BOB JONES University

College of Arts and Sciences

Ma 211
Theory of Geometry
Fall/2019

Instructor:	Dr. Kathy Pilger
Office:	AL 55
Office Hours:	1 pm M-W, F; 10 am T, 10 am Th (electronic)
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* (4th ed.) pdf

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 *Geometer's Sketchpad*.

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/ Geometer's Sketchpad 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	Online Quizzes /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	Transfor-mation 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.

BJUOnline Quizzes

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. Eight online worksheets have been prepared for you to review. Do only the amount of work on them that you need to do to be able to work the problems. You should find corresponding review in the *Schaum's Outlines - Geometry* as you read it. Three BJUOnline quizzes will assess the Euclidean Basics (See schedule for dates).

Course Writing:

A. **Pocket-sized Polyhedra Project (80 points)** – Go to BJUOnline 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 *Geometer's Sketchpad* 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.

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

Girolamo Saccheri (Italian)	Juanos Bolyai (Hungarian)
Johann H. Lambert (German)	Bernhard Riemann (German)
Adrain Marie Legendre (French)	August Mobius (German)
Christian Heinrich von Nagel (German)	Benoit Mandelbrot (Polish)
Nicolai Lobachevsky (Russian)	Magnus Wenninger (American)

D. **Geometer's Sketchpad Project (100 points)** – This assignment requires each student to become very familiar with the dynamic software package called *Geometer's Sketchpad.* This is an exciting tool that brings geometry to life before your very eyes. You will find it installed on several computers in Mack Library Computer Lab 1 (ML1). The Project will be worth 100 points and must include ten (10) *Sketchpad* 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 *Geometer's Sketchpad.* 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 Library is open you have a free math tutor. Go to the Math Lab on second floor of the library 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 2019-20 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 2019-20 student handbook.

Ma 211 – Theory of Geometry

S = Schaum's Outline R = Roads to Geometry HW – Homework

Tentative Schedule

Date	Day	Class	Assignment due on this date
Sept. 4	W	Unit 1 – Introduction; Begin Review of Basic Geometry terminology and notation	
Sept. 6	F	Fundamental Ideas, Parallel Lines and Triangles	Read: Ch. 1, 3, 4 (S) HW: Worksheets #1, 2, 3
Sept. 9	M	Introduction to Geometer's Sketchpad	**BJUOnline Quiz #1 Due** Read: Ch. 5, 6, 10.1-10.4 (S)
Sept. 11	W	Polygons and Perimeter and Area, Similarity,	HW: Worksheet #4; Read Ch. 7 (S) **POW #1 Due**
Sept. 13	F	Right Triangles and Circles	HW: Worksheets #5, 6; Read Ch. 9, 10.5-10.7(S)
Sept. 16	M	Geometric Solids	HW: Worksheet #7; Read Ch. 12, 17 (S) **BJUOnline Quiz #2 Due**
Sept. 18	W	Unit 2 – Transformational Geometry Basics The Game of Tetris	HW: Worksheet #8 **POW #2 Due**
Sept. 20	F	Reflections	**Pocket-sized Polyhedra Project Due** Read Ch. 18 (S)
Sept. 23	M	Translations	**BJU Online Quiz #3 Due**
Sept. 25	W	Rotations	**POW #3 Due**
Sept. 27	F	Dilations	
Sept. 30	M	Composition of functions to show congruence and similarity	
Oct. 2	W	Unit 3 – Analytic Geometry - Introduction to Proof using Analytic Geometry	**POW #4 Due** Read: 5.2 (R)
Oct. 4	F	**Washington Center Challenge Day – No Class**	
Oct. 7	M	Analytic Geometry Proofs	**Transformational Geometry Project Due** Read: 1.2 (R)
Oct. 9	W	Analytic Geometry Proofs	HW p. 256 – 1-3, 5, 7, 13, 16, 18 **POW #5 Due**
Oct. 11	F	Analytic Geometry Proofs	
Oct. 14	M	Analytic Geometry Proofs	Read: 1.1 (R)
Oct. 16	W	Logic	Read: 1.2 (R) **POW #6 Due**
Oct. 18	F	Unit 4 – Roads to Geometry History, 1.1 (R) Ancient History of Geometry	View Ancient History of Geometry PowerPoint HW: p. 5 (R) – 1, 2, 5, 6, 8
Oct. 21	M	1.2 (R) – Axiomatic System	**Analytic Geometry Take-Home Test Due** HW: p. 17 (R) – 1, 3, 4, 6-10, 12, 13, 19, 20, 21 HW: p. 31 – 3, 6, 8, 11
Oct. 23	W	1.2 (R) – Finite Geometries	HW: p. 24 - 1-3, 5-8, 11, 14, 20, 22; Read: 1.4 **POW #7 Due**
Oct. 25	F	1.4 (R) – Incidence Geometry	View Modern History of Geometry PowerPoint
Oct. 28	M	Unit 5 – Proving and Developing Geometry theorems and making conjectures in Euclidean Geometry	HW: p. 31 – 3, 6, 8, 11; Read: 2.1, 2.2 and 2.3 **History Paper Due**
Oct. 30	W	2.2 (R) – Euclid's Geometry 2.3 (R) – Modern Euclidean Geometry	**POW #8 Due**
Nov. 1	F	2.4 (R) – Hilbert's Axioms 2.5 (R) – Birkhoff's Axioms	Read: 2.6; HW: p. 45 – 2, 4, 6-8, 10, 13; p. 49 – 3-5 8, 9
Nov. 4	M	2.6 (R) – SMSG Postulates	HW: p. 49 – 3-5 8, 9
Nov. 6	W	**Chapter 1-2 Test**	
Nov. 8	F	3.2 (R) – Neutral Geometry	Read 3.2; HW: p. 71 – 1, 4-7 **POW #9 Due**
Nov. 11	M	3.3 (R) – Congruence Conditions	Read 3.3 **Geometer's Sketchpad Project Due**
Nov. 13	W	3.3 (R) – Congruence Conditions	**POW #10 Due** HW: p. 88 – 1, 4, 6, 7, 9
Nov. 15	F	4.2 (R) – Parallel Postulate	Read 4.2 HW: p. 135 – 1, 6, 7, 9-14, 16, 21
Nov. 18	M	4.2 (R) – Parallel Postulate	
Nov. 20	W	4.3 (R) – Congruence and Area	Read: 4.3 **POW #11 Due**

Nov.22	F	4.4 (R) – Similarity	Read 4.4; HW: p. 140 – 1-3, 6, 7, 12-14, 18, 19, 23, 24
Nov. 25-29	M-F	**Thanksgiving Break**	
Dec. 2	M	4.5 (R) – Circles	Read 4.5; HW: p. 153 – 3, 10, 11, 13, 14, 19, 22
Dec. 4	W	4.9 (R) - Euclidean Constructions	HW: p. 140 – 1-3, 6, 7, 12-14, 18, 19, 23, 24; Read 4.4
Dec. 6	F	Catch Up/Review	HW: p. 176 – 3, 4, 7, 8, 11-13, 22, 31, 34 **Geometry Proofs Project Due**
Dec. 9	M	**Chapter 3-4 Test**	
Dec. 11	W	4.9 (R) - Euclidean Constructions	HW: p. 153 – 3, 10, 11, 13, 14, 19, 22; Read 4.5
Dec. 13	F	Review	**POW #12 Due**
Dec. 16-19	M-Th	**Final Exams**	