MAT 360: Geometric Structures
Spring 2019

Home
General Information
Syllabus, **in pdf and Word**
Schedule

Welcome to MAT 360 Geometric Structures

Place and time: Library E4320, Tuesday and Thursday 10:00 am - 11:20 am

Lecturer: Jozef Bodnar, `jozef.bodnar at stonybrook.edu`

Office hours: Math Tower 4-117, Tuesday 3:00 - 4:00 pm, Thursday 3:00 - 4:00 pm and by appointment (please write a mail).

Grader: Jean Francois Arbour (Math 3-103)

Please check this website before and after every lecture. You are supposed to be familiar with any information and announcements made on these course pages, in calss or on Blackboard.

Textbook: Marvin Jay Greenberg: Euclidean and Non-Euclidean Geometries, 4th edition, Chapters 1-7

Grades policy: Based on weighted average, with weights: 0.3 for Homework, 0.3 for Midterm and 0.4 for Final exam.

Exam times: Midterm: Apr 2 Tuesday in class, Final exam: May 17 Friday 11:15 am - 1:45 pm

Americans with Disabilities Act/Student Accessibility Support Center Statement:

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Student Accessibility Support Center, ECC (Educational Communications Center) Building, Room 128, (631) 632-6748. They will determine with you what accommodations, If any, are necessary and appropriate. All information and documentation is confidential. **https://www.stonybrook.edu/commcms/studentaffairs/sasc/current_students/accommodation.php** Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Student Accessibility Support Center. For procedures and information go to the following website: **https://ehs.stonybrook.edu//programs/fire-safety/emergency-evacuation/evacuation-guide-people-physical-disabilities**

Academic Integrity:

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at: **https://www.stonybrook.edu/commcms/academic_integrity/**

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Course description: Formal geometries and models. Topics selected from projective, affine, Euclidean, and non-Euclidean geometries.

Textbook: Marvin Jay Greenberg: Euclidean and Non-Euclidean Geometries, 4th edition, Chapters 1-7

Pre-requisites: C or higher in the following: MAT 203 or 205 or 307 or AMS 261; MAT 211 or AMS 210; MAT 200 or MAT 250 or permission of instructor

Grades policy

	Date	Weight
Homework	**Top ten out of twelve through the semester**	**30%**
Midterm	**Apr 02 Tue in class**	**30%**
Final exam	**May 17 Fri 11:15am-1:45pm**	**40%**

The final letter grades will be based **only** on your weighted total percentage score.

Homework: There will be 12 sets of homeworks during the semester. Each will be graded and a percentage score assigned. The lowest two homework percentages will be dropped for everyone, that is, your HW score will be the average of your top 10 HW percentage scores.

Usually, the homework problems will appear on Tuesday on this course page, under the Schedule section, in the last column of the table about scheduled topics. The due date will be indicated, but usually it will be Tuesday of the following week. I will collect them on the lecture. You can also leave your homework (before the due date) in the envelope on my office door Math Tower 4-117.

I am happy to help anyone with the homeworks at any time. I encourage you to contact me by mail or in person (during office hours, after the lectures or during separate appointments) if you want to discuss homework problems.

Discussing the problems with each other is also encouraged, but you should always come up with your own solutions. Please do not share complete solutions with others before the deadline. The experience you gain in problem solving by working on homework is way more useful than the points you get for it. If you found some resource on the internet or some book which you used for the solution, or if the solution is a result of a discussion with someone, please indicate it in your work.

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Syllabus

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Learning outcomes

- be familiar with the basic notions of planar geometry
- be able to make some elementary constructions using compass and straightedge
- know the traditional and modern axiomatic approach to geometry (axioms and undefined terms)
- be familiar with the role and significance of the axiomatic approach
- understand the notion and importance of models to axiomatic systems
- be familiar with the axioms and some models of incidence geometry and projective geometry
- understand the historical importance and issues with Euclid's parallel postulate
- be familiar with the notion of equivalence of axiomatic systems
- know several equivalent versions of the parallel postulate
- be familiar with the notion of absolute geometry and some important results in absolute geometry
- be familiar with the notion of hyperbolic geometry and some important results in hyperbolic geometry
- being able to prove some results in each of absolute, Euclidean and hyperbolic geometry
- know some models (in particular, the Poincare model) of hyperbolic geometry

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Grader: Jean Francois Arbour (Math 3-103)

