MAT-331: COMPLEX ANALYSIS
Spring 2019

It is therefore essential that the original determination of the function concept be broadened to a domain of magnitudes which includes both the real and imaginary quantities, on an equal footing, under the single designation complex numbers.

C. F. Gauss

Professor:	Thomas R. Cameron	**Time:**	M W F 1:30 – 2:20 pm
Email:	thcameron@davidson.edu	**Place:**	CHAM 3084

Course Page: https://www.thomasrcameron.com/courses/MAT-331/mat_331.html
Office Hours: M W F 2:30 – 4:00 pm, Th 10:30 am – 12:00 pm, and by appointment in CHAM 3044.

Textbook: Beck, Marchesi, Pixton, and Sabalka, *A first course in complex analysis*, (vol. 1.41), 2002
Prerequisite: Mathematics 160 and one of Mathematics 220, 230, or 255.

Course Description: The algebra and geometry of complex numbers, sequences and series of complex numbers, derivatives, and integrals of functions of a complex variable. The Cauchy-Goursat Theorem, the Cauchy Integral Formula and its consequences, Taylor series, classification of singularities, the Residue Theorem, Laurent series, harmonic functions, conformal mappings, and, if time permits, miscellaneous applications.

Learning Outcomes: Students will be able to

- Complex Numbers
  - Explain with examples the basic algebraic and geometric properties of the complex field.
  - Perform operations associated with the algebraic manipulation of complex numbers.
- Differentiation
  - Explain with examples the definition of differentiability for complex functions.
  - Define holomorphic and entire functions.
  - Apply the Cauchy-Riemann equation and the real-differentiable concept to give necessary and sufficient conditions on the complex differentiability of a function.
  - Apply the Cauchy-Riemann equation to harmonic functions.
- Visual Complex Functions
  - Explain with examples the phase portrait of a complex function.
  - Define Möbius transformations, stereographic projections, and work with the Riemann Sphere.
  - Visualize the complex logarithm, exponential, and trigonometric functions.
- Integration
  - Explain with examples the definition of integration for complex functions.
  - Prove the Cauchy-Goursat theorem and use it to prove Cauchy's integral formula.

  - Apply Cauchy's integral formula to computing antiderivatives of complex functions.

- Series
  - Explain with examples power series and Laurent series.
  - Identify power series representations of functions and region of convergence.
  - Explain with examples the relationship between power series, analytic functions, and holomorphic functions.

- Residue Theorem
  - Classify singularities.
  - Prove the Residue theorem and describe the argument principle and its uses.
  - Apply residue theorem to Rouchés theorem and discrete applications (infinite sums, binomial coefficients, Fibonacci numbers, the 'coin-exchange problem', and Dedekind sums.

Grading Policy:
Your final grade is broken up as follows.

Category	Percentage
Daily Handouts	15%
Reviews (5% each)	15%
Projects (5% each)	15%
Final Presentation	15%
Homework	20%
Portfolio	20%

Your final letter grade is based on the following scale.

Grade	Percentage Interval	Grade	Percentage Interval
A	$[93, 100]$	C+	$[76, 80)$
A-	$[90, 93)$	C	$[73, 76)$
B+	$[86, 90)$	C-	$[70, 73)$
B	$[83, 86)$	D+	$[66, 70)$
B-	$[80, 83)$	D	$[63, 66)$
		F	$[0, 63)$

Daily Handouts: During each class period, you will be given an opportunity to interact with the material in a way that is above and beyond the daily reading. This may be in the form of handouts, group exercises, pop quizzes, or discussions. These assignments will be graded based on attendance, participation, and your preparation for class (did you do the reading).

Reviews: There will be three short reviews throughout the semester. These reviews will be taken in class and the dates can be found on the class calendar (see the course website). Each review will test you on definitions, short proofs, analysis, and applications of topics from the course. These assignments will be graded based on accuracy.

Projects: There will be three short projects throughout the semester. You are expected to do additional research on the topics from the course that is above and beyond our coverage of the material in class. The specific details of your research project are up to you, but could include historical components, visualization of complex functions, extra problems not done in homework, or applications of the material. You are expected to write $2-3$ pages (in LaTeX) for each project and share your findings in class; the dates for sharing each project can be found on the class calendar (see the course website). You will compile these projects into your portfolio that is due at the end of class. These assignments will be graded based on the accuracy, clarity, and conciseness of your writing, as well as your participation in class when sharing your research and learning from the research of others.

Final Presentation: During the last week of classes, students will present on their favorite aspects of their portfolio. Presentation slides should be made and each student should plan on speaking for 15 minutes. This assignment will be graded on the organization, content, and delivery of your presentation.

Homework: Homework assignments are due bi-weekly. These assignments have modest size and are intended to be thoughtful problems that you find both challenging and enjoyable. These assignments will be graded based on accuracy.

Portfolio: Students will compile a portfolio throughout the semester. This portfolio is intended to encapsulate your research projects and any other material you found interesting throughout the course. You are expected to write $7-10$ pages in LaTeX. In addition, you will include an appendix on homework corrections. For at least one problem from each homework assignment, you should include a statement on what you did wrong, and a complete and accurate solution of the problem. This assignment will be graded based on the accuracy, clarity, and conciseness of your writing, as well as the accuracy of your revised homework problems.

Academic Honesty: Students are expected to complete all graded work in accordance with the Davidson College Honor Code, as it applies to each assignment in this class.

Special Accommodations: The college welcomes requests for accommodations related to disability and will grant those that are determined to be reasonable and maintain the integrity of a program or curriculum. To make such a request or to begin a conversation about a possible request, please contact the Office of Academic Access and Disability Resources, which is located in the Center for Teaching and Learning in the E.H. Little Library: Beth Bleil, Director, bebleil@davidson.edu, 704-894-2129; or Alysen Beaty, Assistant Director, albeaty@davidson.edu, 704-894-2939. It is best to submit accommodation requests within the drop/add period; however, requests can be made at any time in the semester. Please keep in mind that accommodations are not retroactive.

Disclaimer: I reserve the right to diverge from this syllabus in the best interest of the course. Any changes made will be announced in advance.