MATH 406: Advanced Calculus for Engineers / Scientists II
- Complex Variable Techniques -
Penn State University Spring Semester 2009

Location:

MWF 9:05-9:55 AM	009 Life Sci Bldg.	(sect.2)
MWF 10:10-11:00 AM	169 Willard Bldg.	(sect.1)

Instructor: Prof. Andrew Belmonte (322 McAllister Bldg, 865-2491)
email: alb18@psu.edu.

Office hours: TBA, and by appointment.

Required Text:

E. Kreyszig, *Advanced Engineering Mathematics*, 9th edition (Wiley, 2006)
ISBN: 0-471-48885-2.

Additional Texts (not required):

Nakhlé H. Asmar, *Applied Complex Analysis* (Prentice Hall, 2002)
Francis J. Flanigan, *Complex Variables* (Dover, 1983)
→ or any supplementary text on complex variables (see reserve at PAMS library).

Prerequisites: Math 405, plus Math 251 (prereq for 405).

Web Site: Course information and updates will be posted at:
http://www.math.psu.edu/belmonte/math406_09.html

The Course:

As you probably already know by now, the square root of a negative number is allowed in mathematics: the so-called imaginary numbers are multiples of $\sqrt{-1}$. More generally, *complex variables* can take on either real or imaginary values (or both). But is it useful to do this?

This semester we will delve into the properties of complex variables and complex-valued functions, and explore some of the applications that are current in engineering and the fundamental sciences. There are in fact a large number of important results coming from the abstract idea of $i = \sqrt{-1}$, including signal processing, fluid dynamics, electromagnetism, circuit theory, and quantum mechanics, among others. We will study integral and differential calculus of complex functions. Among the topics we will cover are analytic functions, contour integration, residues, conformal mappings, and transforms (Fourier, Laplace, etc). We will however spend more time on techniques (such as the use of transforms to solve partial differential equations) at the expense of more fundamental aspects of the subject (such as sequences and series).

The general structure of the course will follow Chs. 13-18 (Part D, selected sections) of the text, more or less in the same order, with the addition of parts of Ch. 12 (transforms).

Grading: The grades for this course will be determined as follows:

1. **Problems Sets (30%)** One learns mathematics by doing mathematics. Thus the homework assignments will comprise an essential aspect of this course, requiring your time and careful thought. Solutions to the assigned problems should be written up carefully, in a well organized manner and should contain explanations of all critical steps. Keep in mind that the reader of your solutions cannot necessarily read your thoughts.

2. **Quizzes (27%)** There will be a weekly quiz which will follow the material in the problem sets. These quizzes will be short, and are meant as a regular checkup on what you are learning (or not learning) as we progress through the semester.

3. **Attendance (3%)** Your presence and contribution to discussions, with questions or comments, are an essential aspect of how this course should run. You are strongly encouraged to attend every class!

4. **Exams (40%)** There will be two in-class midterm exams, and a comprehensive final examination (as scheduled by the University). The tentative schedule for the exams is as follows:

Midterm I	Wednesday, February 18th (in class).
Midterm II	TBA (in class).
Final Exam	TBA.

Computers: You will be encouraged to use computers in the latter part of this course to help you visualize the material, as well as to solve and check problems. Programs such as Maple, Mathematica, and Matlab have many capabilities, such as performing the basic operations of calculus and differential equations, and are particularly well suited to visualization. I will sometimes use Mathematica in this course (particularly for conformal mapping), and handouts will be provided illustrating how to implement various equations or routines.

Inspirational Quote:

"As early as the 16th century
mathematicians were compelled to introduce expressions
for square roots of negative numbers
in order to solve all quadratic and cubic equations.
But they were at a loss to explain the exact meaning
of these expressions, which they regarded with superstitious awe."

- Courant & Robbins, What is Mathematics?

Academic Integrity: You are of course expected to abide by Penn State's academic integrity policy, which is fully stated at:

http://www.science.psu.edu/academic/Integrity/Policy.htm

Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner...