

UNIVERSITY OF NORTH CAROLINA
AT GREENSBORO

College of Arts & Sciences
Mathematics & Statistics

COURSE SYLLABUS - Spring 2015

1. **Course Prefix and Number:** MAT 405
 2. **Course Title:** Mathematics for Teaching and Teaching Mathematics I
 3. **Credits:** 3:3
 4. **Course Prerequisites/Co requisites:**
Prerequisite: MAT 310 with grade of C or better
 5. **For Whom Planned:** Mathematics majors; required for those seeking high school licensure
 6. **Instructor Information:** Dr. Carol E. Seaman
Email: ceseaman@uncg.edu
Tel: 336-256-1134
Office: 139 Petty Building
Office hours: Tuesdays & Thursdays 11:00am-12:15pm & Tuesdays 3:45-4:45pm or by appointment
 7. **Description:** Capstone survey of real and complex numbers; polynomial, rational, exponential, logarithmic, and trigonometric functions; calculus concepts. 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 first 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 the properties and algebra of real and complex numbers, the fundamental functions on these numbers, and the concepts of calculus – 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 an understanding of, and to enable and support the teaching of, algebraic and functional 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 algebra, pre-calculus, and calculus. Students will need to create mathematical models, as well as to represent them by graphs, and interpret properties of these models and their graphs in the context of the original problem. We will make use of technology (through graphing calculators and web-based resources) to assist in this visualization and investigation. Reading, writing, and oral presentations will also be important components of the course.

In this course students 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 problem solving and critical thinking (and those which are not). In addition students 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.

Interspersed 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 high school students, 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 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 demonstrating the ability to make careful mathematical arguments accessible to secondary students. (CCSSMP, NCPTS IV)
2. Use definitions, models, examples, and non-examples to explore and understand mathematical concepts and objects. (CCSSMP)
3. Develop technical skills using graphing calculators and software programs to explore functions and algebraic relationships in numeric and graphical representations. (CCSSMP, NCPTS IV)
4. Demonstrate the ability to describe patterns in mathematical data based on underlying mathematical structures. (CCSSMP)
5. Make connections across mathematical topics, using algebraic reasoning and functional reasoning to solve problems. (CCSSMP, NCPTS III)
6. Display effective written and oral communication skills in mathematics, including proper use of mathematical symbols and notations, in all written and oral presentations. (CCSSMP, NCPTS IV)
7. 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. (NCPTS II, NCPTS III, NCPTS IV)
8. 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 affecting their world. (NCPTS II, NCPTS IV)

10. Teaching Methods and Assignments for Achieving Learning Outcomes: Class time will be a combination of problem-solving activities (SLO 1-8), individual student presentations (SLO 3-8), and discussion of pre-assigned readings and solutions to homework assignments (SLO 1-3, 7, 8). Students will be expected to present problem solutions and to lead, as well as participate in, whole class discussions (SLO 1-8).

11. Evaluation Methods and Guidelines for Assignments:

- (30%) Written Problem Solution Analyses (SLO 1-6)
- (30%) Class Presentations (SLO 3-8)
- (40%) In-Depth Inquiry Project Paper (SLO 1-6)

In addition, once during the semester students will be assessed, for the purposes of their Electronic Portfolio for Secondary Licensure application, using (this assessment does not contribute to the course grade in MAT 405)

- Candidates Dispositions Assessment Process (CDAP) Rubric (SLO 7,8)

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 multiple representations will be standard requirements for every assignment.

Written Problem Solution Analyses (SLO 1-6)

You will submit five written problem solution analyses for assigned problems, each worth 6% of the final 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) with an argument that your solution(s) is/are correct. Each problem solution analysis is graded on a 3-point rubric as follows (Points will be assigned in $\frac{1}{4}$ point increments, e.g., a $2\frac{1}{2}$ or a $1\frac{3}{4}$, 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 3-8)

Each student will make two presentations to the class, each worth 15% of the final course grade. Each presentation will focus on a particular mathematical topic within one of the strands considered in this course (number systems, algebra, functions & modeling, calculus). The topics to be presented and a

schedule of dates for the presentations will be assigned during the 1st week of the semester. Guidelines and an assessment rubric for these presentations are posted on the Blackboard™ course website.

