



Summer  
2002

# Mathematics

## MathS21a

### Summer 2002

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## Multivariable Calculus

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## Syllabus

- **Math-S21a:** Multivariable Calculus
- **Instructors:** Daniel Goroff and Oliver Knill
- **Course Assistant:** Jonathan Kaplan (jkaplan@math.harvard.edu)
- **Office hours:**
  - Wednesday 11-12:30 for Goroff in SC-427
  - Mondays 11-12:30 for Knill in SC-434
  - Tuesdays 13-14:00 for Kaplan in SC-428b
- **Website:** <http://www.courses.fas.harvard.edu/~maths21a/>
- **Time:** Every Tuesday, Wednesday, and Thursday 9:30-11 except 7/4  
The lectures start at 9:30 sharp.
- **Place:** Maxwell Dworkin G-125
- **Problem sessions:** Thursdays 1-2 in SC-110
- **Homework:** Weekly HW assigned in three parts, one in each lecture. All three parts are due Tuesdays at the start of class. No late homework is accepted. You are encouraged to discuss solution strategies with classmates, but you must write up answers yourself in your own words. As with any academic work, please cite sources consulted.
- **Project:** As an optional 8th homework, you may choose to hand in:
  - a computer laboratory project
  - challenge problems you have completed
  - certain projects and problems from the book

If you do decide to work on an 8th assignment, only the best 7 of your 8 HW scores will count. Projects are due on 8/12 at 9:30 am.
- **Text:** James Stewart, "Multivariable Calculus, Concepts and Contexts" can be purchased on line or at the Harvard Coop. Student

solution manuals are also available. Please read relevant sections of the textbook before you come to class.

- **Calendar:** (18 lectures in 7 weeks)

Su	Mo	Tu	We	Th	Fr	Sa	
23	24	25	26	27	28	29	June 1
30	1	2	3	-	5	6	July 2
7	8	9	10	11	12	13	3
14	15	16	17	18	19	20	4
21	22	23	24	25	26	27	5
28	29	30	31	1	2	3	August 6
4	5	6	7	8	9	10	7
11	12	14			16	17	8

- **Exams:** Two Midterms

Thursday 7/11 at 9:30, in usual room.

Thursday 7/25 at 9:30, in usual room.

One cumulative Final Examination on Wednesday 8/14 at 9:15am.

These three exams are required. Please note the dates and times.

In general, we expect roughly a third of each test to consist of True/False or Conceptual Questions directly from the text, and another third to consist of assigned or unassigned exercises directly from the book.

- **Grades:** There is a total target of T=1000 points for this course. Roughly, we expect people who end up with over 900 points to receive some kind of A, people who have 800-900 points to receive some kind of B, etc. A maximum of 820 points can be obtained during the term:

7 Homeworks, each 60 points	420 points
2 Midterms, each 200 points	400 points

If you earn N points during the term, your final exam will be worth a possible T-N points. For example,

1) If you enter the final with all 820 points and get 50% correct on the final, your course total will be:  
 $820 + (1000-820) * 50/100 = 910$  (probably a low A or high B).

2) If you enter the final with 430 points and get 70% correct on the final, your course total will be:  
 $430 + (1000-430) * 70/100 = 839$  (probably a low B).

Notice this means you can earn back on the final any point you miss during the term, so you always have an incentive to keep working. This grading system is very kind to anyone who eventually masters the material by the day of the final, but very risky for anyone who tries to wait until then. Please keep up, work lots of problems, go over everything you did not get right the first time, ask lots of questions, and you will do fine.

- **About this course:**

- extends single variable calculus to higher dimensions;
- provides vocabulary for understanding the fundamental

- equations of nature (e.g., weather, heat, planetary motion, waves, profit maximization, quantum world);
- provides tools for describing curves, surfaces, and other graphical objects in three dimensions;
  - develops methods for solving optimization problems with and without constraints;
  - prepares you for further study in many other fields of mathematics and its applications;
  - improves thinking skills, problem solving skills, visualization skills, and computing skills.

**- Syllabus:**

Date	Topic	Book section
	<b>I) Geometry of Space</b>	
6/25	Tue - coordinates	9.1
	- distance	
6/26	Wed - vectors	9.2
	- dot product	9.3
6/27	Thu - cross product	9.4
	- lines and planes	9.5
	<b>II) Functions and Graphs</b>	
7/2	Tue - functions, graphs	9.6
	- level curves, quadrics	
7/3	Wed - cylindrical coordinates	9.7
	- spherical coordinates	
7/4	Thu - holiday	
	<b>III) Curves and Surfaces</b>	
7/9	Tue - curves in space	10.1
	- velocity, acceleration	10.2
7/10	Wed - arc length, curvature	10.3
	parametric surfaces	10.5
7/11	<b>Thu - First Midterm</b> (chapters 9-10)	
	<b>IV) Partial Derivatives</b>	
7/16	Tue - functions, continuity	11.1
	- continuity	11.2
	- partial derivatives	11.3
	- linear approximation	11.4
7/17	Wed - chain rule	11.5
	- gradient, directional deriv.	11.6
7/18	Thu - maxima, minima, saddle points	11.7
	- Lagrange multipliers	11.8
	<b>V) Multiple Integrals</b>	
7/23	Tue - double integrals	12.1
	- iterated integrals	12.2
	- general regions	12.3
	- polar coordinates	12.4
7/24	Wed - surface area	12.6
	- triple integrals	12.7
	- polar, spherical coordinates	12.8

	- change of variables	12.9
7/25	<b>Thu - Second Midterm</b> (chapters 11-12)	
	<b>VI) Line Integrals</b>	
7/30	Tue - vector fields	13.1
	- gradient fields	
7/31	Wed - line integrals	13.2
	- fundamental thm line integrals	13.3
8/1	Thu - application: work	
	application: electrostatic	
	<b>VII) Integral Theorems</b>	
8/6	Tue - Greens theorem	13.4
	- curl and divergence	13.5
8/7	Wed - surface integrals	13.6
	- Stokes theorem	13.7
8/8	Thu - Gauss theorem	13.8
	- Applications	
8/14	<b>Wed Final Examination 9:15</b> (chapters 9-12)	

Please send comments to [maths21a@fas.harvard.edu](mailto:maths21a@fas.harvard.edu)