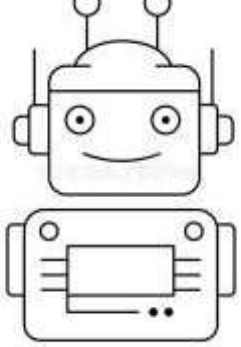
Explanation: In video games, characters move by

transforming their coordinates  
from "Model Space" to "World

Space"

using Linear Transformations.





# Robotics & Automated Factories

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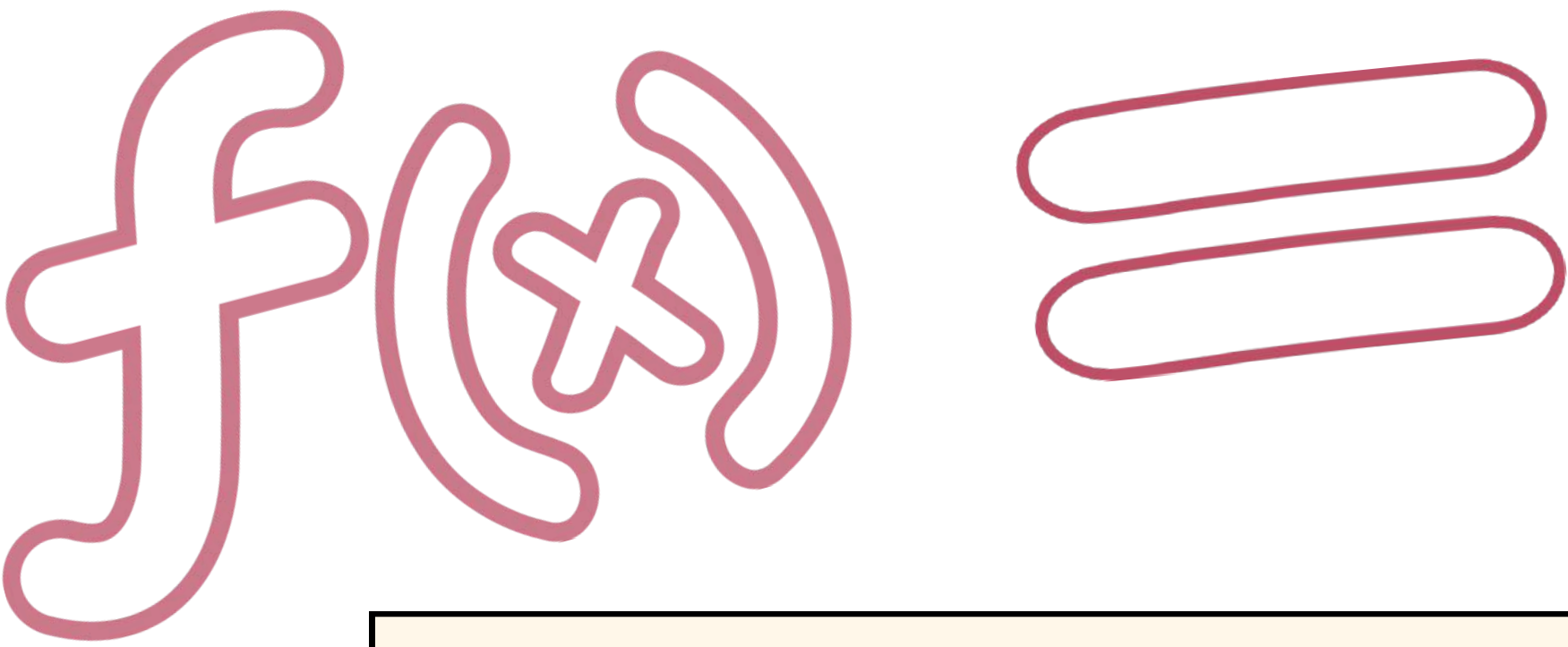
## Robotics & Automated Factories

**Application:** Robotic Arm Precision.

**Explanation:** To move a robot arm to a specific point, the computer solves a system of linear transformations to ensure accuracy.

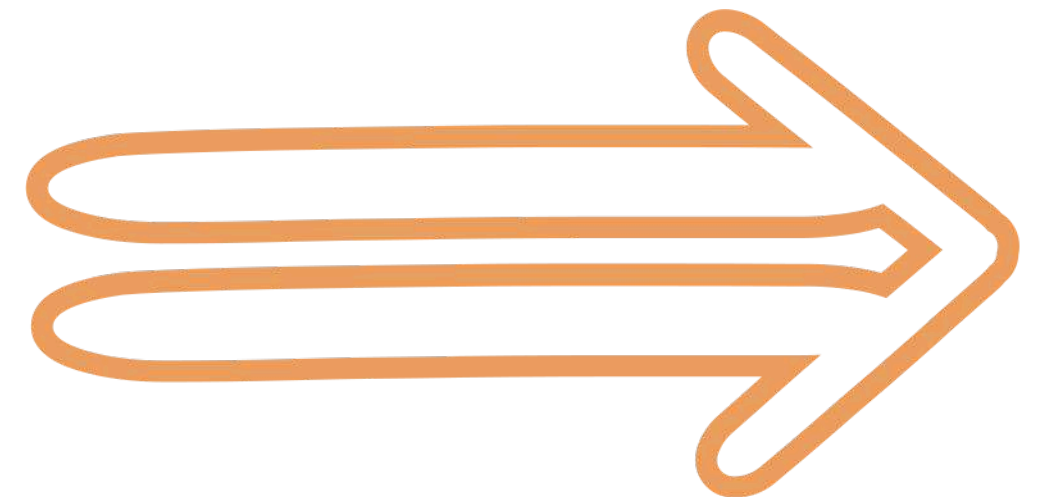


Thank  
you



## **maths assignment**

**topic :- daily uses of my cariculum**  
**presented by:- Bhumisuta Dadsena**  
**Class- Bsc 4<sup>th</sup> sem**



# CONTENT

1

**ISOMORPHISM THEOREM , CYCLIC AND PERMUTATION GROUPS**

2

**RING FIELD AND INTEGRAL DOMAIN IDEALS**

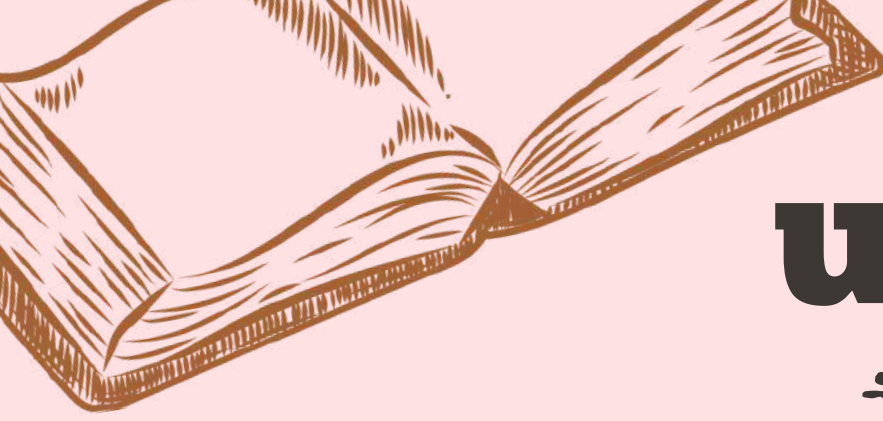
3

**VECTOR SPACE**

4

**LINEAR TRANSFORMATION**

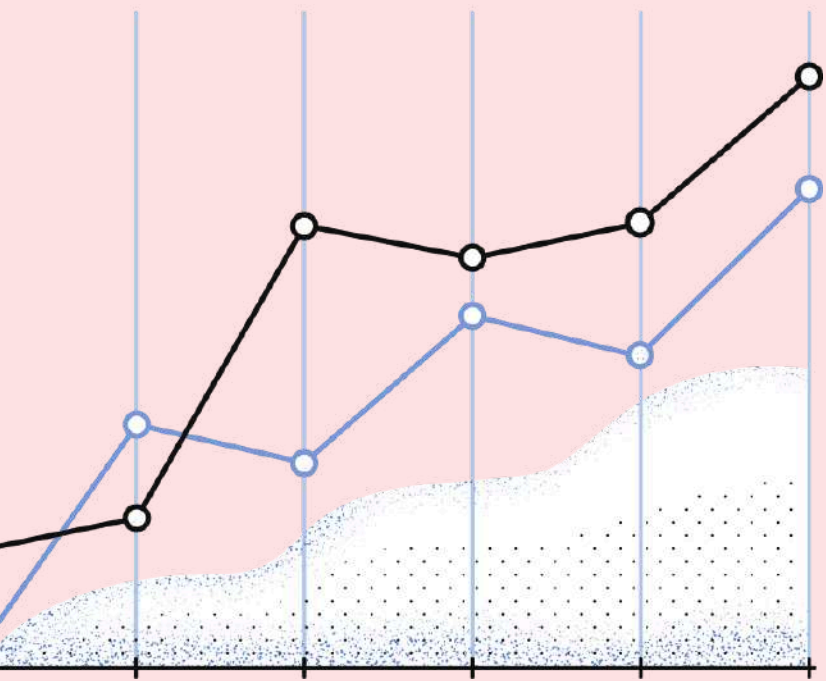




# uses of isomorphism



isomorphism is a way of saying two things are structurally the same even if they look different. it allows us to solve a hard problem by translating it into a simpler, isomorphic one.

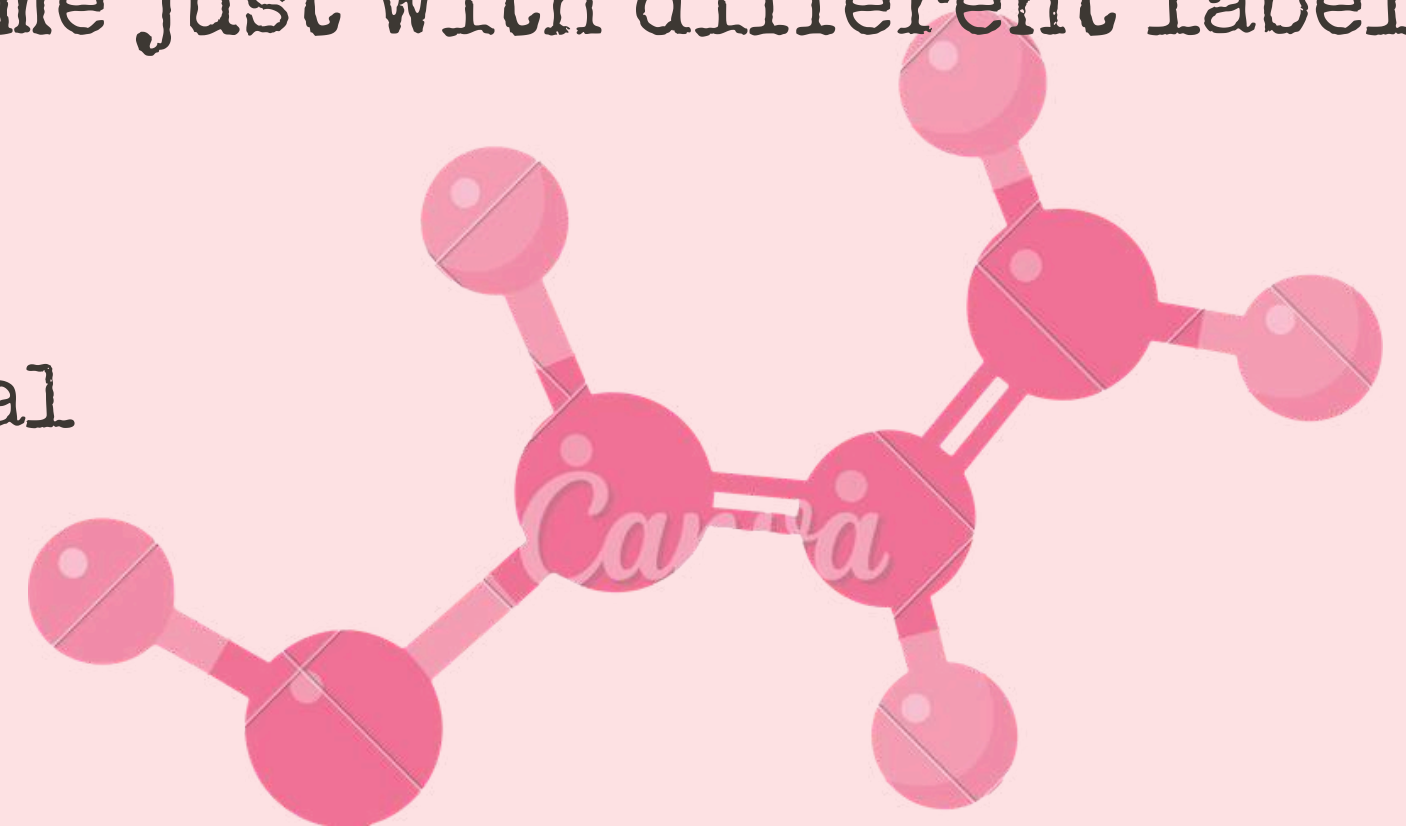


## Graph / network matching:

used in computer vision and social network analysis (e.g. recognizing if two different looking graphs or network are actually the same just with different labels)

## Chemistry (molecular structure):

chemists use graph isomorphism to match chemical structures against data bases to identify compounds.



## Digital circuit verification :



in electronic design it is used to check if two different representation of a circuit are functionally equivalent.



