Math 281-1 Accelerated Mathematics for ISP: First Year Fall 2015

Course: MATH 281-1
Instructor: Jason Siefken (siefkenj@math.northwestern.edu)
Class: MTWF 11:00–11:50 in ISP 203
Dicussion Section: Th 11:00–11:50 in ISP 203
Webpge: http://www.math.northwestern.edu/~siefkenj/math281-1
Office: Lunt 213
Office Hours: TW 2:00–3:30 or by appointment
Textbook: *ISP Mathematics 281 Volume I*, by Leonard Evans

Math 281-1 is the first in a series of three courses designed to acquaint you with the mathematics of multiple dimensions, and in particular, three dimensions. Unlike the one-dimensional, single-variable case, calculus in multiple dimensions becomes quite a bit more interesting—more things can happen when you have more degrees of freedom! (For example, a critical point of a multi-dimensional function could have both a positive *and* a negative second derivative, depending on what direction you take the derivative).
Starting from vectors, we will work our way through multivariate derivatives (what should *the* derivative of $f(x, y) = xy$ even be?), iterated integrals, and finally we will come to an understanding of vector fields (a key object of study in physics), which often arise as derivatives of multivariate functions.

Learning Outcomes

After taking this course, you will be able to:

- Manipulate vectors and vector equations, find derivatives of multivariate functions, integrate multivariate functions and vector fields, visualize 3-dimensional surfaces, and find extreme values of multi-dimensional functions.
- Work independently to understand concepts and procedures that have not been previously explained to you.
- Clearly and correctly express the mathematical ideas of multivariate calculus to others.

Prerequisites

To be prepared for this course, you should have a solid understanding of single-variable calculus including the ability to take limits (for example, $\lim_{x\to 0} \frac{\sin x^2}{1-\cos x}$), the ability to differentiate advanced elementary functions (for example, x^x), and you should be well versed in the techniques of integration.

To Succeed

Learning is hard! It is exercise for the mind, and like exercise, when you're doing it, it feels pretty uncomfortable (and if it doesn't, you're probably doing it wrong). Here are some tips to help you succeed academically (getting the grade you want) and intellectually (learning the most you can).

- Form a regularly-meeting study group of 3–4 people. Having others studying around you will help you study, and having someone to talk about confusing problems with will help you both productively struggle (struggling with others is how real-world problems are solved).
- Read the textbook *before* class. In class we will be working on problems that we haven't gone over before. If you expose yourself to the concepts prior to class, you'll get a lot more out of it.

- Visit the tutors, paid for by the university, at the **Calculus, Chemistry and Physics Resource Room** at Tech HG04 and Allison 1021 (http://www.math.northwestern.edu/undergraduate/tutoring-advising/tutoring/). Also, take advantage of the ISP upperclassmen. They've been through this struggle before!

Assessment

Midterm 1 (15%) In-class midterm on Thursday, October 15.

Midterm 2 (15%) In-class midterm on Thursday, November 12.

Homework and Quizzes (30%) **Homework**: Homework will be assigned throughout the term and typically due at the beginning of class on Tuesdays. You are encouraged to work together to solve homework problems, but *you* must write up your solutions to be turned in.

Some homework will focus on explaining problems rather than just "solving" them. If you'd like your write-ups to look like a pro's, I suggest you use the LaTeX typesetting software. LaTeX is the industry-standard for scientific write-ups in math, physics, chemistry, computer science, and engineering. It has a learning curve but is well worth the effort. See the course webpage for details.

Quizzes: Quizzes will take place at the beginning of discussion section on Thursdays (though not necessarily every Thursday). They may be announced or unannounced.

Final (40%) A comprehensive 2 hour final will be held on Friday, December 11 at 9:00–11:00 AM in ISP 203.

Policies

I have carefully planned the midterm dates, so please ensure you are available for each midterm. If you miss a midterm for a justified reason (illness, family affliction, or other reason recognized by Northwestern's policies), I can excuse it for you by weighting other tests more heavily. However, *there will be no makeup exams.*

If you have a disability/health consideration that may require accommodations, please contact the Office of Services for Students with Disabilities and register for AccessibleNU as soon as possible. All information will remain confidential. http://www.northwestern.edu/accessiblenu

For the rest of Northwestern's polices, please see http://policies.northwestern.edu

Time Table

Below is a preliminary time table, likely to change. Discussion section days are *italicized*.

September		21		
	Week 1	22		**Vectors** Vectors, vector operations, dot products, cross products
		23		
		24		
		25		
	Week 2	28		**3D Objects** Lines, planes, visualizing surfaces, integration along curves
		29		
		30		
		1		
		2		
	Week 3	5		**Multivariate Calculus** Limits and continuity with several variables, partial derivatives, the gradient
		6		
		7		
		8		
		9		
October	Week 4	12		**Multivariate Derivatives** Directional derivatives and the chain rule
		13		
		14		
		15	**Midterm 1**	
		16		
	Week 5	19		**Multivariate Derivatives** Tangent planes, higher order partial derivatives
		20		
		21		
		22		
		23		
	Week 6	26		**Multivariate Integrals** Multiple integrals, iterated integrals, double integrals in polar coordinates, triple integrals
		27		
		28		
		29		
		30		
November	Week 7	2		**Coordinate Systems** Cylindrical and spherical coordinates
		3		
		4		
		5		
		6		
	Week 8	9		**Changing Coordinate Systems** Integrals on surfaces, change of variables
		10		
		11		
		12	**Midterm 2**	
		13		
	Week 9	16		**Vector Fields** Vector fields and their properties
		17		
		18		
		19		
		20		
	Week 10	23		**Vector Fields** Integrating vector fields
		24		
		25		
		26	} Thanksgiving Break (no class)	
		27		
December	Week 11	30		**Vector Fields** Green's Theorem, Stoke's Theorem
		1		
		2		
		3		
		4	Last day of class	
		11	**Final Exam 9:00–11:00 AM in ISP 203**	