MAT 520 SYLLABUS – Spring 2015

1. **Course Prefix and Number:** MAT 520
2. **Course Title:** Non-Euclidean Geometries
3. **Credits:** 3:3:0
4. **Course Prerequisites:**
   Prerequisites: Grade of at least C in MAT 311 or in MAT 395 or graduate standing
5. **For Whom Planned:** Advanced undergraduates or masters level students

6. **Instructor Information:** Carol E. Seaman, Ph. D., 139 Petty Building, 336-256-1134, ceseaman@uncg.edu Office hours: Tuesdays & Thursdays 11:00am-12:15pm & Tuesdays 3:45-4:45pm or by appointment

7. **Course Purpose/Catalog Description:** Investigates the fifth postulate, hyperbolic geometries, elliptic geometries, consistency of the non-Euclidean geometries, models for Euclidean and non-Euclidean geometries, including elements of inversion.

8. **Student Learning Outcomes (SLO):**
   1. Demonstrate the use of the axiomatic method to determine geometric results in a variety of non-Euclidean settings (such as spherical, elliptic, and hyperbolic geometries).
   2. Use models to explore and analyze the properties of non-Euclidean geometries.
   3. Develop technical skills in using geometry software to explore properties of and relationships between geometric objects in non-Euclidean geometries.
   4. Investigate the role of the parallel postulate in the development of geometry within historical and mathematical contexts.
   5. Demonstrate effective written and oral communication skills in mathematics.

9. **Teaching Strategies:** Class meetings will be held in Petty 007 where we can make use of Geometer's Sketchpad™ (mathematical software) to create models in which we will explore and analyze the properties of non-Euclidean geometries. Additionally, class meetings will consist of mini-lectures, class discussion of readings, and student presentations of assigned problems.

10. **Evaluation Methods and Guidelines for Assignments:**

Academic Integrity Policy:

Responsibility for academic integrity lies with individual students and faculty members of the UNCG community. Students are responsible for becoming familiar with the Academic Integrity Policy in all its aspects and for indicating their knowledge and acceptance of the Policy by signing the Academic Integrity pledge for all major work submitted. Specific information on the Academic Integrity Policy and obligations of the faculty and students may be found on the UNCG web site of academicintegrity.uncg.edu or by calling the Office of the Dean of Students at (336) 334-5514.

Assignments:

All written assignments must include a professional standard of spelling, grammar, punctuation, and legibility. Cohesion of thought, clarity of expression, depth of reading, analysis of issues and relevance of discussion will need to be evident. Use of appropriate diagrams, mathematical vocabulary, and

justifying explanations will be standard requirements for each problem-solution assignment. Use citations when quoting or referencing work other than your own and provide a reference list when appropriate.

Grades will be determined in the following manner:	**UG**	**Grad**
1. Written Problem Solutions/Proofs	30%	15%
2. Mid-Term Exam	25%	25%
3. Final Exam	25%	25%
3. Technology Lab Project Reports	20%	15%
5. Graduate Project	0%	20%

Grading Scale – Undergraduate:

A+ 97.0-100	B 83.0-86.9	C- 70.0-72.9
A 93.0-96.9	B- 80.0-82.9	D+ 67.0-69.9
A- 90.0-92.9	C+ 77.0-79.9	D 63.0-66.9
B+ 87.0-89.9	C 73.0-76.9	D- 60.0-62.9
		F 59.9 or less

Grading Scale - Graduate:

A 94-100	A- 90-93
B+ 87-89	B 83-86
B- 80-82	C+ 77-79
C 70-76	F 69 or less

Written Problem Solutions/Proofs (*SLO 1, 2, 4, 5*)

For each problem assigned you will submit a written report in which you demonstrate your understanding of the problem, discuss the problem-solving strategies you used, present and explain the solution(s) obtained, and provide an argument that your solution(s) is/are correct.

