Kutztown University
Kutztown, Pennsylvania

MAT 240: Synthetic Geometry

I. Three semester hours; three clock hours; a required course for Secondary Education mathematics majors.

II. Catalog Description:

MAT 240: Synthetic Geometry 3 s.h.

This course is designed for students who have, in addition to an interest in geometry, some previous experience in this subject are, either on the high school or college level. Topics include Euclidean geometry using Hilbert's axioms; neutral geometry; the historical development of non-Euclidean geometries; and hyperbolic geometry. Prerequisite: MAT 224.

III. Course Objectives:

The student will:

A. Recognize some of the flaws in Euclidean geometry.

B. Examine those foundations of Euclidean geometry using Hilbert's axioms.

C. Examine historical development of non-Euclidean geometry.

D. Study the basic fundamentals of neutral geometry.

E. Study the basic fundamentals of hyperbolic geometry.

F. Increase his/her capability for carrying out deductive proofs.

G. Understand the need for both intuitive and deductive thought processes in the doing of mathematics.

H. Understand and appreciate the nature of geometry.

IV. Course Outline:

A. The make-up of a Mathematical System

1. Undefined and defined terms
2. Mathematical statements
3. Rule of Logic
4. Models

B. Euclid's Geometry

1. Origins of geometry
2. Euclid's Postulates
3. The logical deficiencies of Euclid's geometry
4. The parallel postulate controversy

C. Hilbert's Axiom's

1. Axioms of incidence
2. Axioms of betweenness
3. Axioms of congruence
4. Axioms of continuity
5. Axioms of parallelism

D. Neutral Geometry

1. Axioms of neutral geometry
2. Saccheri - Lengendre Theorem
3. Angle sum of a triangle
4. Equivalence of a parallel postulates

E. Non-Euclidean Geometries - Hyperbolic Geometry

1. Historical events leading up to its discovery
2. Angle sum of a triangle and quadrilateral
3. Similar triangles
4. Classification of parallel lines
5. Area and Defect
6. The angle of parallelism

V. Instructional Resources

Greenberg, Marvin J. *Euclidean and Non-Euclidean Geometries.* San Francisco, CA: W. H. Freeman & Company, 1980.

Bennett, M. K. *Affine and Projective Geometry*. New York, NY: John Wiley & Sons, Inc. 1995.

Berele, A. and Goldman, J. *Geometry: Theorems and Constructions*. Upper Saddle River, NJ: Prentice Hall. 2001.

Coxeter, H. S. M. & Greitzer, S. L. *Geometry Revisited.* New York, NY: Random House, 1967.

Eves, H. *A Survey of Geometry.* 2 vols. Boston, MA: Allyn and Bacon, 1965.

Hansberger, R. *Episodes in Nineteenth and Twentieth Century Euclidean Geometry*. Washington, D.C.: Mathematical Association of America, 1995.

Henderson, D. W. *Differential Geometry: A Geometric Introduction*. Upper Saddle River, NJ; Prentice Hall. 1998.

Henderson, D. W. *Experiencing Geometry in Euclidean, Spherical, and Hyperbolic Spaces*. Second Ed. Upper Saddle River, NJ: Prentice Hall. 2001.

Isaacs. I.M. *Geometry for College Students*. Brooks/Cole Pub. Co. 2001.

Kay, David C. *College Geometry: A Discover Approach, Second Ed*. Boston, MA: Addison Wesley Longman, Inc. 2001.

Meschkowski, H. *Non-Euclidean Geometry*. New York, NY: Academic Press, 1964.

Moise, E. E. *Elementary Geometry form an Advanced Standpoint.* Reading, MA: Addison Wesley, 1963.

O'Daffer, P. G. and Clemens, S. R. *Geometry: An Investigative Approach*. Reading, MA: Addison Wesley, 1992.

Pedoe, D. *Circles: A Mathematical View*. Washington, D.C.: Mathematical Association of America, 1995.

Prenowitz, W. and Jordan, M. *Basic Concepts of Geometry*. New York, NY: Ginn-Blaisdell Publishing Company, 1965.

Reid, C. *Hilbert.* New York, NY: Springer Verlag, 1970.

Sibley, T. Q. *The Geometric Viewpoint: A Survey of Geometries*, Reading, MA: Addison Wesley. 1998.

Smart, J. R. *Modern Geometries, Fourth Ed*. Pacific Grove, CA: Brooks/Cole Pub. Co. 1994.

Tuller, A. *Modern Introduction to Geometries*. New York, NY: Van Nostrand Reinhold, 1967.

Wallace, E. C. and West, S. E. *Road to Geometry, Second Ed*. Upper Saddle River, NJ: Prentice Hall, 1998.

VI. Methods of Presentation and Evaluation:

While conventional methods of instruction - lecture, discussion, problem-solving- are used in this course, special emphasis is placed upon having the student do mathematics. Students are involved in the development of mathematical proofs.

Student performance is based upon class participation, assigned problems and proofs, and test results.

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