

**MATH 379 : Foundations of Euclidean and Non-Euclidean Geometry**  
**4(3+1+0) credit hours**

**Prerequisites:** Math 202, Math 246

**Textbook:** Euclidean and Non-Euclidean Geometry: An Analytic Approach,  
by Patrick J. Ryan, Cambridge University Press (1986).

**Some Other Relevant Books:**

- Introduction to Geometry, by H. S. M. Coxeter, Wiley (1989).
- ~~Non-Euclidean Geometry, by H. S. M. Coxeter, Cambridge University Press (1999)~~

**Course Description:**

**Chapter 1. Plane Euclidean geometry (3 weeks)**

The Euclidean plane  $E^2$ . Perpendicular lines. Parallel and intersecting lines. Reflections. Congruence and isometries. Symmetry groups. Translations. Rotations. Reflections. The isometry group of  $E^2$ . Fixed points and fixed lines of isometries.

**Chapter 2. Affine transformations in the Euclidean plane (3 weeks)**

Affine transformations. Fixed lines. The affine group  $AF(2)$ . Fundamental theorem of affine geometry. Affine reflections. Dilatations. Similarities. Affine symmetries. Triangles and their symmetries. Congruence theorems for triangles. Angle sums for triangles.

**Chapter 3. The projective plane (3 weeks)**

The definition and properties of the projective plane  $P^2$ . Homogeneous coordinates. The projective group. The fundamental theorem of projective geometry. Distance and the triangle inequality in  $P^2$ . Isometries and motions.

**Chapter 4. The hyperbolic plane (3 weeks)**

Algebraic preliminaries. Incidence geometry of  $H^2$ . Perpendicular lines. Pencils. Distance in  $H^2$ . Isometries of  $H^2$ . Reflections. Motions. Rotations.  $H^2$  as a subset of  $P^2$ . Parallel displacements. Translations. Glide reflections. Products of more than three reflections. Fixed points of isometries. Fixed lines of isometries.

**Chapter 5. Classification of isometries of the hyperbolic plane (2 weeks)**

Segments, rays, angles, and triangles in  $H^2$ . Triangles and hyperbolic trigonometry. Asymptotic triangles. Classification of isometries of  $H^2$ . Circles, horocycles, and equidistant curves.

**MATH 379 : Foundations of Euclidean and Non-Euclidean Geometry 4(3+1+0) credit hours**

The Euclidean plane  $E^2$ . Transformations in  $E^2$ . The isometry group of  $E^2$ . Affine transformations in  $E^2$ . The affine group  $AF(2)$ . The projective plane  $P^2$ . Homogeneous coordinates. The projective group. The hyperbolic plane  $H^2$ . Parallel and Perpendicular lines. Distance in  $H^2$ . Isometries of  $H^2$ . Triangles in  $H^2$  and hyperbolic trigonometry.

---

379 رياض : أسس الهندسة الإقليدية 4(3+1+0) ساعة معتمدة

المستوى الإقليدي  $E^2$ . التحويلات في  $E^2$ . زمرة التقاسيم للمستوى الإقليدي. التحويلات التآلفية للمستوى الإقليدي. زمرة التآلفية  $AF(2)$ . المستوى الإسقاطي  $P^2$ . الإحداثيات المتجانسة. الزمرة الإسقاطية. المستوى الزائدي  $H^2$ . المستقيمت المتوازية والمتعامدة. المسافة في  $H^2$ . تقاسيم  $H^2$ . المثلثات في  $H^2$  وحساب المثلثات الزائدي.

---

**Prerequisites:** Math 202, Math 246

**Textbook:** Euclidean and Non-Euclidean Geometry: An Analytic Approach, by Patrick J. Ryan, Cambridge University Press (1986).

**Reference:** Introduction to Geometry, by H. S. M. Coxeter, Wiley (1989).