

**Tennessee Technological University**  
**Mathematics Department**

**MATH 3430: College Geometry**

**I. COURSE DESCRIPTION FROM CATALOG:**

A rigorous development of geometry from first concepts using the metric approach. Topics include constructions and hyperbolic geometry. Lec. 3. Cr. 3.

**II. PREREQUISITE(S):**

C or better in MATH 3400. It is recommended that students complete MATH 2010 Matrix Algebra before taking this class.

**III. COURSE OBJECTIVE(S):**

- To provide an introduction to various geometric systems using the axiomatic and synthetic approaches
- To emphasize paragraph proofs
- To present an analytical model of the Euclidean plane
- To present and classify geometrical transformations of the Euclidean plane
- To introduce students to technology such as *The Geometer's Sketchpad*

**IV. STUDENT LEARNING OUTCOMES:**

Upon successful completion of the course students will understand basic properties of axiomatic systems, including consistency, independence, and completeness, as well as the role of geometric models in establishing these properties; understand geometric and affine transformations of the Euclidean plane and understand an analytic model of the Euclidean plane; understand axioms of hyperbolic and elliptic geometries, including Playfair's Axiom and Dedekind's Axiom of Continuity, and how these axioms differ from those of Euclidean geometry; be able to prove propositions in hyperbolic geometry; understand the concept of duality and be able to check if a set of axioms satisfies the principle of duality; and be able to prove propositions in finite geometries on the basis of the given axioms using Aristotelian logic.

**V. TOPICS TO BE COVERED:**

Axiomatic systems and finite geometries:

Checking independence, completeness, and consistency of axioms via models. Finite geometries such as three-point geometry, four-point geometry, finite projective planes. Applications to error-correcting codes Desargues' Configurations (optional)

Non-Euclidean geometry:

Review of Euclid's postulates and the First 30 propositions of *Elements, Book I*. The Fifth Postulate and its negation. Study of hyperbolic geometry (sensed parallels, asymptotic triangles, Saccheri quadrilaterals, area of triangles, ultra parallels). Brief study of single and double elliptic geometries through models. Geometric transformations of the Euclidean plane:

- (a) Line and point reflections, rotations and finite symmetry groups –exploration
- (b) Translations and frieze pattern symmetries –exploration
- (c) An analytic (affine) model of the Euclidean plane

- (d) Transformations of the Euclidean plane and their classification: isometries (direct and indirect), similarity transformations, affine transformations
- (e) Frieze and wallpaper patterns and their symmetries
- (f) Plane tilings –exploration

**VI. ADDITIONAL INFORMATION:**

A combination of lectures, seminar, small group discussions, student presentations at the board, and/or computer explorations with *The Geometer's Sketchpad* as found appropriate by the instructor

**VII. POSSIBLE TEXTS AND REFERENCES:**

Edward C. Wallace and Stephen F. West, *Roads to Geometry*, Prentice Hall, 3<sup>rd</sup> edition, 2003.

Judith N. Cederberg, *A Course in Modern Geometries*, Second Edition, Springer-Verlag, New York, 2000, ISBN 0-387-98972-2

Wallace, *Roads to Geometry*, Third Edition, Pearson, ISBN 0-13-041396-8

Moise, *Elementary Geometry from an Advanced Standpoint*, Third Edition, Addison-Wesley, ISBN 0-201-50867-2

**References:**

*Journey into Geometrie*" by Martha Sved, Mathematical Association of America, Spectrum Series, 1997 (ISBN 0-883-85500-3)

Supplementary Mathematical Encyclopedia: [MacTutor History of Mathematics](#)

**VIII. ANY TECHNOLOGY THAT MAY BE USED:**

The Geometer's Sketchpad

**IX. STUDENT ACADEMIC MISCONDUCT POLICY:**

Maintaining high standards of academic integrity in every class at Tennessee Tech is critical to the reputation of Tennessee Tech, its students, alumni, and the employers of Tennessee Tech graduates. The Student Academic Misconduct Policy describes the definitions of academic misconduct and policies and procedures for addressing Academic Misconduct at Tennessee Tech. For details, view the Tennessee Tech's Policy 217 – Student Academic Misconduct at [Policy Central](#).

**X. DISABILITY ACCOMMODATION:**

Students with a disability requiring accommodations should contact the Office of Disability Services (ODS). An Accommodation Request (AR) should be completed as soon as possible, preferably by the end of the first week of the course. The ODS is located in the Roaden University Center, Room 112; phone 372-6119. For details, view the Tennessee Tech's Policy 340 – Services for Students with Disabilities at [Policy Central](#).