 Ma 121

College of Arts and Sciences

Division of Mathematical Sciences

**Theory of Geometry**

*Fall/2025*

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| Instructor: | Dr. Kathy Pilger |
| Office: | AL 84 |
| Office Hours: | 9 a.m. MWF; Others by appointment |
| Email: | kpilger@bju.edu (This is the best way to contact me. I read email often.) |
| Textbook(s): | *Elementary Geometry for College Students,* by Alexander, D.C. & Koeberlein, G.M, (7th ed.), Cengage, 2020, ISBN: 978-1-337-61408-5.[Welcome to WebSketchpad (geometricfunctions.org)](https://geometricfunctions.org/fc/tools/) |

**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, circles, and 3-D figures including transformational geometry and analytical geometry. Experience with Mathematical Action Technology (MAT) such as Web Sketchpad

/Desmos/Geogebra.

**Context:** The faculty of the Division of Mathematical Sciences has developed four broad goals and has aligned these goals with the Bob Jones University Institutional Goals and Liberal Arts Core. The Division Goals (DG) are as follows:

The student will…

1. Understand the essential theory of mathematics … and appropriately apply the theory in solving problems.
2. Use critical-thinking/analytical skills to understand mathematical … problems and design solutions with the aid of appropriate tools.
3. Apply an understanding of how mathematics/computing can be used in service to Christ as tools to the examination of the world He created.
4. Construct a foundation upon which they, after graduation, can continue the development of their God-given abilities and the learning necessary for work and life.

**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)
4. To develop a greater appreciation for the beauty and power of geometry (DG 2, 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)

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

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| **Course Objectives**  | **Course Goals Supported** | **Course Content** | **Primary Assessment** |
| 1. Reason, construct, and evaluate mathematical arguments and develop an appreciation for mathematical rigor and inquiry. (NCTM/CAEP 1e, 2b)\*
 | 3, 5 | ChaptersP, 1, 2 | Geometry Proof Portfolio |
| 1. Recognize reasoning and proof as fundamental aspects of mathematics. (NCTM/CAEP 1e, 2b)
 | 3, 4 | ChaptersP, 1, 2, 3 | Tests |
| 1. Make and investigate mathematical conjectures. (NCTM/CAEP 1e, 2b)
 | 3, 5 | ChaptersP, 4, 5 | Tests |
| 1. Use spatial visualization, dynamic geometric software and geometric modeling to explore and analyze geometric shapes, structures, and their properties. (NCTM/CAEP 4c)
 | 2, 3, 4, 5, 6 | Chapters 3, 4, 6 | Polyhedra Project |
| 1. Demonstrate knowledge of core concepts and principles of Euclidean geometry in two and three dimensions. (NCTM/CAEP 1e, 2b, 4c, 4d)
 | 4, 6 | Chapter P, 1, 2, 3, 4, 5, 6, 8, 9 | Test |
| 1. Specify locations and describe relationships using coordinate geometry. (NCTM/CAEP 1e, 4d)
 | 3, 5, 6 | Chapter 10 | Self-Study Project |
| 1. Demonstrate knowledge of the historical development of Euclidean and non-Euclidean geometries including contributions from diverse cultures.
 | 1, 4, 6 | Chapter P, 1, 2, 3, 4, 5, 6, 8, 9 | Paper/Perspective On History Readings |
| 1. Perform transformations in the plane including reflections, rotations, translations, glide reflections and dilations and relate these to congruence and similarity. (NCTM/CAEP 1e, 2b, 4c, 4d)
 | 2, 3, 4, 5, 6 | Chapter 2, Transform-ation Handouts | Transformational Geometry Project |

\*NCTM Standards 2020 – Secondary [www.nctm.org/caep](http://www.nctm.org/caep)

**General Policies:**

 **Materials Requirements:**

Straightedge and compass

**Course Reading:**

The textbooks should be read thoroughly. Students are responsible for all the information in the textbook.

