1. **Course Prefix and Number:** MAT 406
2. **Course Title:** Teaching Mathematics and Mathematics for Teaching II
3. **Credits:** 4:3:3
4. **Course Prerequisites/Co requires:**
   - Prerequisites: MAT 405 or MAT 330 with grade of C or better
5. **For Whom Planned:** Mathematics majors; required for those seeking high school licensure
6. **Instructor Information:** Dr. Tracey H. Howell
   - Email: thowell@uncg.edu
   - Tel: 336-334-5836
   - Office: 127 Petty Building
   - Office Hours: Tuesdays & Thursdays 12:00 pm -1:45 pm, or by appointment
7. **Description:** Capstone survey of Euclidean and non-Euclidean geometries; concepts and applications of probability, data analysis, and discrete mathematics. Special teaching problems and procedures for secondary topics in relation to their mathematical foundations.

8. **Department of Mathematics & Statistics Mission Statement:** The mission of the Department of Mathematics and Statistics at the University of North Carolina at Greensboro is to provide intellectual leadership in the mathematical sciences that is of direct benefit to the State of North Carolina and that commands national and international respect for the quality of its educational programs and for its depth of scholarship. To achieve this mission, the Department has identified goals directed at achieving excellence in all three of the University’s major functions - teaching, research and service. In particular, we are committed to offering well-rounded academic programs, which will provide our graduates with competitive job skills, to contribute to the advance of knowledge and techniques in Mathematics and Statistics through an active research program and to advance our role in providing high quality training in mathematics teacher education to supply the anticipated need for well-prepared, competent elementary and secondary school mathematics teachers.

**Teachers Academy Conceptual Framework Mission Statement:** The mission of professional education at The University of North Carolina at Greensboro is to ensure “Access to Opportunities through Teaching, Learning and Caring.” This requires excellence in all our programs through alignment to state and national standards; explicit connections between research, theory and practice; candidates’ acquisition of the knowledge, skills and dispositions of their disciplines; detailed evaluation of our candidates’ continual professional growth; collaboration among stakeholders; ongoing self-study; and an overriding commitment to fostering beliefs and actions that promote education for all. Toward these ends, our Unit and programs focus on six areas: leadership, professional knowledge, professional practice, educational environments, data-informed decision making, and professional growth to support the learning of all children in the context of 21st century complexity and dynamic change.

9. **Student Learning Outcomes:**
   - **General:** This course is the second semester of a two-semester capstone course (MAT 405/406) that focuses on the foundations of mathematics for secondary teaching. In this course we explore Euclidean and non-Euclidean geometries; concepts and applications of probability and data analysis; and concepts and applications of discrete mathematics, including number theory – main strands of mathematics taught in the
high school grades. Students in this course should gain an appreciation for the dynamic nature of mathematics and for the connected development of seemingly separate areas of mathematics. This course aims to develop a deep understanding of, and to enable and support the teaching of, geometric and statistical reasoning in the high school grades. Our emphasis will be on doing mathematics in a problem-solving setting and on making sense of this mathematics within the context of high school teaching.

Successful students will be involved in investigating, questioning, conjecturing, reasoning, and communicating about the major ideas of geometry, statistics, and discrete mathematics. Students will need to create mathematical models, as well as to represent data by graphs, and interpret properties of these models and graphs in the context of the original problem. We will make use of technology (through graphing calculators, geometry and statistics software, and other web-based resources) to assist in this visualization and investigation. Reading, writing, and oral presentations are also important components of the course.

In this course you also will have the opportunity to develop the ability to distinguish problem solving and critical thinking from exercises and routine thinking. We will identify attitudes and beliefs that are conducive to success in mathematical problem solving and critical thinking (and those which are not). In addition you will continue to develop: (1) effective written and oral communication skills; (2) skills related to critical thinking, problem solving and creativity; and (3) reasoning skills, including rational inquiry, data collection, analysis, conjecture formulation, and making mathematical arguments.

Throughout this course, we will explore three broad questions regarding the teaching and learning of mathematics by secondary students:

• The Beliefs Question: What is mathematics, and what does it mean to teach and learn mathematics?
• The Knowledge Question: What are important mathematical ideas for adolescents, and what do we know about the ways in which students learn these ideas?
• The Practices Question: In what ways can teachers support students in learning mathematics?

The following specific learning objectives also identify the ways in which this exploration will enable students to prepare to incorporate the Common Core State Standards in Mathematical Practices (CCSSMP) with the North Carolina Professional Teaching Standards (NCPTS).

