

Mathematics 352, Spring 2005

Complex Analysis

It is no paradox to say that in our most theoretical moods we may be nearest to our most practical applications.

Alfred North Whitehead (1861-1947)

There is a famous formula - perhaps the most compact and famous of all formulas - developed by Euler from a discovery of De Moivre: $e^{i\pi} + 1 = 0$... It appeals equally to the mystic, the scientist, the philosopher, the mathematician.

Edward Kasner and James Newman, *Mathematics and the Imagination* (1940)

Instructor:

Dr. Myrtle Lewin, Buttrick 325, telephone # 6201,
email mlewin@agnesscott.edu

Classes meet Monday and Wednesday 2:30-3:45, and Thursday 2:15 to 3:05 in Buttrick room 221.

Prerequisites:

Three semesters of calculus (including MAT 220), good algebraic skills, and a beginning understanding of power series are essential. Some experience with formal proof writing is desirable.

Texts and Materials:

- Required text: *Complex Variables*, Second Edition, by Stephen D. Fisher.
- I will post materials on Blackboard, and expect you to check both Blackboard and your email regularly.
- Useful Resources and Good Related Reading (McCain Library is denoted **(L)**, available in my office is denoted **(P)**.
 - ⇒ There are several classic texts in complex analysis, somewhat more difficult than the required text, by Walter Rudin, Einar Hille, Lars Alfors.

You are encouraged to read from some of the texts listed here as the course progresses.

- ⇒ *e The Story of a Number*, by Eli Maor, for an interesting source of light reading **(L)**, **(P)**;
- ⇒ *An Imaginary Tale, the story of $\sqrt{-1}$* , by Paul Nahin, a wonderful companion reader **(L)**, **(P)**;
- ⇒ *A History of Mathematics*, Victor Katz, for a good brief history of the development of complex numbers and complex analysis **(L)**, **(P)**;
- ⇒ *Math Through the Ages*, William Berlinghoff and Fernando Gouvea, Oxtan House, 2002. **(P)**;
- ⇒ *Basic Complex Analysis*, Jerrold Marsden and Michael Hoffman, W.H. Freeman, 1999 **(P)**;
- ⇒ *Complex Analysis*, Ian Stewart and David Tall: Chapter 0 provides an excellent overview **(P)**;
- ⇒ *Complex Variables and Applications*, Churchill and Brown (various editions) **(P)**;
- ⇒ *Basic Complex Variables*, John H. Matthews, 1982 **(P)**;
- ⇒ *Introduction to Complex Analysis*, Zeev Nehari (1968) **(P)**;

Course Objectives:

- to develop good skills at working with the field of complex numbers and the complex transcendental functions, and to appreciate their value in related courses and topics;
- to develop a rudimentary understanding of the topology of the Euclidean plane, and of how multi-valued functions can be made meaningful within this context;
- to understand the basic properties of analytic functions, including Cauchy's Theorem and the Residue Theorem;
- to understand a proof of the Fundamental Theorem of Algebra;
- to broaden your understanding of power series, and to appreciate their role in representing analytic functions;
- to see some applications of complex analysis to real analysis, to appreciate the difference between the two central ideas of calculus (differentiation and integration) in these two settings, and (if time permits) to learn about some applications to the solution of physical problems.

Course content:

- We plan to study the first three chapters (omitting the starred sections). We'll do bits of chapter 4 if we have time. This is consistent with the recommendations of the author. You are encouraged not to read technical details, but rather to interact with the text. Take worked discussions, and ignore the text, go through the details on your own. After all, the text gives only one possible way to do something, and it reads pretty dry. This is a fact for almost all upper level math texts – so get used to it. Let me help you. Do a variety of problems, honing your skills and remembering the insights you gain from that experience. Read the development – that's the central role of the text.

Office Hours and Sources of help:

- You are encouraged to brainstorm together, and to develop productive collaborative (study buddy) relationships. But also make sure that you are in control of your own learning, and developing the technical skills you need on your own. Acknowledge collaboration (plagiarizing in mathematics includes using others' ideas without acknowledgment).
- As you probably know, I do not schedule specific office hours, but my door is invariably open for you to be able to schedule meetings with me (on the white board in my office) at your convenience. Sometimes a telephone call to (X6201), or e-mail query and response, will provide you with the nudge you need.
- You are welcome to come to the Math Learning Support Center (in Buttrick G12) when I am there for my 100 level students. I'll tell you when and where these are, or we can arrange to meet there at your convenience.

