

**Math 422/522/692**  
**Applied Complex Variables/Engineering Analysis II**

Professor David E. Keyes

<http://www.math.odu.edu/~keyes>

Spring 2001, Mon 4:20 – 7:00 pm, BAL 238

**Motivation:** Complex variables complete the reals in many essential ways: “missing” roots of some polynomial equations are found in the complex plane, values of certain apparently singular real integrals can be defined by limit processes in the complex plane, certain identities involving transcendental functions are seen to be the real and imaginary parts of simpler identities, etc. In addition, complex analysis has deep structure and beauty; Leibniz described complex numbers as a “wonderful refuge of the divine spirit.” However, for most people enrolled in Math 422/522/692 (“Math 422” for short) at ODU, the main motivation to study complex variables is not their elegance or mystique, but their practical power. Integral transforms, boundary value problems, function theory required in differential equations, and many other topics in the application of mathematics to practical problems can be approached effectively from the vantage point of complex variables. This is a practical course in complex variables and complex function theory. Theory is important to understanding, but emphasis is on applications, and students will be evaluated on their ability to perform practically motivated calculations.

**Course Description:** As implied by its location in the curriculum, Math 422 is for advanced undergraduates majoring in mathematics or related subjects, and graduate students throughout the sciences and engineering who need fluency with the manipulations and results of complex analysis. Core topics include: complex numbers, analytic functions and their properties, derivatives, integrals, series representations, residues, and conformal mappings. Application of the calculus of residues and mapping techniques to the solution of boundary value problems in physics and engineering is a major part of the course.

**Prerequisite Relationships:** The prerequisite of Math 422 is advanced calculus of real variables; at ODU this is Math 312. An earlier or concurrent course in differential equations provides much to “tie in” but is not required for success in this course. There is a more advanced graduate course (Math 605), which requires this course as a prerequisite.

**Text and References:** There is one “required” text: *Complex Analysis for Mathematics and Engineering, Fourth Edition*, by J. H. Mathews & R. W. Howell (Brown, 2001). We will cover nearly the entire book. Mathews & Howell serves as a source for coverage of the topics to be evaluated and as a source for homework exercises; however, topics will not necessarily be followed in strict textbook order. The fourth edition is new this year and bundles a CD-ROM of possible value and convenience. However, the subject matter of this course has not changed for over a century; earlier editions, and, indeed, many other texts will do as well, provided a student has loan access to the text for a few minutes per week to translate and photocopy homework assignments. The instructor will lecture from a mix of earlier offerings of the same course at other institutions with various texts.

**Course Requirements:** Student performance will be measured in three ways. There will be written homework exercises, which will be collected, graded, and returned. There will also be three in-class tests and a final exam. Lecture attendance is not required, but recommended. Assignments

and modifications to schedules made in lecture will be assumed “posted” to all students. (See also “Course Communications” below.)

**Course Evaluation:** Grading will be based on a composite index weighted as follows:

30%	Final Exam
45%	Term-time Exams
25%	Written Homework

Problem sets will be assigned in small chunks at regular intervals. For greatest pedagogical benefit, they will sometimes be discussed in class *on* their due dates, following which credit cannot be rewarded. Cooperation is not permitted on the exams, but it is explicitly encouraged on the written homework. [No student is required to work collaboratively on the homework, but all students are allowed to seek out others in the class for this purpose.] Independent write-up and submission is required for credit, however.

At their option, students can be evaluated, instead, with the following composite index:

40%	Final Exam
60%	Term-time Exams

The latter index will be computed for all students, as well as the former, and if it is superior, due to poor or missing performance on the written work, it can be used in place of the first index as a basis for assignment of the final grade. Experience shows that in a course such as this one, with a premium on manipulative ability and experience (as opposed to instinct and creative innovation), problem set performance correlates well with exam performance. Therefore, students would ordinarily be expected to do as well or better under the first index. However, the second is available, should circumstances and priorities dictate that students cannot keep up with the term-time problem sets.

The final assignment of a letter grade will be made on a “curve.” At midsemester and just before the final, students will be given a histogram of class performance and an association of numerical score with letter grade.

**Standards for Written Work:** The exams and problem sets require written derivations. Simple statements of final results are, in most cases, not sufficient for full or even substantial credit. Written derivations should flow sequentially, with references made to earlier partial results by labeling equations. They should be reasonably free of spelling, grammatical, and typographical errors, as well as mathematically logical and concise. Written work should be presented one side per page, and each new exercise should be started at the top of a new page and labeled. Since the best grading practice often proceeds problem-by-problem, rather than student-by-student, the student’s name should appear on every page, so that the pages can be separated for grading, and reassembled for recording the grades. (Students are welcome to turn in scrap or recycled paper (e.g., from computer outputs), with miscellany on the back sides.)

**Use of Calculating Devices:** Students may employ calculators, graphing devices, computers with symbolic manipulation software, etc., while seeking to understand and present the results of exercises. None of these devices is expected and none is required for success. In exams, only “dumb” calculators are permitted, and they are not expected to be particularly useful.

**Class Schedule:** Lectures are scheduled for the following 14 Monday evenings:

January 8, 22, 29  
February 5, 12, 19, 26  
March 12, 19, 26  
April 2, 9, 16, 23

Note that January 15 is the Martin Luther King, Jr. holiday and the week of March 5 is midsemester break. The last date to withdraw from classes without transcript consequences this spring is Tuesday March 13. The Monday evening lecture period will include a break of ten minutes at approximately 5:35pm, to coincide with the usual change of classes.

**Course Communications:** A class e-mail alias will be created for dissemination of any news pertaining to shifted due dates, corrections to problem sets and exercises, or other late-breaking announcements. The class link, [www.math.odu.edu/~keyes/math422.html](http://www.math.odu.edu/~keyes/math422.html), in the instructor's home WWW area will also be used for such purposes, and a repository of class assignments and handouts will be maintained there. Office hours will be immediately after class for an hour, and at other times midweek to be arranged by consensus. As the instructor travels frequently, the hours besides Monday evening will often be served by a teaching assistant. If it is necessary to meet the instructor outside of these hours, please make an appointment by e-mail to [dkeyes@odu.edu](mailto:dkeyes@odu.edu).

**Warning Concerning University and External Regulations:**

Various acts and misrepresentations pertaining to submitted work and exams in this course can land students in serious trouble with university authorities. Generally, these acts (including plagiarism, invasion of privacy, seizure of the intellectual property of others, by oral, written, or electronic means) do not happen "by accident." Any student accustomed to a callous attitude toward the ODU Honor Code or copyright law violation is hereby warned that the current instructor will enforce applicable codes of the university to their full extent, in order to safeguard from abusers the privileges and respect that our academic and larger communities currently enjoy.