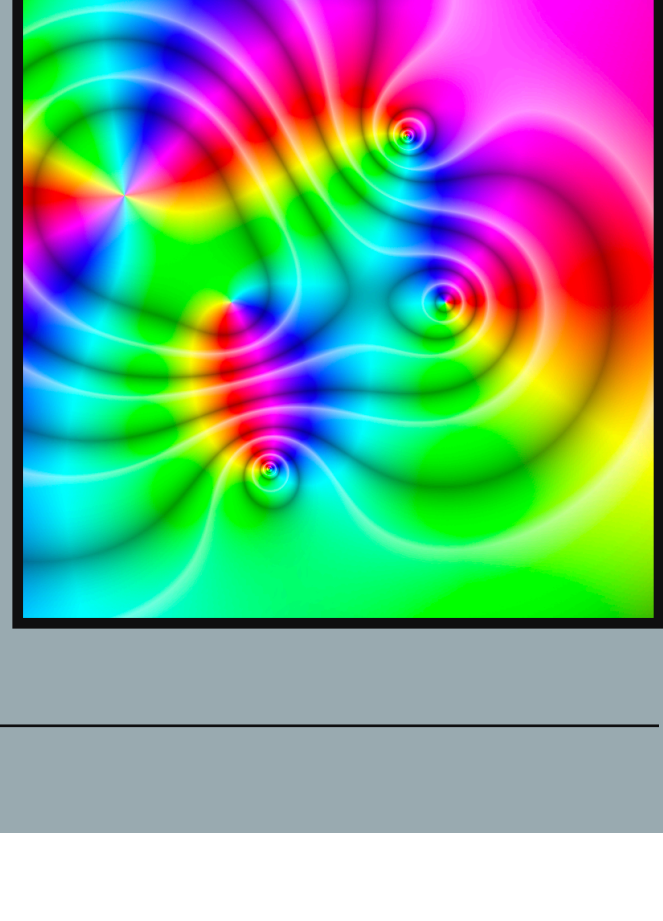


# Complex Analysis



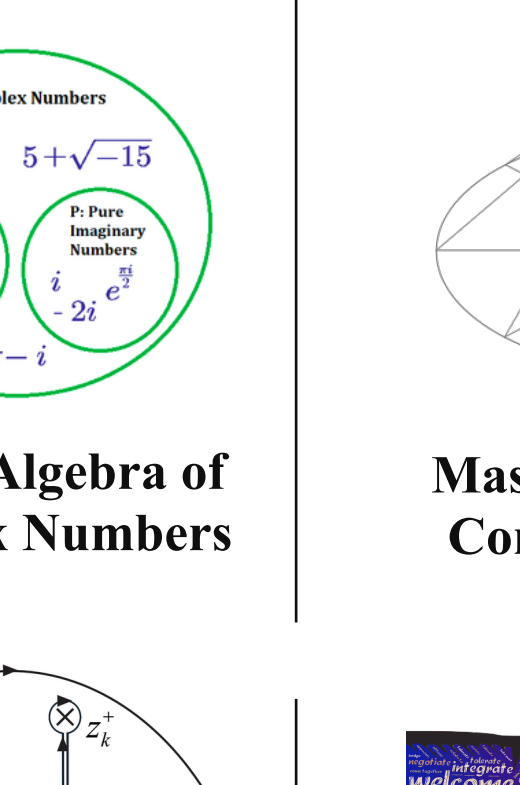
MST 317/617

**Dr. John Gemmer:** gemmerj@wfu.edu  
**Office:** Manchester 388  
**Course Website:** <http://users.wfu.edu/gemmerj/math316-617F22.html>  
**Canvas:** The course syllabus and grades will be posted on Canvas  
**Office Hours:** T 9:00-11:00, W 11:00-12:00, Th 3:00-5:00  
**Class Meeting Times:** MWF 10:00-10:50  
**Class Location:** Who Knows