Exams

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

In-Depth Inquiry Project/Research Paper (SLO 1,2,4,5 6)

The In-Depth Inquiry Project (IDIP) is a required (by the State of North Carolina Department of Public Instruction, NCDPI) evidence for the Electronic Portfolio for Secondary Licensure application. One part of the IDIP is an academic expository research paper (including theorems with proofs) which documents the candidate's depth of content (i.e., mathematics) knowledge. This paper is a graded requirement in MAT 405, even for students not intending to apply for licensure.

The first stage in writing the paper consists of choosing a mathematical area and a specific topic within that area. A description of the topic, including a complete list of the definitions and theorems to be investigated, described, and proven, and a preliminary reference list must be submitted by 1/29/2015 and approved by the instructor. The reference list must include mathematics journals such as *The College Mathematics Journal* and original sources (translated to English) such as Euclid's *Elements*. Correctness of the statements of the definitions and the theorems and adequacy of the reference list will be evaluated.

The second stage involves researching the theorems, including the historical and mathematical contexts in which they arise, proofs for them in the most general axiom system in which they reside, and real world or mathematical scenarios to which the theorem can be applied or which extend/generalize the theorem to related problems. Proofs of the theorems will be evaluated based on the exposition of the mathematical/historical context and the clarity, completeness, and correctness of the proof presentations. Evaluation of the scenarios/extensions will be based on correct use of the theorems and the creativity and originality of the examples/problems /extensions. A first draft of the proofs is due on 3/3/2015 and a first draft of the scenarios /extensions is due on 3/17/2015.

The third stage is writing the research paper reporting the findings of the first two stages. The paper should be expository in nature, giving clear, complete, detailed, and correct mathematical explanations of the items required in the first two stages. Appropriate references must be used and properly cited within the paper as well as contained in a reference list at the end of the paper. Your paper must meet a professional standard of spelling, grammar, and punctuation and will be evaluated on the cohesion of thought, clarity of expression, depth of exposition, analysis of research, and relevance of citations evidenced. A rough draft of the paper is due on 4/2/2015, a second draft (if requested) is due on 4/16/2015 and the final paper is due 4/23/2015. Failure to meet any of these deadlines will result in a mandatory decrease in the final grade assigned to the paper by one grade step (i.e., from an A- to a B+). You are welcome to submit any stage early in order to receive feedback sooner.

A second part of the IDIP is a set of digital files that provide interactive illustrations/demonstrations of the theorems presented in the research paper. Guidelines and an assessment rubric for these files will be posted to the Blackboard™ website. The files are due on April 28, 2015.

The In-Depth Inquiry Project/Research Paper will be assessed for the course grade using the guidelines indicated in the preceding paragraphs and will also be evaluated, for licensure students, by the following rubric from NCDPI, which is applied to the entire IDIP in the electronic licensure portfolio after a course grade has been determined. Your IDIP must be scored "proficient" or "exceeds expectations" in all items on this rubric in order to be acceptable as evidence for licensure.

