MATH.4270/9MATH.5270 Geometry

Fall 2019

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Overview

This course is designed for current and prospective geometry teachers. Most of the term will be devoted to a technical and instructive development of Euclidean geometry. Included will be discussions and applications of transformational geometry with translations, reflections, rotations and dilations. We will also discuss tessellations and fractals and examine software generated applications. There will also be an introduction to non-Euclidean geometries (spherical and hyperbolic geometry) and we will compute triangle measurements for each type. The interrelationship between the geometry topics and higher-level mathematics material will be discussed whenever appropriate. In particular, we will discuss 3D surfaces, compute areas of spherical triangles, find angles of a hyperbolic triangle, find the area of a hyperbolic triangle in relation to a fixed hyperbolic triangle, and will perform calculus based derivations of area and volume for surfaces and solids and relate them to Euclidean geometry. Discovery through the use of technology will be an integral part of the course. Students will become familiar with geometry applications in Geometer's Sketchpad software, and to a lesser degree with Maple and Mathematica. Technology projects will be assigned and competence in the geometry tools is expected. Students will also be exposed to the use of the online software GeoGebra and Cabri for a graphing calculator environment.

Evaluation

Evaluation will be based on projects, assignments, quizzes, a take-home exam and participation. It is expected that participants will frequently present in class problem and assessment solutions. Participation will be worth 3 points. A total of 105 points is available.

The guideline for grade assignment is:

Average	[93,100]	[90,93)	[87,90)	[83,87)	[80,83)	[77,80)	[73,77)	[70,73)	[67,70)	[60,67)	[0,60)
Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	F

A tentative schedule for all work due is:
Assignment one, 8 points, arc length in spherical geometry, due 9/19
Project one, 8 points, due 9/26
Take-home 1, 8 points, chapters 3 and 4, 10/3
Assignment two, 8 points, area of a spherical triangle, due 10/17
Take-home 2, 8 points, chapters 5.1-5.5 and 6.1-6.2, 10/24
Project two, 8 points, triangle dilation, Routh's theorem, due 10/31
Project three, 8 points, 9-point circle, Euler line and analytic proof, due 11/7
Take-home 3, 8 points, chapters 6.3-6.4, 7.1-7.3 and 8.1-8.5, due 11/14
Assignment three, 8 points, compute angles and area of a hyperbolic triangle, due 11/21
11/28 is Thanksgiving
Take home exam, 30 points, due 12/12.

All assignments and exams are due in class on the dates listed. One point will be deducted for each portion of a day late. No take home exam will be accepted after the due date without prior notification and agreement. All assessments must be prepared in a word document format with appropriate Sketchpad or other graphic files imbedded in the document. Only hard copy will be accepted.

Text

Alexander and Koeberlein, *Elementary Geometry for College Students*, 6th edition, Cengage Learning, 2015 and accompanying student solution manual. The UML bookstore will carry the text and student manual . The texts are available separately and also may be able to be obtained through Amazon or other online sites. The loose-leaf

version of the text is available at the UML bookstore. Standard prices for different options are listed at www.cengagebrain.com. At this site, search for 'Geometry' and then access the course text. Other options include the eBook and rental. Amazon and other sites should have various options as well. If investigating rentals, they will be needed through the end of the term. The student solution manual 978-1-285-19681-7 contains worked out solutions to select odd numbered problems.

There will also be handouts and online files to address material dealing with spherical and hyperbolic geometry, transformations in geometry, and explorations with Euclidean geometry.

Tools

In addition to the textbook, the primary geometry software that will be used is:

- Geometer's Sketchpad V5.06: access the site https://sketchpad.keycurriculum.com for a free complimentary copy of the software. Details will be discussed in class.

We will also discuss the features of the online software GeoGebra and Cabri for the TI-89 and Cabri Jr. for the TI-84. Further information about these geometry products is available from TI at *education.ti.com*. Cabri Jr. is an application provided with the TI-84 Plus Silver Edition. Also a PC or Mac demo version of Cabri can be downloaded from the same site.

Links

A few links that should prove to be helpful are:

- Massachusetts Department of Education MCAS material at *www.doe.mass.edu/mcas*
- Cabri geometry reference material can be found at a Texas Instrument's web site *education.ti.com*
- Course material at MATH.4270/MATH.5270

The attached problems are those open for class discussions.