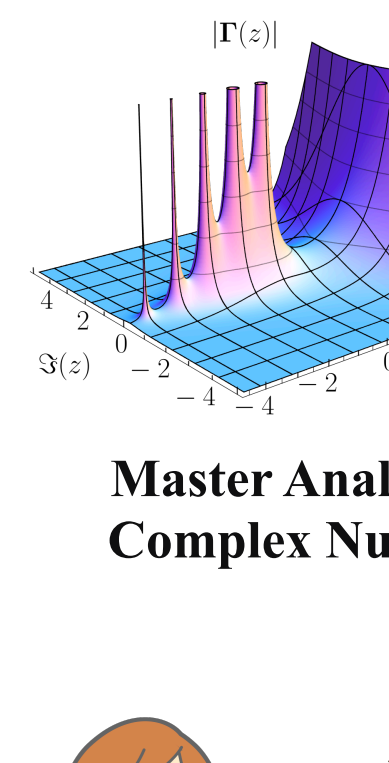
## COURSE DESCRIPTION

The calculus of complex numbers is an indispensable tool to the modern mathematician. The primary goal of this course is to develop the algebraic, geometric, and analytic foundations of complex numbers. This may sound intimidating as for the real numbers this is typically done through six courses: Algebra I, Geometry, Algebra II, Calculus I-III. However, the mathematical structure of complex numbers builds on familiar concepts from the real numbers in a natural manner and much of our intuition and prior training still hold. In particular, complex analysis is more “nice” than real analysis in the sense that much of the technical difficulties drastically simplify when using complex numbers. Along the way, we will discuss many applications drawn from applied topics such as fluid dynamics, electrostatics, and oscillating systems and pure topics such as roots of polynomials, fractals, and analytic continuation. While I will motivate all concepts by their underlying physics the focus will be on the mathematics.

## REQUIREMENTS



**Prerequisites:**  
Calculus I-II, Vector Calculus



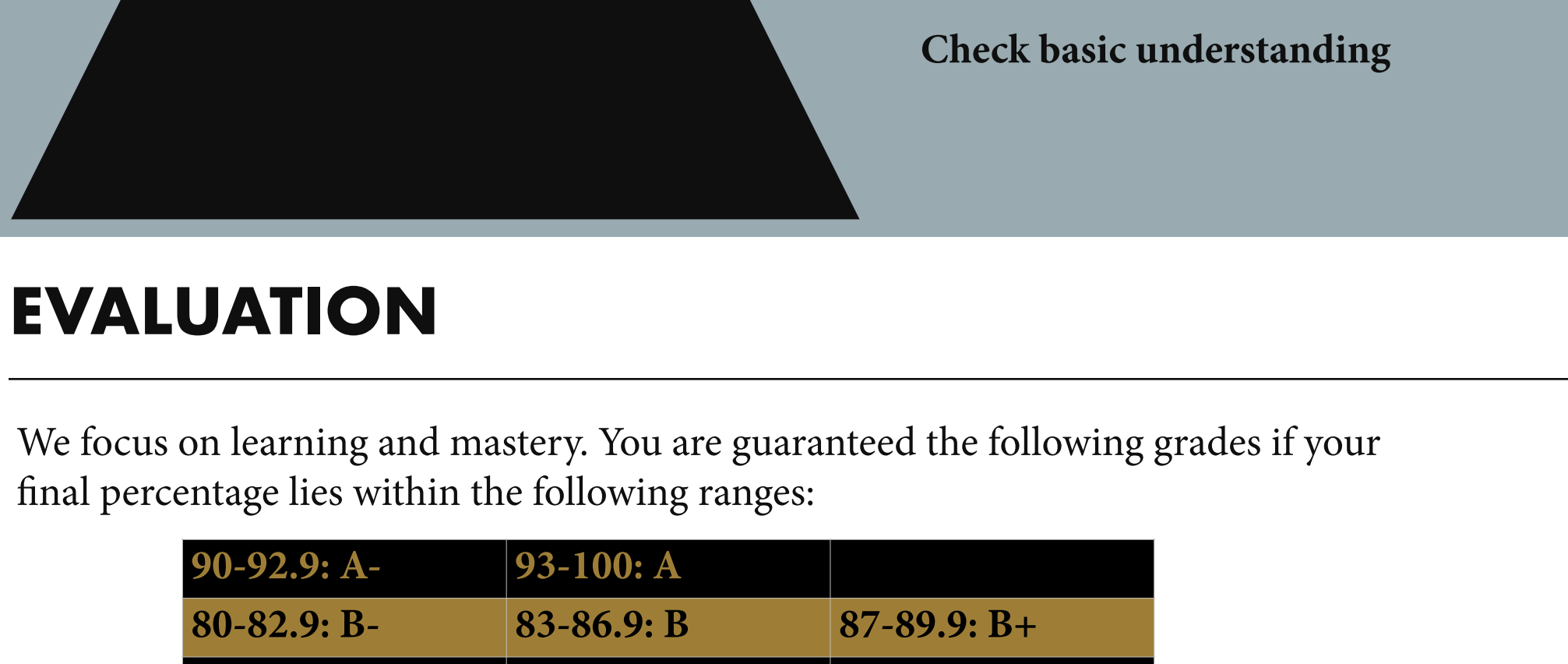
**Textbook:**  
Fundamentals of Complex Analysis  
Saff and Snyder (3rd ed.)