**Assignments:**

1. **Historical Paper (30 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)

Appollonius of Perga (Greek)

Zhang Heng (Chinese)

Thabit ibn Qurra (Islamic)

Giovanni Ceva (Italian)

Leonardo da Vinci (Italian)

John Playfair (Scottish)

Farkas Bolyai (Hungarian)

John Wallis (English)

Girolamo Saccheri (Italian)

Johann H. Lambert (German)

Adrain Marie Legendre (French)

Nicolai Lobachevsky (Russian)

Juanos Bolyai (Hungarian)

Bernhard Riemann (German)

August Mobius (German)

Benoit Mandelbrot (Polish)

George B. Halsted (American)

 Magnus Wenninger (American)

 Stephanie Alexander (American)

 Fredrick Almgren (American)

1. **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.
2. **Construction Project (50 points) –** After you are exposed to a variety of basic constructions early in the course, you will be introduced to an online tool called [Constructions - Math Open Reference](https://www.mathopenref.com/tocs/constructionstoc.html). Using the knowledge learned from the textbook and this reference tool, you will complete a take-home construction project using only a straightedge and compass.
3. **Geometry Proof Portfolio (100 points)** – This assignment requires you to demonstrate a knowledge of geometry proof techniques discussed in class. You will be given ten geometric statements, eight of which are to be completed and included in a professionally designed Geometry Proof Portfolio. You may work on these problems and submit proposed solutions to me. The proofs may be e-mailed 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 the proofs for further comment. Professional math type and diagrams are required.
4. **Self-Study Chapters –** See required problems on Schedule.

**Chapter 7 (30 points)**

**Chapter 10 (50 points)**

1. **Pocket-sized Pop-up 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 using a web-based tool called *WebSketchPad* found at [Welcome to WebSketchpad](https://geometricfunctions.org/fc/tools/). Each correctly constructed pop-up polyhedra 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

**Grading Scale:**

 90% - 100% A

 80% - 89% B

 70% - 79% C

 60% - 69% D

**Homework:**

**Homework** **problems (10 points per chapter)** will be assigned and should be attempted before the next class period. These problems will be discussed in class and students will present solutions in class for selected problems. A completed homework summary sheet will be uploaded to Canvas for each chapter.

**Daily Practice Problems (4 points per week)** Class will begin each day with a DPP. These problems are intended to keep students current with the material being presented in class and will help and not hurt you.

**Extra Credit:**

Four points of extra credit can be earned for each Chapter covered in class. Self-study chapters are not included. The extra credit requires completion of the Chapter Test found at the end of each chapter. The extra credit can be turned in on the day of the associated Chapter Test or on the day of the Final Exam.

**Help:**

I am available to help you when needed. If you cannot come to my office hour because of conflicts, make an appointment with me at another time. Whenever Mack Building is open you have a free math tutor. Go to the Math Lab on second floor of Mack Building, ML201. 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. The classroom is to be a professional environment. That means you are to come to class prepared for the day’s discussion, your attention is expected to be on course related material, and you are expected to positively contribute to the class.

**BJU Mathematics Division Expectations**

**Presentation of Work**

The goal is professional, fluent, and clear communication of what you know.

1. Proper use of mathematical notation is expected. The structure of notation conveys specific meaning and should be used appropriately.
2. Mathematical presentation is like grammar. There are subjects, verbs ($=,\leq ,>$, etc.), and objects. Always write in “complete sentences.”
3. Tests/presentations/projects are not about what you know, but about what you can communicate about what you know – so the presentation of your work/logic should always be neat, orderly, clearly defined, and with the appropriate amount of supporting detail. (Excessive steps are not required; however, answers alone are not (usually) acceptable.)
4. Always work down the page. (Working in multiple columns is generally not acceptable.) There should be one problem worked in each ``row'' because this contributes to clarity and the development of your logical argument.
5. Skip lines between problems. If you have dense handwriting, skip every other line and skip 2-3 lines between problems.
6. Clearly label problems/sub-problems. Problems do not necessarily have to be worked in order but must be clearly labeled either way. Your professor will communicate their expectation on presenting problems out of order.
7. Answers are to be presented as the logical conclusion of your work, not as the only important thing (e.g. at the start of the problem and/or unconnected with any justifying work).
8. Work should be submitted on clean $8.5× 11$ inch (standard-size) paper and should not be submitted with “spiral”/ripped edges.
9. Take-home tests (when time is not limited) should be neatly presented (rewritten, organized, no scratchwork, etc.) as a final polished piece.

**Your professor may refuse to accept work that does not meet the minimum presentation requirements above, or they may choose to deduct up to 10% from the assignment grade.**

**Problems Expectations**

The goal is to prove your mastery (not your just barely comprehending).

