

## University Studies Course Approval Proposal

### Mathematics/Statistics Flag

The Department of Mathematics and Statistics proposes the following course for inclusion in the University Studies Mathematics/Statistics Flag courses at Winona State University. The full department at the Thursday, February 1, 2001 department meeting approved this action.

Course: Modern Geometry (MTED 322), 4 s. h.

Catalog Description: This course is designed to give the prospective teacher of secondary school geometry an exposure to the concepts of non-Euclidean geometries, their relation to, and their impact on secondary school geometry. Teaching methodology and related items will be incorporated throughout the course. This is a University Studies course satisfying requirements for the Mathematics/Statistics Flag. Prerequisites: MATH 165 and MATH 210. Offered spring semester.

This is an existing course, previously approved by A2C2.

Department Contact Person for this course:

Jeffrey R. Anderson, Mathematics and Statistics Department Chair  
Email: janderson@vax2.winona.msus.edu

Prepared by George Gross

Email: wngros144@vax2.winona.msus.edu

### Mathematics/Statistics Flag:

The purpose of the Mathematics/Statistics flag course requirement is to reinforce the outcomes specified for the basic skills area of mathematics/statistics. These courses are intended to provide students with significant practice in applying prerequisite mathematical or statistical knowledge.

Courses can merit the Mathematics/Statistics Flag if students will be required to make essential use throughout the semester of mathematical or statistical models appropriate to their prerequisite knowledge of those areas, and if the correct use of techniques based on such models will comprise a significant portion of a student's final grade. It is understood that mere rote computations, algebraic manipulations, or graphical design without inferential content would not merit a Mathematics/Statistics Flag.

This course includes requirements and learning activities that promote students' abilities to...

**a) practice the correct application of mathematical or statistical models that are appropriate to their prerequisite knowledge of those areas**

Generally, included with all the concepts covered in the course are learning activities and assignments that require the students to apply appropriate related mathematical models correctly.

For instance in dealing with finite geometries, the students participate in activities that use “real life” situations that then evolve towards the concept and a study of finite geometries. The students to prove conjectures and work with other more in-depth characteristics of the geometries then do written assignments.

**b) make proper use of modern mathematical or statistical methods appropriate to their level of prerequisite knowledge, to include, if statistics is used in a substantive way, the use of a statistical package with graphics capability when appropriate**

Generally, built within the discussion of many of the concepts and activities used in the development of the activity, references are made to, and use of the technology associated with computer software.

For example, the Guided Tours, constructions, and investigations done by the students on the computer software called Geometer’s Sketchpad enable the students to use dynamic geometric figures to investigate various concepts, make conjectures, and then prove the conjectures as theorems in a mathematically legitimate way.

**WINONA STATE UNIVERSITY  
COLLEGE OF SCIENCE AND ENGINEERING  
DEPARTMENT OF MATHEMATICS AND STATISTICS**

**Course Outline-Mathematics Education 322**

**Course Title:** Modern Geometry

**Frequency of Offering:** Yearly, Spring Semester

**Prerequisite(s):** MATH 165 and MATH 210

**Grading:** Secondary majors and minors Grade Only basis; P/NC option available to others

**Course Applicable:** MTED Secondary Major and Minor, required.

**Catalog Description:** This course is designed to give the prospective teacher of secondary school geometry an exposure to the concepts of non-Euclidean geometries, their relation to, and their impact on secondary school geometry. Teaching methodology and related items will be incorporated throughout the course. This is a University Studies course satisfying requirements for the Mathematics/Statistics Flag. Prerequisites: MATH 165 and MATH 210. Offered spring semester.

**Number of Credits:** 4 Semester Hours

**Required Textbooks:** 1) Modern Geometries, 5<sup>th</sup> Edition, by James R. Smart.  
2) Geometry in the Middle Grades: Addenda Series, Grades 5-8, NCTM.

**Additional Readings:** None

**Standards Included:** Minnesota law requires that Secondary programs include topics appropriate to issues encountered in grades 5-12. This course is designed to help students develop competencies outlined in the Minnesota Standards of Effective Practice for Beginning Teachers.

In particular this course will address the following standards:

- Standard 1 - Subject Matter
- Standard 2 - Student Learning (A, C, E, F, G)
- Standard 3 - Diverse Learners (I, K, P, Q)
- Standard 4 - Instructional Strategies (D, G, I, L)
- Standard 5 - Learning Environment (D, H, M, N, R)
- Standard 6 - Communication (H)
- Standard 7 - Planning Instruction (G)
- Standard 9 - Reflection and Professional Development (D, I, J)

**Additional Requirements:** None

**Course Description:** This course will focus on three major areas of importance to the prospective 7-12 mathematics teacher.

- 1) To facilitate the student's construction of a perspective of geometry and its nature that is much broader than the perspective which is currently held by the prospective teacher.
- 2) To develop a perspective of the place and emphasis geometry had historically in school mathematics, as well as the place and emphasis that geometry may have in K-12 schools in the future.
- 3) To add depth to the student's current level of knowledge, skills, appreciation, and understanding of geometry, including proof skills, cognitive processes, manipulative skills, understanding of mathematical systems, and a deeper appreciation of the geometry of the world that surrounds them.