## OBJECTIVES

<p><b>Master Algebra of Complex Numbers</b></p>	<p><b>Master Geometry of Complex Numbers</b></p>	<p><b>Master Analysis of Complex Numbers</b></p>
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<p><b>Learn Basic of Contour Integration</b></p>	<p><b>Learning to collaborate</b></p>	<p><b>Write Effectively</b></p>
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## CLASS STRUCTURE



## EVALUATION

We focus on learning and mastery. You are guaranteed the following grades if your final percentage lies within the following ranges:

90-92.9: A-	93-100: A	
80-82.9: B-	83-86.9: B	87-89.9: B+
70-72.9: C-	73-76.9: C	77-79.9: C+
60-62.9: D-	63-66.9: D	67-69.9: D+

### Undergraduate Student Evaluation

- Classworks (5%)**  
Structured in class group assignments  
Grades based on attendance
- Quizzes (10%), at least 1 dropped**  
5-10 minutes  
In class on Fridays
- Weekly Homework (25%), at least 1 dropped**  
Open book, collaboration allowed with citation  
Homework is due on Friday in class
- Two summative assessments (30%)**  
In class, closed notes
- Final Exam (30%)**  
Comprehensive  
In class, closed notes

### Graduate Student Evaluation (Undergraduate Students can opt in)

- Classworks (5%)**  
Structured in class group assignments  
Grades based on attendance
- Quizzes (5%), at least 1 dropped**  
5-10 minutes  
In class on Fridays
- Term paper presentation (10%)**  
Presentations should be done on computer  
Final presentations will occur during the last week of class
- Term paper (20%)**  
Term paper should be written in LaTeX  
The term paper is due on the assigned date of the final exam
- Weekly Homework (20%), at least 1 dropped**  
Open book, collaboration allowed with citation  
Homework is due on Friday in class
- Two summative assessments (20%)**  
In class, closed notes
- Final Exam (20%)**  
Comprehensive  
In class, closed notes

**Classworks:** Throughout the course there will be several class works. These consist of structured group assignments that will be completed during class time. These assignments will generally be exploratory allowing students to synthesize concepts through a “hands on” approach. Classworks will be graded based on attendance.

**Quizzes:** On most Fridays there will be a short 5-10 minute in-class quizzes. These quizzes will consist of a very short problem that will test your knowledge of the prior lectures and homework. These quizzes are to help both the students and the instructor understand concepts that students may be struggling with. All quizzes will be announced in class. There will be no “pop” quizzes. There are no retakes for missed quizzes, however I will drop the lowest quiz score from your final grade.

