MATH 231 Multivariable Calculus Fall 2013

Section 1	**MTWF 9:00 – 9:50 am**	**King 239**
Section 2	**MTWF 10:00 – 10:50 am**	**King 239**

Instructor: Susan Jane Colley
King 222
775-8388 (office) or -8380 (messages)
775-3680 (home—please call before 10:00 pm)
E-mail: sjcolley@math.oberlin.edu
Susan.Colley@oberlin.edu
Web page: www.oberlin.edu/math/faculty/colley.html

Office Hours:

Monday	3:30 – 5:00 pm
Tuesday	2:30 – 4:30 pm
Wednesday	3:30 – 5:00 pm
Thursday	4:30 – 5:30 pm
Friday	11:00 am – noon, 1:30 – 2:30 pm

Also by appointment

Text: S. J. Colley, *Vector Calculus,* 4th ed., Pearson. This text is required and available at the Oberlin Bookstore. In addition, you should make sure that you have easy access to a one-variable calculus text in the event that you need to review some topics.

On Reserve: There are several copies of alternative texts on multivariable calculus placed on reserve for this course in Mudd Library, namely:

J. Marsden, A. Tromba, and A. Weinstein, *Basic Multivariable Calculus,* W. H. Freeman / Springer Verlag.
J. Marsden and A. Tromba, *Vector Calculus,* 3rd ed., W. H. Freeman.
K. Pao and F. Soon, Study Guide for *Vector Calculus,* 3rd ed.
J. Stewart, *Multivariable Calculus,* 2nd ed., Brooks/Cole.

You are welcome, even encouraged, to consult these books (and any others) to see additional examples and alternative approaches to the concepts. The only time you will be asked not to use these books is when you take certain exams.

Goals: This course is devoted to the development of the calculus (differentiation and integration) of functions of several variables. Many of the ideas we will explore are natural generalizations of concepts you have seen in one-variable calculus. The emphasis in this course will be on developing your mathematical intuition (especially your geometric intuition) as well as your technical prowess, so that you gain a meaningful understanding of the theory, computations, and applications that can be employed in a variety of contexts.

Homework: The attached syllabus contains problems for you to work in order to gain some familiarity with the material. These problems are *not* to be turned in (unless otherwise noted). You should do as many or as few of them as you need in order to feel comfortable with the topics discussed in class. In addition, there will be separately assigned, hand-in problem sets due weekly (usually Wednesdays). No late assignments will be accepted, but you may submit incomplete assignments. Solutions to the hand-in problem sets will be available online.

Exams: There will be one in-class, closed-book exam, two open-book, take-home exams, and a two-hour, closed-book final. Tentative dates for the midterm exams are **October 4** (in-class), **November 1** (in-class), and **December 4** (take-home due). Please let me know as soon as possible if there is a problem with any of these dates. The final exam will take place on **Tuesday, December 17 from 2:00 to 4:00 pm for Section 1 (9:00 class)** and **Thursday, December 19 from 2:00 to 4:00 pm for Section 2 (10:00 am class)**.

Participation: Class attendance is not a formal part of your grade for the course. Therefore, you need not explain if you must miss a class, but you are responsible for finding out what material was discussed. It is certainly recommended that you attend as many classes as possible, and that you are an active participant in them. Please try to arrive on time; it can be quite disruptive to your classmates to have latecomers and, moreover, it can be much more difficult for you to get what you need from class if you are late.

Grading:

Midterm exams (100 points each)	300
Final exam	200
Homework	100
TOTAL	600

Deadlines: I will endeavor to be as clear as I can about the nature of assignments, and I will provide fair warning about when they are due. **Late assignments normally will not be accepted.** At the same time, I do understand that emergencies arise, so if *unforeseen* circumstances are interfering with your ability to complete some work in the course (e.g., significant illness, but *not* assignments for other classes), please contact me immediately, preferably *before* the assignment is due.

