

Ma 211
Theory of Geometry
Fall/2021

Instructor: Dr. Kathy Pilger
 Office: AL 55
 Office Hours: 2 p.m. M-F, Others by appointment
 Email: kpilger@bju.edu (This is the best way to contact me. I read email often.)
 Textbook(s): *Roads to Geometry* by Edward Wallace and Stephen West (3rd ed.), *Schaum's Outlines - Geometry* (any edition is acceptable)

Catalog Description:

Structure of proof, deductive reasoning, a survey of the theory of Euclidean geometry with an emphasis on proofs involving lines, angles, triangles, polygons and circles with an emphasis on transformational geometry and analytical geometry. Experience with *Desmos.com/geometry*.

Context: The faculty of the Division of Mathematical Sciences has developed five broad goals and has aligned these goals with the Bob Jones University Institutional Goals (IG) and the goals of the Bible and Liberal Arts Core (BLA). We believe these goals support the IG/BLA of the University. The Division Goals (DG) are to:

1. Mature the student in the theory and applications of mathematics and computer science.
2. Provide the student the required mathematical and computing background to function and contribute effectively in today's technological society.
3. Provide the student a platform for continued learning and development of his God-given abilities.
4. Instill in the student a desire to use his abilities in service to Christ.
5. Provide an appropriate liberal arts complement to a wide variety of majors.

Course Goal (CG):

1. To develop a Christian perspective of geometry (DG 3, 4)
2. To develop Christlike qualities such as perseverance, diligence, and dependence on God. (DG 3, 4)
3. To develop mathematical maturity and independent thinking (DG 1, 2, 3, 5)
4. To develop a greater appreciation for the beauty and power of geometry (DG 3, 4)
5. To develop a greater interest in exploring mathematical ideas independent of the teacher (DG 1, 2, 3, 4)
6. To develop the foundation of Euclidean geometry (DG 1, 2, 3, 5)

Course Objectives: With at least 70% accuracy, the student will be able to do the following:

Course Objectives	Course Goals Supported	Course Content	Primary Assessment
A. Reason, construct, and evaluate mathematical arguments and develop an appreciation for mathematical rigor and inquiry. (NCTM/CAEP A.3.8)*	3, 5	Chapters 1, 2, 3, 4	Geometry Proof Portfolio
B. Recognize reasoning and proof as fundamental aspects of mathematics. (NCTM/CAEP A.3.8)	3	Chapters 1, 2, 3, 4	Tests
C. Make and investigate mathematical conjectures. (NCTM/CAEP A.3.8)	3, 5	Chapters 1, 2, 3, 4	Tests
D. Use spatial visualization, dynamic geometric software and geometric modeling to explore and analyze geometric shapes, structures, and their properties. (NCTM/CAEP A.3.6, A.3.10)	3, 4, 5, 6	Chapters 3, 4	Polyhedra Project/ Desmos.com/geometry Project
E. Demonstrate knowledge of core concepts and principles of Euclidean geometry in two and three dimensions. (NCTM/CAEP A.3.1, A.3.4, A.3.6, A.3.7)	4, 6	Chapter 1/Euclidean Basics Review	Geometry Math Modules /Test

F.	Specify locations and describe relationships using coordinate geometry. (NCTM/CAEP A.3.9)	3, 6	Chapter 5	Take-Home Test
G.	Demonstrate knowledge of the historical development of Euclidean and non-Euclidean geometries including contributions from diverse cultures. (NCTM/CAEP A.3.10)	1, 4, 6	Chapter 1	Paper
H.	Perform transformations in the plane including reflections, rotations, translations, glide reflections and dilations and relate these to congruence and similarity. (NCTM/CAEP A.3.2, A.3.3)	4, 5, 6	Transformation Handouts	Transformational Geometry Project

*NCTM/CAEP Program Standards 2012

General Policies:

Materials Requirements:

Straightedge and compass

Course Reading:

The textbooks should be read thoroughly. Students are responsible for all of the information in the textbooks even if not discussed in class.

Math Module Review

Euclidean Basics Review – It is assumed that you have had a geometry class in the past but may need to brush up on basic geometry concepts and vocabulary. You should find corresponding review in the *Schaum's Outlines - Geometry* as you read it. You are required to work through the Geometry modules online that will be assigned to you. You will find these modules at www.catchupmath.com (See schedule for dates).

Course Writing:

- A. **Pocket-sized Polyhedra Project (80 points)** – Go to Canvas to find the *Mathematics Teacher* article called *Ponderings on Pocket-sized Polyhedra* by S. Louis Gould and the rubric for this project. After reading this article, research the ideas of Platonic Solids and Euler's Formula. Write a two-page paper describing, defining, and discussing these ideas and the article. Be sure to include a third page of references and include at least one print source. The paper is worth 30 points. The other 50 points that make up the project involves working through the activities found in the article on *Desmos.com/geometry* and creating the pop-up solids as described there. Each correctly construct pop-up polyhedral that is turned in will count 10 points to make a total of 50 points for the polyhedra. You should turn in five polyhedra to earn the maximum number of points on the construction part of the project. You should create a tetrahedron, cube, octahedron, dodecahedron and icosahedron. These should be quality products that you would be pleased to use in a real classroom setting in the future.
- B. **Transformational Geometry Project (80 points)** – This project will assess understanding of basic Transformational Geometry and its application to real-world problems as well as congruence and similarity. Students will be able to use their notes and the Canvas source materials to work through this project.
- C. **Historical Paper (50 points)** - A paper on a historical figure in the development of Geometry is required. Be sure to include a reference section. You should have at least one print source in your references. The paper should include the life, culture and works of one of the following mathematicians. Include the mathematicians work on Euclid's Parallel Postulate. Each student will be required to choose a different figure to research and write about so that a collection of papers can be made and distributed to the members of the class.

