



Math 446: Applied Complex Variables

Offered through **NetMath**

Academic Year 2026-2027 Term, 16-week course

Instructor Information

Instructor – Barry Walker

- Contact information: math446@netmath.illinois.edu
- Fridays at 2:00pm CST

Course Information

Credit Hours

3 credit hours

Course Description

For students who desire a working knowledge of complex variables; covers the standard topics and gives an introduction to integration by residues, the argument principle, conformal maps, and potential fields. Students desiring a systematic development of the foundations of the subject should take MATH 448.

Prerequisite

MATH 241

Course Objectives:

The two main objectives are to develop theory that is useful in applications of complex variables and to introduce applications of residues and conformal mapping. The former includes evaluating real improper integrals and locating zeros of functions and the latter includes solving boundary value problems in differential equations.

Course Content:

- **Complex numbers**

Basic algebraic properties, absolute value of a complex number, triangle inequality, complex conjugate, polar form, Euler's formula, de Moivre's formula, argument, principal argument, n th roots of complex numbers, regions in the complex plane

- **Analytic functions:** Mapping by complex functions, limits, continuity and differentiability, Cauchy-Riemann equations, Cauchy-Riemann equations in polar form, analytic functions
- **Elementary functions:** Exponential and logarithmic functions, branches of logarithmic functions, principal branch of logarithmic functions, power functions for any complex exponents, principal branch of power functions, trigonometric functions, zeroes and singularities of trig. functions, hyperbolic functions
- **Integrals:** Contour integrals, upper bound of the absolute value of a contour integral, antiderivatives, Cauchy-Goursat theorem, Simply connected domain, Cauchy Integral Formula (CIF) and extended CIF, Liouville's Theorem and Fundamental Theorem of Algebra, Maximum Modulus Principle
- **Series:** Convergence of series, power series, Taylor's series, Maclaurin series, Laurent series, sums of power series, integration and differentiation of power series, multiplication and division of power series
- **Residues and poles:** Isolated singularity, residues, Cauchy's residue theorem, residue at infinity, classification of isolated singularities (removable singularity, poles, essential singularity), zeros and poles
- **Applications of Residues:** Evaluation of real improper integrals, Jordan's lemma, real definite integrals of rational functions, logarithmic functions, power functions with arbitrary real exponents, rational functions of sine and cosine functions, Argument Principle, Rouché's Theorem
- **Mapping by elementary functions:** Linear transformation, Linear Fractional Transformation, Mappings of upper half-plane, mappings by exponential functions, trigonometric functions, square functions, square root functions
- **Conformal mapping:** Angle preservation, local inverse, harmonic conjugates, explanation of boundary value problems
- **Applications of conformal mapping:** Boundary value problems: Dirichlet problem, Neumann problem, and mixed problems

Course Structure:

This course is fully online and asynchronous. Students have 16 weeks from their course start date to complete the course. The course is self-paced, and students may complete their coursework prior to the assigned end date. However, students are encouraged to follow the guided structure provided by the instructor with suggested deadlines for assignments and exams. As this is a 3-credit hour course, students are expected to dedicate 9 hours per week to learning course content.

Students should work through a unit each week and complete the associated homework. There are three exams and a final exam. Canvas and Gradescope are required. Calculus type results should not be used until proved in class.

Exams:

Information	Exam 1	Exam 2	Exam 3	Final Exam
Coverage:	Unit 1-5	Unit 6-9	Unit 10-13	Comprehensive
Time Limit	90 Minutes	90 Minutes	90 Minutes	3 Hours

All exams will be administered online, free of charge to students. Exams are administered using ProctorU Record+. [More information on taking exams.](#)

Calculators are not permitted or required for NetMath exams.

The use of outside sources is prohibited.

Refer to the Academic Integrity policies below in the syllabus for more details.

Scratch paper is allowed during exams.

Exams must be taken in course order, and students should not take more than 1 exam within a 24-hour period.

Grading:

Grading Breakdown:

Component	Weight
Homework	25%
Exam 1	15%
Exam 2	15%
Exam 3	15%
Final Exam	30%

Letter Grade Scale:

Percentage	Letter Grade
97 - 100	A+
93 - 96	A
90 - 92	A-
87 - 89	B+
83 - 86	B
80 - 82	B-
77 - 79	C+
73 - 76	C
70 - 72	C-
67 - 69	D+
63 - 66	D
60 - 62	D-
59 and below	F

Final grades are rounded to the nearest integer before applying the scale above.

Grades are not curved.

Once you complete your exam, you will receive a 0 on any homework leading up to that exam that has not been submitted. Under special circumstances, students may request that they be allowed to submit these assignments. This is left to the discretion of the course instructor.

Students are encouraged to follow the guided deadlines in their course. However, as our courses are self-paced, students may occasionally submit several assignments in a short period of time. Please note that instructors are only expected to grade one exam per five-business-day week, and instructors are only expected to grade up to two submitted assignments per five-business-day week. Under special circumstances, students may request that additional assignments be graded. This is left to the discretion of the course instructor.

