

SYLLABUS

Modern Developments in Geometry MAT 610

June 2009

Wayne State College
Physical Science and Mathematics Department

COURSE DESCRIPTION:

MAT 610
Modern Developments in Geometry

June 2009
Semester Hours: 3

Instructor: Dr. J. Bauer
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Description: A survey of geometries to include Euclidean, Transformation, Finite, and Coordinate geometries and how they relate to high school geometry.

The course is included in the core for the MSE in Mathematics Education

Class Meeting Time/Place: TBA

COURSE COMPETENCIES: College geometry has experienced a reform similar to that experienced by calculus. The reform emphasizes three main concepts.

1. New approaches in concepts are supported by reformed pedagogy.
2. Computer technology is incorporated into the course material.
3. Students are expected to understand more about mathematics and its connections, and be able to express these understandings verbally and in writing.

The conference proceedings sponsored by COMAP, Inc., *Geometry's Future*, has also provided many goals and recommendations for the study of geometry. These include the use of an experimental and inductive point of view, applications of geometry, inclusion of recent developments in geometry, the use of figures and diagrams, the use of physical models, collaborative learning, and an emphasis on transformations. Furthermore, there is an emphasis on the distinction between the mathematics of geometry and physical geometry. The meaning of and examples of mathematical proofs is also very important.

The *Curriculum and Evaluation Standards for School Mathematics* (1989) published by the National Council of Teachers of Mathematics (NCTM), strongly influence the study of geometry. Standard 7 refers to the study of geometry Modern Developments in Geometry synthetically, and Standard 8 refers to the study of geometry algebraically. The Standards also advocates the inclusion of the synthetic, coordinate, and transformational aspects of geometry. *The Principles and Standards of School Mathematics* (2000) also published by NCTM has geometry as a common thread throughout the K-12 curriculum.

The course will follow these findings in content and manner of presentation.

INSTRUCTIONAL MATERIALS:

Required Text: *Modern Geometry*, David Thomas, Brooks/Cole, 2002.
(ISBN: 0-534-36550-7)

References:

Allen, Frank B., et al (1960). *Mathematics for High School: Geometry, Volumes I & II*. New Haven: Yale University Press.

Beutelspacher, Albrecht and Rosenbaum, Ute (1998). *Projective Geometry: From Foundations to Applications*. Cambridge, UK: Cambridge University Press. (ISBN: 0-521-48364-6)

Burger, W.F. (1992). A geometry curriculum for prospective elementary teachers based on the Van Hiele model of development. *Pythagoras*, 29, August, pp 9-17.

Burger, W.F. & Shaughnessy, J.M. (1986). Characterizing the Van Hiele levels of development in geometry. *Journal for Research in Mathematics Education*, 17, pp 31-48.

Cederburg, Judith (2001). *A Course in Modern Geometries, 2E*. New York, NY: Springer-Verlag New York Inc. (ISBN: 0-387-98972-2)

Crowley, Mary L. (1987). The Van Hiele model of the development of geometric thought. *Learning and Teaching Geometry, K-12*, 1987 Yearbook, pp 1-16. Arlington, VA: NCTM.

Devaney, Robert L. (1990). *Chaos, Fractals, and Dynamics: Computer Experiments in Mathematics*. Menlo Park, CA: Addison-Wesley Publishing Company. (ISBN: 0-201-23288-x)

De Villiers, Michael (1995). An alternative introduction to proof in dynamic geometry. *MicroMath*, Spring, pp 14-19.

De Villiers, Michael (1995b). The handling of geometry definitions in school textbooks. *Pythagoras*, 38, pp 3-4.

De Villiers, Michael (1996). The future of secondary school geometry. (Slightly adapted version of Plenary presented at the SOSI Geometry Imperfect Conference, October 2-4, 1996, UNISA, Pretoria.)

De Villiers, M.D. & Njisane, R.M. (1987). The development of geometric thinking among black high school pupils in KwaZulu. *Proceedings of the 11th PME Conference*, Montreal Vol 3, pp 117-123.