1. Read all words carefully in questions. Everything is important, so know the meaning of all words and how those words tell you to respond.
2. Theory is a precise expression of important ideas. While it is not graded word for word, jot for jot, the precise ideas must be maintained. Embrace thorough, smooth learning and presentation. Can you recite the theory from the last class period quickly, comfortably, and conversationally?
3. Theory tells us how to solve problems. Know exactly what problems connected to each theorem or definition look like, and know how to solve them.
4. Know what the key steps of each problem are. Present only the key steps (or the minimum needed to get the answer right and show all your logic).
5. Do enough practice for each type of problem so that you are smooth.

Failure to meet these expectations will be reflected in lower test scores.

**Late Policy**

Assignments not submitted as directed by the due date will incur the following late penalty.

LP 1. No late homework/in-class assignments are accepted.

LP 2. Written assignments/projects/take-home tests are penalized at 10% per day for the first three days and will receive a grade of 0% after that. Oral presentations are a 0 if not presented on the day assigned. Late paper submissions must include the date and time the paper is submitted and be in the credenza by 8 am the next day. The next day penalty begins at 8 am.

LP 3. In-class tests must be taken by the date given in class (or selected time in the case of an oral exam) unless there is incapacitating illness (see attendance policy below). Missing a test or taking the test late (including an oral exam) will result in a 10% penalty unless excused by the professor. Tests should be made up prior to the next class period unless other arrangements have been made with the professor.

 LP 4. Work may always be completed early. Contact your professor if you wish to take a test early.

**Attendance Policy**

BJU attendance policy is in effect (see <https://home.bju.edu/bju-policies/> for details).

 AP 1. Scheduled tests/quizzes should be taken before your planned absence; please contact your professor to make arrangements for doing so. You are personally responsible for getting notes from your classmates and discussing the missed material with them. You should not expect your professor to privately re-teach you the material you missed. Your professor is always available to help you with specific questions. If an unannounced quiz/assessment is taken during the class that you miss, you will NOT be allowed to make it up, and you WILL receive a zero on the assignment. Work may always be completed early (see your professor if you wish to take a test early).

 AP 2. Missing an in-class test because you feel you are not prepared to take it is not acceptable. Work missed for this reason will not be made up and you will receive a zero on the assignment.

 AP 3. For absences due to incapacitating illness or emergency, you should contact the instructor as soon as you realize you will not be in class to make arrangements to make up any missed work. Tests will be made up without penalty for the first occurrence. Each subsequent time a test is missed because of incapacitating illness or emergency, an additional 10% grade penalty for that test will be incurred. A 10% penalty will be assessed for a late submission of take-home tests. All late work must be made up by the next class period unless other arrangements have been made with the professor.

**Emergencies During Class**

In case of emergency requiring evacuation, students will go down the stairs on the fountain side and exit the door underneath the stairs, facing Wade Hampton Blvd. Students will immediately cross the street and gather by the fence with their class. If we are unable to exit the building, the professor will instruct the students on the best course of action. To be able to respond quickly to external threats, professors may keep classroom doors locked. If you are late arriving to class, you may need to knock on the door to be let in.

**Academic Integrity Policies:**

The university’s Academic Integrity Policy is in effect (see <https://home.bju.edu/bju-policies/> for additional details).

Definitions of Integrity Violations

Integrity is the reflection of the character and nature of God in our actions; therefore, students will be expected to work with integrity. In academia, violations of integrity generally fall into one or more of the following categories:

AI 1. Cheating: unauthorized use or attempted use of assistance, information, or aids in any academic assignment

AI 2. Falsification: submitting work done by others, changing work after submitting an assignment, reporting false information about the completion of an assignment

AI 3. Unacceptable collaboration: working with others when not permitted, using AI to generate ideas,

 thoughts, or content without the explicit permission of the professor

AI 4. Facilitation of Cheating: helping another student violate academic integrity, communicating quiz/test questions to other students

AI 5. Plagiarism: the intentional or unintentional use to any degree of the ideas or words of one’s source material without proper acknowledgement

 All work done for this class must represent your own effort, your own understanding, and your own communication of the material.

**Course Integrity Policies**

If information is taken from other sources (which is at times appropriate), it always needs to be referenced and credit given where it is due. Use standard referencing techniques as taught in En 102. Solutions found on the internet are not to be copied.

CI 1. Homework: While you are encouraged to work together on the homework assignments, simply copying someone else’s solution is neither useful nor acceptable. Your homework should represent your work and your understanding of the work.