Online: Copies of assignments, handouts, etc. will be posted on the course Blackboard site. Go to **`blackboard.oberlin.edu`** (and your "Academic Hub") to access these materials.

Note: If you have a documented disability and wish to discuss academic accommodations, please contact me as soon as possible.

Help: You should feel free to ask me questions about the material discussed in class, problems with the homework, life outside of vector calculus, etc. My office hours appear above, but if they are inconvenient, you are welcome to arrange another time to meet with me. Besides me, you can also get help through Student Academic Services. This is mainly for more extensive help. To obtain this service, you need to get a card from Kay Knight in Peters 114 and bring it to me. After I sign the card, you shortly thereafter will be assigned a private undergraduate tutor.

Note: Please note that the text, *Vector Calculus,* contains more material in places than you will be expected to master. When doing your reading, you should stress those topics and examples that align most closely with class discussions, although, of course, you are certainly welcome (even encouraged) to read more thoroughly. I will be happy to discuss any subtleties or more advanced topics with you individually.

Outline of the Course

Vectors (Chapter 1)	3 weeks
Differentiation in several variables (Chapter 2)	3 weeks
Vector-valued functions (Chapter 3)	1.5 weeks
Maxima and minima (Chapter 4)	1.5 weeks
Multiple integration (Chapter 5)	2 weeks
Line integrals (Chapter 6)	1 week
Surface integrals (Chapter 7)	1 week

Readings and problems below are from *Vector Calculus*, 4th ed. Note that "7/ 1" means problem 1 on page 7 of *Vector Calculus*. The problems assigned below are *not* to be turned in (unless otherwise noted); they are intended for your own practice. As a result, you should feel free to work together on these questions, ask me about them, etc.

A strongly recommended routine is for you to do some relevant reading in the text *before* a topic is discussed in class, then to reread and work problems once that topic has been discussed. Also, please note that the dates indicated below are only approximations—please come to class to find out where we are!

Date	Topics	Reading	Problems
	VECTORS		
T 9/3	Introduction	Preface (pp. xv–xvii)	
	Vectors in $\mathbf{R}^2$ and $\mathbf{R}^3$	1.1	7/ 1,2,3,9,19,21,25, 27
W 9/4	Vectors (contd.)	1.2	16/ 1,3,5,9,10,11,13,17
F 9/6	Vectors (contd.)	1.2	16/ 27,30,31,33,35,37
M 9/9	Introduction to *Mathematica*		
T 9/10	Dot product	1.3	26/ 1,3,5,7
W 9/11	Dot product (contd.)	1.3	26/ 13,21,25,31,34
F 9/13	Cross product	1.4	38/ 1,3,5,7,8,11,13,15,18,20,25
M 9/16	Flat stuff	1.5	47/ 1,3,5,10,11,13
T 9/17	Flat stuff (contd.)	1.5	47/ 15,17,19,25,29,31
W 9/18	Some *n*-dim'l geometry	1.6	59/ 1,3,5,7,13
F 9/20	*n*-dim'l geometry (contd.)	1.6	59/ 17,19,23,24
M 9/23	Cylindrical, spherical coords.	1.7	73/ 1,3,5,9,11,15,17
T 9/24	Cylin., spherical coords. (contd.)	1.7	74/ 23,27,31,33
	DIFFERENTIATION IN SEVERAL VARIABLES		
W 9/25	Functions of several variables	2.1	95/ 1,5,7,10,15
F 9/27	F'ns of sev'l vars. (contd.)	2.1	96/ 23,28,29,32,39,41,45
M 9/30	Limits	2.2	114/ 7,8,9,11,13,19
T 10/1	Limits (contd.)	2.2	114/ 1,3,5,21,29,33,38,43,50
W 10/2	Problem Session		
F 10/4	**Exam 1** (in class)		
M 10/7	Differentiation	2.3	131/ 1,3,5,15
T 10/8	Differentiation (contd.)	2.3	132/ 19,21,29,31,35,37,43,59
W 10/9	Higher order derivatives	2.4	141/ 3,5,7,9,13,21,27,29
F 10/11	Chain rule	2.5	155/ 1,2,3,5