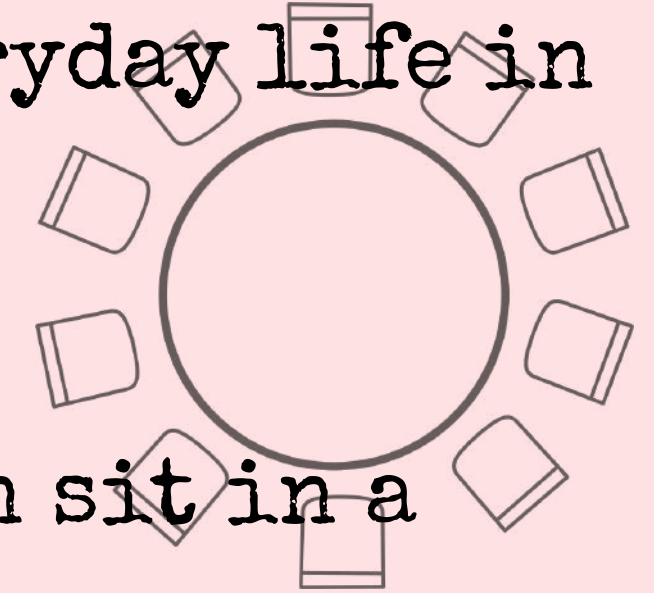
## social media filter:

filters that change your face by rearranging or adding element (permutation) often use isomorphism to map the new image back to a structure the computer understand.



# Uses of permutation

A permutation is used when we need to arrange objects or items in a specific order. It has many practical applications in everyday life in different fields



## main uses of permutation

1. seating arrangement: used to find the number of ways people can sit in a row, around a table, or in a classroom



## 2. password and security

permutation help calculate the number of possible password or pin combination to security in phones, bank, and computer

## 3. License plate number

goverrrment create unique vehicle numbers using different arrangement of letters and digits

# uses of cyclic group



Cyclic groups are common in our daily life. A cyclic group is a group with an element that has an operation applied that produces the whole set

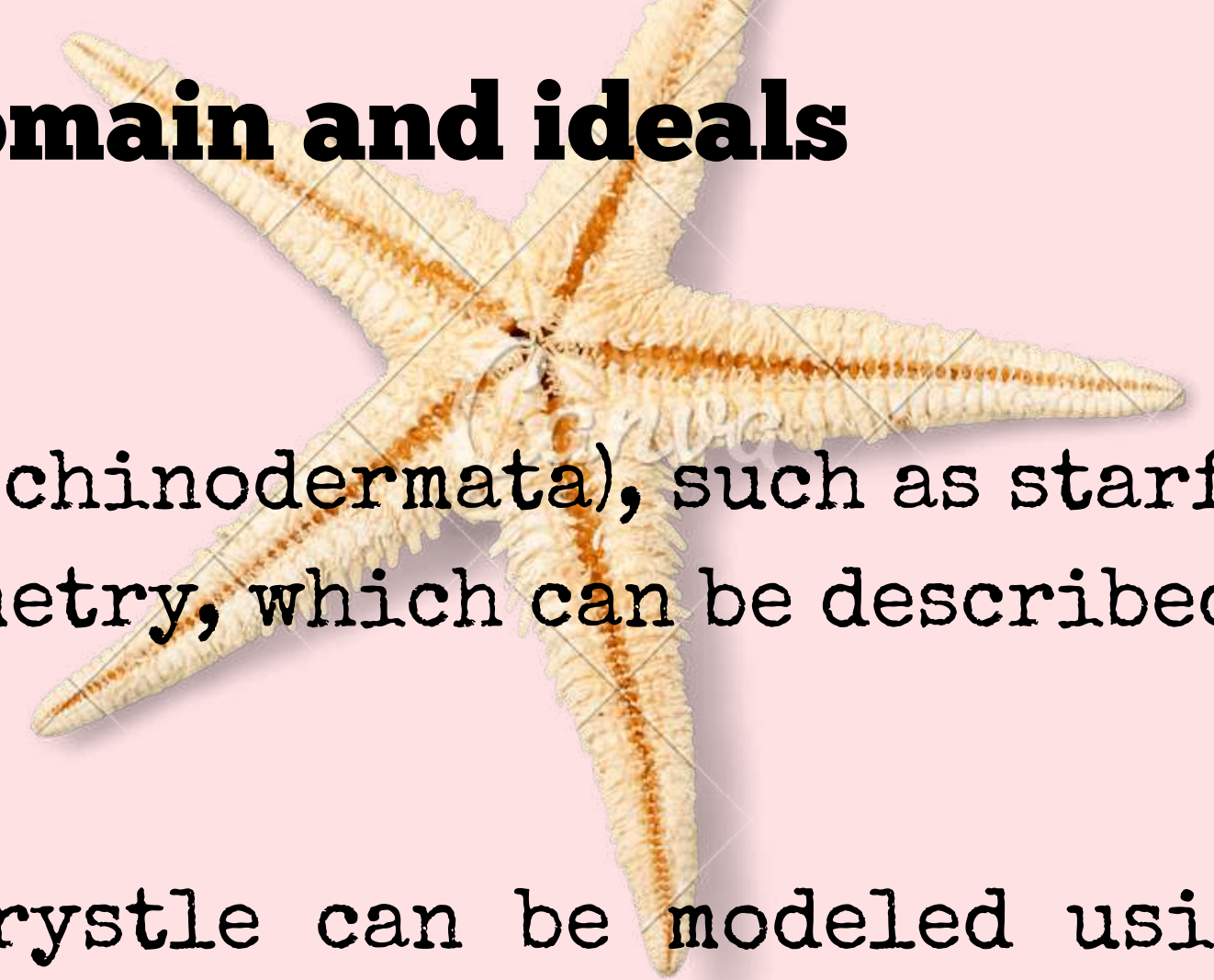
- cyclic groups can be used in fun puzzles such as the Rubik cube or in protecting sensitive information such as through cryptography
- 12-hours clock: the numbers 0-11 (or 1-12) on a clock cycle, returning to the start after 12 hours. This is the most common example of finite cyclic groups.
- musical octaves :- the frequency of musical notes cycles; for example, an octave doubles the frequency, and the ear hears it as the same note



# uses of ring, field and integral domain and ideals

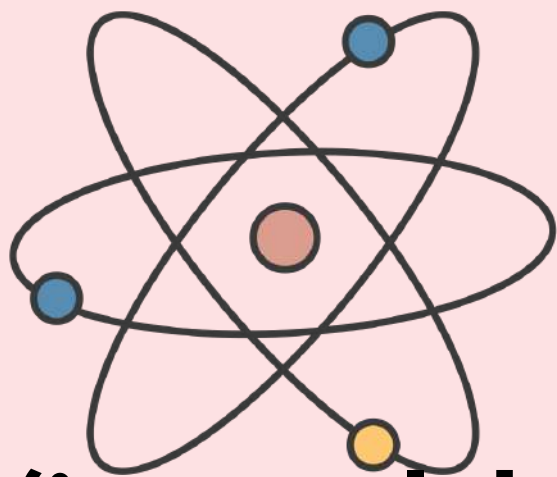
## Pattern formation(symmetry fields):

**Biology** the pattern on sea creatures (phylum echinodermata), such as starfish or sand dollars, exhibit dihedral symmetry, which can be described by algebraic group.



## crystalline structure(Rings):

**material science:** the atomic structure of crystal can be modeled using ring theory to predict how they interact with light or x-rays, as atoms are arranged in repeating, highly symmetric patterns.



## (integral domains):

**natural growth:** the study of polynomial rings, a type of integral domain, is used in modeling the growth patterns of plants and the branching of trees, which often follow recursive algebraic rules



# uses of vector space

## 1. Projectile motion:

when a fruit falls from a tree or a bird dives, its motion (velocity and acceleration) is analyzed using vector component (horizontal and vertical) to determine its path.

## 2. Engineering and construction:

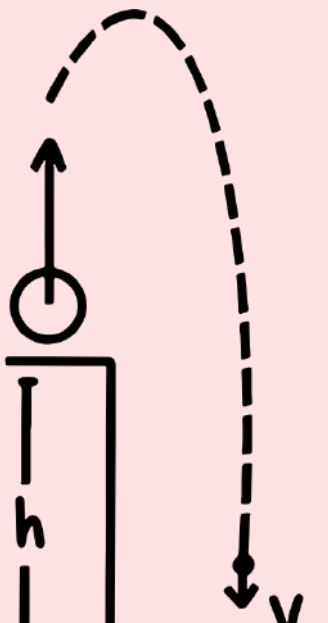
vectors determine the forces, torques, and stress acting on structure like bridges, enabling stable design.

## 3. Electromagnetic fields:

Earth's magnetic field is a vector quantity with components parallel and perpendicular to the surface. Electric and magnetic fields in nature are re-presented as vector spaces to calculate their force on objects.

## 4. Computer graphics and Gaming:

vectors are used to map 3D objects, define lighting, and calculate movement within virtual environments and video games.



# linear Transformation

## 1.Economic modeling and supply chain

businesses use linear transformation to manage resources . if a bakery makes bread and cakes, and each requires a specific amount of flour and sugar , the relationship between “product made” and “ingredients used” is a linear transformation.



## 2.Machine learning:

neural networks use matrix multiplication at each layer (a linear transformation ) followed by an activation function to learn complex patterns

## 3.Photo Editing

filters in applications like photoshop use matrices to manipulate pixel data for rotating , flipping, resizing ,or adjusting brightness.



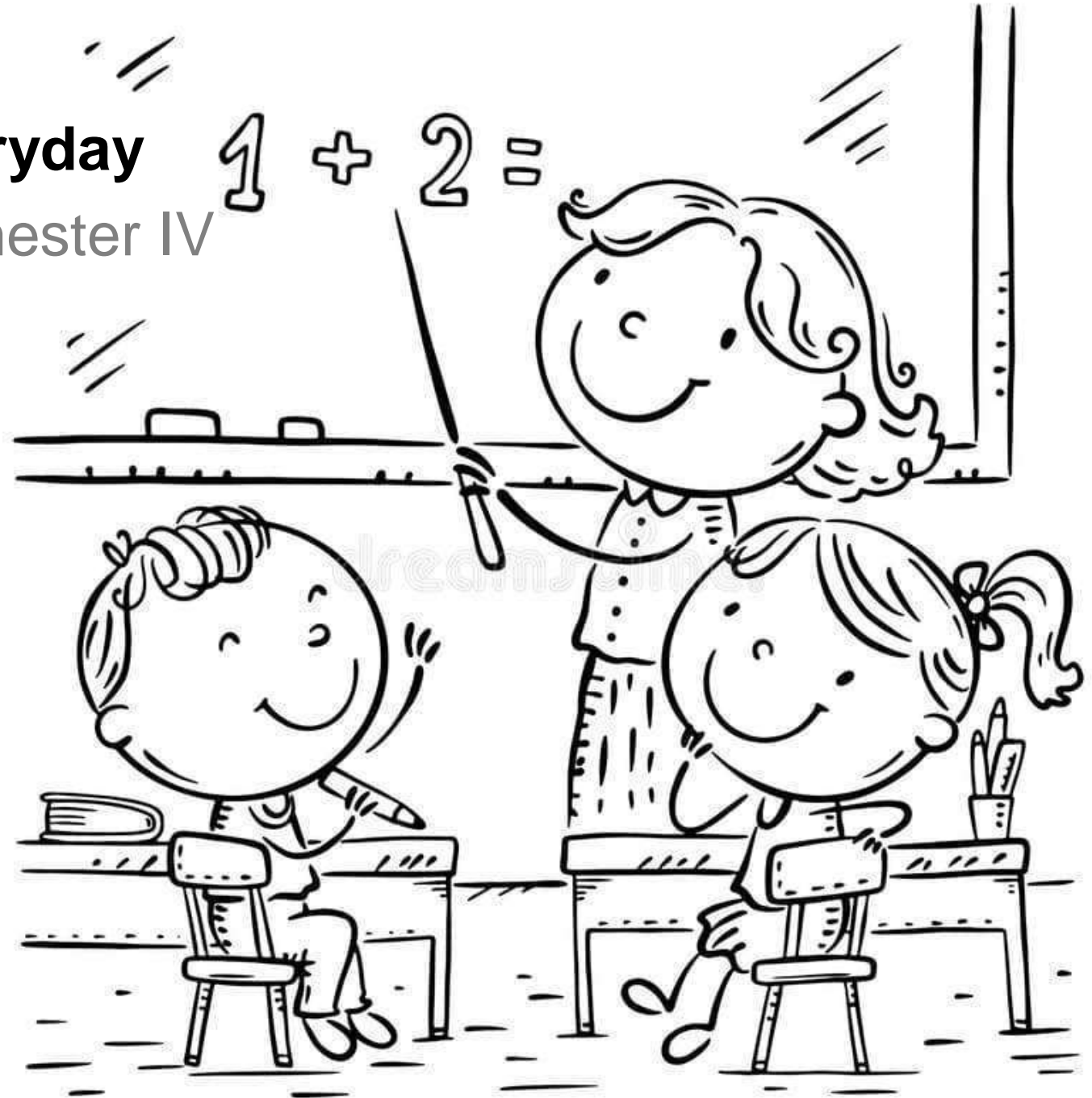
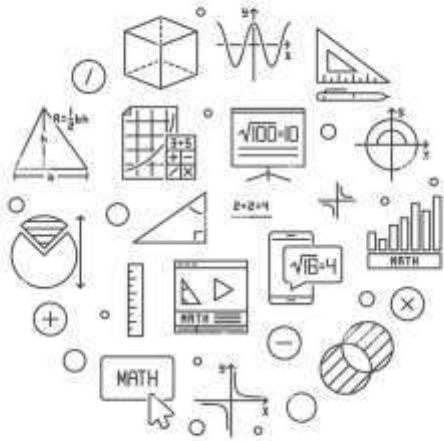
THANKYOU