Course page: https://www.math.stonybrook.edu/~bodnar/mat360-spr19/

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Date	Topics	Reference (textbook)	Homework and further resources
01/29 Tu	Overview. Basic notions	Parts of Chap 1, Ch 1 Exerc 1,2,4	**HW 1** due 02/07 Th
01/31 Th	Elementary constructions	Ch 1 Major Ex 1-3	
02/05 Tu	Constructions continued. Proofs and diagrams.	Ch 1 Power of diag, **64 = 65**, **Chocolate bar**	**Sol HW1**
02/07 Th	Axioms, interpretation, models. The first axiom.	Ch 1 Danger in diag, 1st postulate, Ch 2 incidence ax 1	**HW 2** due 02/14 Th
02/12 Tu	No class: snow morning.		Some **notes** for HW 2, accepted until 02/19 Tu
02/14 Th	Incidence geometry. Parallel postulate. Affine geometry.	Ch 2 Incidence, Affine	**HW 3** due 02/26 Tu
02/19 Tu	Elliptic postulate. Projectie models. Projectivization.	Ch 2, Proj and Aff Planes	**Sol HW2**
02/21 Th	Order of finite planes. Affine models. Finite fields.	Ch 2 Major Exer 7, 8; Order seven affine plane projectivized, in **pdf** and **png**	**HW 4** extended 03/05 Tu
02/26 Tu	Real projective plane. **Hyperbolic incidence** models.	Ch 2 (Example 7); Exer 9 (c), 11, (9 (e), 10 (c), Major Exer 10)	
02/28 Th	Euclid's vs Hilbert's axioms. Betweenness axioms.	Ch 3, Betw Ax 1,2,3, Prop 3.1	**Sol HW3**

03/05 Tu	Plane separation axiom.	Ch 3 Betweenness, Prop 3.4, Pasch, int of angles, **Hyperbolic model HW 3/3(c)**	**HW 5** due 03/12 Tu **Sol HW4**
03/07 Th	Axioms of congruence	Ch 3, Prop 3.11-15.	**HW 6** due 03/26 Tu
03/12 Tu	Axioms of congruence: ordering, angle addition	Ch 3, Prop 3.16-3.23	
03/14 Th	Congruence interpretations. Axioms of continuity. Dedekind cuts.	Ch 3 Ax of cont, Segment-circle, Archimedes Ax, Ch 3 Example 3, 4 (Project 2,5)	**HW 7** due 03/28 Th
03/19 Tu	NO CLASS: Spring Break		
03/21 Th	NO CLASS: Spring Break		**Solutions HW 5** and **Sample midterm**
03/26 Tu	Congruence interpretation in the upper halfplane model	**Congruence in the upper halfplane** Move A,B,C,P; AB = CD	**Solutions HW 6** and **Sample midterm solutions**
03/28 Th	Neutral geometry, alternate interior angles, uniqueness of perpendicular, existence of parallel lines	Ch 4, Thm 4.1, Cor 1, 2	**Solutions HW 7**
04/02 Tu	**MIDTERM**	**Solutions**	No HW due midterm week.
04/04 Th	angle inequalities in triangles, AAS congruence	Ch 4, Thm 4.2, Prop 4.1	**HW 8** typo corrected, 1 (e) refers to (a) due 04/11 Th
04/09 Tu	Hypothenuse-leg cong, midpoints, bisectors, side-angle inequalities, triangle ineq	Ch 4, Thm 4.2, Prop 4.2-4.6., Triang ineq	
04/11 Th	measuring, angle sum of triangles, defect, Saccheri--Legendre thm	Ch 4 Measurement Thm 4.3, Exercise 15; 3rd Ed Ch 4, Sacch--Leg, Angle sum	**HW 9** due 04/18 Th

04/16 Tu	Saccheri and Lambert qudrilaterals. A zero defect triangle implies existence of a rectangle.		**HW 10** due 04/25 Th
04/18 Th	Existence of a rectangle implies zero defect for every triangle. Hilbert's and Euclid's parallel postulate.	Ch 4 Thm 4.4	**Solutions HW 8**
04/23 Tu	Euclidean point line pair implies zero defect triangle. Aristotle property	Ch 4 Prop 4.11	**Solutions HW 9**
04/25 Th	Zero defect triangles imply the parallel postulate.	Ch 5 Proclus Thm, **Proclus attempt in upper halfplane (move Y)**	**HW 11** due 05/07 Tu
04/30 Tu	AAA congruence in hyperbolic geometry, equidistant loci	Ch 6 Prop 6.2, Ch 5 Clavius	**Solutions HW 10**
05/02 Th	Parallels, common perpendiculars and limiting rays	Ch 6 Prop 6.3-6.5	**Solutions HW 11**
05/07 Tu	Limiting rays, Upper halfplane model, cross ratio, log length	Ch 6 Thm 6.6, Ch 7	**HW 12** due 05/13 Mo **Right triangles**, **Saccheri** and **Lambert** quadrilaterals
05/09 Th	Inversions, SAS in the upper halfplane, Poincare disk model	Ch 7, **Inv_1**, **Inv_2**, **Inv_3**, **Angle preserving**, **Translations**	**Sample final (not to submit)**
05/17 Fr	**Final exam**		**Solutions**