
MthSc 481: Topics in Geometry & Topology

SPRING 2012

Martin Hall M-103, TTh 8:00-9:15am

Instructor	Matthew Macauley (macaule@clemsun.edu) OFFICE: Martin Hall O-325 PHONE: (864) 656-1838 OFFICE HOURS: T 3:00-4:00, Th 2:00-3:00, or by appointment
Textbook	<i>A Gateway to Modern Geometry: The Poincaré Half-Plane</i> , by Saul Stahl.
Prerequisites	MthSc 206 (vector calculus), and a familiarity with reading and writing basic proofs. We will also see a few elementary concepts from linear algebra (MthSc 311), abstract algebra (MthSc 412), and real analysis (MthSc 453), but not enough to warrant making these official prerequisites.
Policies	<ul style="list-style-type: none">• Attendance: Class attendance is mandatory. If you miss a class for some reason, it is your responsibility to get notes, etc. from someone in class. I will not repeat lectures during my office hours.• Course material will be posted on Blackboard and/or my website (preferred), as I like to make all materials freely available to everybody (Warning: Websites such as <i>Course Hero</i> are a SCAM!)• All drop/add procedures are your responsibility.• Absent Professor Policy: If the instructor has not arrived within 15 minutes of the scheduled class time, you may assume that class has been canceled.• All use of cell phones, laptops, and PDAs is prohibited during lecture. Calculators, cell phones, laptops, and PDAs will not allowed during exams.• Cell phone policy: http://www.youtube.com/watch?v=FYwpXU_G4Z0
Learning Outcomes	This course will be an introduction to selected mainstream topics in geometry and topology. Special focus will be given to understanding hyperbolic geometry and its symmetries. Hyperbolic geometry is similar to standard high-school geometry, but with a few subtle differences (notably as the absence of the “parallel postulate”) that lead to deep consequences and beauty. At first, it may seem exotic, but it is just as prevalent and important to mathematics and physics as its familiar cousin, Euclidean geometry. We will begin with a quick review of basic Euclidean geometry, and then move into few advanced aspects including its isometries, conformal maps, and circle inversions. These will provide a foundation for an introduction to hyperbolic geometry. After defining it formally, we will examine some of its basic constituents such as its isometries and trigonometry. This will lead us to the general linear group $GL_n(\mathbf{R})$, the projective linear group $PGL_n(\mathbf{R})$, and Möbius transformations. We will study the isometries of the hyperbolic plane in more detail, and classify them by type: elliptic, parabolic, and hyperbolic. Next, we will turn our attention to both orientable and non-orientable surfaces, such as spheres, tori, and projective planes. This will be done in the setting of simplicial complexes, and in particular, quotient maps of side-paired polygons. Finally, we will learn about the invariance of the Euler characteristic, and use this to give the classification of two-dimensional surfaces. If time permits, we will learn about the celebrated Gauss-Bonnet theorem which provides a remarkable link between the geometry and the topology of a surface.

Grading The final grade will be calculated as follows:

HOMEWORK: 25%
ATTENDENCE: 5%
MIDTERM: 20%
FINAL EXAM: 30%
FINAL PROJECT: 20%

GRADING SCALE: $A \geq 90\% > B \geq 80\% > C \geq 70\% > D \geq 60\% > F$

The final project will consist of a written report on some topic related to what we're studying in class. Additionally, there will be a short one-on-one oral presentation of the project (like an oral exam) in my office. This will satisfy the capstone requirement for the Mathematical Sciences major at Clemson University.

Homework Students can collaborate on their homework problems, but they *must* write up and submit their homeworks separately. Late homeworks will **not** be accepted, but anyone typesetting their homework using L^AT_EX will get an extra 24 hours to complete it (okay to hand-draw pictures, though). You should keep all the graded homeworks in case of missing grades due to missing name or typo errors.

Key Dates

January 11 (Wed)	Classes begin; late enrollment fee applies
January 16 (Mon)	Martin L. King Jr. holiday
January 18 (Wed)	Last day to register or add a class
January 25 (Wed)	Last day to drop a class or withdraw from the University without a W grade
March 16 (Fri)	Last day to drop a class or withdraw from the University without final grades
March 19 – 23	Spring break
April 30 – May 4	Final Examinations
May 11 (Fri)	Commencement

Note

- <http://bb.clemson.edu/> (Blackboard)
- <http://www.registrar.clemson.edu> (acad. calendar, registration, grading)
- <http://www.clemson.edu/academics/academic-integrity> (academic integrity)

The official statement on Academic Integrity

As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a *high seminary of learning*. Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form.

When in the opinion of a faculty member, there is evidence that a student has committed an act of academic dishonesty, the faculty member shall make a formal written charge of academic dishonesty including a description of the misconduct, to the Dean of the Graduate School. At the same time, the faculty member may, but is not required to, inform each involved student privately of the nature of the alleged charge.