Multidimensional Calculus (21-268) – Syllabus

Laurent Dietrich
Carnegie Mellon University, Spring 2017, Sec. A and B

Class info	**Instructor info**	**T.A. info**
Time: MWF 3:30pm–4:20pm	*Name:* Laurent Dietrich	*Name:* Christopher Cox
Location: Scott Hall 219	*Office:* Wean Hall 7128	*Office:* Wean Hall 6201
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1 Course content

1.1 Introduction, topics covered

A serious introduction to multidimensional calculus that makes use of matrices and linear transformation. Results will be stated carefully and rigorously. Students will be expected to write some proofs; however, some of the deeper results will be presented without proofs. Topics to be covered include: functions of several variables, regions and domains, limits and continuity, partial derivatives, linearization and Jacobian matrices, chain rules, inverse and implicit functions, geometric applications, higher derivatives, Taylor's theorem, optimization, vector fields, multiple integrals and change of variables, Leibnitz's rule, line integrals, Green's theorem, path independence and connectedness, conservative vector fields, surfaces and orientability, surface integrals, divergence theorem and Stokes's theorem.

1.2 Learning objectives

By the end of the course you should be able to :

(1) Accurately explain basic definitions and results of the class.

(2) Analyse basic topological properties of sets of $\mathbb{R}^n$ like openness, closedness, connectedness.

(3) Analyse continuity and compute limits of functions of several variables.

(4) Differentiate functions of several variables and know how to handle different representations (partial derivatives, directional derivatives, jacobian, gradient) as well as the algebra behind it (chain rule, inverse functions, higher order derivatives...).

(5) Understand and apply linearization and Taylor's theorem.

(6) Understand and apply the inverse and implicit function theorems.

(7) Understand and apply necessary and sufficient conditions to find unconstrained minima/maxima.

(8) Handle basic vectorial calculus operations involving gradient, divergence, curl.

(9) Compute integrals of functions of several variables over various domains, curves, or surfaces, using techniques such as change of variable, Green's, Stoke's or divergence theorems.

1.3 Textbook

- *Advanced Calculus* by Wilfred Kaplan. I will use the 5th edition. You can use the previous ones but make sure that the correspondence is right when some assignment comes from the book. I will write self contained lectures though.

2 Assignments and grades

- Homework assignments (1/week), average (HW).
- Midterm exams (M1, M2) (2 in total).
- Final exam (F).

To accomodate for accidents, your grade will be computed as the maximum of the two following :

$$0.2 \times HW + 0.25 \times M1 + 0.25 \times M2 + 0.3 \times F$$

$$0.2 \times HW + 0.25 \times \text{highest midterm} + 0.15 \times \text{lowest midterm} + 0.40 \times F$$

Cutoffs will be decided after each exam and the total cutoff will be the average of all cutoffs with the same weights as the respective grades.

3 Schedule

Schedule will be updated accordingly to what we cover in class on my webpage :

`http://www.math.cmu.edu/~ldietric/21-268/`

and regular announcements will be made on Blackboard.

4 Policies

4.1 Attendance and participation

- Time will not allow me to check attendance in this class, however, it is expected that you will attend class regularly. If you do miss a class you are responsible to find out what was covered (possibly by e-mailing me).
- Participation is strongly encouraged. I ask a lot of questions during classes and I will want to hear your thoughts. Do not hesitate to go for it !

4.2 Academic honesty and integrity

- Collaboration : I encourage you to collaborate and form study groups. Learning collaboratively opens your minds and forces you to clarify yours. Nonetheless it is clear that collaboration stops completely during the midterms and the final. Moreover, concerning the homework assignment, you should all write your solutions by yourselves. To avoid what I could consider as plagiarism, you should not write your assignment during collaborative sessions, but do that alone once your mind is clear.

- External resources : same thing here, I encourage you to use external resources (books, papers, internet...) but only to get your thoughts clear. If you copy something straight from some external resource, this is considered as plagiarism and constitutes cheating according to Carnegie Mellon's Policy on Cheating and Plagiarism. I plagiarise here David Handron's table which is a great summary of the above :

	you may...	you may not...
Homework	○ Consult with you instructor or your TA . ○ Use other textbooks or online resources to gain a better understanding of the materials. ○ Work together with your classmates to find solutions to problems.	○ Copy another students homework paper, or any portion thereof. ○ Copy a solution found in another textbook or web page. ○ Copy a solution from notes that are also copied by another student. ○ Use Solutions or graded homework from a previous semester's course in any manner.
Exams	○ Ask questions of any proctor (the proctor may or may not answer the question).	○ Ask any question of another student or answer questions asked of you. ○ Consult any unauthorized materials (books, notes, papers) or have these materials in a position where they may be consulted. ○ Attempt to view another student's exam or materials (authorized or unauthorized). ○ Listen to headphone devices.

4.3 Homework submission

Written assignments will be given on Wednesdays and due on the next Wednesday. You can give it to me just before the beginning of the lecture, or put it in your TA's mailbox (WEH 6113, look carefully at the arrow next to the name) before 5pm (the mailbox office will close at that time). After that, homework will be considered late and will not be accepted without a valid excuse. LaTeX documents will be also accepted by e-mail to me **and** your TA, please write 21-268 in the subject of the e-mail in that case.

4.4 Talk to me, pay attention in class, and take care of yourself !

I want you to enjoy this course, and I care about your mental state. So do not hesitate to talk to me and your TA for any reason. I encourage feedback, which you can provide by speaking to me or through e-mail. If you encounter difficulties of any kind, I will be here to help you find a solution or to guide you, and the sooner the better.

Also, I know that writing down notes can be a pretty intense activity but it is very important that it should not monopolize your attention in class. The most important thing in class is to pay attention to what I say, as I will do a lot of remarks on the course content, interconnections between the topics, some practical remarks etc, and I can't write everything down.

Finally, do know that nerves and sleep quality are generally a much more important factor in your exam performance than memory, I have seen this apply countless times, so don't neglect your sleep and take time to relax. It is utterly important. In my experience, I can definitely recall that the most important parts in the success of my undergrad were: paying attention in class and sleeping 8 hours a night. I really encourage you to do the same.