**Weekly Homework:** Homework will be assigned most weeks on Thursday and will be due Friday in class the following week. Late homework will not be accepted under any circumstances. However, I will drop at least one homework assignment from your grade. While you are allowed to collaborate with your colleagues, homework must consist of solutions that show all steps, be your own work and be written clearly using complete sentences as appropriate (see homework policy). All homework will be submitted in class on paper. I will not accept digital versions of your homework.

**Term Paper:** A significant portion of the student's progress towards completion of the course goals will be evaluated through the completion of a term paper. Potential topics will be posted on the course website. The student will select a topic to study in detail, reproduce the results in the reference and complete some assigned problems on the topic. The complete assessment of the term paper consists of a final term paper and a final presentation. The final version of the term paper should be written in an expository form with all mathematical details fully written out including the solutions to the assigned problems. The term paper should be written using a professional typesetting program such as LaTeX and the final presentation should be done on a computer. The final presentations will occur during the last week of class.

**Summative Assessments:** There will be three in class summative assessments in the course and a cumulative final exam.

**Late Work Policy:** Except in very extreme circumstances, I do not accept late assignments or reschedule exams. If you have a situation in which you cannot make an exam for personal reasons, you must arrange accommodations with the instructor to schedule the exam **before the scheduled exam date**. If you have a legitimate emergency situation, I will make sure that all students in the course will have access to the same exception to this policy.

**If you need to miss class due to a university sponsored activity, such as athletics. Please contact the faculty member as soon as possible to reschedule due dates.**

## COURSE ENVIRONMENT

### Names/Pronouns

You **deserve** to be addressed in the manner you prefer. To guarantee that I address you properly, you are welcome to tell me your pronoun(s) and/or preferred name at any time, either in person or via email.

### Diversity

We embrace diversity of age, background, beliefs, ethnicity, gender, gender identity, gender expression, national origin, religious affiliation, sexual orientation, and other visible and non-visible categories. **I do not tolerate discrimination.**

### Accessibility

I want you to succeed in this course. Wake Forest University provides reasonable accommodations to students with disabilities. If you are in need of an accommodation, then please contact me privately as early in the term as possible. Retroactive accommodations may not be provided. Students requiring accommodations must also consult the Center for Learning, Access, and Student Success (118 Reynolda Hall, 336-758-5929, <http://class.wfu.edu>). For personal issues, stress, health problems or life circumstances see [shs.wfu.edu/](http://shs.wfu.edu/). Contact me if you have other special circumstances. **I will find resources for you.**

### Title IX

You **deserve** a community free from discrimination, sexual harassment, a hostile environment, sexual assault, domestic violence, dating violence, and stalking. If you experience or know of a Title IX violation, you have many options for support and/or reporting; see [titleix.wfu.edu/](http://titleix.wfu.edu/).

### Emergency Fund

You **deserve** a learning environment in which all of your physiological and safety needs are met. If you are experiencing situations in which these needs are not met, e.g. you do not have adequate housing or sufficient food security, the Chaplain's Office has an emergency fund which can provide support: <https://chaplain.wfu.edu/care-support/chaplains-emergency-fund/>. In situations in which you need immediate assistance funding available through the Department of Mathematics and Statistics. If you are in need of emergency help you are encouraged to reach out to a faculty member in the Department of Mathematics and Statistics who will work with the chair of the department to address your needs.

### Course Resources

The department has a limited amount of funding for class materials. If you cannot afford class materials, you are encouraged to contact the chair of the department privately as early in the term as possible. Due to the limited amount of funds, students must exhaust all other sources of funding before applying to the department for assistance.

### The Honor Code

At Wake Forest, we expect you to behave as honorable citizens of the class, the university, and the world as a whole. When you complete an assignment with your name on it, you are representing that everything you are turning in is your own work. That means that you do not copy from other students, textbooks, or websites. If at any time I become aware of cheating or plagiarism in this course, I will submit the information to the honor council.