Durbin, John R. (1985). *Modern Algebra: An Introduction, 2E*. New York, NY: John Wiley and Sons. (ISBN: 0-471-88487-1)

Eves, Howard (1984). *An Introduction to the History of Mathematics, 5E*. Philadelphia, PA: Saunders Publishing. (ISBN: 0-030062064-3)

Gardner, Martin (2001). *The Colossal Book of Mathematics*. New York, NY: W.W. Norton and Company. (ISBN: 0-393-02023-1)

Govender, M. (1995). Pupils' proof-writing achievement in circle geometry. Unpublished B.Ed. dissertation, University of Durban-Westville.

Greene, Brian (2003). *The Elegant Universe: Superstrings, Hidden Dimensions, and the Quest of the Ultimate Theory*. New York, NY: Norton & Company, Inc. (ISBN: 0-393-05858-1)

Kay, David C. (2001). *College Geometry: A Discovery Approach, 2E*. Boston, MASS: Addison-Wesley Publishing Company. (ISBN: 0-321-04624-2)

Kilpatrick, J. & Wirzup, I. (1969). Soviet studies in the psychology of learning and teaching mathematics. Chicago, IL: University of Chicago.

Larson, Hostetler and Edwards (1999). *Calculus: Early Transcendental Functions, 2E*. Boston: Houghton-Mifflin Company. (ISBN: 0-395-93320-x)

Lee, Carl (1998). Some comments on geometry and models.
www.ms.uky.edu/~lee/ma502/notes5/node2.html

Lott, Johnny W. editor (2001). *Navigating through Geometry in Grades 9-12*. Arlington, VA: NCTM. (ISBN: 0-87353-514-6)

Luthuli, D. (1996). Questions, reflection, and problem solving as sources of inquiry in Euclidean geometry. *Pythagoras*, 40, pp 17-27.

Malkevitch, Joseph, editor (1991). *Geometry's Future*. Arlington, VA: COMAP. (ISBN: 0912843217)

Malkevitch, Joseph (1999). New directions for geometry standards.
www.york.cuny.edu/~malk/CUPMGeometry/dimacs.geometry.html

Malkevitch, Joseph (2001). Geometry in utopia II.
www.york.cuny.edu/~malk/utopia.html

Malkevitch, Joseph (2002). Joseph Malkevitch's home page.
www.york.cuny.edu/~malk/

Manning, Henry Parker, Editor (2005). *The Fourth Dimension Simply Explained*. Mineola, NY: Dover Publications Inc. (ISBN: 0-486-43889-9)

Manning, Henry Parker (2004). *Introductory Non-Euclidean Geometry*. Mineola, NY: Dover Publications Inc. (ISBN: 0-486-44262-4)

Manning, Henry Parker (1914). *Geometry of Four Dimensions*. The Macmillan Company (Reprinted by Dover Publications, 1956).

Mlodinow, Leonard (2001). *Euclid's Window: The Story of Geometry from Parallel Lines to Hyperspace*. New York, NY: Free Press. (ISBN: 0-684-86523-8)

Moise, Edwin E. (1990). *Elementary Geometry from an Advanced Standpoint, 3E*. Reading, MASS: Addison-Wesley Publishing Company. (ISBN: 0-201-500867-2)

Morgan, Frank (1998). *Riemannian Geometry: A beginner's Guide, 2E*. Natick, MASS: A.K. Peters. (ISBN: 1-56881-073-3)

NCTM (2000). *Principles and Standards for School Mathematics*. Arlington, VA: NCTM. (ISBN: 0-87353-480-8)

Opera, John (1997). *Differential Geometry and Its Applications*. Upper Saddle, NJ: Prentice Hall. (ISBN: 0-13-340738-1)

Shaughnessy, J.M. & Burger, W.F. (1985). Spadework prior to deduction in geometry. Mathematics Teacher, 78, pp 419-28.

Smart, James (1998). *Modern Geometries, 2E*. Pacific Grove, CA: Brooks Cole Publishing Company. (ISBN: 0-534-35188-3)

Smith, R.R. (1940). Three major difficulties in the learning of demonstrative geometry. Mathematics Teacher, 33, pp 99-134 & 150-178.

