Department: Mathematical Sciences Semester Hours: 3

Course Title and Number: MATH 353 Axiomatic Geometry

Course Description: The study and development of geometric axiomatic systems. Topics selected from Hilbert's axioms for Euclidean geometry; projective, affine and Euclidean spaces over real vector spaces; convexity. Primarily intended for students preparing to teach mathematics.
PRQ: MATH 240 or consent of department.

Course Objectives: to gain functional understanding and skills for working with

- reasoning in general and mathematical reasoning in particular;
- the concepts of undefined terms, definitions, axioms, theorems, and their distinctions;
- axiom systems and models (examples) of such systems;
- relationships among and applications of various geometric concepts;
- Euclidean geometry as a particular example of more general types of geometries.

Syllabus (The first four topics covered in four weeks):

- Brief history of Euclidean geometry, parallel postulates, origins of non-Euclidean geometry.
- Examples of alternative planes (including the sphere and the Klein-Beltrami hyperbolic plane).
- Informal logic (including negations and indirect proof).
- Least upper bounds.
- Introduction to absolute planes (including betweenness and axioms for relative location of collinear points).
- Development of absolute planes (including separation and dual axioms for relative location of coterminal rays).
- Completion of axioms for absolute planes (including congruence and the side-angle-side criterion).
- Further structure of absolute planes (properties of triangles, perpendicularity, exterior angle inequality, triangle inequality, parallel lines).

Selective Bibliography:

H. Blau, **Foundations of Plane Geometry**, 2nd edition, Whittier Publications (2008).
M. J. Greenberg, **Euclidean and Non-Euclidean Geometries: Development and History**, W. H. Freeman (1993).
D. C. Kay, **College Geometry, a Discovery Approach**, Harper Collins (1994).
G. E. Martin, **The Foundations of Geometry and the Non-Euclidean Plane.**
E. C. Wallace and S. F. West, **Roads to Geometry**, 3rd edition, Prentice Hall (2004).