Archimedes (Greek)	Thabit ibn Qurra (Islamic)
Claudius Ptolemy (Greek)	Omar Khayyam (Persian)
Proclus (Greek)	Giovanni Ceva (Italian)
Appollonius of Perga (Greek)	Leonardo da Vinci (Italian)
Zhang Heng (Chinese)	John Playfair (Scottish)

Farkas Bolyai (Hungarian)
John Wallis (English)
Girolamo Saccheri (Italian)
Johann H. Lambert (German)
Adrain Marie Legendre (French)
Christian Heinrich von Nagel (German)

Nicolai Lobachevsky (Russian)
Juanos Bolyai (Hungarian)
Bernhard Riemann (German)
August Mobius (German)
Benoit Mandelbrot (Polish)
Magnus Wenninger (American)

- D. **Desmos.com/geometry Project (100 points)** – This assignment requires each student to become very familiar with the dynamic software package called *Desmos.com/geometry*. This is an exciting tool that brings geometry to life before your very eyes. You will find it at <https://www.desmos.com/geometry>. The Project will be worth 100 points and must include ten (10) *Desmos* activities. Each of these activities must relate to the material that is being discussed in class. It can focus on the grade level of your interest. You must include 1) objectives for the activity, 2) instructions/worksheets, and 3) a copy of the result done with *Desmos*. You may find activities in books or on the Internet. You may use these activities but always site the source and give credit where it is due.
- E. **Geometry Proof Portfolio (100 points)** – This assignment requires each student to demonstrate a knowledge of geometry proof techniques discussed in class. You will be given twelve geometric statements, ten of which you are to complete and include in your Geometry Proof Portfolio. You will work on these problems and submit proposed solutions to me at the end of the semester. You may e-mail portfolio proofs to me a maximum of two times to be critiqued. I will make recommendations about these solutions (such as, “Start over”, Wonderful – don’t make any changes.”) If necessary, you should then consider rewriting and resubmitting your proofs for further comment. Basically, when you submit a proof, you are asking me, “Is this good enough for my portfolio?” The Notebook when completed will be worth 100 points.

Grading Scale:

90% - 100%	A
80% - 89%	B
70% - 79%	C
60% - 69%	D

Homework:

Daily homework problems will be assigned and should be attempted before the next class period. These problems will be discussed in class and students will present the solutions.

Problems of the Week (POW) (5 points each = 80 points) A sheet of vocabulary terms and problems will be given each week to be handed in on Wednesday of each week at the beginning of class. These problems are intended to keep you current with the material being presented in class.

Help:

Whenever Mack Building is open you have a free math tutor. Go to the Math Lab on second floor of Mack Building, ML 1. There you will find a qualified upperclassman math student who is willing and capable to help you.

Classroom Deportment:

Compliance with student handbook policies is expected during class.

Attendance Policy:

Regular attendance is very important in this class. If you miss a class you will be missing some essential information that will help you be more successful in your career. I will follow the BJU Attendance Policy that is set forth in your Student Handbook. For additional information, please see the Bob Jones University 2021-22 Student Handbook.

Naturally, if you are absent on a day when you have been informed in advance that work is due, then the late policy is (10% deduction for each calendar day late) and applies for that assignment regardless of the nature of the absence.

Academic Integrity:

Doing your own work brings Glory to God. The claiming of someone else's work as your own is cheating and is a sin. All work done for this class needs to be your own. If information is taken from other sources, it always needs to be referenced and credit given where it is due. I value academic integrity. Therefore, I will take appropriate action if cheating or plagiarism occurs in this course. For additional information, please see the Bob Jones University 2021-22 student handbook.

Copyright (2021, Pilger) as to this syllabus and all lectures. Students are prohibited from selling (or being paid for taking) notes during this course to or by any person or commercial form without the express written permission of the professor teaching the course.

