MATH 451 **FALL 2015**

AXIOMATIC GEOMETRY

TR 2:00–3:15 **EMS W109**

INSTRUCTOR: Fredric Ancel OFFICE: EMS E473 PHONE: 229-6372
EMAIL: ancel@uwm.edu WEB PAGE: https://pantherfile.uwm.edu/ancel/www/
OFFICE HOURS: TR 1:00 – 2:00, and by appointment

TEXT: available at UWM Bookstore, and on instructors web page (address above). Open the folder MATH 451 FALL 2015 followed by the folder MATH 451 TEXT.

AUXILIARY TEXT (not required): *The Foundations of Geometry,* by Gerard A. Venema

PREREQUISITES: Math 232 and Math 341, or graduate standing, or consent of the instructor.

COURSE OBJECTIVES: Geometry is the study of figures in space, visual patterns and symmetry. It makes important contributions to other areas of mathematics and to other sciences. Currently, the role of geometry in the elementary school and high school curricula is being enlarged and intensified.

The subject has a several thousand year history and mention of geometric methods can be found in some of the earliest written human records. Euclid's development of geometry by the so-called *axiomatic method* 2300 years ago has served as the principal model for the presentation of mathematical, scientific and philosophical theories ever since. In the seventeenth century Descartes added a powerful new method to the geometer's toolkit by creating analytic or coordinate geometry. In the nineteenth and early twentieth centuries geometry was revolutionized by the realization that if the parallel postulate, which governs classical plane Euclidean geometry, is relaxed, then a new variety of geometry called hyperbolic geometry results.

This course will first view geometry from a very general perspective as a study of spaces in which distance can be measured. The problem of decided when two such spaces are equivalent is solved by the concept of *isometry.* An isometry is a distance-preserving onto function from one such space to another. Our study of the geometry of various spaces will include an analysis of the isometries that relate these spaces. The real line $\mathbb{R}$ is the first space whose geometry we will explore in detail. Next we will focus on the geometry of Euclidean spaces. Finally, as time permits, we will investigate spherical and hyperbolic geometry. Geometric spaces which are *homogeneous,* meaning that they look the same at every point of the space, fall into one of the three categories: Euclidean, spherical or hyperbolic. These geometries have many properties in common but they diverge because they satisfy different parallel postulates and different angle sum theorems for triangles.

COURSE FORMAT: Class time will be a mix of lectures by the instructor and discussion of homework exercises by students and the instructor. The course moves quickly and covers many challenging concepts. To stay abreast of the course material, it is *essential* that students keep up with the homework exercises and come to class prepared to talk about them.

GRADES AND EXAMS: Grades will be based on three in-class exams, a final exam, and written homework. Each in-class exam is worth 100 points, the final exam is worth 150 points, and homework is worth 100 points. In determining your final grade, your lowest in-class exam score will be replaced by $^2/_3$ of your final exam score if it is to your advantage.

TENTATIVE EXAM DATES:

EXAM 1: Tuesday, September 29
EXAM 2: Thursday, October 22
EXAM 3: Tuesday, November 17
FINAL EXAM: Thursday, December 17, 12:30 – 2:30

MAKE-UP EXAMS. Normally make-up exams will not be given. A missed in-class exam will be regarded as your lowest exam score and will be replaced by $^2/_3$ of your final exam score. (An exception to this policy will be granted in the case of a SERIOUS medical situation. In such a situation the student should inform the instructor about the situation BEFORE the exam, if possible, and provide DOCUMENTATION of the medical situation.)

WEB PAGE: During the semester certain information such as this syllabus, the course text and solutions to homework problems will be posted on the instructor's web page (address near the top of the previous page.)

UNIVERSITY POLICIES: Links to UWM policy statements for faculty and students can be found on-line at:

http://www4.uwm.edu/secu/SyllabusLinks.pdf

These statements cover a variety of topics including students with disabilities, religious observance, military duty, discriminatory conduct such as sexual harassment, academic misconduct, and complaint and grade appeal procedures.