MA 508: Geometry for Secondary Teachers

Symmetries and Transformations: Connections between Algebra and Geometry
online section

Instructor: Dr. Andrew Cooper, `andrew.cooper@math.ncsu.edu`
Office Hours: TBA drop-ins via Google Hangout
Website: Moodle, accessible at `wolfware.ncsu.edu`
Text: Tapp, *Symmetry: A Mathematical Exploration* and supplements
Materials: Internet- and PDF-capable device.
University Policies: The course will be administered in accordance with all University Policies, Rules, and Regulations, which can be found at `policies.ncsu.edu`.

Overview

> *We do not listen with the best regard to the verses of a man who is only a poet, nor to his problems if he is only an algebraist; but if a man is at once acquainted with the geometric foundation of things and with their festal splendor, his poetry is exact and his arithmetic musical.*
>
> Ralph Waldo Emerson, *Society and Solitude*, 1876

Scope and Objectives. In this course we will study some geometry of the plane and other two-dimensional spaces. We will address the problems of geometry from axiomatic and transformational viewpoints, with particular emphasis on the connections between algebra and geometry.

Topics. In terms of mathematical content, there are three main goals of the course:

depth: Understand the structures and reasons for some facts from school geometry.
breadth: Explore topics apart from, but related to, school geometry.
connections: Develop connections between school geometry and school algebra, and between school geometry and the wider world.

We will cover roughly the following topics:

(1) symmetry and its algebra (Tapp 1-5)
(2) solid objects, platonic solids, and the hyperbolic plane (Tapp 7-8)
(3) making symmetry more algebraic (Tapp 12-13)
(4) some axiomatics
(5) the Erlanger Programm

Practices. Not everything we will learn in this course is a matter of definitions and theorems. We will try to build the CCSS-M "Standards of Mathematical Practice", and in particular

PRACTICE.MP1: Make sense of problems and persevere in solving them.
PRACTICE.MP2: Reason abstractly and quantitatively.
PRACTICE.MP3: Construct viable arguments and critique the reasoning of others.
PRACTICE.MP5: Use appropriate tools strategically.
PRACTICE.MP6: Attend to precision.
PRACTICE.MP7: Look for and make use of structure.

Prerequisites. I will assume working knowledge of school geometry and school algebra. You will be asked to prove quite a bit.

Assignments and Grades

Evaluation. Your grade will be determined solely on the basis of the following graded work:

Online Activities: Viewing/Reading Quizzes and Explorations. 20% of the grade.
Homework: Traditional problems, submitted via Moodle. 20% of the grade.
Midterm Exam: Moodle exam. 30% of the grade.
Summary Project: 30% of your grade.

Online Activities. Each content module has three parts, two of which are assignments you must complete:

exploration: Complete the Exploration first. As the name implies, you may not know the answers to some or all of the questions. The point of explorations is to get you in the frame of mind for the reading and viewing.

reading and viewing: Reading refers to pages from Tapp or the notes. Viewing refers to video modules. These are generally short but may be dense, so it may be smart to pause or rewind certain parts.

reading and viewing quiz: Complete this after you've finished the reading and viewing. It's allowed (and may be wise) to keep the reading and viewing open while you do the quiz.

Homework. There will be four 'traditional' homework assignments, one for each of the first four topics. Selected problems graded for correctness. You will need access to a scanner or a camera. Please submit each assignment as a single PDF file. Feedback will be returned to you digitally.

Midterm. About halfway through the course, we will have a midterm exam, administered via Moodle. You will have a 48-hour window to complete this exam.

Final Project. The course will culminate in a final summative. There are two components: a presentation and a tangible product. See the document *Final Project Guidelines*.

Pacing and Due Dates. The Moodle site contains a suggested calendar for completing content modules. There are four checkpoints throughout the semester by which modules are strictly **due**.

Academic Integrity. The definition of academic integrity is simple and broad: *do not take credit for others' work*. This applies to all assignments. All assignments–absent an explicit statement to the contrary–should be completed individually.

You may not collaborate on exams in any form.

Infractions of academic integrity will be addressed through the University's Office of Student Conduct pursuant to University Policy 11.35.01 and Regulation 11.35.02.

A Note on the Text

The textbook is written, not for mathematics majors or teachers of mathematics, but for a general audience. Tapp assumes his audience has "no background beyond high school level algebra". Thus the text sweeps quite a bit under the rug — but Tapp is generally good enough to inform the reader that he is doing so. Nevertheless many of the exercises in the text will give anyone a bit of a challenge. It is my hope that you will share with your students not only some of the excitement and beauty of the mathematics we learn in this course but also the book itself.