Due to the rolling enrollment structure of the NetMath program, instructor workloads vary throughout the year. During peak periods, response times and grading turnaround may be longer than usual. Students should expect significant delays in grading and instructor responses between June and August.

Communication:

You may reach out to the instructor via email, post to the course forum, or attend office hours.

If you experience consistent and significant delays in reaching your instructor, please contact instruction@netmath.illinois.edu with your concerns.

If you have non-course specific questions, you may reach out to the NetMath office. It is recommended to [review the NetMath website](#) first as it often has the answers you need.

General Inquiries: netmath@illinois.edu

Proctoring Questions: proctor@netmath.illinois.edu

Technology Questions: tech-staff@netmath.illinois.edu

Main Office Phone: [\(217\) 265-0439](tel:(217)265-0439)

Phone hours: Monday - Friday, 9am - 12pm & 1pm - 4pm CST

Textbook:

Recommended: James Ward Brown, Ruel V. Churchill. (2014). Complex Variables and Applications. (9th Edition). McGraw-Hill Higher Education.

Technical Requirements:

Students are expected to have a device with an up-to-date operating system to access their course materials, reliable internet access, and must meet the requirements set by ProctorU for exam proctoring. [NetMath IT - Frequently Asked Questions](#).

Other Information:

This is an online course featuring video lectures from the UIUC Summer 2019 course taught by Professor Joseph Miles.

Policies:

Accommodations:

The University of Illinois Champaign-Urbana, is committed to ensuring that all students, including students with disabilities, do not experience barriers to learning and participating fully in class. Students who have a letter of accommodation from DRES are advised to share that with their instructor and NetMath staff at instruction@netmath.illinois.edu as soon as possible to ensure accommodation needs can be discussed and met.

Students enrolled in a degree program at another institution may refer to their home institution's student services or disability office for accommodations. Current, non-expired documentation from other institutions listing the specifics of an accommodation is acceptable and should be sent to instruction@netmath.illinois.edu.

To obtain disability-related academic accommodations, disabled students must contact Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, please visit 1207 S. Oak Street, Champaign, call [\(217\) 333-1970](tel:2173331970), email disability@illinois.edu, or [visit the DRES website](#).

Academic Integrity:

The University of Illinois Urbana-Champaign [Student Code](https://studentcode.illinois.edu/) (<https://studentcode.illinois.edu/>) should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the [Academic Integrity Policy](https://studentcode.illinois.edu/article1/part4/1-401/) (<https://studentcode.illinois.edu/article1/part4/1-401/>). Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

AI Large Language Models (such as ChatGPT, Claude, Gemini, etc.) are prohibited during exams. Using these during the exam will be considered a violation of academic integrity and may incur sanctions as outlined in the Illinois Student Code. Students should be aware the exam proctoring process involves screen recording of the computer. While AI will not be strictly prohibited for homework as they can be useful tools for studying and brainstorming, students are strongly encouraged to work on the homework themselves or collaborate with peers when appropriate. Students are required to submit their own work and answers. This improves learning outcomes and best prepares students for exams. Homework is designed to help students understand the content and develop skills. Students may be unprepared for exams if there is heavy reliance on AI.

Students are expected to follow the [University guidance on intellectual property](#). Students are not to share course content outside of the course.

Campus Holidays:

Instructors are expected to respond to student communications and grade homework assignments in a timely manner. Observed Campus Holidays, illness, personal obligations, or other circumstances outside the instructor's control may affect normal grading and response time. If you experience consistent and significant delays, please contact instruction@netmath.illinois.edu with your concerns.

Extensions:

Students in this course are eligible for up to two 1-month course extensions. There is a non-refundable \$350 fee for each approved extension. [Students should review the extension guidelines for more information](#).

FERPA:

See [FERPA – Office of the Registrar](https://registrar.illinois.edu/academic-records/ferpa/) (<https://registrar.illinois.edu/academic-records/ferpa/>) for more information on the Family Educational Rights and Privacy Act (FERPA).

Any student who has suppressed their directory information pursuant to FERPA should self-identify to the instructor to ensure protection of the privacy of their attendance in this course.

Mental Health:

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Health Service Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

[Counseling Center](#) or [\(217\) 333-3704](#)

[McKinley Health Center](#) or [\(217\) 333-2700](#)

[National Suicide Prevention Lifeline](#) or [\(800\) 273-8255](#)

[Rosecrance Crisis Line](#) or [\(217\) 359-4141](#) (available 24/7, 365 days a year)

If you are in immediate danger, call [911](#).

*This statement is approved by the [University of Illinois Counseling Center](#)

Sexual Misconduct Reporting Obligation:

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the [Title IX Office](#) will provide information about rights and options, including supportive measures, resources, the campus disciplinary process, and law enforcement options.

[Designated Confidential Employees](#): A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality.

Other information about [resources and incident reporting](#).