**Topic:-**

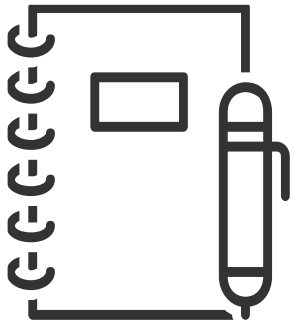
# **The Mathematics of Everyday**

**Life** Real-World Applications of Semester IV  
Curriculum (Units I-IV)



Presentated by :- Krishna Patel

Guided by :- Raj kishor Patel sir



# CONTENT

S

— INTRODUCTION

**Step.1**

— UNIT 01 Group & Isomorphism

**Step.2**

— UNIT 02 Rings & Fields

**Step.3**

— UNIT 03 Vector space

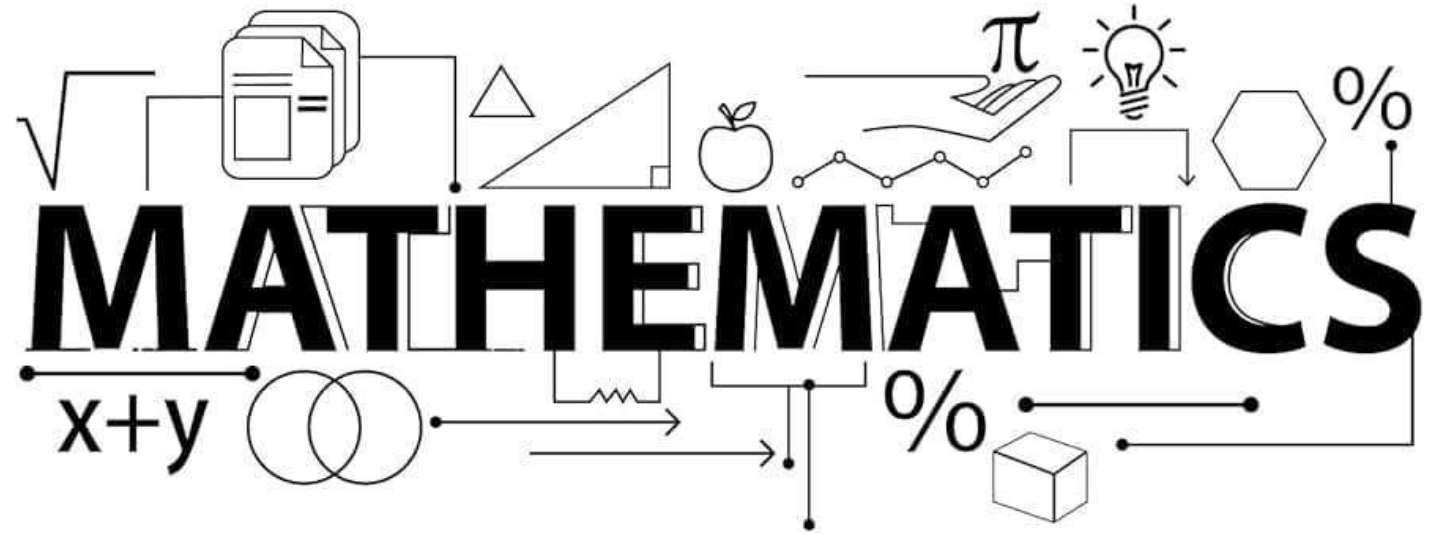
**Step.4**

— UNIT 04 Linear Transformation

**Step.5**

# 01

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# Introduction

Math Beyond The Blackboard



# Mathematics: The invisible architecture of life

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## The Common Misconception

Many students believe that concept like "Isomorphisms" or "Vector Spaces" are purely theoretical ideas . confined to dusty textbooks.

## The Reality

Mathematics is the "Operating System" of the modern world. It is the language of patterns, structures, and logical relationships

## A Daily Experience

When you unlock your phone with your face (Linear Algebra), send an encrypted WhatsApp message (Group Theory), or search for a video on YouTube (Vector Spaces), you are using the very curriculum we study in Semester IV.

## The Goal of this Presentation

To peel back the layers of abstract theory and reveal the mathematical engines driving our daily technology, nature, and art.





# Overview Of The curriculum

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## UNIT - 02

Rings & Fields  
(The Science of Data Integrity).

## UNIT - 03

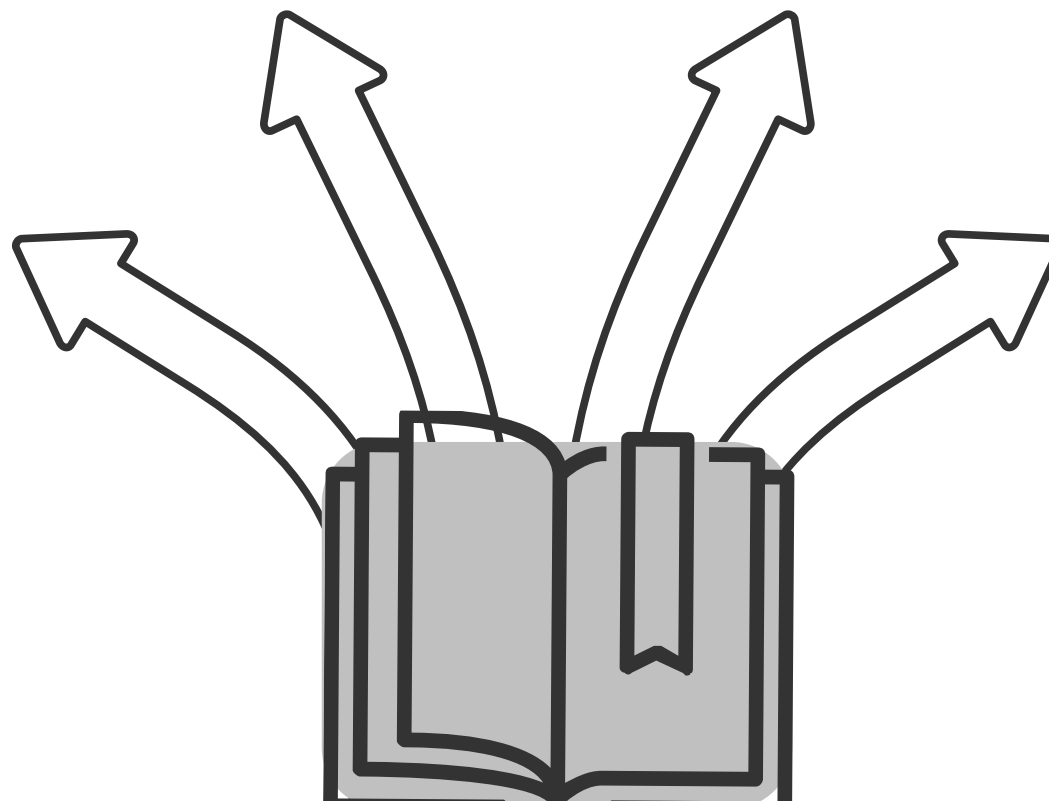
Vector Spaces  
(The Science of Data Representation).

## UNIT - 01

Groups & Isomorphisms  
(The Science of Symmetry).

## UNIT - 04

Linear Transformations  
(The Science of Motion).



# 02

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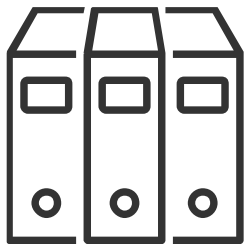


## UNIT -01

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### **Groups & Isomorphisms (The Science of Symmetry).**

- *Modern Cryptography*
- *The clock math*



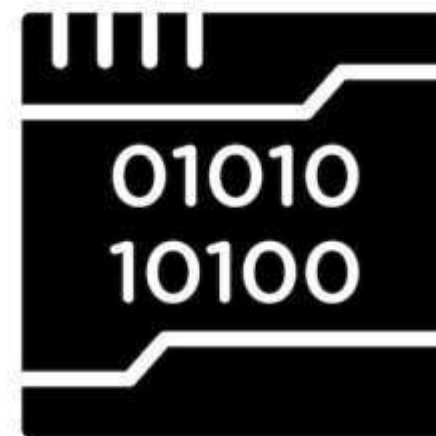
# Modern Cryptography: Whatsapp & Banking

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**Topic:** Cyclic Groups and Finite Groups.

**Application:** End-to-end encryption.

**Explanation:** Group theory allows us to create "one-way" mathematical functions. Your messages are locked using group operations that only the receiver can reverse.





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**Topic:** Cosets and Lagrange's Theorem.

**Application:** Timekeeping and Scheduling.

**Explanation:** Our 12-hour and 24-hour clocks are "Additive Groups" modulo 12 and 24 respectively. Even planning weekly schedule is an application of Group Theory.



# 03

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## UNIT -02

---

**Rings & Fields**  
**(The Science of Data Integrity).**

- *QR Codes & Scratched CDs*
- *Computer Hardware & Logical Ga*



# QR Codes & Scratched CDs

---

## QR Codes & Scratched CDs

**Application:** Reed-Solomon Error Correction.

**Explanation:** When a QR code is dirty, math fills in the gaps. Polynomial rings allow the scanner to "calculate" the missing data.





# Computer Hardware & Logical Gate

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## Computer Hardware & Logical Gate

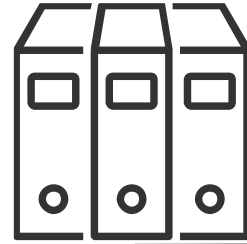
**Application:** Microchip Design.

**Explanation:** Every computer chip runs on "High" or "Low" voltage, which corresponds to the Field  $\{0, 1\}$ . Ring theory helps optimize these circuits.



# 04

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## UNIT -03

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**Vector Spaces**

**(The Science of Data  
Representation).**

- *Google Search & Digital Imaging*
- *Artificial Intelligence*

# Google Search & Digital Imaging

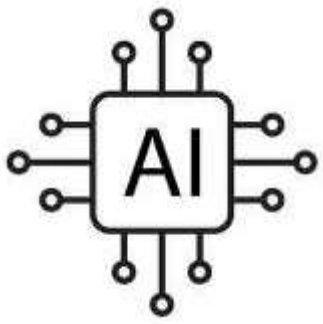
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## Google Search & Digital Imaging

**Explanation:** Google treats every webpage as a vector in a massive "Web Space." Your search query is a vector, and math find the "Closest Basis" to give you results.

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# Artificial Intelligence

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**Explanation:** Your music taste is a vector in a "Song Space." Spotify finds a "Subspace" of songs that are mathematically closest to your taste. Sound waves are vectors.

Noise-canceling headphones create a "negative vector" to cancel out the background noise vector.

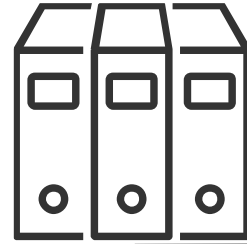
## Designing an Exceptional User Experience: Unveiling the Secrets of the Spotify App

Spotify



# 05

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## **UNIT -04**

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### **Linear Transformations (The Science of Motion)**

- *Computer Animation*
- *Robotics & Automated Factories*



# Computer Animation

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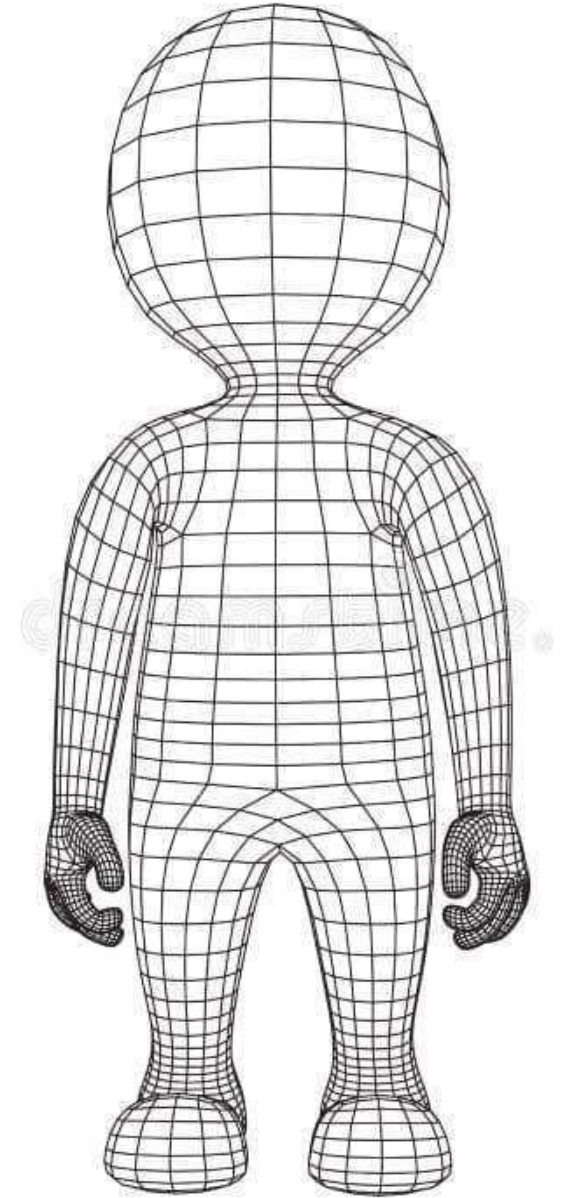
Application: 3D Character Movement.