Section	Topic	Homework
Chapter 1	Line and Angle Relationships	
1.1	Statements and Reasoning	p.8/1-23 odd, 33-35
1.2	Informal Geometry and Measurement	p.17/1-13 odd, 17-27 odd,49,50
1.3	Early Definitions and Postulates	p.26/9-31 odd
1.4	Angles and Their Relationships	p.35/1-13 odd,17-39 odd, GSP for 41 and 44,45
1.5	Introduction to Geometric Proof	p.42/7-15 odd,21,22,23,28-31
1.6	Relationships: Perpendicular Lines	p.48/1,2,3-13 odd,28
1.7	The Formal Proof of a Theorem	p.55/1-5 odd,17,31,32,34
Chapter 2	Parallel Lines	
2.1	The Parallel Postulate and Special Angles	p.74/5-19 odd,20,21,GSP for 33 and 35
2.2	Indirect Proof	p.80/19-24,30
2.3	Proving Lines Parallel	p.87/7-10,17,18,19,38
2.4	The Angles of a Triangle	p.92/11-19 odd,23,25,31,32,36,42,45,48
2.5	Convex Polygons	p.100/1-13 odd,20,27,29,31,37,39
2.6	Symmetry and Transformations	p.110/15,18,19,36 with GSP
Chapter 3	Triangles	
3.1	Congruent Triangles	p.128/1-17 odd,21-29 odd,40
3.2	Corresponding Parts of Congruent Triangles	p.136/1,3,5,9,13,19,20,33,39,40
3.3	Isosceles Triangles	p.145/3,5,21,23,25,29,35,36,42,43-47
3.4	Basic Constructions Justified	p.151/15 and 25 with GPS,39,40
3.5	Inequalities in a Triangle	p.158/11-13,23,26,27
Chapter 4	Quadrilaterals	
4.1	Properties of a Parallelogram	p.17617,18,23 and 24 with GSP,27-34,36 with GSP,39
4.2	The Parallelogram and Kite	p.184/3,6,9,11,13,18,19,23,25,27,28,39,40

4.3	The Rectangle, Square, and Rhombus	p.193/5,6,19,20,23,24,32,35,37,39,44
4.4	The Trapezoid	p.200/1,3,6,11,17,23,33,38,39
Chapter 5	Similar Triangles	
5.1	Ratios, Rates, and Proportions	p.216/3,4,15,17,21-27 odd,37-39
5.2	Similar Polygons	p.222/7,29,30,32,36-38,40
5.3	Proving Triangles Similar	p.230/10,13,14-16,22,35,41,42
5.4	The Pythagorean Theorem	p.240/1,15,16,18,19,25,27,35,38,39
5.5	Special Right Triangles	p.247/5,9,21,24,25,27,31,34
5.6	Segments Divided Proportionally	p.255/1,20,31,33,34,35
Chapter 6	Circles	
6.1	Circles and Related Segments and Angles	p.275/1-5 odd,9-27 odd,35
6.2	More Angle Measures in the Circle	p.285/1,3,6,7,9,13,23,27,29,34,41,47
6.3	Line and Segment Relationships in the Circle	p.295/1,28,29,33,35,37,42
6.4	Some Constructions and Ineq. for the Circle	p.301/9,11
Chapter 7	Locus and Concurrence	
7.1	Locus of Points	p.317/2-9 odd,13,23
7.2	Concurrence of Lines	p.325/7-21 odd,27,29,31
7.3	More About regular Polygons	p.332/1-7 odd,13,15,19,21,23,26-29,31
Chapter 8	Areas of Polygons and Circles	
8.1	Area and Initial Postulates	p.348/1,5,11,13,15,19,21,22, 25-29 odd,33,35,41,47,49
8.2	Perimeter and Area of Polygons	p.359/1,3,5,9,13,15,21,23,27,38,41,42
8.3	Regular Polygons and Area	p.366/7,13,15,17,21,29,31
8.4	Circumference and Area of a Circle	p.372/1,5,7,9,15,21,27,33,34,35
8.5	More Area Relationships in the Circle	p.378/1-13 odd,17,23,27
Chapter 9	Surfaces and Solids	
9.1	Prisms, Area, and Volume	p.396/1,7,9,14,17,31,33,34,35
9.2	Pyramids, Area, and Volume	p.406/19,20,27,29,31,34,35
9.3	Cylinders and Cones	p.416/11,19,21,29,36,41,42
9.4	Polyhedrons and Spheres	p.425/10,13,15,17,18,21,26,34,35,37,39
Chapter 10	Analytic Geometry	
10.5	Equations of Lines	p.472/45,46,47
10.6	3D Coordinate Systems	p.481/1,11,15,19,20,21,28,33,34,39
Chapter 11	Introduction to Trigonometry	
11.1	The Sine Ratio and Applications	p.496/21,23,27,29,33,34
11.2	The Cosine Ratio and Applications	p.503/1,17,31,33,36,37,40
11.3	The Tangent Ratio and Other Ratios	p.511/37,40,41,42,46
11.4	Applications with Acute Triangles	p.519/29,30,31,36,37,38