Honors 213 Foundations of Geometry

Goals

Non-Euclidean Geometry We will explore the 2000 year history and development of one of the most interesting ideas to arise in western civilization. Our approach will follow that of our author (Greenberg) who uses historical vignettes as motivation and the axiomatic method as the primary tool for understanding the basics of non-Euclidean Geometry.

Reading/Writing It is important that you read the text. In fact, developing the ability to read technical material with understanding is one of the primary goals of this course. Another is to fine-tune the ability to present written arguments clearly and gracefully. It is easier to do this in mathematics than most other disciplines since standard practice in mathematics is to explicitly justify every claim.

Proof Most of this course, either directly or indirectly, deals with the issue of "proof" and communication. In particular, you will learn what it means when a mathematician claims to have proven a fact and, through the assigned paper, you will have the opportunity to explore other notions of communication. Our primary tools for the study of mathematical proof are exactly the same as those used by our primary author (Greenberg) in his presentation of non-Euclidean geometry: elementary formal logic and the axiomatic method.

Since much of what we will see is directly linked to seeing the power of axiomatized mathematics to unambiguously communicate (certain) ideas, we will piggy-back on the visit of Keith Devlin (NPR's "Science Guy") in April. One of Devlin's research areaa concerns "what it is to think, to reason, and to engage in conversation." We will meet with him in late March or early April to discuss his book *Goodbye Descartes (The End of Logic and the Search for a New Cosmology of the Mind.*

Course Information

TEXT *Euclidean and Non-Euclidean Geometries* , Third Edition, Marvin Jay Greenberg, W.H. Freeman and Company, 1993.

TIME 2:00–2:50 P.M. M,T, W, F

ROOM Thompson Hall 318

INSTRUCTOR Professor Bryan Smith

OFFICE Thompson Hall 321-E

PHONE 879-3562

E-Mail bryans@ups.edu

OFFICE HOURS

Monday:	9:00-9:50 AM	1:00-1:50 PM		
Wednesday:			3:00-3:50 PM	7:00-8:30 PM
Friday:		1:00-1:50 PM		

I am also available for meetings at other times. In particular I will frequently be available on Thursday during class hour. If you have trouble meeting during office hours please make an appointment for a better time.

Day to Day Structure The class weeks will be typically be structured as follows.

Weeks 1-7 On Monday I will lecture on new material and collect homework from the previous week.

On Tuesday we will discuss Devlin's book and other non-geometry issues and questions.

On Wednesday we will brainstorm on the homework problems.

On Friday students will present solutions of homework problems on the board. Any problem we agree to accept will receive a perfect grade. Problems that are not presented or that we do not accept will be due in written form the next Monday.

Weeks 8-15 On Monday I will lecture on new material and collect homework.

On Tuesday I will lecture or we will discuss problems.

On Wednesday we will brainstorm on homework problems.

On Friday we will alternate between lecture and presenting homework on the board.

EXAMINATIONS There will be three, 100 point, one hour, in-class examinations. Make-up examinations are at my discretion and their existence has the necessary (but not sufficient) condition that you make arrangements prior to the exam. Sufficient interest from the class can change examination dates or move the exams to a 2-hour, evening format. Examinations will typically consist of three questions from the homework and two questions you have not seen before. When taking the examinations you will be allowed to use your copy of my handout of definitions and theorems as a personalized resource. The examinations are tentatively scheduled for the following days:

Examination One	Tuesday February 8
Examination Two	Tuesday March 8
Examination Three	Tuesday April 12

FINAL EXAMINATION: Friday May 13 at 8:00 A.M. The Final will actually be a fourth examination on the material covered since the third in-class examination.

HOMEWORK There will be homework assignments every week and problems will be graded using the rubric attached at the end of these notes. Think of these take-home assignments as weekly papers in which you first analyze and solve a problem and then completely explain that analysis and solution. At the very least you should write these problems:

- Using complete sentences
- In the first person plural
- With accurate punctuation
- For an audience consisting of students not in this class but with an equivalent background
- In a clear, easy to follow expository style

You are not to work with anyone when doing these assignments with two exceptions.

- You may use (with citation) any idea verbalized during a "brainstorming" session.
- You may use (with citation) any idea you obtain in discussion with me.