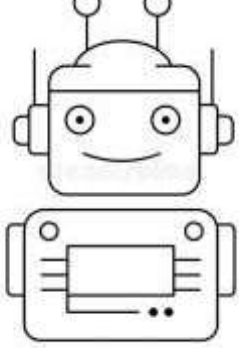
Explanation: In video games, characters move by

transforming their coordinates  
from "Model Space" to "World

Space"

using Linear Transformations.





# Robotics & Automated Factories

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## Robotics & Automated Factories

**Application:** Robotic Arm Precision.

**Explanation:** To move a robot arm to a specific point, the computer solves a system of linear transformations to ensure accuracy.





**Pure Mathematics is, in its way, the poetry of logical ideas.**

# Lt. Raja Virendra Bahadur Singh govt. College Saraipali



Class- BSC 4th sem

Subject - mathematics

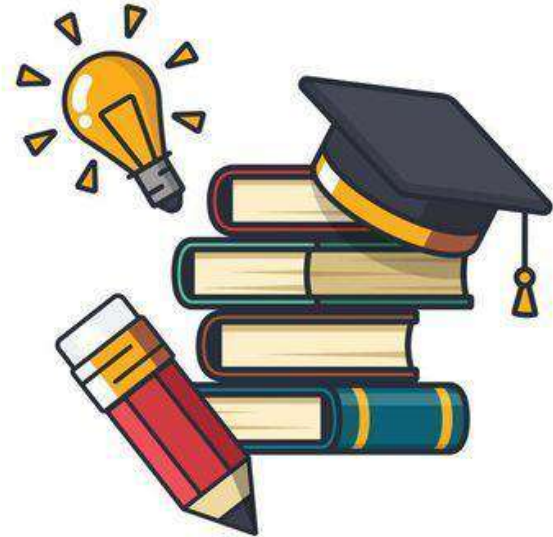
# DAILY USES OF MY CURRICULUM

Submitted by  
~Muskan Swarnkar

Guided by  
~Raj kishor Patel Sir

# Contents

- Uses of Isomorphism Theorem, cyclic and permutations Groups
- Uses of Ring, Field and Integral Domain, Ideals
- Uses of Vector spaces
- Uses of Linear Transformation



# UNIT - 1

## Isomorphism :--

The Isomorphism Theorem tells us that two mathematical systems can look different but have the same structure and rules. In daily life, this idea appears when we convert units like meters to centimeters or rupees to paise — the numbers change, but the relationship stays the same. It is also seen in time formats, such as 12-hour and 24-hour clocks, which represent the same time differently. When we simplify equations in mathematics, the form changes but the meaning remains the same. This concept helps us understand that different representations can still follow the same structure and logic.

## Cyclic :--

A cyclic group is something that repeats in a fixed pattern. In daily life, we see this in clocks — after 12, it starts again from 1. Days of the week repeat every 7 days, and months repeat every year. This repeating system follows cyclic rules. Cyclic patterns are also used in modular arithmetic, like finding remainders (for example, time calculations such as “3 hours after 10 PM”). Calendar planning, shift rotations, and timetable scheduling also follow cyclic patterns. So, cyclic group ideas help us understand repetition, rotation, and periodic systems in everyday life.



## Permutations :--

Permutations are used in daily life whenever we arrange things in different orders. For example, seating arrangements in a classroom or at a wedding depend on different possible orders of people. Passwords and PIN codes are based on different arrangements of numbers and letters. Shuffling cards in a game creates different permutations each time. In exams, roll numbers can be arranged in many ways. Tournament schedules and team line-ups also use permutations. Even arranging books on a shelf or choosing outfits in different combinations involves permutations. So, permutations help us understand how many possible arrangements are possible in real life.

# UNIT - 2

## Ring:-

In algebra, a ring is an important mathematical structure used in many fields. It helps in solving polynomial equations and studying number properties. The concept of rings is also used in computer science, cryptography, and coding theory to secure data and detect errors in digital communication systems used in daily technology.

## Fields:-

**A field in algebra is useful in many daily technologies. It helps in making correct calculations in science, engineering, and computers. Fields are also used to protect information on the internet, like online banking and passwords. They help in sending and receiving data correctly in mobile phones, computers, and digital communication.**

## Integral Domains:-




An integral domain in algebra helps in doing accurate calculations without errors in multiplication. It is useful in computer science, coding theory, and cryptography. These concepts help protect digital information and improve data transmission. Integral domains are also used in mathematics, engineering, and computer systems to solve problems and design reliable technologies.

## Ideals:-

In algebra, ideals help in simplifying complex calculations and solving equations. Their concept is used in computer science, coding theory, and cryptography to protect digital information. Ideals also help in designing error-correcting codes used in mobile communication, computers, and data storage systems to make data transmission more accurate and reliable.

# UNIT - 3

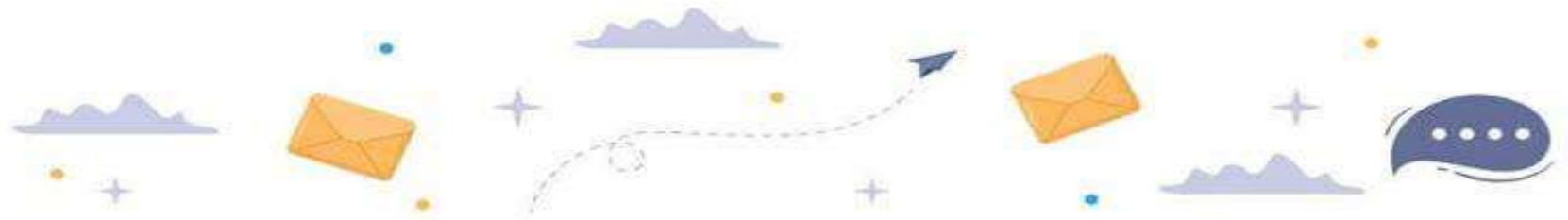
## Vector Space:-

Vector space is used in many areas of daily life and modern technology. It helps in computer graphics to create images and animations, in physics to describe forces and motion, and in engineering for designing machines and structures. Vector spaces are also used in data science, signal processing, and communication systems.   

# UNIT - 4

## Linear Transformation:-

Linear transformation is used in computer graphics to rotate, resize, and move images and objects. It is important in robotics, engineering, and physics for changing coordinates and analyzing motion. Linear transformations are also used in image processing, data science, and machine learning to transform and analyze large amounts of data.



**THANK YOU**

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# LATE. RAJA VIRENDRA BAHADUR SINGH GOVT. COLLEGE, SARAIPALI



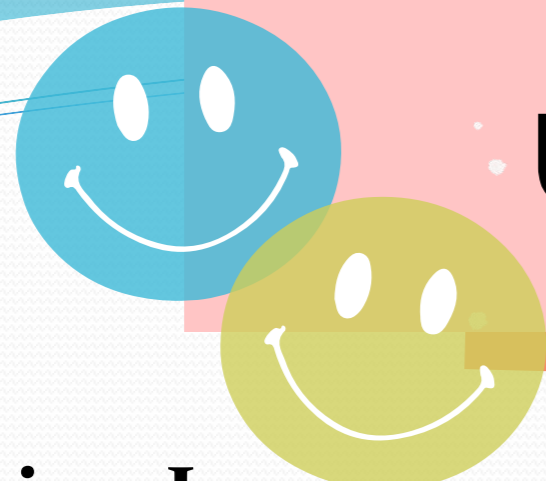
2025-26  
CLASS- B.Sc. 4<sup>th</sup> Sem  
SUBJECT:- MATHEMATICS

GUIDED BY :-  
RAJ KISHORE PATEL SIR

SUBMITTED BY=  
SARIKA PRADHAN

# INDEX

- 1) **Isomorphism Theorem , Cyclic and Permutation groups.**
- 2) **Ring ,Field and Integral Domain ,Ideals.**
- 3) **Vector Spaces.**
- 4) **Linear Transformation.**



# Unit:-1 Isomorphism Theorems uses

## 1. Programming Language & Type Theory

**First Isomorphism Theorem** mirrors how functions map inputs to outputs — the "kernel" is what gets ignored, the "image" is what matters Used in **functional programming languages** (Haskell, Scala) to prove that two different code structures behave identically

## 2. System Equivalence in Engineering

Two electrical circuits that behave identically are **isomorphic** — engineers use this to replace complex circuits with simpler equivalent ones

## 3. Structural Engineering

The **Second Isomorphism Theorem** helps decompose complex symmetry groups of buildings and bridges into manageable subgroups





# Cyclic Groups — Real Life Uses

## 1. RSA Cryptography & Internet Security

Every **https://** website uses arithmetic

RSA encryption: encode message  $M$  as  $M^e \pmod n$  — security depends on the cyclic structure of  $(\mathbb{Z}/n\mathbb{Z})^*$

**Diffie-Hellman key exchange** — shared secret computed using generators of cyclic groups

Protects: Gmail, WhatsApp, online banking, Netflix logins



## 2. Bitcoin & Blockchain

Bitcoin uses **Elliptic Curve Cryptography (ECC)** — the curve points form a cyclic group

Your Bitcoin wallet address is derived from a **generator point** of a cyclic group of order  $\sim 2^{256}$

Transaction signing uses the **discrete logarithm problem** in cyclic groups

Also used in: Ethereum, digital passports, Apple Pay, Google Pay



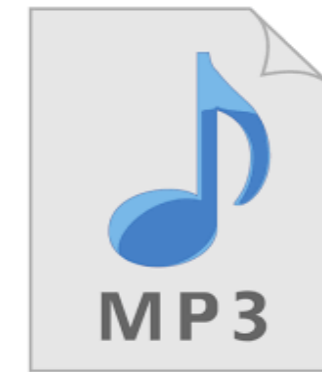
## 3. Music & the 12-Tone Scale

The 12 musical notes form  $\mathbb{Z}_{12}$  — a cyclic group of order 12

Chord progressions, inversions, and modulations all follow cyclic group arithmetic

#### 4. Signal Processing & Fast Fourier Transform (FFT)

Powers: MP3/AAC audio, JPEG images, 5G networks, WiFi, MRI machines, rad



#### 5. QR Codes & Error Correction

**Reed-Solomon error correction** uses cyclic algebraic structures (finite fields)

A QR code can be **30% destroyed** and still scan correctly

Data is encoded as elements of cyclic polynomial rings

Used in: QR codes, barcodes, CDs, DVDs, Blu-ray, satellite TV, deep space communicat



## 6. Calendars & Time

Days of the week:  $\mathbb{Z}_7$  — "What day is 100 days from Wednesday?" = pure cyclic arithmetic

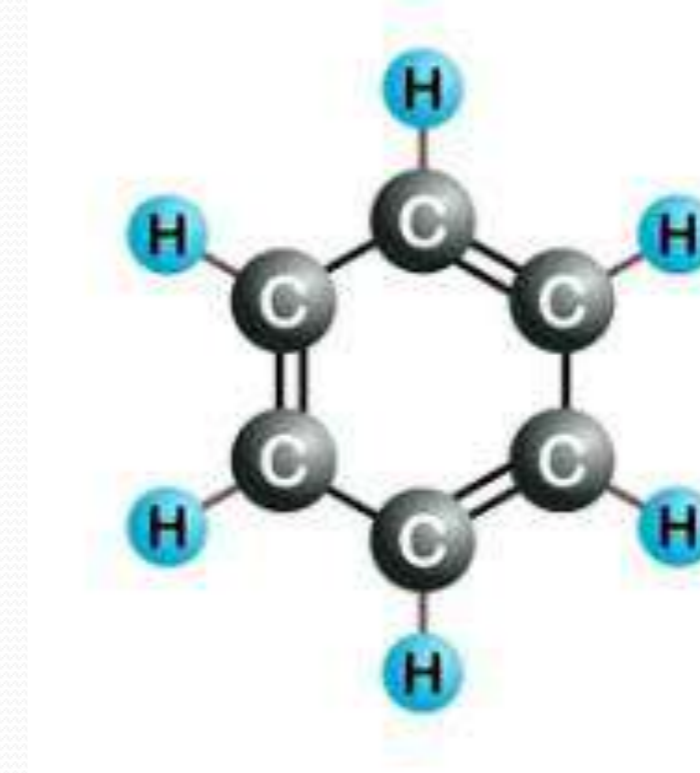
Hours on a clock:  $\mathbb{Z}_{12}$  or  $\mathbb{Z}_{24}$

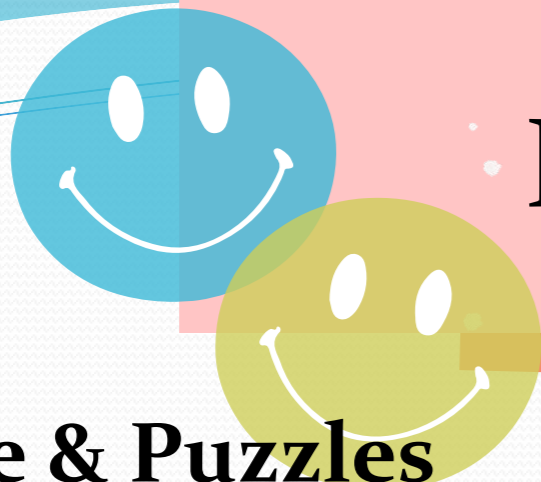
Calendar calculations, scheduling recurring events, leap year cycles all use cyclic group arithmetic



## 7. Chemistry — Molecular Rings

Benzene ( $C_6H_6$ ) has cyclic symmetry group  $C_6$  — used in designing plastics, dyes, pharmaceuticals