**Thus, the successful student will:**

1. Gain an appreciation for the need to answer the “why” question by developing the ability to make careful mathematical arguments that are accessible to secondary students. (CCSSMP, NCPTS IV)
2. Use and create definitions, models, examples, and non-examples to explore and understand mathematical concepts and objects, particularly in geometry and statistics/probability. (CCSSMP)
3. Develop technical skills in using graphing calculators and statistical software to explore data analysis numerically and graphically. (CCSSMP, NCPTS IV)
4. Develop technical skills in using geometry software to explore properties of and relationships between geometric objects. (CCSSMP, NCPTS IV)
5. Demonstrate the ability to describe patterns in mathematical data based on the underlying mathematical structures and the tools of statistical analysis. (CCSSMP)
6. Make connections across mathematical topics, using geometric reasoning and statistical reasoning to solve problems. (CCSSMP, NCPTS III)
7. Develop effective written and oral communication skills in mathematics, including proper use of mathematical symbols and notations. (CCSSMP, NCPTS IV)
8. Develop an awareness of teaching that critically analyzes the relationships among their beliefs about mathematics, their own understandings of mathematics as well as their students’, and their instructional choices. (CCSSMP, NCPTS IV)
9. Develop a variety of pedagogical strategies for teaching students mathematics in ways that honor students’ experiences, incorporate what is known about students’ understandings, draw on effective instructional strategies, and challenge students to use mathematics as a means of understanding and effecting their world. (NCPTS II, NCPTS III, NCPTS IV)

10. Teaching Methods and Assignments for Achieving Learning Outcomes: Class time will be a combination of problem-solving activities (SLO 1-9), individual student presentations (SLO 1-9), and discussion of pre-assigned readings and solutions to homework assignments (SLO 1-2, 5-9). Students will be expected to present problem solutions and to lead, as well as participate in, whole class discussions (SLO 1-9).

11. Evaluation Methods and Guidelines for Assignments:
   • (15%) Written Problem Solution Analyses (SLO 1-7)
   • (22.5%) Class Presentations (SLO 1-9)
   • (7.5%) Reflection Final Paper (SLO 8,9)
   • (55%) Unit Lesson Plan Project (SLO 1-9)

In addition, once during the semester students will be assessed on dispositions, for the purposes of their Electronic Portfolio for Secondary Licensure application, using
   • Candidates Dispositions Assessment Process (CDAP) Rubric (SLO 8,9)
   • Teacher Growth and Assessment for Pre-Service Teachers (TGAP) Rubric (SLO 8,9)
(These two assessments do not contribute to the course grade in MAT 406.)

Dispositions: Teacher preparation programs at UNCG (such as this one in secondary mathematics) emphasize dispositions that drive application of the knowledge base and we believe that we must model and monitor these dispositions as conscientiously as we provide opportunities for building the knowledge base. Candidates should display behaviors that are: · reflective, · ethical, · inclusive, · engaged in and committed to professional practice, · dedicated to life-long learning, · self-efficacious, · receptive to feedback, · affirming of diversity, · professionally responsible, and · collaborative.

Assignment Guidelines:
   General: All written assignments should include a professional standard of spelling, grammar, punctuation, and legibility. Cohesion of thought, clarity of expression, and completeness of analysis will need to be evident. Use of appropriately labeled diagrams, proper symbolic notation, and valid proof formats will be standard requirements for each assignment.

Written Problem Solution Analyses (SLO 1-7)
You will submit three written solution analyses for assigned problems, each worth 5% of your course grade (problems and due dates are posted to Blackboard™). For each problem, you will write a problem solution analysis in which you demonstrate your understanding of the problem (including the assumptions you make), discuss the problem-solving strategies and reasoning habits you used, and present the solution(s) and an argument that your solution(s) is/are correct. Each problem solution analysis 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 ¼, when the solution falls between categories.):
   • 3 – Solution is clearly communicated, demonstrates a comprehensive analysis of the problem, including the assumptions made and the problem-solving strategies and reasoning habits used, is entirely correct in content and format, and contains appropriate diagrams/notation/models/graphs that illuminate the solution. (equivalent to a grade of A+)
   • 2 – Solution is communicated with only minor errors, demonstrates an adequate analysis of the problem, including the assumptions made and the problem-solving strategies and reasoning habits...
used, is correct in content and format in most respects, and contains appropriate diagrams/notation/models/graphs. (equivalent to a grade of B)

