Math 121A: Mathematical Tools for the Physical Sciences, Spring 2015

Instructor: [Nikhil Srivastava](#), email: *firstname at math.berkeley.edu*

Lectures: MWF 9-10am, Cory Hall 289.

Office Hours: Monday 2-3, Tuesday 9-10, and Thursday 11-1, Evans Hall 1035.

Text: Mary L. Boas, *Mathematical Methods in the Physical Sciences, 3e.*

Grading: 30% Homework, 30% Midterms, 40% Final. The lower midterm score will be replaced by the final exam score, if it helps.

Homework will be assigned every Friday and due the following Friday at the end of class, except for the week of 3/20 (Midterm 2), when it will be due two days earlier on 3/18. Solutions will be posted on this page each Friday or early Saturday, and late homework will not be accepted. The two lowest homework grades will be dropped.

Announcements

- (2/11) HW4 will be assigned early on Wednesday, 2/11. It will *not* be collected, but solutions will be posted online on Monday, 2/16, so please do it before that. The material on HW4 will be included in the first midterm.
- (2/12) There will be extra office hours on Tuesday, 2/17, the day before the midterm.
- (2/12) The midterm is in-class and closed book: no notes, textbooks, etc.
- (2/14) Here is a [sample midterm 1](#), as well as [solutions](#).
- (2/14) Here are some extra practice problems for linear algebra: [extra linear algebra problems](#).
- (2/20) New midterm grading policy: I will replace your lower midterm score with your final exam score, if it helps.
- (2/21) Here are the [solutions](#) to [midterm 1](#).
- (3/9) Office hours for the week of March 9-13 will be: Tu 8-9, We 2-3, Th 8-9 and 1230-130.
- (3/9) Reminder: HW8 will be assigned early (3/11) and collected early (3/18).
- (3/15) Here is a [sample midterm 2](#).
- (3/17) Here are the [sample midterm 2 solutions](#)
- (3/18) Here is a [handout](#) describing what you can cite on the midterm while calculating limits of integrals. It also includes some [extra problems](#) for practice.
- (4/3) Here are the [midterm 2 solutions](#)
- (4/14) HW10 is due on Monday, April 20.
- (5/4) A [sample final](#) with practice problems is up
- (5/7) Sample final [solutions](#).

Readings and Homework Schedule

#	Date	Topic	Readings	HW	Notes
	Jan				

1	21	Intro to series	1.1-1.4		
2	Jan 23	Tests for convergence	1.5-1.9	[HW1](#) assigned	
3	Jan 26	Power series	1.10-1.13		
4	Jan 28	Taylor series, error terms	1.13-1.14		
5	Jan 30	Asymptotic notation, applications of series	1.15-1.16 + [Lecture notes](#)	[HW2](#) assigned* [HW1 Solutions](#) posted	guest lecture by [Marius Beceanu](#) HW1 due
6	Feb 2	Diagonalization, decoupling principle	[Lecture notes on diagonalization](#)		
7	Feb 4	More diagonalization, applications	3.11-3.12		
8	Feb 6	Spectral theorem, inner product spaces	3.9, 3.14	[HW3](#) assigned [HW2 Solutions](#) posted	HW2 due
9	Feb 9	Partial differentiation, chain rule	4.1-4.5		
10	Feb 11	More chain rule, gradients, max/min problems	4.6-4.9 [Lecture notes on chain rule](#)	[HW4](#) assigned	
11	Feb 13	Max/min problems, Lagrange multipliers	4.9-4.10	[HW3 Solutions](#) posted	HW3 due
	Feb	No class		[HW4 Solutions](#)	

	16			posted	
12	Feb 18	Midterm 1			
13	Feb 20	Complex numbers	2.1-2.5	HW5 assigned	
14	Feb 23	Complex series, the exponential function, Euler's formula	2.6-2.15 lecture notes		
15	Feb 25	Powers, roots, logarithm, trig functions	2.11-2.15		
16	Feb 27	Complex differentiation, Cauchy-Riemann equations	14.1-14.2	HW6 assigned HW5 solutions posted	
17	Mar 2	Contour integration	14.3		
18	Mar 4	Cauchy's integral formula and consequences	14.3		
19	Mar 6	Laurent series	14.4	HW7 assigned HW6 solutions posted	
20	Mar 9	Residue theorem	14.5-14.6 Lecture notes on residue thm and Laurent Series		
21	Mar 11	Applications of residue calculus	14.7 Lecture notes on Jordan's lemma and PV	HW8 assigned	
22	Mar 13	Applications of residue calculus	14.7	HW7 solutions posted Grader's	

				solutions	
23	Mar 16	Integrating along a branch cut, Liouville's Thm, FTA	14.7		
24	Mar 18	Summing series using residues, review		HW8 solutions posted	
25	Mar 20	Midterm 2			
26	Mar 30	Intro to Fourier series, heat equation	lecture notes, skim 7.1-7.7		
27	Apr 1	Inner product space formulation, convergence in L2	lecture notes		
28	Apr 3	More on L2 convergence		HW9 assigned	due April 14 at 5pm
29	Apr 6	Pointwise convergence, differentiation, even/odd functions	lecture notes		
30	Apr 8	The Fourier transform, Gaussians	lecture notes		
31	Apr 10	Properties of Fourier transforms, convolution	lecture notes		guest lecture by Marius Beceanu
32	Apr 13	More convolution, Poisson summation	lecture notes	HW10 assigned	Due April 20 at 5pm
33	Apr 15	Delta functions	8.11		

34	Apr 17	Shannon-Nyquist theorem, Isoperimetric inequality		HW9 solutions written by our grader	
35	Apr 20	The Laplace Transform	8.8, 8.9	HW11 posted	Due April 27
36	Apr 22	Inversion by convolution, the Bromwich Integral	8.9, 14.7 lecture notes		
37	Apr 24	Green's functions	8.11, 8.12	HW12 posted	
38	Apr 27	Green's functions, weak solutions	8.11, 8.12		
39	Apr 29	Finish Green's functions	lecture notes	HW10 solutions posted HW11 solutions posted	
40	May 1	Review, evaluations		HW12 solutions written by our grader	

Course Outline:

1. Infinite Series (Chapter 1)
2. Linear Algebra (Chapter 3)
3. Partial Differentiation (Chapter 4)

   Midterm 1, Wednesday 2/18

4. Complex Analysis (Chapters 2 & 14)

   Midterm 2, Friday 3/20

5. Fourier Series & Transforms (Chapter 7)
6. Laplace Transforms (Chapter 8, end)
7. Calculus of Variations (Chapter 9)

   Final Exam, Monday 5/11