# Permutation Groups — Real Life Uses

## 1. Rubik's Cube & Puzzles

All Rubik's Cube states form a **permutation group** — a subgroup of  $S_{48}$   
Total states: ~43 quintillion = the order of the Rubik's group



## 2. DNA & Genetics

**DNA strand operations** — replication, transcription, and mutation are modeled as permutations of base pairs

Comparing **genome sequences** uses permutation distance metrics

**Protein folding symmetries** are analyzed using permutation groups

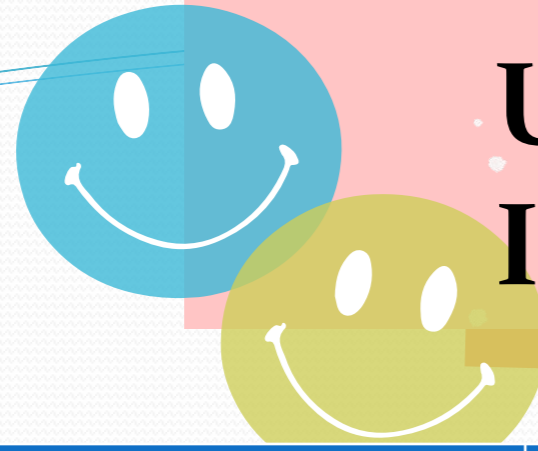
Helps identify which genetic mutations are structurally equivalent



## 3. Robotics & Manufacturing

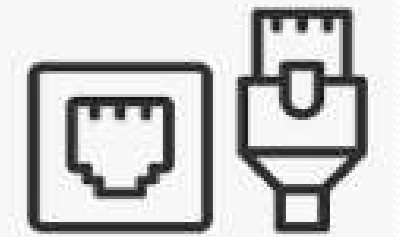
A **robot arm** with  $n$  joints — all reachable configurations form a permutation

Assembly line scheduling: arranging  $n$  tasks in optimal order = permutation optimization

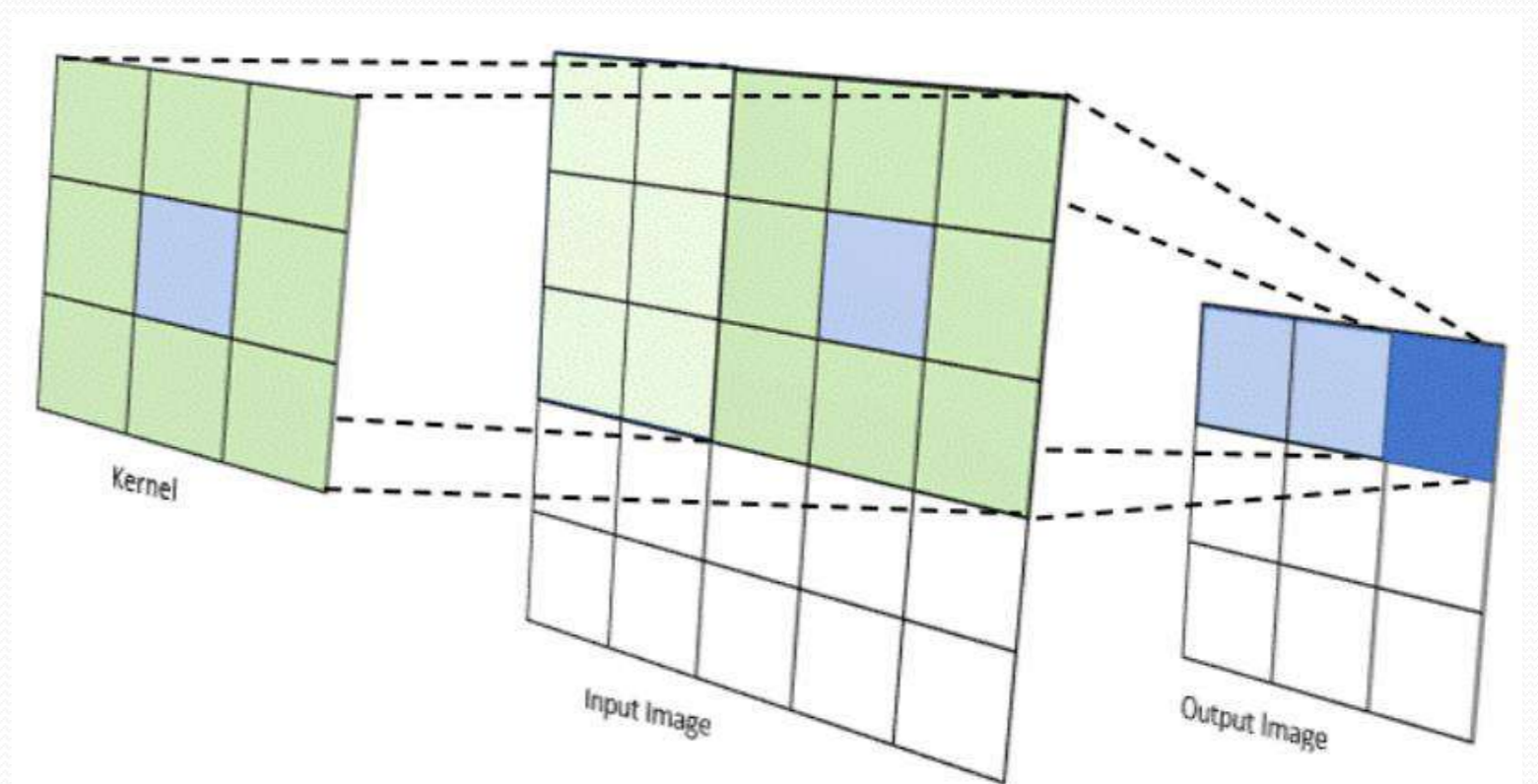


# Unit:-2 Ring ,Field and Integral Domain , Ideals

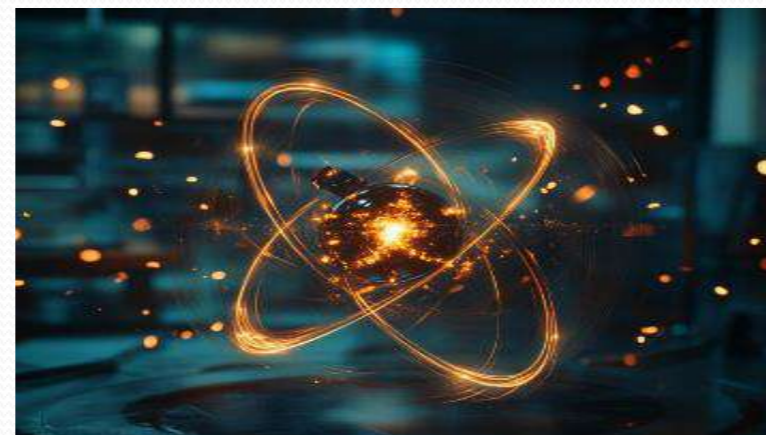
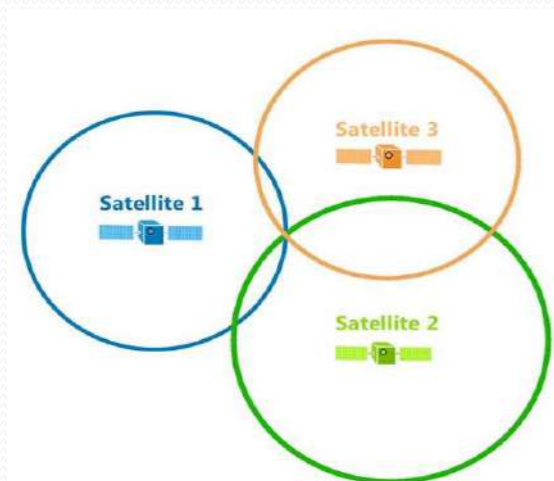
Topic	Application Area	Specific Real Use
Rings	Cryptography	Post-quantum Ring-LWE encryption
	Hardware	CPU integer overflow arithmetic
	Data integrity	CRC checks in USB/Ethernet
Fields	Graphics	Image convolution, filters
	Encryption	AES in $GF(2^8)$
	Communication	5G OFDM, Reed-Solomon codes
	Navigation	GPS trilateration
	Finance	Black-Scholes option pricing
Physics	Quantum field theory	



Post-quantum Ring-LWE encryption



Convolution Visualized (Kernel already flipped)



<b>Integral Domains</b>	Cryptography	RSA unique factorization security
	Engineering	Polynomial system modeling
	CAD	Geometric intersection computation
<b>Ideals</b>	Post-quantum crypto	CRYSTALS-Kyber (NIST standard)
	Robotics	Inverse kinematics solving
	Coding theory	Cyclic codes as ideals
	Computer vision	3D reconstruction from photos
	Chemistry	Reaction network equilibria