Tests, Assignments, Expectations and Grading:

Class involvement:	10%
Graded homeworks:	35%
Three quizzes:	15%
Midterm test:	25%
Final exam:	25%

- I will use a ten point scale for this course, using + and - as appropriate. But the two tests (midterm and final) are the best measure of your consolidated knowledge. You must score at least 84% average on these two for an A-, at least 74% for a B-, and so on (you get the formula). But given that you do this, an overall average of 90% guarantees you an A-, 80% a B-, 70% a C-, and 60% a passing grade.
- **Class Involvement:** This includes your willingness to share your insights, to listen respectfully to others, to come to class regularly and on time, to do the vast majority of the homework problems assigned, and to let me know if I am overloading you. You will be expected to share your insights, and solutions to homework problems, class. I expect you to read ahead in the text, and re-read after we've discussed a section of material. By now, we know how to be good mathematical citizens (10 points).
- **Graded homeworks:** As in any math course, doing problems is a daily routine, and it will be assumed that you are doing this, and that if I don't hear from you, all is well. Use the Examples in the text as exercises with solutions – never read them but rather work them with the text as a check on how well you are thinking. Use the answers at the back of the book wisely – you do not have answers to the even numbered problems.
- You are expected to turn in some problems most Mondays by 6:00 p.m. The problems to turn in will be announced in class by Wednesday during the previous week, either in class or on Blackboard. I will do my best to get the graded work back to you by the next class (Wed). You will be given a homework envelope, and homework will be accepted only if it is turned in to me in your homework envelope, properly organized. (You know this routine from 204.)
- Each homework assignment will be graded A/B/C/U (with + and – as appropriate), and will not be accepted late. You are encouraged to make corrections, due within two classes of my returning the graded first attempt. (So if I return work to you Wed, then corrections are due the following Monday, etc.) The original must accompany any resubmitted work. If these corrections are well done, your grade on the homework can go up by as much as one letter (from a B- to an A-, or from a U to a C, for example).
- Your best 8 homeworks will count (expect about 10 to be given). 8 A's will give you 33 (you need some A+'s for a 35), 8 B's will give you 27, 8 C's give you 21, and a U will not count (30 points).
- **Quizzes:** There will be four 30 minute, 20 point take home **closed book** quizzes, two before the midterm, two after. Your best three will count for 15 points. They will be given to you in class on Monday, and will be due in class the following Thursday (due dates: February 10, March 3, April 7, and April 28). There will be no makeup quizzes, no quizzes turned in late (15 points)
- **Midterm test:** There will be one untimed open book take-home midterm test, given to you on Thursday March 3 (before Spring Break), and due on Wednesday March 16 (after Spring Break) in class. This test should take you about four hours to complete (25 points).
- **Final exam:** There will be one untimed open book take-home final exam. It will be given to you at the last class (Monday May 2), and is due at the end of the exam period (Tuesday May 10 for seniors, Wednesday May 11 for others). It should take you about four hours to complete (25 points).

**Mathematics 352, Spring 2005
Course Schedule**

Week beginning	Monday	Wednesday	Thursday
1/17			Classes begin Thu Jan 20.
1/24		Homework # 1 out, begin regular schedule...	
1/31	Homework # 1 due, begin regular schedule...	Homework # 2 out	
2/7	Homework # 2 due First quiz out Monday	Homework # 3 out	First quiz due
2/14	Homework # 3 due	Homework # 4 out	
2/21	Homework # 4 due	Homework # 5 out	
2/28	Homework # 5 due, Second quiz out Monday		Second quiz due, Midterm Test out March 3.
3/7	Spring Break!	Spring Break!	Spring Break!
3/14		Midterm test due March 16. Homework # 6 out	
3/21	Homework # 6 due	Homework # 7 out	Friday 3/25 Easter Break
3/28	Homework # 7 due	Homework # 8 out	
4/4	Homework # 8 due Third quiz out Monday	Homework # 9 out	Third quiz due Thursday
4/11	Homework # 9 due	Homework # 10 out	
4/18	Homework # 10 due	SpARC!	Homework # 11 out
4/25	Fourth quiz out Monday	Homework # 11 due	Fourth quiz due Thursday
5/3	Last class Monday May 2, Final exam given out.		