Ma 211 – Theory of Geometry

S = Schaum's Outline

R = Roads to Geometry

T = Transformational Geometry

HW – Homework

Tentative Schedule			
Date	Day	Class	Assignment due on this date
Aug. 25	W	Unit 1 – Introduction; Begin Review of Basic Geometry terminology and notation	
Aug. 27	F	Fundamental Ideas, Parallel Lines and Triangles	Read (S): Ch. 1
Aug. 30	M	Introduction to Desmos.com/Geometry Begin work on Pocket-sized Polyhedra Project	Read (S): Ch. 4, 5, 12 Module Ch 1 Complete
Sept. 1	W	Polygons and Perimeter and Area, Similarity,	POW #1 Due
Sept. 3	F	Desmos workday on Pocket-sized Polyhedra Project	Read (S): Ch. 3 Module Ch 3 Complete
Sept. 6	M	Labor Day	Read (S): Ch. 9 Module Ch 4 Complete
Sept. 8	W	Right Triangles and Circles	POW #2 Due
Sept. 10	F	Geometric Solids	Read (S): Ch. 7 Module Ch 5 Complete
Sept. 13	M	Unit 2 – Transformational Geometry Basics The Game of Tetris	Pocket-sized Polyhedra Project Due
Sept. 15	W	Reflections	POW #3 Due
Sept. 17	F	Translations	Read (S): Ch. 6, 10; (T): Reflections; HW (T): 1-15 Module Ch 6 Complete
Sept. 20	M	Rotations	Read (S): Ch. 9; (T): Translations; HW (T): 1-16 Module Ch 9 Complete
Sept. 22	W	Dilations	POW #4 Due Read (T): Rotations; HW (T): 1-9
Sept. 24	F	Composition of functions to show congruence and similarity	Module Ch 10 Complete Read (T): Dilations; HW (T): 1-11
Sept. 27	M	Workday on Transformational Geometry Project	Module Ch 11 Complete
Sept. 29	W	Unit 3 – Analytic Geometry - Introduction to Proof using Analytic Geometry	Read (R): 5.2 and (S) Ch. 17
Oct. 1	F	Analytic Geometry Proofs	Transformational Geometry Project Due
Oct. 4	M	Analytic Geometry Proofs	
Oct. 6	W	Analytic Geometry Proofs	HW (R): p. 256 – 1-3, 5 POW #5 Due
Oct. 8	F	Analytic Geometry Proofs	HW (R); p. 256 - 7, 16, 18
Oct. 11	M	Logic	Read (R): 1.1
Oct. 13	W	Logic	View Ancient History of Geometry PowerPoint Read (R): 1.2 POW #6 Due
Oct. 15	F	Unit 4 – Roads to Geometry History 1.1 (R) Ancient History of Geometry 1.2 (R) – Axiomatic System	Analytic Geometry Take-Home Test Due
Oct. 18-19	M-T	Fall Break	
Oct. 20	W	1.2 (R) – Axiomatic System; Discuss Desmos Project	Read (R): 1.4 HW (R): p. 5 – 1, 2, 5, 6, 8 POW #7 Due
Oct. 22	F	1.4 (R) – Incidence Geometry	View Modern History of Geometry PowerPoint HW(R): p. 17 – 1, 3, 6-8, 10-12, 19, 20, 21
Oct. 25	M	Unit 5 – Proving and Developing Geometry theorems and making conjectures in Euclidean Geometry	Read (R): 2.1, 2.2 and 2.3 History Paper Due
Oct. 27	W	2.2 (R) – Euclid's Geometry 2.3 (R) – Modern Euclidean Geometry	POW #8 Due HW (R): p. 31 – 2, 5
Oct. 29	F	2.4 (R) – Hilbert's Axioms 2.5 (R) – Birkhoff's Axioms	Read (R): 2.6 HW (R): p. 45 – 2, 4, 6-8, 10, 13; p. 49 – 3-5 8, 9
Nov. 1	M	2.6 (R) – SMSG Postulates	
Nov. 3	W	Chapter 1-2 Test	
Nov. 5	F	3.2 (R) – Neutral Geometry	Read (R): 3.2 POW #9 Due
Nov. 8	M	3.3 (R) – Congruence Conditions	Read (R): 3.3 Desmos Project Due
Nov. 10	W	3.3 (R) – Congruence Conditions	HW (R): p. 88 – 1, 4, 6, 7, 9
Nov. 12	F	4.2 (R) – Parallel Postulate	Read (R): 4.2 HW (R): p. 94 – 1, 4, 7
Nov. 15	M	4.2 (R) – Parallel Postulate	HW (R): p. 135 – 1, 6, 7, 9-11, 14, 16, 21
Nov. 17	W	4.3 (R) – Congruence and Area	POW #10 Due Read (R): 4.4
Nov. 19	F	4.4 (R) - Similarity	HW (R): p. 140 – 1-3, 7, 12-13, 18, 19, 23

Nov. 22-26	M-F	Thanksgiving Break	
Nov. 29	M	4.5 (R) – Circles	Read (R): 4.5; HW (R): p. 153 – 3, 11, 13, 14, 19, 22
Dec. 1	W	4.9 (R) - Euclidean Constructions	
Dec. 3	F	Catch Up/Review	HW (R): p. 176 – 3, 4, 7, 11-13, 17, 22, 31 Geometry Proofs Project Due
Dec. 6	M	Chapter 3-4 Test	
Dec. 8	W	4.9 (R) - Euclidean Constructions	POW #11 Due
Dec. 10	F	Review	Construction Worksheet
Dec. 13-16	M-Th	Final Exams	