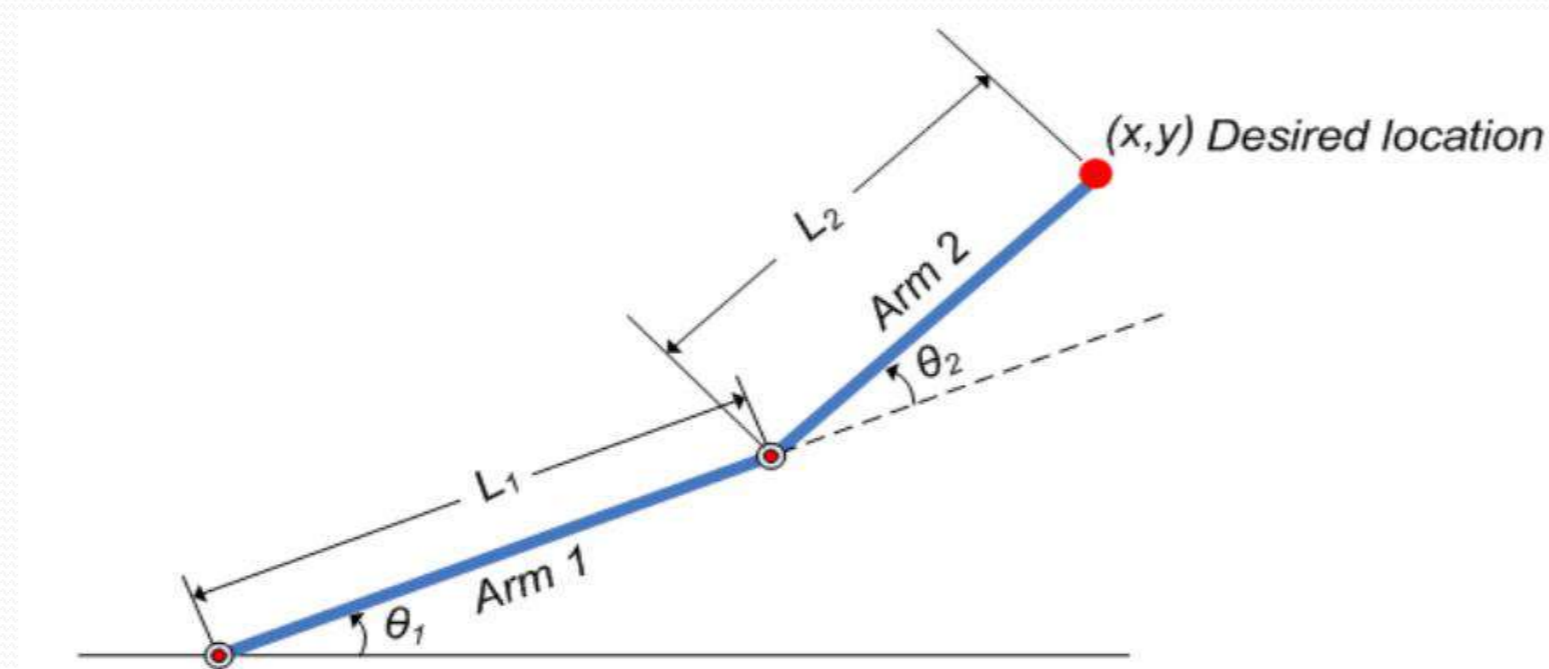
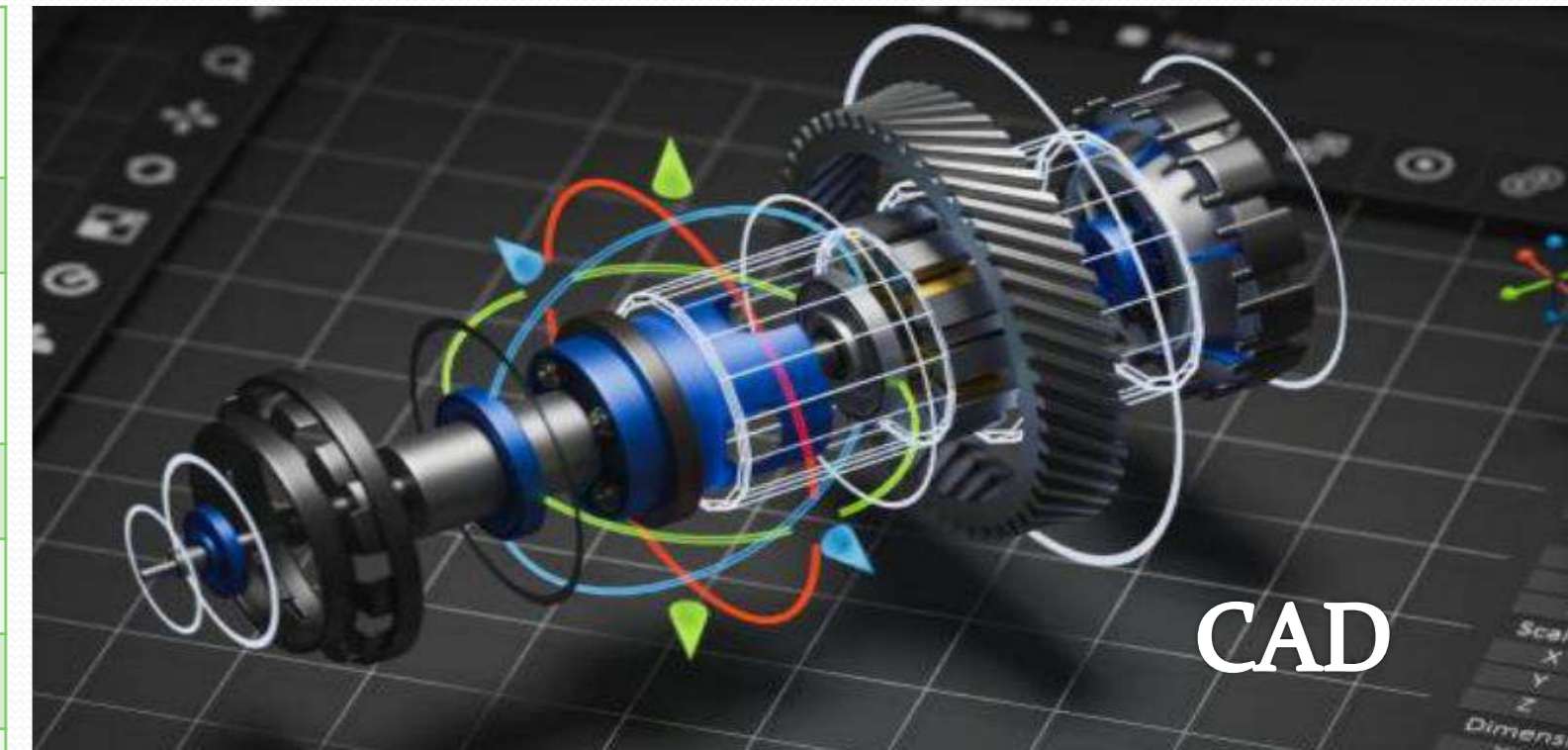
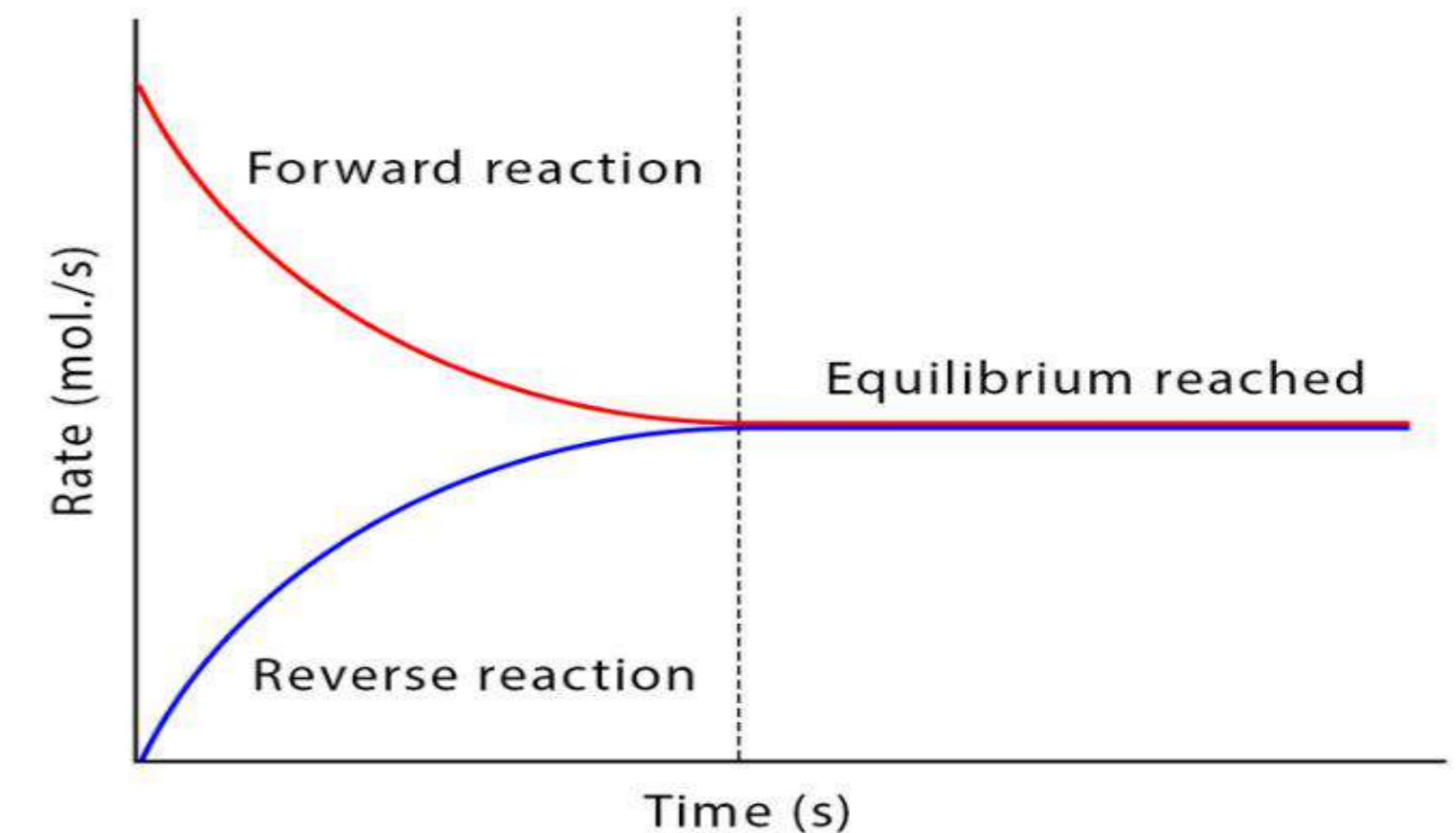
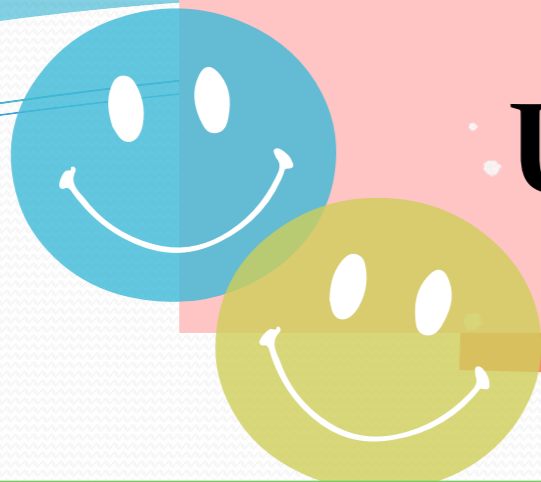


Figure 1: Illustration showing the two-joint robotic arm with the two angles, theta1 and theta2



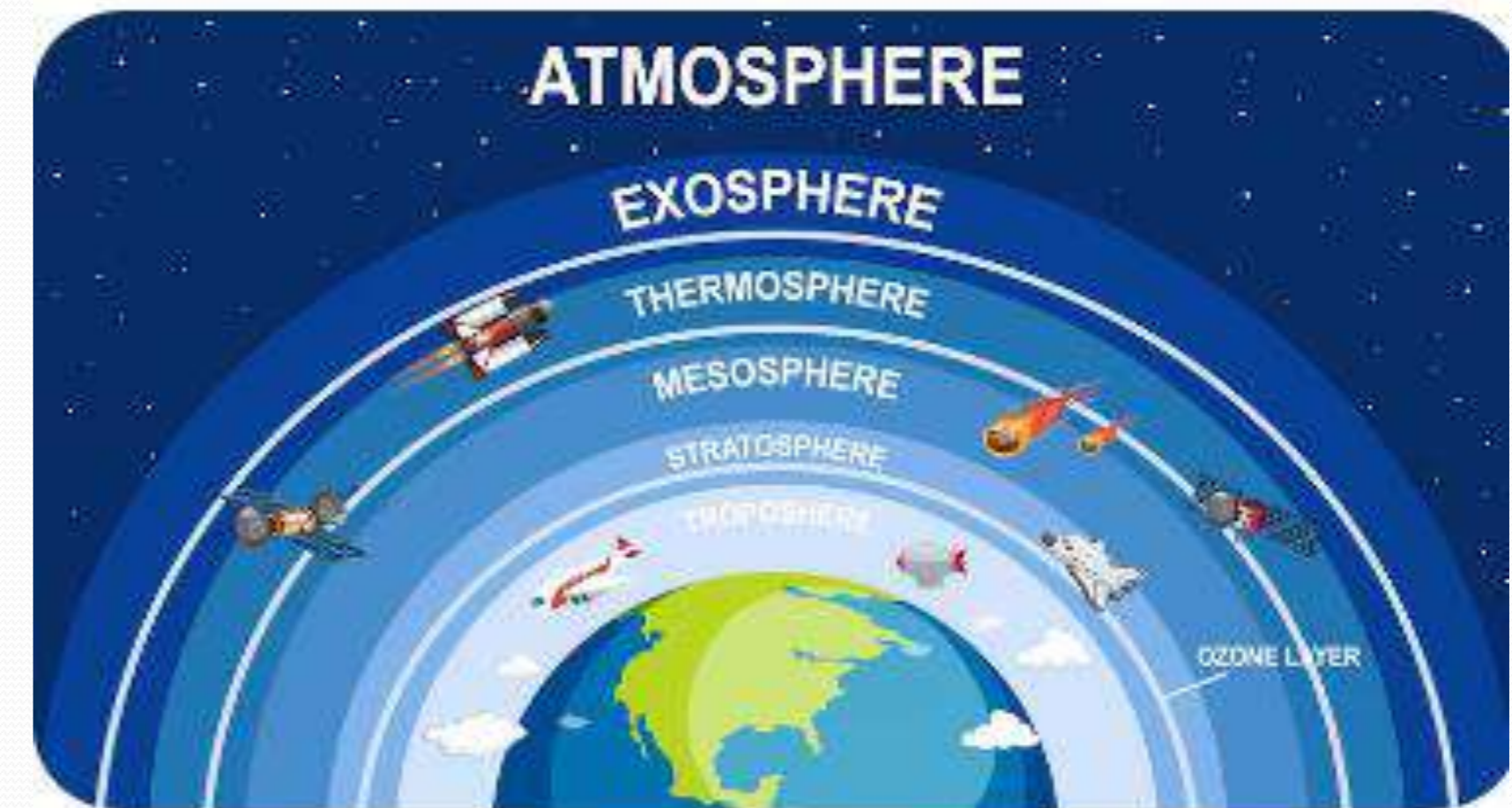
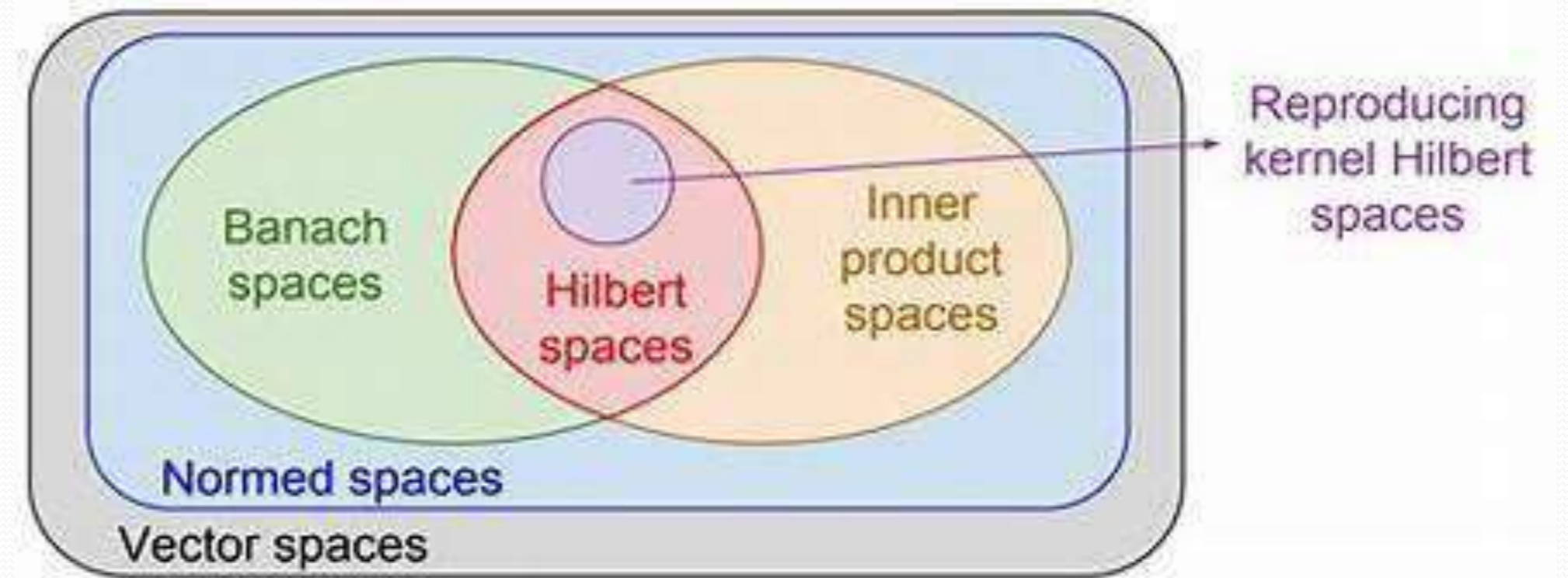