Rubric for Content: In-depth Inquiry Project	Not met	Proficient	Exceeds Expectations
Proficient			
NCPTS 3b Product: Content investigation, such as an academic research paper, performance, etc.			
The candidate identifies and clearly states a topic that is significant in his or her field (a major understanding, concept, controversy or question).			
The significance of the topic to the discipline is explained.			
Literature of the discipline (scholarly and theoretical work) is cited and is used to support the ideas that are presented in the product. <ul style="list-style-type: none"> • The literature is current, accurate, relevant and authoritative. • Sufficient literature is cited to develop a convincing argument or understanding of the topic. It includes multiple perspectives about the topic. • The use of the literature demonstrates an understanding of how knowledge in the discipline is generated, how information is analyzed, interpreted and applied, what qualifies as data and how data is used. • The candidate explains the connections between this literature and the topic. 			
<ul style="list-style-type: none"> • The candidate collects, interprets and uses data from multiple sources and other information appropriate to the topic and discipline. 			
The product reflects an understanding of the complexity of the topic and provides multiple interpretations.			
The candidate draws conclusions that demonstrate appropriate and logical integration of data and ideas as well as independent, critical thinking.			
The format and organization of the product is appropriate to the discipline, is clearly presented and demonstrates appropriate language conventions.			
Comments			

Grade Scale:

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

Final grades will be made available at the end of the semester on UNCGenie, UNCG's student information system.

12. Required Texts:

- NCTM. (2014). *Principles to actions: Ensuring mathematical success for all*. Reston, VA: NCTM.
- Smith, M., & Stein, M. (2011). *5 Practices for orchestrating classroom discussions*. Reston, VA: NCTM.
- Selected Articles from *Mathematics Teacher* (NCTM) and other readings posted on Blackboard™
- Common Core State Standards for Mathematics (<http://www.corestandards.org/Math/>)
- North Carolina Professional Teaching Standards. North Carolina Department of Public Instruction (<http://www.ncpublicschools.org/docs/educatoreffect/ncees/standards/prof-teach-standards.pdf>).
- The UNCG Teacher Education Handbook (2015) (<http://oss.uncg.edu/academic-advising/handbooks>).
- You will need a graphing calculator (TI-83/84 preferred).

13. Topical Outline:

Week 1	<ul style="list-style-type: none"> • Algebra and properties of natural numbers and integers • Introductions to Teaching Mathematics
Week 2	<ul style="list-style-type: none"> • Algebra and properties of rational and irrational numbers • Common Core State Standards for Mathematics
Week 3	<ul style="list-style-type: none"> • Algebra and properties of real numbers • Equity Principle and Setting Learning Goals
Week 4	<ul style="list-style-type: none"> • Algebra and properties of complex numbers • High Demand Tasks
Week 5	<ul style="list-style-type: none"> • Problem-solving through modeling – algebraic/graphic approaches • Curriculum Principle and Maintenance of High Demand Tasks
Week 6	<ul style="list-style-type: none"> • Properties and representations of polynomial functions • Procedural versus Conceptual Tasks and Anticipating Students' Responses
Week 7	<ul style="list-style-type: none"> • Properties and representations of polynomial and rational functions • Thinking Through the Lesson Protocol and Modifying Tasks
Week 8	<ul style="list-style-type: none"> • Properties and representations of exponential and logarithmic functions • Classroom Discourse and Lesson Planning
Week 9	<ul style="list-style-type: none"> • Properties and representations of trigonometric functions • The Five Practices for Orchestrating Effect Mathematical Discourse
Week 10	<ul style="list-style-type: none"> • Problem-solving through modeling – functional approaches • The Five Practices for Orchestrating Effect Mathematical Discourse
Week 11	<ul style="list-style-type: none"> • Concepts of calculus: infinity and limits • The Five Practices for Orchestrating Effect Mathematical Discourse
Week 12	<ul style="list-style-type: none"> • Concepts of calculus: the derivative and applications • Assessment
Week 13	<ul style="list-style-type: none"> • Concepts of calculus: the integral and the Fundamental Theorem of Calculus • Manipulatives and Instructional Games

Week 14	<ul style="list-style-type: none"> • Problem-solving through modeling – analytic approaches • Technology in the Classroom
---------	---

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 step (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 will be posted to the Gradebook section in our course area on Blackboard™. You may also check this website for readings and other course materials, current assignments, due dates, and other announcements.

“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.