CI 2. Tests (In-Class and Take-Home): No resources may be used while taking the test unless permitted by the professor. The presence of any unauthorized material on your desk, in your calculator, on your laptop, etc. while taking a test will be construed as cheating and will be dealt with as such.

Internet/AI enabled devices or any communication devices (including but not limited to smart glasses, watches, earbuds, etc.) are not permitted to be used and should be stored out of sight during the testing period. Accessing these type of devices during the test will be construed as cheating and will be dealt with as such.

Cheating on a test will likely result in a zero on the test and will be submitted to the Academic Integrity Committee.

CI 3. Projects: You are encouraged to discuss the general ideas needed to complete the project as discussed in this course with your classmates but are not permitted to “work together” on your project (outside of your own team and any faculty appointed advisors). Your projects must represent your own ideas, your own work, and your own communication of your work.

Assignment submissions will be evaluated for plagiarism and AI usage at the discretion of the professor. If you have a question about any source you are considering using, it is wise to gain your professor’s approval before using it. You are always permitted to ask your professor for help. Any help they choose to provide is acceptable.

**AI Usage Policy**

The goal of the assignments in this course is to learn to develop the skills covered, NOT to complete the tasks assigned. The use of AI to complete or jumpstart tasks defeats the goal of the assignments. Therefore, you may not use generative AI tools in this course for any assignment without the professor’s express permission. AI tools include, but are not limited to, CoPilot, Apple Intelligence, Chat GPT, Bing Chat, Google Bard, Grok, Deepseek, Grammarly, and language translators.

**Documentation of Permitted AI Use**

Should an AI tool be used with permission, its use must be documented (including the tool used, a summary of the prompts provided and the portions of the assignment that were based on AI generated work). See <https://style.mla.org/citing-generative-ai/> for details on citing the use of AI.

Copyright (2025, 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 121 – Theory of Geometry**

