

18.04 Complex Variables with Applications Spring 2000 MIT

<http://www-math.mit.edu/18.04>

Lectures: MWF 12-1 in 4-370.

Lecturer: Prof. M. Bazant, 2-363B, 253-1713, bazant@math.mit.edu, Office hours: W 1:30-3.

Recitations: W 2-3 in 2-131, Th 2-3 in 2-131, Th 3-4 in 2-132.

Instructor: Prof. R. Rosales, 2-337, 253-2784, rrr@math.mit.edu, Office Hours: TBA.

Text: E. Saff & A. Snider, *Fundamentals of Complex Analysis*, 2nd ed. (1993).

Reading: At least skim the assigned reading *before* each lecture.

Homework: Problems from the text (esp. the underlined ones) are recommended for practice.

Grading: Four problem sets (25% total), two hour exams (20%+25%) and a final exam (30%).

Problem Sets: Due *at lecture* on Fridays Feb 11, Mar 10, Mar 31 & Apr 28. Grades will reflect not only correctness but also cleverness and *clarity* (i.e. English explanations). *Late problem sets will not be accepted.*

Hour Exams: During lecture hours on Fridays Feb 25 and Apr 14 in Walker Gym 50-340.

Final Exam: During the final exam period, May 15-19.

I. Complex Numbers and Functions

Lecture	Date	Reading	Topics & Homework
1	W Feb 2	1.1-1.3	Algebra & <i>geometry</i> of complex numbers. p5: 7,9,16 <u>b</u> ,24 p11: 6,7,14,17 p19: 6,7,8,15,16
2	F Feb 4	1.4, 1.5	Euler's formula, application to the damped harmonic oscillator. p25: 1,3,4,11,12,14 p31: 4,5 <u>d</u> ,7,9,10,11,12 p35: 2
3	M Feb 7	2.1-2.3	Powers, geometric series, roots, analyticity. p44: 4,5,6 p49: 5,9 <u>d</u> ,15 p56: 4,7,11 <u>e</u> ,12,13,14
4	W Feb 9	2.4, 2.5	Cauchy-Riemann equations, harmonic conjugates. p62: 1,3,6,8,11,16 p68: 2,3 <u>b</u> c,6,9,12,18
5	F Feb 11	Skim 7.3	Mappings of the complex plane, conformality. p45: 7,8,9,10,12 p56: 8 p325: 3 <u>b</u> e,8
6	M Feb 14	3.1	Exponential, trigonometric & hyperbolic functions. p80: 5,9,14,17 p314: 11,13
7	W Feb 16	3.2	Complex logarithms. p86: 1,4,5,6,8,11,14
8	F Feb 18	3.3	Complex powers, inverse trigonometric functions. p93: 1,4,5,9,11,14
9	T Feb 22	Rosales notes	Branch points and cuts, multivalued functions. p87: 11,19 p93: 7,15

II. Contour Integration

10	W Feb 23	4.1, 4.2	Contour integrals in the complex plane. p113: 2,4,8,13 p122: 3 <u>b</u> ,6c,9,11,12,14
	F Feb 25	Review	Exam covering lectures 1-9.
	EXAM#1		
11	M Feb 28	4.3,4.4a	Antiderivatives & path dependence. p128: 1 <u>a</u> e <u>h</u> ,2,6,7,11
12	W Mar 1	4.4b	Cauchy's (Gauss') integral theorem. p149: 6,9,10,13,15,17,18,19
13	F Mar 3	4.5	Cauchy's integral and derivative formulae. p160: 1,3 <u>a</u> b <u>d</u> ,5,6,8,13
14	M Mar 6	4.6	Liouville's theorem, mean-value & max-modulus principles. p167: 7,10,14,15,24
15	W Mar 8	Skim 4.7	Harmonic functions, Poisson's integral formula. p174: 4,6,7,11

III. Laurent Series and Residue Calculus

16	F Mar 10 PS#2 DUE	5.2, 5.3	Taylor series, power series. p195: <u>1a,4,5,11</u> p203: <u>7,13a</u>
17	M Mar 13	5.5	Laurent series. p217: <u>3,5,6,7a,10</u>
18	W Mar 15	5.6, 5.7	Types of zeros and singularities, Riemann sphere. p225: <u>1,2,3,5,12</u> p230: <u>1,6,9</u>
19	F Mar 17	6.1,6.2	Residue theorem. Integrals around the unit circle. p251: <u>1,3,7</u> p255: <u>2,6,9</u>
20	M Mar 27	6.3	Rational & exponential integrands on the real axis. p262: <u>1,3,6,10,11,13</u>
21	W Mar 29	6.4	Trigonometric integrands, Jordan's lemma. p271: <u>1,3,7,11,12</u>
22	F Mar 31 PS#3 DUE	6.5	Indented contours, principle-value integrals. p279: <u>1a,3,5,10,12</u>
23	M Apr 3	6.6	Multivalued integrands, branch cuts. p287: <u>1,2,4,8,10</u>
24	W Apr 5		Summation of series. p263: <u>14,15</u>
25	F Apr 7	6.7	Argument principle, Rouché's thm, application to control theory. p298: <u>3,4,9,21</u>

IV. Conformal Mapping

26	M Apr 10	7.1	Laplace equation in the plane, invariance under mapping. p306: <u>1,3,4</u>
27	W Apr 12	7.2, 7.3	Conformality again, Möbius transformations. p314: <u>1b,3,6</u> p325: <u>3cd,6,7b,11</u> p336: <u>16</u>
	F Apr 14 EXAM#2	Review	Exam covering lectures 10-26.
28	W Apr 19	7.6	Application to electrostatics & steady heat flow. p359: <u>1,2,3,6,10</u>
29	F Apr 21	7.7	Application to fluid mechanics. p366: <u>3,5,6</u>

V. Fourier Series and Transform Methods

30	M Apr 24	8.1 to p377	Laurent series on the unit circle, complex Fourier series. p384: <u>1a,2ac</u>
31	W Apr 26	Skim 3.4	Even & odd functions, application to oscillating systems. p99: <u>1b,2</u> p326: <u>13</u> p384: <u>5,6,7a,10</u>
32	F Apr 28 PS#4 DUE	Finish 8.1	Discontinuities, branch cuts, convergence. p384: <u>7c,11</u>
33	M May 1		Gibbs phenomenon, aliasing, Fast Fourier Transform. p387: <u>12</u>
34	W May 3	8.2	Fourier transform, application to unsteady heat flow. p397: <u>1abd,3abc,4ac,5,6</u>
35	F May 5		Convolution theorem, application to random walks.
36	M May 8	Skim 8.3	Laplace transform, application to diffusion.
37	W May 10	Review	Final exam review, lectures 1-34.

During May 15-19
FINAL EXAM