## TENTATIVE COURSE CALENDAR

### Complex Numbers and Analytic Functions

- Week 1:
- 8/22: Intro to course, algebra of complex numbers, **Sections 1.1**
  - 8/24: Point representation of complex numbers, **Section 1.2**
  - 8/26: Vectors and polar forms, **Section 1.3**
- Week 2:
- 8/29: The complex exponential, **Section 1.4**
  - 9/31: Powers and Roots, **Section 1.5**
  - 9/02: **Classwork #1, Homework #1 Due.**

- Week 3:
- 9/05: Planar Sets, **Section 1.6,**
  - 9/07: The Riemann Sphere and stereographic projection, **Section 1.7**
  - 9/09: Functions of a complex variable, **Section 2.1, Quiz #1, Homework #2 Due.**
- Week 4:
- 9/12: Limits and continuity, **Section 2.2,**
  - 9/14: Analyticity, **Section 2.3**
  - 9/16: **Classwork #2, Quiz #2, Homework #3 Due.**

- Week 5:
- 9/19: Cauchy-Riemann equations, **Section 2.4**
  - 9/21: Harmonic functions, **Section 2.5**
  - 9/23: **Summative Assessment #1 on Sections 1.1-2.3**

### Elementary Functions and Integration

- Week 6:
- 9/26: Polynomials and rational functions, **Section 3.1**
  - 9/28: Transcendental functions, **Section 3.2**
  - 9/30: Logarithmic functions, **Sections 3.3, Quiz #3, Homework #4 Due.**
- Week 7:
- 10/03: Complex powers and inverse trigonometric functions, **Section 3.5**
  - 10/05: Contours, **Section 4.1**
  - 10/07: **Classwork #3, Quiz #4, Homework #5 Due.**

- Week 8:
- 10/10: Contour integrals, **Section 4.2**
  - 10/12: Independence of path, **Section 4.3, Homework #6 Due.**
  - 10/14: **Fall break.**
- Week 9:
- 10/17: Cauchy's integral theorem, **Section 4.4,**
  - 10/19: Cauchy's integral formula and its consequences, **Section 4.5**
  - 10/21: **Classwork #4, Quiz #5, Homework #7 Due.**

- Week 10:
- 10/24: Bounds for analytic functions, **Section 4.6**
  - 10/26: **Classwork #5**
  - 10/28: **Summative Assessment #2 (Sections 2.4-4.5)**

### Series Representations and Residue Theory

- Week 11:
- 10/31: Sequences and series, **Section 5.1**
  - 11/02: Taylor series, **Section 5.2**
  - 11/04: Power series, **Section 5.3, Quiz #6, Homework #8 Due.**
- Week 12:
- 11/07: Laurent series, **Section 5.4**
  - 11/09: Zeros and singularities, **Section 5.5**
  - 11/11: **Classwork #6, Quiz #7, Homework #9 Due.**

- Week 13:
- 11/14: The residue theorem, **Section 6.1**
  - 11/16: Trigonometric integrals, **Section 6.2**
  - 11/18: Improper integrals over infinite domains, **Section 6.3, Quiz #8, Homework #10 Due.**
- Week 14:
- 11/21: Improper integrals with trigonometric functions, **Section 6.4**
  - 11/23: **Thanksgiving break**
  - 11/25: **Thanksgiving break**

- Week 15:
- 11/28: Indented contours, **Section 6.5**
  - 11/30: Integrals involving multi-valued functions, **Section 6.6**
  - 12/02: **Classwork #7, Quiz #9, Homework #11 Due.**

**Final Exam: 10/05, 9:00 AM.**

## SUCCESS

<p>Attend class</p>	<p>Participate constantly</p>	<p>Invest time</p>
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<p>Concentrate on concepts in addition to calculations</p>	<p>Seek help when needed</p>	<p>Eliminate Virtual Distractions</p>
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