# Unit:-3 Vector Spaces uses

Field	Vector Space Use	Real Example
AI / NLP	Word embeddings	Google Search, ChatGPT
AI / ML	Neural network layers	GPT, image recognition
Gaming	3D transformations	Unity, Unreal, PS5
Graphics	Ray tracing, lighting	Pixar, RTX GPUs
Audio	Fourier basis decomposition	MP3, noise cancellation
Images	DCT compression	JPEG, Netflix streaming
5G	MIMO beamforming	Wireless networks



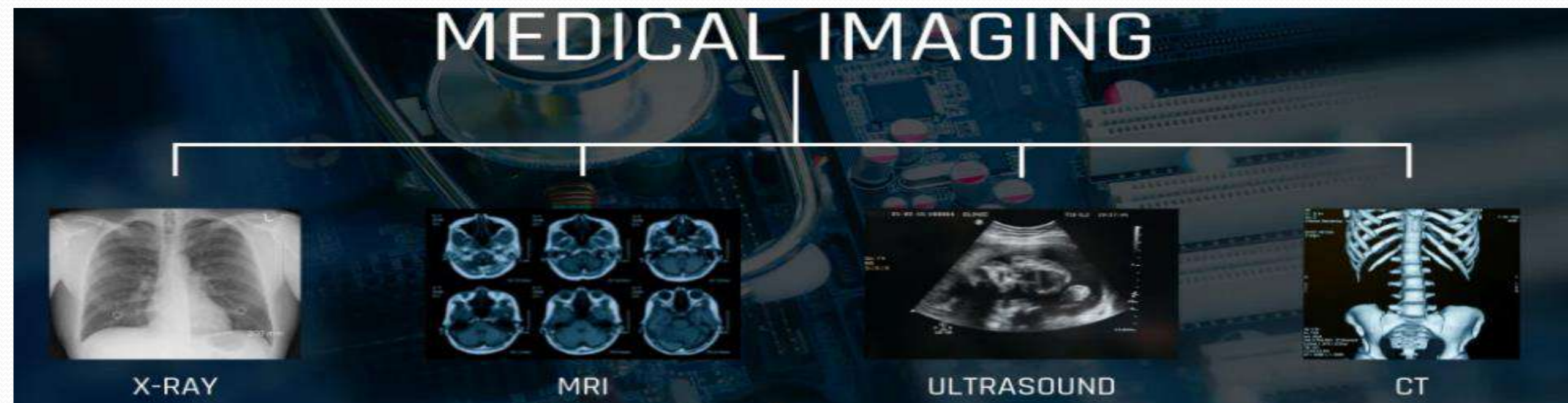
Medicine	MRI reconstruction	Hospital imaging
Genomics	Gene expression vectors	Cancer diagnosis
Quantum	Hilbert space states	Quantum computing
Engineering	FEA stress analysis	Bridges, aircraft
Finance	Portfolio optimization	Hedge funds
Climate	Atmospheric state vectors	Weather forecasting
Crypto	Lattice hard problems	Post-quantum security
Search	PageRank eigenvector	Google



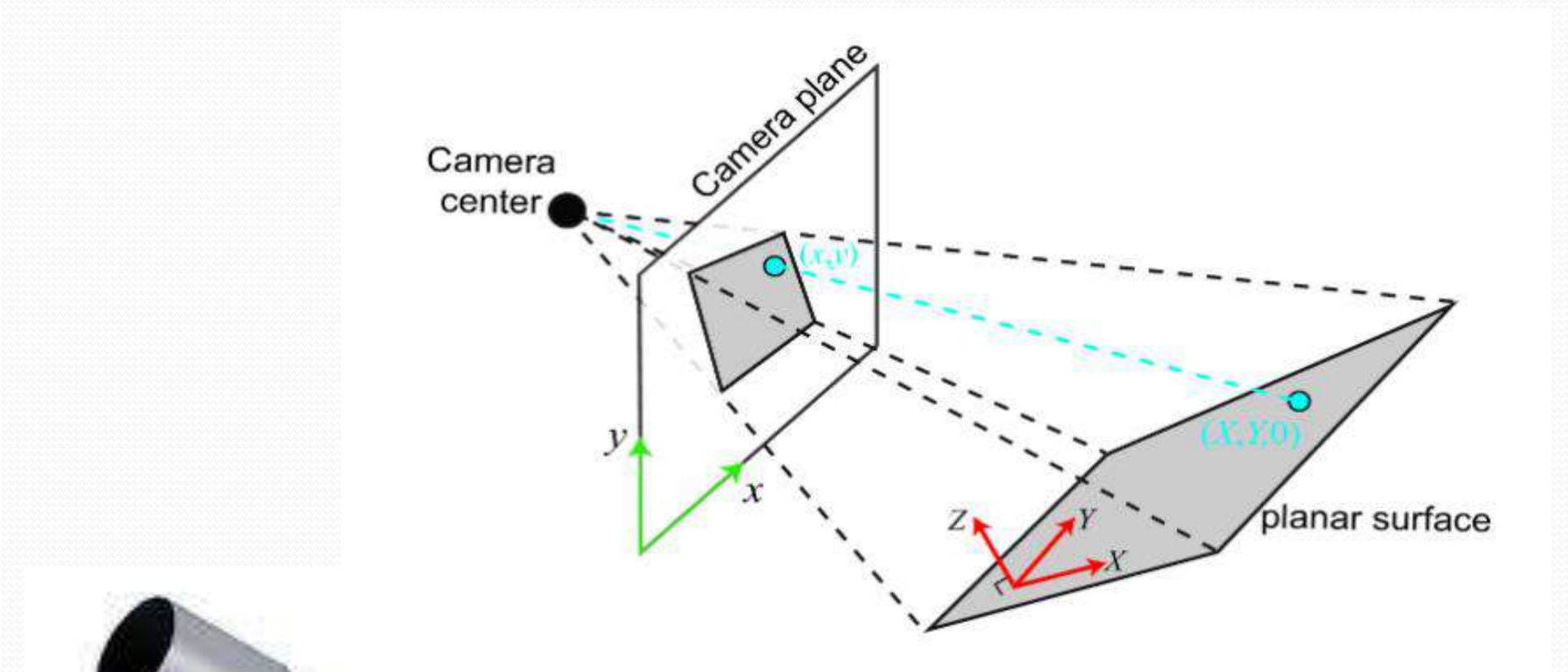


# Unit:-4 Linear Transformation uses

Domain	Linear Transformation	Specific Application
AI / Deep Learning	Weight matrix multiplication	ChatGPT, image recognition
Transformers	Q, K, V projections	BERT, GPT, Claude
Graphics	MVP matrix pipeline	Unity, PS5, Unreal
Animation	Bone skinning transforms	Pixar, game characters
Image Processing	Convolution, DCT	JPEG, Instagram filters
Audio	DFT, convolution	MP3, noise cancellation
Video	DCT per block	Netflix, YouTube, Zoom
MRI	Inverse Fourier transform	Medical imaging



CT Scan	Inverse Radon transform	Cancer diagnosis
5G / WiFi	MIMO channel matrix	Wireless communication
OFDM	DFT / IDFT pair	4G, 5G, WiFi
Robotics	Homogeneous transforms	Robot arms, SLAM
Autonomous Cars	Homography, projection	Tesla, Waymo
Navigation	Kalman filter matrices	GPS, autopilot
Quantum Computing	Unitary gate matrices	IBM Quantum, Google
Structural Eng.	Stiffness matrix $Ku=f$	Bridges, aircraft
Optics	ABCD ray matrices	Camera, telescope design



Homography, projection



Thank

You





## Table of contents :-

Daily life uses of  
unit 1 - Isomorphism theorem ,  
cyclic and permutations groups.  
unit 2 - Ring , Field and integral  
domain, ideals  
unit 3 - Vector Spaces  
unit 4 - Linear transformation

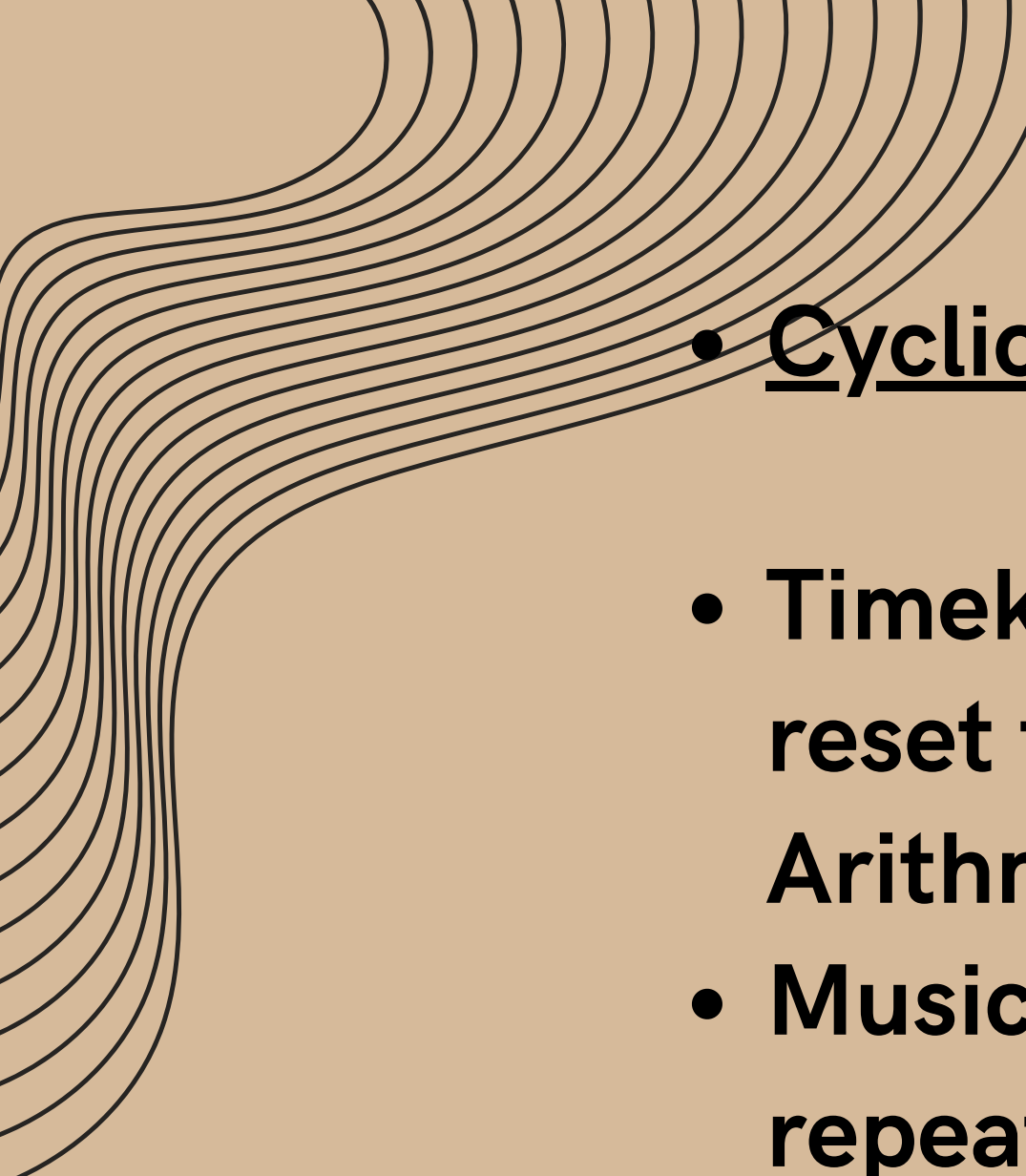
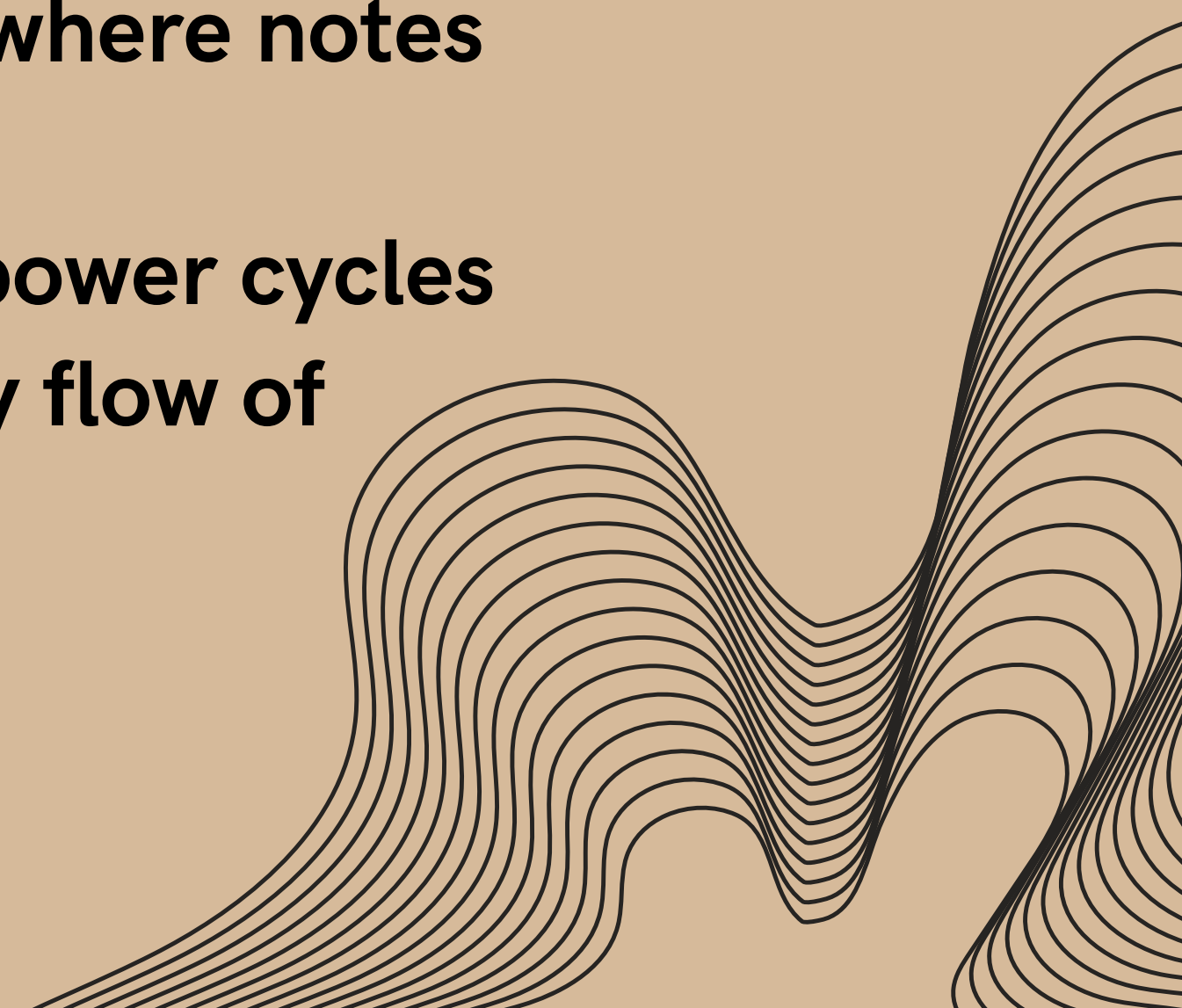