- 1 – Solution contains flaws in communication, an incomplete analysis of the problem and/or the problem-solving strategies and reasoning habits used, errors in content and/or format, and/or inadequate/misleading diagrams/notation/models/graphs. (equivalent to a grade of C–)

- 0 – No solution is submitted. (equivalent to a grade of zero)

**Classroom Presentations** (SLO 1-9)
You will make three presentations in class during the course of the semester (in addition to the “micro-teaching” presentations that are a part of the Unit Lesson Plan Project), each worth 7.5% of your final course grade. One of these presentations will focus on a particular mathematical problem/topic within one of the strands considered in this course (geometry, probability and data analysis, discrete mathematics, or number theory). The second will present an article from *Mathematics Teacher* that discusses problem-solving in the high school classroom (with the problem coming from geometry, probability and data analysis, discrete mathematics, or number theory). In the third presentation you will share content from a session of the NCCTM conference. (Attendance is a class activity for Thursday 11/5/2015.) The problem/topics and articles to be presented and a schedule of dates for the presentations will be assigned by the 2nd week of the semester. Guidelines and an assessment rubric for these presentations will be posted to Blackboard™.

**Reflection Final Paper** (SLO 8,9)
The purpose of this assignment is for you to write about your mathematics classroom. It should involve reflecting on your experiences observing and/or teaching, the reading assignments from MAT 405/406, the class discussions in MAT 405/406, and the sessions you attended at NCCTM. Guidelines and an assessment rubric for this paper will be posted to the Blackboard™ website. The paper is due on 12/4/2015.

**Exams** - There will be no exams or final exam in this course.

**Unit Lesson Plan Project/ Electronic Portfolio Evidence 3** (SLO 1-9)
The Unit Lesson Plan Project (ULPP) is a required evidence for the Electronic Portfolio for Secondary Licensure, which includes the submission of a complete teaching unit aligned with the Common Core State Standards for Mathematics comprised of at least three lessons, with two containing a high demand task. In addition the ULPP should include diagnostic and benchmark assessments, summative assessment, performance assessment, and a final summary paper. The following are the components of the complete ULPP.

- **Unit Plan Topic, Goals, & Outline (5% of course grade)**
  Select a unit that you may be teaching during student teaching. Choose the topic carefully because you will be working with this topic throughout the course. Your plan outline should include the topic, significant concepts, content and practice standards, timeline, rationale for pedagogical approaches, and resources. A template will be provided. Peer review of this component on 9/24/2015 and outline is due on 9/29/2015.

- **Diagnostic and Benchmark Assessments (7% of course grade)**
  Create one diagnostic assessment to use at the beginning of the unit and one benchmark assessment to use at the middle of the unit. These assessments must contain at least one open-ended question. You may use other question types; however, any multiple choice items must have plausible distractors. In one paragraph, describe how you will use the results from the diagnostic assessment to inform your instruction when you implement the unit. In one paragraph, describe how you will use the results to ensure your students met your learning goals for the unit. Peer review of this component on 11/5/15 and assessments are due on 11/10/15.

- **Lesson Plan One (7% of course grade)**
The Thinking through the Lesson protocol (Smith et al. 2009) format should be used for Lesson Plan One. Guidelines and an assessment rubric for these lesson plans will be posted to the Blackboard™ website. Peer review of this component on 11/15/15 and assessments are due on 11/20/15.

Lesson Plan Two (7% of course grade)
The shorter lesson plan format based on Accessible Mathematics (Leinwand, 2013) should be used. Guidelines and an assessment rubric for these lesson plans will be posted to the Blackboard™ website. Peer review of this component on 10/22/15 and assessments are due on 10/27/15.

Lesson Plan Three (7% of course grade)
The Thinking through the Lesson protocol (Smith et al. 2009) format should be used for Lesson Plan Three. Guidelines and an assessment rubric for these lesson plans will be posted to the Blackboard™ website. Peer review of this component on 10/29/15 and assessments are due on 11/3/15.

Summative Assessment (5% of course grade)
Create a summative assessment to use at the conclusion of the unit. In one paragraph, describe how you will use the results to ensure your students met the learning goals for the unit. Guidelines and an assessment rubric for this assessment will be posted to the Blackboard™ website. Peer review of this component on 11/12/15 and assessments are due on 11/17/15.

Performance Assessments (5% of course grade)
Create or find an authentic or performance assessment associated with your unit. Design a rubric for assessing the students’ understanding of the topic. Guidelines and an assessment rubric for this assessment will be posted to the Blackboard™ website. Peer review of this component on 11/19/15 and assessments are due on 11/24/15.

