Mathematics 3260H – Geometry II: Projective and Non-Euclidean Geometry

[Last modified 2017.09.06.] TRENT UNIVERSITY, Fall 2017 *[In Peterborough!]*

Instructor

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Fall hours: Weekdays (except Tuesdays) 12:00-12:50,
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Prerequisite

MATH 1110H (or 1100Y or 1101Y) or 1350H. Please note that MATH 2260H – *Geometry I: Euclidean Geometry* is *not* required, though it is somewhat helpful here and there.

Text

Notes will be provided by the instructor, drawn from various sources, for the material on non-Euclidean geometry. (See the handout *Sources*.) For projective geometry, we will use *A Problem Course on Projective Planes*, by Stefan Bilaniuk, which is freely available for download in pdf format at: `euclid.trentu.ca/math/sb/pcpp/` .

Meetings

Lectures: Tuesday 14:00-15:50 in GCS 111 and Wednesday 13:00-13:50 in GCS 110.
Seminars: Monday 16:00-16:50 in GCS 111.

Marking Scheme

There will be eleven weekly quizzes, eleven weekly assignments, and a take-home final examination. These will weigh as follows in the final mark:

Best 10 quizzes (2% each)	20%
Best 10 assignments (4.5% each)	45%
Final Examination	35%

Note that at least 25% of the course marks will be obtained by the final date (Tuesday, 7 November) to withdraw from Winter half-courses without academic penalty. Assignments will not normally be accepted after the due date. Students who miss more than one quiz or assignment for reasons beyond their control should contact the instructor as soon as possible.

This scheme may be modified for individual students in *exceptional* circumstances, such as a lengthy absence due to illness. Any such modification will require the agreement of both the student and the instructor.

Content & Learning Outcomes

MATH 3260H is an introduction to alternatives to Euclid's axioms, beginning with alternatives to the parallel postulate. Students will acquire some familiarity with basic results about hyperbolic and elliptic planes, especially the relationship between areas and interior angles of triangles, as well as the Poincaré disk and/or half-plane models of the hyperbolic plane and the antipodal sphere model of the elliptic plane. Students will also learn the axioms for affine and projective planes and basic properties of these structures, and various examples of and constructions of affine and projective planes and their properties, especially the real projective plane, as well as the introduction of coordinate systems in and transformations of projective planes, and related geometrical results, especially Desargues' and Pappus' Theorems.

Schedule

Please note that where the material covered is concerned this schedule is a polite fiction: no lesson plan survives contact with actual students unchanged!

Week 0. *(7–8 September) Classes begin on Thursday, 7 September.* MATH 3260H doesn't meet this week ...
Week 1. *(11–15 September)* Euclid's and Hilbert's axioms for Euclidean plane geometry. The parallel postulate and the hypotheses of the acute angle and the obtuse angle.
Week 2. *(18–22 September)* The neutral geometry of triangles. Quiz #1 written and Assignment #1 due on Wednesday, 20 September.
Week 3. *(25–29 September)* Hyperbolic and elliptic planar geometry, the Poincaré disk and half-plane models of the hyperbolic plane, the antipodal sphere model of the elliptic plane. Quiz #2 written and Assignment #2 due on Wednesday, 27 September.
Week 4. *(2–6 October)* Triangles in hyperbolic and elliptic planes; defect, excess, and area of triangles. Quiz #3 written and Assignment #3 due on Wednesday, 4 October.
Week 5. *(9–13 October)* The inconsistency of the hypothesis of the obtuse angle with Euclid's Postulate II; consistency with Postulates I, III, and IV. Quiz #4 written and Assignment #4 due on Wednesday, 11 October. *No classes on Thanksgiving Day, Monday, 9 October.*
Week 6. *(16–20 October)* The consistency of the hypothesis of the acute angle with Euclid's Postulate's I–IV. Quiz #5 written and Assignment #5 due on Wednesday, 18 October.
Fall Reading Week. *(23–27 October)* Enjoy!
Week 7. *(30 October – 3 November)* Incidence structures, axioms for projective and affine planes, configurations. Quiz #6 written and Assignment #6 due on Wednesday, 1 November.
Week 8. *(6–10 November)* Examples of affine and projective planes. Quiz #7 written and Assignment #7 due on Wednesday, 8 November. *The last date to drop Fall half-courses without academic penalty is Tuesday, 7 November.*
Week 9. *(13–17 November)* Constructions of affine and projective planes, affine and projective coordinates. Quiz #8 written and Assignment #8 due on Wednesday, 15 November.
Week 10. *(20–24 November.)* Collineations, coordinatization. Quiz #9 written and Assignment #9 due on Wednesday, 22 November.
Week 11. *(27 November – 1 December)* Algebraic *vs.* geometric properties. Quiz #10 written and Assignment #10 due on Wednesday, 29 November. Take-home final examination distributed on Wednesday, 29 November.
Week 12. *(4–6 December)* Desargues' and Pappus' Theorems. Quiz #11 written and Assignment #11 due on Wednesday, 6 December. *Wednesday, 6 December, is the last day of classes.*
Fall examination period. *(8–20 December)* Take-home final examination due on Friday, 16 December.

Academic Integrity

> *Academic dishonesty, which includes plagiarism and cheating, is an extremely serious academic offence and carries penalties varying from failure on an assignment to expulsion from the University. Definitions, penalties, and procedures for dealing with plagiarism and cheating are set out in Trent Universitys Academic Integrity Policy. You have a responsibility to educate yourself – unfamiliarity with the policy is not an excuse. You are strongly encouraged to visit Trents Academic Integrity website to learn more:* `www.trentu.ca/academicintegrity` .

For clarity, the following guidelines will apply in MATH 3260H:

> You are permitted and encouraged to work with others and ask anyone willing (especially the instructor!) for explanations, hints, and suggestions on the assignments, and to consult whatever sources you wish. However, **all work submitted for credit must be written up entirely by yourself, giving due credit to all relevant sources of help and information. No aid may be given or received on the quizzes and final exam**, except with the intructor's permission. You may use a calculator and an aid sheet, with whatever you want on it, for the quizzes.

Access to Instruction

> *It is Trent University's intent to create an inclusive learning environment. If a student has a disability and documentation from a regulated health care practitioner and feels that he/she may need accommodations to succeed in a course, the student should contact the Student Accessibility Services Office (SAS) at the respective campus as soon as possible.*

Web Page

MATH 3260H will make minimal or no use of Blackboard/LearningSystem. All handouts will be posted to: `www.trentu.ca/mathematics/sb/3260H/`