

Department: Mathematics

Course Title: Transformation Geometry

Course Code: Math 2052

Credit hours: 3 , **Contact hrs: 3** , **Tutorial hrs: 2**, **Course category:** Compulsory

Course description: This course covers group of transformations, Affine Geometry, orthogonal transformations, orientation preserving transformations, representation of orthogonal transformations, similarity transformations, Affine transformations, and projective transformations.

Course Objectives

On completion of the course, successful students will be able to:

- understand the basic properties of transformations,
- recognize the axioms and the associated theorems of affine geometry,
- understand the basic properties of orthogonal transformations,
- understand the basic similarity transformations and their representations,
- understand the basic properties of affine transformations,
- identify several classes of affine transformations,
- understand the relationship between affine transformations and linear mappings.

Chapter 1: Transformations and Collineations

1.1 Definition of Transformation and Collineation

1.2 Properties of Transformations

1.3 Groups of Transformations

1.4 Examples of group of Transformations

Chapter 2: Affine Geometry

2.1 Axioms of an affine space

2.2 Geometry in an affine space

2.3 Lines and planes in an affine space

2.4 Concurrency

2.5 Classical Theorems (Menelaus, Ceva, Desargues, and Pappus)

Chapter 3: Orthogonal transformations

- 3.1 Properties of orthogonal transformations
- 3.2 Orientation preserving and orientation reversing orthogonal transformations
- 3.3 The fundamental types of orthogonal transformations of the plane (**translations**)
- 3.3 The fundamental types of orthogonal transformations of the plane (**reflections**)
- 3.3 The fundamental types of orthogonal transformations of the plane (**rotation**)
- 3.4 Representation of orthogonal transformations as product of the fundamental orthogonal transformations
- 3.5 Orthogonal transformations of the plane in coordinates

Chapter 4: Similarity Transformations

- 4.1 Properties of similarity Transformations
- 4.2 Homothetic Transformations
- 4.3 Representation of similarity transformations as the product of homothetic and orthogonal transformations
- 4.4 Similarity transformations of the plane in coordinates.

Chapter 5: Affine Transformations

- 5.1 Definition and examples of affine transformations (orthogonal and Similarity transformations)
- 5.1 Definition and examples of affine transformations (Skew reflection, compressions, Shear)
- 5.2 Properties of Affine transformations
- 5.3 Affine transformations and linear mappings

Textbooks:

- G. E. Martin, Transformation geometry: An introduction to symmetry, Springer-Verlag, 2009
- P. S. Modenov, Geometric transformation

Recommended References

1. Judith N. Cedrberg, A course in modern geometries, 2nd ed., 2001
2. David A. Thomas, Modern geometry, 2002
3. Edward C. Wallace & Stephen F. West, Roads to geometry, 3rd ed., 2004
4. College geometry: A problem solving approach with applications, 2nd ed., 2008