Kotebe University of Education
College of Natural and Computational Sciences
Department of Mathematics

Course Syllabus on ‘Fundamental Concepts of Geometry’

Course Code: Math 2052

Credit Hours/ ECTS: 3, **Contact hrs:** 3, **Tutorial hrs:** 2

Length of time to complete the course: 16 weeks

Total number of load hours the student will carry to complete the course: 189 hrs

Prerequisite courses: Math 2042, Math 2052

Course category: Compulsory

Year: II Semester: II

Program: B.SC. in Mathematics

Aims

The course intends to introduce students to various types of elementary geometry from an advanced standpoint. The axiomatic approaches dealt with in the course empower students in performing advanced mathematical proofs in subsequent courses.

Course description

This course covers absolute geometry, Euclidean geometry and its consistency, Hyperbolic geometry and its consistency.

Learning Outcomes

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

- understand the basic notions in absolute geometry,
- apply concepts of algebraic geometry in Euclidian and hyperbolic geometry,
- apply the distance function and related concepts to prove the congruence between triangles,

- understand the basic axioms of Euclidian geometry and its consistency,
- apply axioms and theorems to solve different problems,
- understand the properties of congruence and similarity theorems and apply them to solve problems,
- understand the basic axioms and unique properties of hyperbolic geometry and its consistency,
- understand The Poincare Model,
- distinguish the difference between Euclidian and hyperbolic geometry,
- develop skills in mathematical proofs.

Mode of Delivery: This course will be offered in a semester based mode of delivery

Course Contents

1. **Absolute geometry (12 hrs)**

   1.1 Axioms of incidence

   1.2 Distance functions and the ruler postulate

   1.3 The axiom of betweenness

   1.4 Plane separation postulate

   1.5 Angular measure

   1.6 Congruence between triangles

   1.7 Geometric inequalities

   1.8 Sufficient conditions for parallelism

   1.9 Saccheri quadrilaterals

   1.10 The angle-sum inequality for triangles

   1.11 The critical function

   1.12 Open triangles and critically parallel rays

2. **The Euclidean geometry (9 hrs)**

   2.1 Parallel postulate and some consequences

   2.2 The Euclidean parallel projections

   2.3 The basic similarity theorem

   2.4 Similarity between triangles

   2.5 The Pythagorean theorem

2.6 Equivalent forms of the parallel postulate

3. **Hyperbolic geometry (9 hrs)**

   3.1 The Poincare model

   3.2 The Hyperbolic parallel postulate

   3.3 Closed triangles and angle sum

   3.4 The defect of a triangle and the collapse of similarity theorem

4. **The consistency of the Hyperbolic geometry (9 hrs)**

   4.1 Inversion of a punctured plane

   4.2 Cross ratio and inversion

   4.3 Angular measure and inversion

   4.4 Reflection across L-line in the Poincare model

   4.5 Uniqueness of the L-lines through two points

   4.6 The ruler postulate; betweenness: Plane separation and angular measure

5. **The consistency of the Euclidean geometry (9 hrs)**

   5.1 The coordinate plane and isometries

   5.2 The ruler postulate

   5.3 Incidence and parallelism

   5.4 Translations and rotations

   5.5 Plane separation postulate

   5.6 Angle congruence

Teaching-Learning Strategy/Methods

Lectures, Tutorial, Group Assignments

Assessment Strategy/Methods

- Assignment: 20%
- Tests: 30%
- Semester Examination: 50%

Course Policy

A student has to

- Attend at least 85% of the classes
- Take all continuous assessments
- Take final examination
- Respect all rules and regulations of the university

References

[1] Getinet and et. al. (2010). Fundamental concepts of geometry. Haramaya University, (unpublished).

[2] Martin, G. E. (2012). The foundations of geometry and the non-Euclidean plane. Springer Science & Business Media.

[3] Moise, E. E. (1990). Elementary geometry from an advanced standpoint. Addison-Wesley.

[4] Cederberg, J. N. (2013). A course in modern geometries. Springer Science & Business Media.

[5] Faber, R. L. (1983). Foundations of Euclidean and non-Euclidean geometry. New York/Basel: Dekker.

[6] Greenberg, M. J. (1993). Euclidean and non-Euclidean geometries: Development and history, Macmillan.

[7] Meserve, B. E. (2014). Fundamental concepts of geometry. Courier Corporation.

[8] Thomas, D. A. (2002). Modern geometry. Brooks/Cole.