Micro-Teaching (7% of course grade)
Teachers will teach their lesson from Lesson Plan I or III to the class during weeks 10 and 11. Guidelines and an assessment rubric for these presentations will be posted to the Blackboard™ website.

Final Unit Lesson Plan Project (Evidence III) (5% of course grade)
Teachers will edit and compile the components from their project to complete the requirements for Evidence III. In addition to the prior components the final project will contain a summary including: (1) a unit overview addressing anticipated students’ prior understandings, national and state standards, connections with other mathematical ideas under development as well as to other disciplines; (2) an analysis of at least two of the lessons using the Thinking through the Lesson protocol (Smith, et al. 2009); (3) multiple methods for differentiating for diverse learners across the unit; (4) a means of evaluating the effectiveness of the unit; and (5) an additional one page reflection of the unit plan.

For all mathematics majors seeking secondary licensure, the entire completed Unit Lesson Plan Project Electronic Portfolio will also be evaluated by the following rubric, which is the required assessment for your licensure application. Your ULPP must be scored “proficient” or “exceeds expectations” in all items in order to be acceptable as evidence for licensure. It is a course requirement of MAT 406 that you complete all components of the ULPP Electronic Portfolio by 12/1/15. The ULPP Electronic Portfolio must be uploaded to Task Stream™ by January 31, 2016 for evaluation as part of your licensure application.

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<tr>
<th>Evidence 3</th>
<th>Not met</th>
<th>Proficient</th>
<th>Exceeds Expectations</th>
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<tr>
<td>Pedagogical Knowledge and Skills: Planning</td>
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| NCPTS 1a.2, 2b.3, 2d.1, 3a.1, 3c.1, 3c.2, 3d.1, 4a.1, 4a.2, 4b.1, 4c.1, 4d.1, 4e.1, 4f.1, 5c.1 | **Product:** Unit plan, lesson plans and reflection  
**Note:** The Unit Plan and reflection demonstrate the candidate’s ability to use research-verified approaches to instructional design, with attention to the North Carolina Standard Course of Study, 21 differences, formative and summative assessments, and the interdisciplinary nature of knowledge and learning.  
The unit plan and lessons are aligned with the North Carolina Standard Course of Study and integrate  
• content from other disciplines and grade levels  
• literacy instruction  
• 21st century skills and content  
• global awareness  
The unit plan and lessons include multiple formative assessments, including  
• assessments for identifying students’ entry-level skills  
• plans and procedures for monitoring progress during instruction  
The unit plan includes summative assessments that demonstrate students’ mastery of the unit goals and objectives of the lessons.  
Materials included in the unit counteract stereotypic thinking, acknowledge the contributions of all cultures, and meet the needs of diverse students.  
Materials and activities expose students to different points of view/ways of thinking about the topic/concern.  
Materials and activities focus on relevance of content to students.  
The candidate draws on appropriate data about students in making instructional decisions.  
Lesson plans are differentiated to address the developmental and learning needs of all students including students from diverse backgrounds, students with special needs and students who speak English as a second language.  
The unit plan and lessons integrate technology with instruction to maximize students’ learning.  
The unit plan and lessons integrate specific instruction that help students apply processes and strategies for critical thinking and problem solving.  
The unit includes activities for students to develop knowledge and skills in the following areas: leadership, ethics, accountability, adaptability, personal productivity, personal responsibility, interpersonal skills, self-direction and social responsibility.  
Lesson plans include procedures for creating a safe, orderly and welcoming classroom.  
Planning reflects collaboration with colleagues, including special educators and other relevant specialists (i.e., speech and language specialists, social workers, school nurses and content specialists). This collaboration is documented in the reflection.
13. **Topical Outline:**