As long as you cite it, feel free to use (or not) any technology that you like (e.g., CABRI, Geometers Sketchpad, calculators, *Mathematica*, MATLAB, etc.).

Paper There will be one paper assigned slightly after the midpoint of the semester.

The primary goal of this course is for you to learn the basics of 'mathematical reasoning' or 'mathematical ways of knowing'. You will learn how mathematics addresses the related concepts of proof, communication, meaning, and truth. To provide contrast with mathematical methodology, your paper will examine either how some other discipline (your major, minor or some other field of interest) approaches these same fundamental concepts or you will further develop some concept presented in Devlin's book. You can find examples of papers addressing the first of these themes at

`math.ups.edu/~bryans/Current/HTML/journalhome.html`.

Clearly this material begs for entire books rather than a paper written in 2-4 weeks, so keep your topic focussed. The primary goal of the paper is for you to begin to explore such philosophical fundamentals as: proof, communication, or truth.

Paper Logistics

Due March 11: Last day to have a topic **accepted**. You should meet with me before this to discuss possible topics since merely turning in a topic on this date does not guarantee it will be accepted. Don't wait until the last minute.

Due April 8: Turn in 3 copies of a draft of the paper (please print on both sides to save paper). I will distribute 2 of those copies to your referees. (This means each of you will referee two papers.) The referees will read the paper for accuracy, clarity of exposition and appropriateness for the *Journal of Undergraduate Mathematics at Puget Sound* as outlined in the *Journal* Guidelines for Authors (see the class web page for details).

Due April 15 Referees give their reports to authors.

Due April 22: Turn in the final version of the paper along with all referee comments. If the paper receives a passing grade, it will be published in the journal.

The author will receive a grade for the paper itself and the referees will receive grades for the quality of their comments.

Course Information Updates If you wish, I will post (and update) a grade report on your current standing in the class on my university web page. You should keep track of your grades on the various assignments and check them against these reports. If there are any discrepancies they should be dealt with immediately.

To have your information posted you need to print your name, the class (HON 213), and a code on a sheet of paper. Then sign the paper and physically hand it to me. The code is to be a sequence of up to 23 symbols I can type on a keyboard.

TOTAL POINTS

Homework	55%
Paper	10%
Referee Reports	3%
Examinations	24%
Final Examination	8%

First Assignment (Due Friday January 23) Find my university web page

(http://math.ups.edu/ → faculty → Bryan Smith)

and locate the *Journal of Undergraduate Mathematics at Puget Sound* "Guidelines for Authors" page. Then send an e-mail message to me at bryans@ups.edu indicating that you have an account, understand how to access the World Wide Web, and are aware of how to avoid mistakenly sending e-mail to Beverly Smith that is meant for Bryan Smith.

Homework (Writing Assignments) Non-Euclidean Geometry

Points	Logic and Mathematics
5	Arguments are correct, complete and without extraneous or misleading material.
4	Arguments have only one of: a few minor errors, omissions or inappropriate material.
2	Arguments have at least two of: minor errors, omissions and inappropriate material.
0	Arguments are more seriously flawed.

Points	Use of Terminology and Notation
2	All technical terms, concepts and notation are used correctly.
1	There are minor problems with terminology and or concepts.
0	There are major problems with terminology or concepts.

Points	Written Presentation
3	Follows citation requirements and all other writing guidelines.
2	Follows almost all of the guidelines with only one or two minor lapses.
1	Has more than one or two minor lapses on following the guidelines.
0	Has a major lapse in followingthe guidelines.

Writing Guidelines

It is best to think of these formal homeworks as officially assigned papers in which you completely explain and justify your analyses of the problems. I expect your problem solving and your papers to be

- Completely your own work with the exception of ideas obtained during brainstorming sessions or in discussions with me.
- Fully footnoted and documented. Specifically,
    1. Any idea obtained during brainstorm sessions or in discussions with me are footnoted or cited in-line.
    2. All textbook results (theorems, propositions, and lemmas) are cited in the text.
    3. Any use of technology is footnoted or cited in-line.
- Written with a word processor. (I will show you how to use Scientific Notebook in the labs or you can use Microsoft Word. Please check with me before using any other program.)
- Written using complete, accurately punctuated sentences.
- Presented in the first person and with a clear, easy-to-follow expository style.
- Targeted at an audience consisting of students not in this class but with an equivalent mathematical background.