Each problem solution/proof is graded on a 3-point rubric as follows (I will assign points in ¼ point increments, e.g., a 2 ½ or a 1 ¾, when the solution falls between categories.):

- 3 – Solution/proof is clearly and completely communicated, demonstrates a comprehensive analysis of the problem, is entirely correct in content and format, and contains appropriate diagrams/illustrations that clearly illuminate the solution/proof. (equivalent to a grade of A+)
- 2 – Solution/proof is communicated with only minor errors, demonstrates an adequate analysis of the problem, is correct in content and format in most respects, and contains appropriate diagrams/illustrations. (equivalent to a grade of B)
- 1 – Solution/proof contains flaws in communication, incomplete analysis of the problem, errors in content and/or format, and/or inadequate/misleading diagrams. (equivalent to a grade of C-)
- 0 – No solution/proof is submitted. (equivalent to a grade of zero)

Technology Lab Project Reports (*SLO 2, 3, 5*)

You will be assigned several technology lab projects that explore, using Geometers' Sketchpad™ (GSP), the application of the Poincaré disk model to illustrate the main features of hyperbolic geometry. Your reports for these lab projects should include: an introduction consisting of a complete statement of the goals of the lab project as you understand them, including all relevant definitions, axioms, and theorems; a clear and organized presentation of any data you collect or examples you explore (with diagrams taken from GSP files); a statement of your solutions to the questions posed in the lab projects; and a mathematical argument or explanation to convince me that your solution is correct and complete. The report should follow all general guidelines for written work and be accompanied by the

GSP files created during the project. Rubrics for assessment of the Technology Lab Project Reports will be posted to Blackboard™.

Exams:

You will have a mid-term exam, tentatively scheduled for March 17, 2015, and a final exam, scheduled for Tuesday, May 5, 2015.

Graduate Project:

Each graduate student will complete a major project in some area of mathematics related to Non-Euclidean geometries. The project will be due on April 21, 2015 and each graduate student will give a brief presentation to the class sharing their project on April 21, 2015. A one-page proposal for the project, describing the topic, format, and tentative references is due February 3, 2015. Feedback on the proposal, individual guidelines for completing it, and rubrics for grading will be provided by February 17, 2015.

11. Suggested Text(s)/Readings/References:

Foundations of Geometry (2nd Ed.) by G. Venema, Pearson, Prentice Hall, 2012.
The Shape of Space (2nd Ed.) by Jeffrey Weeks, Marcel Decker, 2002.
Experiencing Geometry (3rd Ed.) by D. Henderson and D. Taimina, 2005.
Roads to Geometry (3rd Ed.) by E. Wallace and S. West, 2004.
Euclidean and Non-Euclidean Geometries (4th Ed.) by Marvin Greenberg, Freeman, 2008.
Other selected readings from various sources to be provided.
Required: Laptop with Geometer's Sketchpad™ (GSP) –
https://www.mheonline.com/program/view/2/16/2647/00000SPAD

12. Topic Outline:

Week 1 (1/13)	- Geometry on non-flat surfaces: Moebius Strip, Cylinder, Torus, Klein Bottle
Week 2 (1/20)	- Circle Inversions & Intro to GSP
Week 3 (1/27)	- Definitions, Axioms, & Theorems for Neutral Geometry
Week 4 (2/3)	- Definitions & Axioms for Hyperbolic Geometry
Week 5 (2/10)	- Models for Hyperbolic Geometry
Week 6 (2/17)	- Exploring Hyperbolic Geometry with GSP
Week 7 (2/24)	- Theorems for Hyperbolic Geometry
Week 8 (3/3)	- Exploring Hyperbolic Geometry with GSP
Week 9 (3/17)	- Mid-Term Exam
Week 10 (3/24)	- Definitions, Axioms, & Models for Spherical Geometry
Week 11 (3/31)	- Exploring Theorems in Spherical Geometry
Week 12 (4/7)	- Definitions, Axioms, & Theorems for Elliptic Geometry
Week 13 (4/14)	- Exploring Models in Elliptic Geometry
Week 14 (4/21)	- Graduate Project Reports
Week 15 (5/5)	- Final Exam

13. Inclement Weather:

If the university is closed, course meetings will be cancelled and the week's content will be presented online through Blackboard™. In case you are unsure, check your e-mail and Blackboard™ – you may also call the UNCG "inclement weather announcement" at 336-334-4400.