**Course Objectives:** The future teacher should be able to:

- 1) use a problem-solving approach to investigate and understand geometry content,
- 2) formulate and solve problems from both geometric and everyday situations,
- 3) communicate geometric ideas orally and in writing using everyday and mathematical language,
- 4) make and evaluate mathematical conjectures and arguments and validate their own geometric thinking,
- 5) show an understanding of interrelationships within geometries,
- 6) connect geometry to other disciplines and real-world situations,
- 7) use geometric concepts and relationship to describe and model mathematical ideas and real-world constructs,
- 8) understand the role of axiomatic systems in geometry,
- 9) understand the major concepts of both Euclidean and non-Euclidean geometries,
- 10) use computer software to explore and solve mathematical problems,
- 11) select appropriate mathematical tasks that will stimulate students' development of geometric concepts and skills,
- 12) use written and oral discourse between teacher and students and among students to develop and extend their future students' geometric understanding,
- 13) create a learning environment in which students feel free to take risks,
- 14) create and implement a lesson,
- 15) obtain a working familiarity with Van Hiele levels in geometric thinking

### **Mathematics/Statistics Flag**

The purpose of the Mathematics/Statistics flag course requirement is to reinforce the outcomes specified for the basic skills area of mathematics/statistics. These courses are intended to provide students with significant practice in applying prerequisite mathematical or statistical knowledge.

Courses can merit the Mathematics/Statistics Flag if students will be required to make essential use throughout the semester of mathematical or statistical models appropriate to their prerequisite knowledge of those areas, and if the correct use of techniques based on such models will comprise a significant

portion of a student's final grade. It is understood that mere rote computations, algebraic manipulations, or graphical design without inferential content would not merit a Mathematics/Statistics Flag.

This course includes requirements and learning activities that promote students' abilities to...

- a) practice the correct application of mathematical or statistical models that are appropriate to their prerequisite knowledge of those areas; and
- b) make proper use of modern mathematical or statistical methods appropriate to their level of prerequisite knowledge, to include, if statistics is used in a substantive way, the use of a statistical package with graphics capability when appropriate.

### **Course Outline of the Major Topics and Subtopics:**

- I. Sets of Axioms and Finite Geometries
  - A. Introduction to Geometry
  - B. Development of Modern Geometries
  - C. Introduction to Finite Geometries **a)**
  - D. Four-Line and Four-Point Geometries **a)**
- II. Geometric Transformations
  - A. Introduction to Transformations **a)**
  - B. Euclidean Motions of the Plane **a)**
  - C. Applications of Transformations in Computer Graphics **a)**
  - D. Similarity Transformations **a)**
  - E. Introduction to the Geometry of Fractals and Fractal Dimension **a)**
- III. Simple Curves and Networks **a)**
- IV. Middle School Lesson Presentation
- V. Straightness and Symmetry
  - A. When do you call a Line Straight? **a)**
  - B. How do you construct a Straight Line? **a)**
  - C. The symmetries of a Line **a)**
- VI. Straightness on a Sphere and Cylinder
  - A. What is straight on a Sphere and cylinder? **a)**
  - B. Symmetries of Great Circles **a)**
  - C. Geodesics on Cylinders and Cones **a)**
- VII. Non Euclidean Geometries
  - A. Hyperbolic Geometry **a)**
  - B. Elliptic Geometry **a)**
- VIII. Geometry in the Secondary Schools
  - A. Learning Difficulties & Van Hiele Levels of Geometry Learning
  - B. Geometry from Multiple Perspectives **a)**
  - C. Conjecturing in the Geometry Classroom **a)**
- IX. Constructions and The Geometer's Sketchpad
  - A. The Philosophy of Constructions **a)**
  - B. Constructible Numbers **a)**
  - C. Constructions in Advanced Euclidean Geometry **a)**
  - D. Guided Tours on the Sketchpad and Introductions **a), b)**

### E. Investigations and Constructions on the Sketchpad a), b)

**Method of Instruction:** The basic instructional plan will consist of discovery in small group and individual format, teacher guided discussion, teacher lecture, reports, oral student presentations, examinations, and written assignments (including homework and lesson plan(s)). In addition, independent “research” and study is expectation.

**General Expectations:** All students are expected to attend class on a regular basis, to be active participants in class and to be readers of the texts and related writings. Students will be expected to demonstrate their knowledge of the subject through writing, problem solving, and presentations, peer teaching, projects, and at least one examination.

**Method of Assessment:** Assessments will vary in style, including: 1) teacher and peer evaluation of presentations/lesson, 2) peer teaching evaluation, 3) teacher evaluation of written problems and examinations.

#### **Additional References:**

- Commissioner on Standards for School Mathematics (2000). Principles and Standards for School Mathematics. Reston, VA: National Council of Teachers of Mathematics.
- Experiencing Geometry on Plane and Sphere by Henderson.
- Modern Geometry with Applications by G. A. Jennings.
- Connecting Mathematics: Addenda Series, Grades 8-12, NCTM
- Geometry from Multiple Perspectives: Addenda Series, Grades 9-12, NCTM