- DAILY LIFE USES OF-

## Unit 1 - Isomorphism theorems, Cyclic and permutation Group

- Isomorphism Theorems (Structural Mapping):
- **Data Compression & Encryption:** Mapping complex data into simpler structures without losing information.
- **Pattern Matching:** Used in computer vision to recognize that two different-looking shapes are structurally the same.
- **Chemical Databases:** Identifying identical molecular structures regardless of how they are drawn.


$$ax^2 + bx + c = 0$$

- 
- **Cyclic Groups (The "Repeating" Principle)**
  - **Timekeeping: The 12-hour clock and 7-day week reset to 1 after reaching their limit (Modular Arithmetic).**
  - **Music: The 12-tone scale (octaves) where notes repeat in a fixed, circular pattern.**
  - **Power Grids: Three-phase electric power cycles through phases to maintain a steady flow of energy.**
- 


**MATH**



## Permutation Groups (The "Ordering" Principle)

- **Digital Security: Passwords and PINs, where the specific order of the same characters creates a unique identity.**
  - **Scheduling: Organizing flight paths or delivery routes to find the most efficient sequence.**
  - **Gaming: Shuffling cards or solving a Rubik's Cube, which are essentially exercises in manipulating permutation groups.**
- 

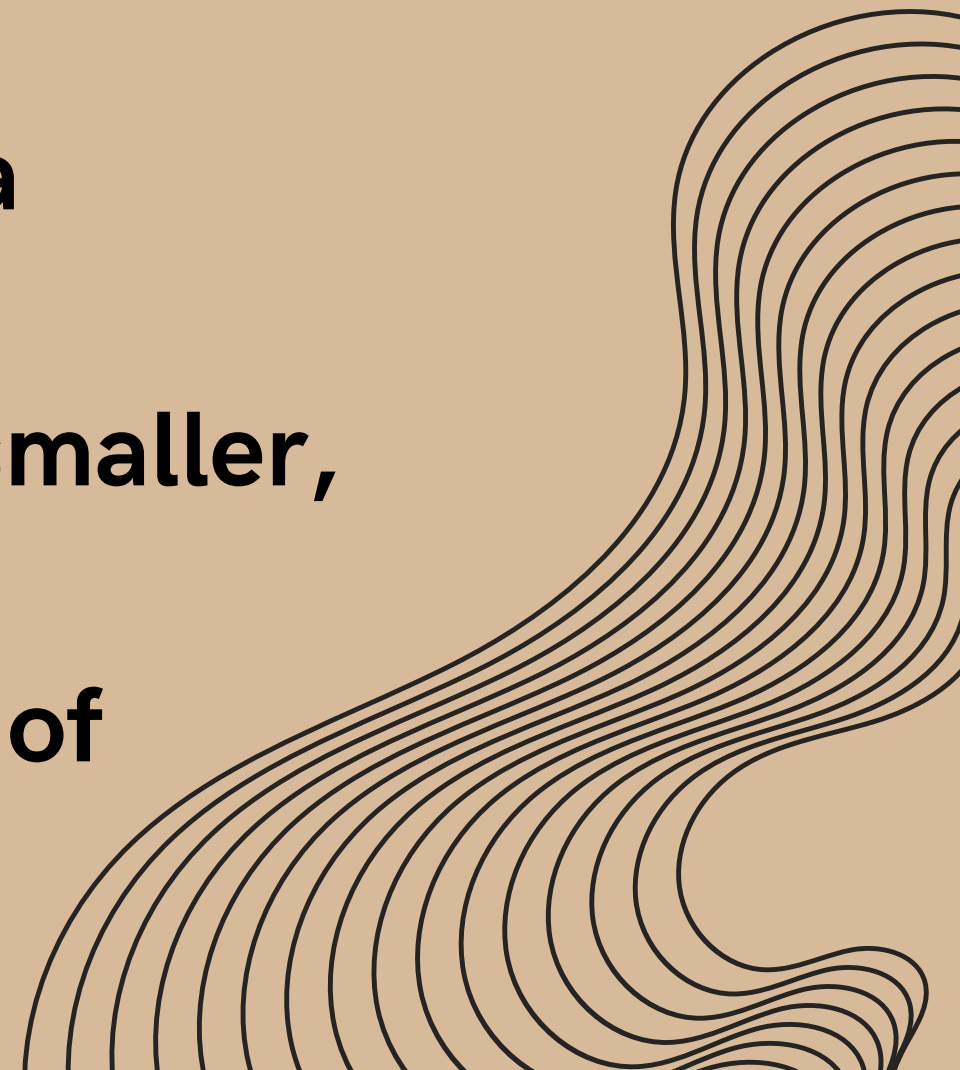
# Summary Table of Daily Applications

Concept 	Core Idea	Daily/Practical Use
<b>Isomorphism</b>	Same structure, different form	Image/pattern recognition, database search, cryptography
<b>Cyclic Group</b>	Elements repeat in a circle	Clocks, music theory (octaves), snowflake symmetry
<b>Permutation Group</b>	Rearranging order of objects	Rubik's cube, card shuffling, scheduling, sorting algorithms


# Unit 2 - Ring, Field andr integral Domain, Ideals

- Rings (Addition + Multiplication)
- **Cryptography:** Modern encryption (like AES) treats data as elements of a ring to scramble sensitive info.
- **3D Graphics:** Matrix rings allow computers to calculate rotations and lighting in video games and movies.
- **Modular Arithmetic:** The math behind barcode/ISBN validation relies on ring structures to catch typing errors.
  
- Fields (Division + Total Flexibility)
- **QR Codes:** Use "Finite Fields" to build in error correction, allowing the code to be read even if it's dirty or torn.
- **Mobile Networks:** 5G and Wi-Fi signals use field arithmetic to pack data into radio waves without interference.
- **Satellite TV:** Corrects "noise" in the signal during storms using Reed-

- **Integral Domains (Consistency + No Zero-Divisors)**
- **Secure Keys:** The RSA algorithm relies on the properties of integral domains to ensure that unique decryption keys exist.
- **Data Integrity:** Guarantees that if a calculation starts with non-zero data, it won't "vanish" or become zero during processing.
- **Ideals (Subsets for Filtering)**
- **File Verification:** Used in Check-sums to verify that a downloaded file is identical to the original.
- **Data Compression:** Helps "map" complex data into smaller, simplified sets (Quotient Rings) for faster storage.
- **Robotics:** Polynomial ideals help calculate the range of motion for robotic arms in factories.



## Unit 3 - Vector Spaces

- **GPS & Mapping:** Calculating your precise position, direction, and speed relative to a destination.
  - **Search Engines:** Converting words into "word vectors" to find relevant results based on how similar they are in meaning.
  - **Computer Graphics:** Rendering 3D shapes, shadows, and movement in video games and movies.
  - **Streaming Recommendations:** Representing your movie/music tastes as a point in a vector space to find nearby matches you might like.
  - **Digital Imaging:** Storing and editing photos, where each pixel's color and position are treated as vector coordinates.
  - **Structural Engineering:** Balancing competing forces (gravity, wind, tension) to ensure buildings and bridges remain stable.
  - **AI & Facial Recognition:** Mapping facial landmarks (distance between eyes, nose shape) into a coordinate system to identify individuals.
- 

# Unit 4 - Linear transformation

- **Digital Photos: Scaling (resizing), rotating, and flipping images.**
- **Computer Graphics: Rendering 3D characters and environments onto a 2D screen.**
- **Social Media Filters: Applying effects that distort or adjust facial features in real-time.**
- **GPS & Maps: Converting spherical Earth coordinates into flat, readable maps on your phone.**
- **Search Engines: Organizing and ranking web pages based on relevance using vector-based algorithms.**
- **Audio Processing: Adjusting volume or applying equalizers to music files.**
- **Data Compression: Shrinking file sizes (like JPEGs) while maintaining image quality.**



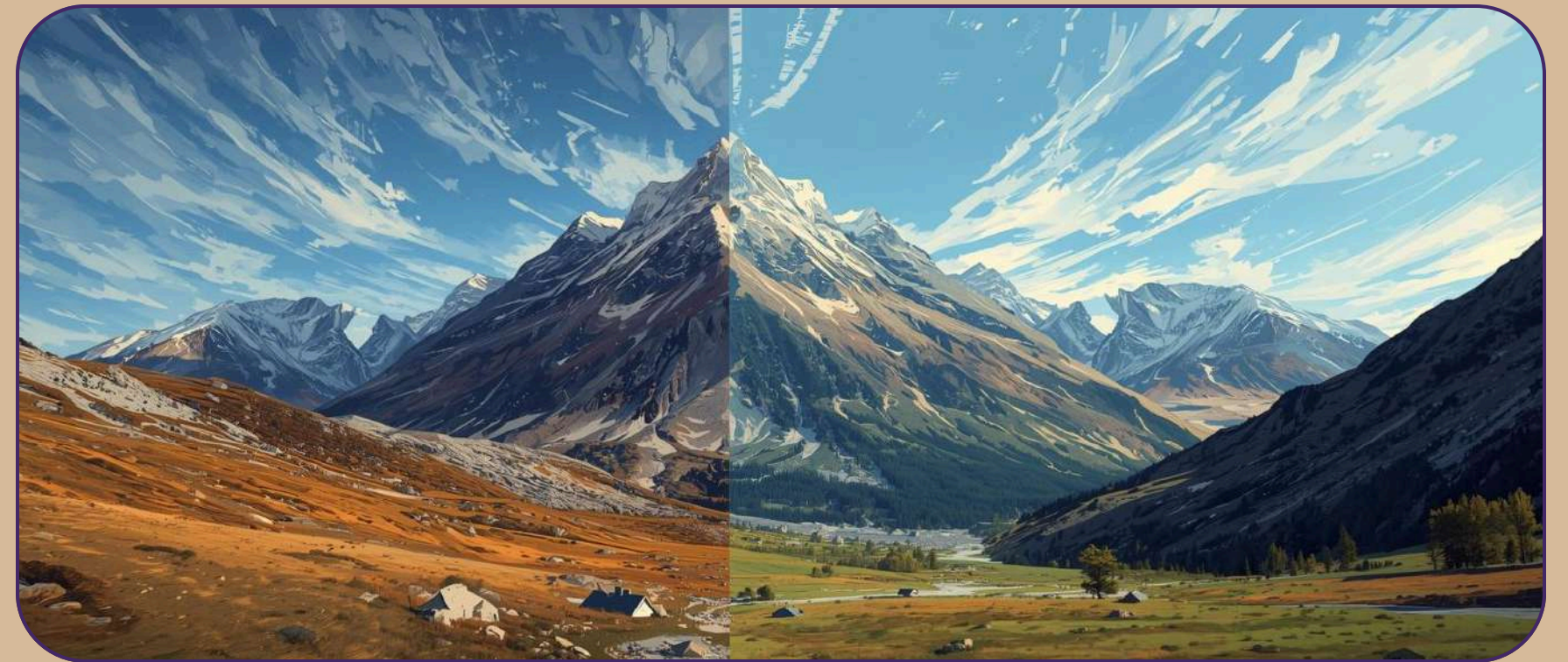
# Linear Transformations

- **Linear transformations are key mathematical tools that stretch, rotate, and project data representations, allowing for flexible manipulation in various applications such as graphics and machine learning.**



# Before and After Transformations

**Linear transformations allow us to manipulate images effectively, showcasing the differences between raw data and its transformed state for enhanced clarity and comprehension.**



Thank you

