Ma345 - Functions of a Complex Variable - Spring 2026 Syllabus
Department of Mathematics, Albert Nerken School of Engineering
The Cooper Union for the Advancement of Science and Art

Instructor   Robert Smyth, Professor, Mathematics.
See `faculty.cooper.edu/smyth` for office hours and contact information.

Class Hours   Tuesdays 6-7:50 PM (Room 505), Thursdays 6-6:50 PM (Room 505)

Catalog Description   Topological properties of complex plane, complex analytic functions, Cauchy-Riemann equations, line integrals, Cauchy's integral theorem and formula. Taylor series, uniform convergence, residues, analytic continuation, conformal mappings and applications.
3 credits. Prerequisite: Ma 223

Textbook   Brown and Churchill, "Complex Variables and Applications", 9th edition, McGraw Hill (2014), ISBN: 978-0-07-338317-0

Course Objectives   1. Extend the fundamental definitions and operations of calculus to complex valued functions.
2. Prove various fundamental properties of complex analytic functions and gain familiarity with a catalog of elementary functions.
3. Prove and apply elementary theorems describing the behavior of contour integrals in the complex plane.
4. Extend the theory of sequences and series to the complex field.
5. Prove and apply basic properties of residues of complex functions.
6. Prove and apply the conformality of complex analytic functions.

Course Topics   1. Complex numbers, properties, topology of the complex plane, powers and roots.
2. Functions of a complex variable, mappings, limits, continuity.
3. Derivatives, Cauchy-Riemann equations, polar coordinates, analytic functions.
4. Harmonic functions, exponential functions, logarithms, trigonometric and hyperbolic functions, complex exponents.
5. Contour integrals, antiderivatives, Cauchy-Goursat theorem.
6. Cauchy integral formula, Morera's theorem.
7. Maximum modulus principle, Liouville's theorem and the fundamental theorem of algebra.
8. Taylor and Laurent series.
9. Convergence of power series, properties of convergent series.
10. Singularities, residues, the residue theorem.
11. Applications of the residue theorem.
12. Logarithmic residues and Rouchè's theorem.
13. Conformal mappings, harmonic conjugates, applications.
14. Inverse Laplace transforms.

Assessment   Your term grade will be determined by homework collected every other week (6%), two midterms (28% each) and a cumulative final exam (38%). Homework problems and due dates are online at `faculty.cooper.edu/smyth/ma345/ma345.htm`. The exams will test your familiarity with the principles of the subject with routine problems and your ability to extrapolate creatively from these principles on challenging problems.

See **Grades of Record** at
`cooper.edu/engineering/curriculum/academic-standards-regulations` for the
letter grades used for this course and their proper interpretation. The exam schedule
is posted at `http://faculty.cooper.edu/smyth/ma345/ma345.htm`.

Homework Policies   You may work individually or in groups of at most three students. A group must
make a single joint submission with all team members listed at the top of the front
page. In the case of a group submission all members will receive the same grade for
the assignment. You should make sure you understand all the solutions your team is
submitting, even if other team members came up with them. Any assistance you (or
your group) receives and all sources you use in preparing your homework assignments
must be properly credited in writing on your submission. Groups may be re-formed on
an assignment-by-assignment basis. Homework assignments must be submitted at the
beginning of the class period on the assignment due date. Each assignment includes all
problems from the list at `faculty.cooper.edu/smyth/ma345/hw.htm` not previously
submitted up to and including those pertaining to the last section completed as of the
end of the week *before* the assignment due date. Select problems from each assignment
will be graded carefully and each assignment will be assessed for completeness. Credit
will not be awarded for late submissions. However your lowest homework grade will
be dropped.

Exam Policies   All exams are closed book / closed notebook exams. You may use a basic scientific
calculator, but no graphing or programmable calculators, computers, cellphones, books,
notebooks, or other resources may be used. Bring a pencil or pen on the day of the
exam. Paper will be provided. Exams are timed. Your score may be reduced if
you do not stop working on your exam after time has been called. If you choose to
leave the exam room during the exam period you will not be permitted to resume
working on the exam after returning. Registered students must sit for the course
examinations on the scheduled day and time. Failure to do so will generally result in
forfeiture of the percentage credit allotted to the missed exam. Students who have
medical excuses for missing an exam should contact the Dean of Students promptly.
Failure to register a request for a medically excused absence in a timely manner with
the Dean of Students may complicate and potentially invalidate the request. Any
student requesting a medically excused absence must provide the Dean of Students
with documentation from a medical provider justifying the absence. The Dean of
Students will inform me when an absence is due to a valid medical issue/condition so
that the absence can be considered excused. In the event of an excused absence, the
student must schedule an oral makeup exam with me as soon as is possible.

ADA Accommodations   If you believe you are entitled to an accommodation through the Americans with
Disabilities Act you must self-identify to the Office of the Dean of Students, and meet
with me during the first or second week of the term to discuss arrangements for meeting
your accommodation. You should either come to this meeting with a copy of your
Accommodation Verification Letter from the Office of Student Affairs, or email a copy
to me *prior* to the meeting. Cooper Union has limited resources and extra time may
be required for accommodation arrangement to be feasible. If you are entitled to
an accommodation on exams, you must confirm exam accommodation requests with
me (by email) promptly after our meeting discussing your Accommodation Verification

Letter. Students will not be afforded any special accommodations retroactively, i.e., for academic work completed prior to disclosure of the disability to me. Support services for students are described `here`.