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| Tentative Schedule |
| Date | Day | Class | Assignment |
| 8/27 | W | Intro, P.1 |  |
| 8/29 | F | P.1, P.2 |  |
| 9/1 | M | Labor Day |  |
| 9/3 | W | P.2 | **P.1:** 9, 11, 13-17, 19, 21, 25, 27, 31-37 (odd) |
| 9/5 | F | P.3 | **P.2:** 1, 3, 5-11, 13-27 (odd), 31-35 (odd) |
| 9/8 | M | 1.1 | **P.2:** 39-43 (odd), 49-55 (odd), 56; **P.3:** 4-6, 9-17, 19-23 |
| 9/10 | W | 1.2, 1.3 | **P.3:** 27, 33-37 (odd), 40, 41, 43, 47; 1.1: 2, 3, 5-10, 13-15, 17, 19, 23, 25-27, 29-35 (odd), 38, 41 |
| 9/12 | F | 1.4 | **1.2:** 1, 3, 5-11, 13, 17-27 (odd), 31-37 (odd), 41, 43, 46; **1.3:** 1-11 (odd), 12-16, 23-31 (odd), 35-39 (odd) |
| 9/15 | M | 1.5 | **1.4:** 1-5, 7-19 (odd), 23, 26, 28 |
| 9/17 | W | 2.1, 2.2 | **Historical Paper Due** **1.5:** 1-9 (odd), 10-11, 13-33 (odd) |
| 9/19 | F | 2.2, 2.3 | **2.1:** 1-7 (odd), 8, 9-23 (odd), 27-31 (odd), 37, 39 |
| 9/22 | M | 2.4, 2.5 | **2.2:** 1-21 (odd), 25, 27, 35; 2.3 3-23 (odd), 27-37 (odd) |
| 9/24 | W | REACH Seminars—No Classes |  |
| 9/26 | F | Review, 2.6 | **2.4:** 3-33 (odd), 37, 39, 45, 49; **2.5:** 1-19 (odd), 23-27, 31, 33-35, 37, 41, 45, 49 |
| 9/29 | M | **Ch. P-2 Exam** | **Ch. P-2 Exam** |
| 10/1 | W | Transformational Geo. | **2.6:** 1-9 (odd), 13-23 (odd), 27, 31-35 (odd) |
| 10/3 | F | 3.2, 3.3 | **3.1:** 1-9 (odd), 10-13, 15-21 (odd), 22-25, 27-37 (odd), 43 |
| 10/6 | M | 3.4 | **Transformational Geometry Project Due**  **3.2:** 1, 3, 7, 9, 13, 17-29 (odd), 33, 37, 41, 43, 44 |
| 10/8 | W | 3.5 | **3.3:** 1-7 (odd), 11-23 (odd), 27, 29, 33, 35, 41-43, 49 |
| 10/10 | F | 4.1 | **3.4:** 3, 5, 13, 15, 17, 21, 25, 29, 31, 35, 38; **3.5:** 3, 7, 9, 13-19 (odd), 23, 27, 29, 31, 35 |
| 10/13 | M | 4.2, 4.3 | **4.1:** 3-11 (odd), 15, 17, 21-25 (odd), 29-35 (odd), 39, 41, 46 |
| 10/15 | W | 4.4 | **4.2:** 3, 5, 11-15 (odd), 21, 25, 37, 39, 44; **4.3:** 1-3, 5, 9, 13, 17, 21-24, 29, 35, 39 |
| 10/17 | F | 5.1 | **Construction Project Due****4.4:** 5, 7, 11-17 (odd), 29, 31, 45 |
| 10/20-21 | M-T | Fall Break |  |
| 10/22 | W | 5.2, 5,3 | **5.1:** 3, 7, 11, 15, 17, 21, 25, 27, 33, 37 |
| 10/24 | F | 5.4, 5.5 | **5.2:** 1, 3, 7, 9, 11, 17, 23, 29, 33, 39; **5.3:** 1-7 (odd), 11-15 (odd), 27, 29, 33, 35, 41 |
| 10/27 | M | 5.6 | **5.4:** 1, 3, 5, 11, 13, 17, 19, 23, 25, 31, 35, 39, 41; **5.5:** 5-11 (odd), 15, 17, 25, 29, 33, 37 |
| 10/29 | W | 6.1 | **5.6:** 3, 5, 7, 11, 13, 17, 21, 23, 31, 33, 37, 39 |
| 10/31 | F | **Ch. 3-5 Exam** | **Ch. 3-5 Exam** |
| Nov. 3 | M | 6.2 | **6.1:** 1-11 (odd), 17, 19, 23, 33, 35, 37, 43 |
| Nov. 5 | W | 6.3 | **6.2:** 1, 3, 7, 13, 15, 17, 23, 27, 31, 37, 41, 47 |
| Nov. 7 | F | 6.4 | **6.3:** 1-9 (odd), 13, 17, 21, 23, 25, 29, 33, 45 |
| Nov. 10 | M | 8.1 | **6.4:** 1, 3, 9, 13, 17, 23, 27, 31, 35 |
| Nov. 12 | W | 8.2 | **8.1:** 1, 5, 7, 13-21 (odd), 25-33 (odd), 39, 45, 47, 53, 55 |
| Nov. 14 | F | 8.3 | **Proof Portfolio Project Due****8.2:** 3, 7, 9, 11, 19, 23, 29, 35, 39 50, 57 |
| Nov. 17 | M | 8.4 | **8.3:** 3, 9, 11, 17, 21, 29, 37 |
| Nov. 19 | W | 8.5 | **8.4:** 3, 7, 13, 17, 21-25 (odd), 29, 33, 37, 45 |
| Nov. 21 | F | **WebSketchPad Work Day** | **Chapter 7 Self-Study Due**  **8.5:** 3, 7, 11, 15, 19, 23, 27, 33 |
| Nov. 24-28 | M-F | Thanksgiving Break |  |
| 12/1 | M | 9.1 |  |
| 12/3 | W | 9.2 | **9.1:** 1-15 (odd), 19, 25, 29, 37, 43 |
| 12/5 | F | 9.3, 9.4  | **9.2:** 5-13 (odd), 19, 23, 27, 31, 35, 37, 41 |
| 12/8 | M | **Review** | **Pop-up Polyhedra Project Due** **9.3:** 5, 7, 9, 13, 15, 21-27 (odd), 31. 35, 37, 41, 43, 45; **9.4:** 3, 7, 21, 25, 31 |
| 12/10 | W | **Ch. 6, 8, 9 Exam** | **Ch. 6, 8, 9 Exam** |
| 12/12 | F | **Final Exam Review** | **Chapter 10 Self-Study Due** |
| 12/16 | T | **Final Exam 9:30 am** |  |