Temple, G. (2004). *Cartesian Tensors: An Introduction*. Mineola, NY: Dover Publications Inc. (ISBN: 0-486-43908-9)

Thomas, David A. (2002). *Modern Geometry*. Pacific Grove, CA: Brooks Cole Publishing Company. (ISBN: 0-534-36550-7)

Thomas, David A. (1998). *Active Geometry*. Pacific Grove, CA: Brooks Cole Publishing Company. (ISBN: 0-534-34485)

Thorlacius, L arus & Jonsson, Thordur, Editors (2000). *M-Theory and Quantum Geometry*. Norwl, MASS: Kluwer Academic Publishers. (ISBN: 0-7923-6475-9)

Uzizkin, Zalman (1982). Van Hiele levels and achievement in secondary school geometry. Final report, Cognitive Development and Achievement in Secondary Schools Project. Chicago, IL: University of Chicago.

Wallace, Edward C. and West, Stephan E. (1998). *Roads to Geometry, 2E*. Upper Saddle River, NJ: Prentice Hall Publishing. (ISBN: 0-13-181652-7)

Resources/Equipment: (accessible *The Geometer's Sketchpad* on the college's computer network)

COURSE OUTLINE:

- 1 Introduction (Supplement)
 - Developments
 - Definition of Geometry
 - Recent Issues
 - National & State Standards
 - Axiom Sets
- 2 Finite Geometries (Chapter 1 & Supplement))

- Finite Geometries
 - Four-Line and Four-Point Geometries
 - Fano & Young
 - Pappus & Desargues
 - Other Finite Geometries
- 3 Geometric Transformation (Chapters 4 & 5)
- Introduction
 - Groups
 - Euclidean Motion
 - Equations of Motion
 - Homogeneous Coordinates & Matrix Equations
 - Group Properties
 - Similarity
 - Fractals
- 4 Projective Geometry (Chapter 6)
- Fundamentals
 - Postulation
 - Duality
 - Harmonic Sets
 - Projective Transformations
 - Equations of Transformations
 - Conics
- 5 Modern Euclidean Geometry (Chapter 2 & Supplement)
- Fundamentals
 - Modern Synthetic Geometry
 - Nine-Point Circle and Early 19th Century
 - Recent Synthetic Geometry of the Triangle
 - Applications of Synthetic Geometry
- 6 Non-Euclidean Geometries (Chapter 3 & Supplement)
- Foundations
 - Hyperbolic Geometry
 - Ideal Points & Omega Triangles
 - Quadrilaterals and Triangles
 - Line Pairs and Area of Triangular Regions
 - Curves
 - Elliptic Geometry
 - Spatial Geometry

EVALUATION: Student may be evaluated on the basis of two test scores, and five assignments. Grades are determined on 10% intervals, i.e. the 90s are an A, the 80s a B, and ... The importance of attendance is understood; if however, the student misses an excessive number of times, his/her grade will reflect it.

Each test will constitute 30% of the grade and each assignment will be worth 8% of the grade.

WSC STATEMENT OF STUDENT RESPONSIBILITIES:

Wayne State College strives to develop students of a wide range of academic abilities through quality teaching and support. It is our desire to prepare students to accept the privileges, duties, and responsibilities of global citizens; to develop moral and ethical values, to encourage creative ability and develop aesthetic judgments, to encourage the ability to think critically about their world and work; and to promote competence in and understanding of fields of knowledge which required of educated people.

To this end we, the faculty and staff of WSC, have established a standard of student responsibilities in the following statement:

All students will:

Take responsibility for their education. This will include:

- Being knowledgeable of academic requirements and college policies concerning registration, academic standing, payment of tuitions and fees, withdrawal and graduation.
- Initiating communication with faculty, advisors and administration regarding questions, concerns and intellectual dialogue.

Cultivate an attitude of integrity both in and out of the class. Integrity is demonstrated by:

- Showing courtesy, dependability, honesty and respect for instructor expectations concerning attendance, assignments, deadlines and appointments.
- Showing courtesy and respect toward others with diverse points of view in and out of class.
- Displaying a positive work ethic and a genuine interest in welfare of others.

ASSIGNMENTS: