Math 4302 Foundations of Geometry (4 credits)
Course Information

Textbooks:

- *Euclidean and Non-Euclidean Geometries: Development and History, By Marvin Jay Greenberg , Published by W. H. Freeman, 4th edition*

- *Geometry Revisited, by H. S. M. Coxeter, Samuel L. Greitzer, Publisher: The Mathematical Association of America; 1st edition (1967), ISBN-10: 0883856190, ISBN-13: 9780883856192*

Course Prerequisite: Mathematics 2001 and a minimum of six credits in advanced Mathematics Department courses.

List of Topics:

- A brief history of Euclidean geometry

- Axioms of incidence - Examples of finite incidence geometries

- Affine and projective planes - Models of the real projective plane - Affine and projective planes based on finite fields

- Axioms of order - Segments, rays, and half-planes

- Angles and triangles - Inside of an angle and inside of a triangle - Pasch's theorem and crossbar theorem - Convexity

- Axioms of congruence - Segment comparison - Congruence of triangles

- SAS and ASA criteria for congruence of triangles - Isosceles triangles

- Supplementary angles - Vertical angles

- Angle addition and angle subtraction - Angle comparison

- Right angles and perpendicular lines - SSS criterion for congruence of triangles

- Alternate interior angles theorem - Exterior angle theorem - SAA and HL criteria for congruence of triangles

- Midpoints, angle bisectors, and perpendicular bisectors

- Inequalities involving triangles - Hinge theorem

- Axioms of continuity - Segment and angle measurements

- Sum of the internal angle measures of a triangle and Saccheri-Legendre theorem

- Parallel axiom - Axiomatic introduction to hyperbolic geometry - Equivalent statements to the parallel axiom - Models of the hyperbolic plane

- Parallelograms, parallel projection, and similar triangles - Area of a triangle

- Ceva's theorem - Menelaus's theorem

- Important points associated with triangles: circumcenter, incenter, centroid, and orthocenter

- Circles - Subtended arcs and angle measures

- Projective plane revisited: Theorems of Pappus, Desargues, and Pascal

- Simson's line - Ptolemy's theorem - Pedal triangles - Fagnano's theorem - Napoleon triangle theorem