| Week 1 | • Euclidean geometry & Trigonometry – Axioms and theorems of Euclidean geometry  
|        | • Professionalism in the Classroom |
| Week 2 | • Euclidean geometry & Trigonometry – Fundamental Theorem of Similar Triangles with connections to trigonometry  
• Professionalism in the Classroom |
|---|---|
| Week 3 | • Euclidean geometry & Trigonometry – Area and volume formulas  
• Technology Principle |
| Week 4 | • Euclidean geometry & Trigonometry – Transformations of the plane  
• Technology Principle |
| Week 5 | • Analytic geometry – Proofs of two-dimensional Euclidean geometry results using analytic methods  
• Diagnostic, Benchmark, and Performance Assessments |
| Week 6 | • Analytic geometry – Proofs of three-dimensional Euclidean geometry results using analytic methods  
• Diagnostic, Benchmark, and Performance Assessments |
| Week 7 | • Non-Euclidean geometries – Spherical geometry, Fractal geometry, Taxicab geometry  
• Geometrical Reasoning |
| Week 8 | • Probability – Multiplication Principle, Bayes Theorem, Normal & Binomial distributions  
• Statistical Reasoning |
| Week 9 | • Data analysis – Descriptive statistics, Estimation, Sampling distributions, Central Limit Theorem  
• Statistical Reasoning |
| Week 10 | • Data analysis – Hypothesis testing, Regression and correlation  
• Micro-Teaching |
| Week 11 | • Data analysis & probability – Estimation, Misconceptions, and Fallacies  
• Micro-Teaching |
| Week 12 | • Discrete mathematics – Graph theory & Combinatorics  
• Discrete mathematics in secondary grades |
| Week 13 | • Number theory – The Binomial Theorem, Pascal’s Triangle, Mathematical Induction  
• Do’s and Don’ts of Student Teaching |
| Week 14 | • Number theory – Euclidean Division Algorithm, The Chinese Remainder Theorem  
• Mathematics Teaching & Learning: What, How, Why – Answers to the Big Questions! |

14. **Other Information:**

**Academic Integrity Policy:** Each student is required to adhere to the Academic Integrity Policy on all work submitted for the course. Make sure to review this academic policy in regards to plagiarism: “Representing the words of another, as one’s own in any academic exercise.” Plagiarism may occur on any paper, report,
or other work submitted to fulfill course requirements. This includes submitting work done by another, whether a commercial or non-commercial enterprise, including Web sites, as one’s own work. Faculty should take into account whether the student has had the opportunity to learn appropriate citation procedures based on previous course work successfully completed before formalizing Academic Integrity charges.” Please let your instructor know if you have any questions about this matter. For guidelines regarding proper citation, please consult your instructor or refer yourself to the Webpage for the Writing Center, where proper citation is clearly explained. For more information on UNCG’s Academic Integrity Policy, including breaches of the Policy (cheating, plagiarism, etc.) and the recommended sanctions, please go to http://academicintegrity.uncg.edu/complete/. All work must bear a statement signed by the student confirming that s/he understands and accepts the Academic Integrity Policy.

**Attendance Policy:**
To be effectively engaged in this class you will need to be present for each class meeting and:

- Be prepared by reading and reflecting on assigned material for each class meeting, including preparation of problem solutions for class discussion.
- Show involvement in class through participation in class discussion.
- Demonstrate purposeful engagement with activities during class time.
- 3 absences = final grade in the course will be lowered by one letter grade level (A- to B+)
- 5 absences = final grade in the course will be lowered by one full letter grade (A- to B-)
- 8 absences = F in the course
- 3 tardies = 1 absence, this means arriving to class late and/or leaving class early

**Blackboard™:**
Grades for all assignments and exams will be posted to the Gradebook section in our course area on Blackboard™. You may also check this website for course materials, current assignments, due dates, and other announcements.

**Task Stream Electronic Portfolio:** During this course, you will begin to prepare the Task Stream electronic portfolio, which is needed as part of your application for teaching licensure in NC. Included in the portfolio will be Teacher Growth and Assessment for Pre-Service Teachers (TGAP) Rubric (assessed during MAT 406) and your Candidates Dispositions Assessment Process (CDAP) Rubrics (assessed in MAT 405 and MAT 406). The portfolio will also include Evidence 2 (the IDIP prepared in MAT 405) and Evidence 3 (the ULPP prepared in MAT 406). The balance of the portfolio will be prepared during MAT 465 (Student Teaching). Students will be required to purchase a 1-year subscription to Task Stream.

**“UNCG Cares” Statement:**
UNCG cares about your success as a student. We recognize students often balance many challenging personal issues and demands. Please take advantage of the University resources designed to help. For assistance accessing these resources contact the Dean of Students Office at 334-5514 or Student Academic Services at 334-5730. The Counseling and Testing Center is available for mental health assistance, 334-5874. You may also visit me during my office hours.

**Inclement Weather:**
If the university is closed, class will be cancelled. In case you are unsure, check your e-mail and Blackboard or call the UNCG “inclement weather announcement” at 336-334-4400.

**15. Alignment with State and National Standards:** See # 9.