M	10/14	Chain rule (contd.)	2.5	156/ 15,23,27,29,31
T	10/15	Directional derivatives	2.6 (to p. 168)	173/ 1,3,5,9,11,13,15
W	10/16	Direct. derivs. (contd.)	2.6 (to p. 168)	174/ 17,19,23,29

VECTOR-VALUED FUNCTIONS

F	10/18	Parametrized curves	3.1	200/ 1,2,5,7,9,13,15,17,19,27
M	10/28	Arclength	3.2 (to p. 207)	219/ 1,3,9,10,11
T	10/29	Curvature and torsion	3.2 (to p. 214)	220/ 17,19,21
W	10/30	Problem Session		
F	11/1	**Exam 2** (in class)		
M	11/4	Vector fields	3.3	226/ 1,3,5,9,17,19,21
T	11/5	Divergence and curl	3.4	235/ 1,3,5,7,11,13,15,23,27

MAXIMA AND MINIMA

W	11/6	Taylor's Theorem	4.1	262/ 1,5,7,8,15,19,25,29,31,33,39
F	11/8	Extrema of functions	4.2	276 1,3,7,9
M	11/11	Extrema (contd.)	4.2	276 17,21,23,29,41,43
T	11/12	Lagrange multipliers	4.3	290/ 1,3,5,9,13,21,25,31,35
W	11/13	Lagrange mults. (contd.)	4.3, 4.4 (skim)	

MULTIPLE INTEGRATION

F	11/15	Introduction: volumes	5.1	313/ 1,3,7,11,13
		Double integrals	5.2	332/ 3,5,11
M	11/18	Double integrals (contd.)	5.2	332/ 15,17,21,23,40
		Changing order of integration	5.3	336/ 1,3,7,15
T	11/19	Triple integrals	5.4	347/ 1,5
W	11/20	Triple integrals (contd.)	5.4	347/ 8,11,13,17,27
F	11/22	Change of variables theorem	5.5	371/ 1,3,7
M	11/25	Change of variables (contd.)	5.5	371/ 9,13,17
T	11/26	Applications	5.6 (to p. 383)	386/ 1,3,9
W	11/27	Applications (contd.)	5.6 (to p. 383)	386/ 11,13,15,23

LINE INTEGRALS

M	12/2	Line integrals	6.1 (to p. 421)	426/ 1,3,9,13,17
T	12/3	Line integrals (contd.)	6.1 (to p. 421)	426/ 21,23,27,31,35
W	12/4	Green's Theorem **Exam 3 due** (take-home)	6.2	436/ 1,3,9,11,17,25,31
F	12/6	Conservative vector fields	6.3	448/ 1,3,5,15,25,33

SURFACE INTEGRALS

M	12/9	Parametrized Surfaces	7.1	467/ 1,3,7,11,13,23
T	12/10	Surface integrals	7.2	488/ 1,5,7,11,15
W	12/11	Stokes's and Gauss's Theorems	7.3	505/1,5,9,11

Tuesday, 12/17	2:00–4:00 pm	**FINAL EXAM for SECTION 1**
Thursday, 12/19	2:00–4:00 pm	**FINAL EXAM for SECTION 2**

Honor Code Policies

Homework

You are permitted, even encouraged, to collaborate on homework. For homework that is not graded, feel free to consult anyone at all: your classmates, me, other students, friends, relatives, Barack Obama, Stephen Colbert (these last two not really). For homework that is to be handed in and graded, I expect you to be somewhat more careful. Specifically, you should continue to ask questions of me regarding homework problems and you may collaborate with one or two of your classmates (per assignment). Please do not undertake significant collaboration with more than two students without permission. If you do collaborate, you are expected to write your own solution to problems (i.e., not to copy) and to indicate the name(s) of any student(s) with whom you worked.

You may consult any written sources for hand-in homework, provided that you give appropriate citations. Please write your homework solutions with care.

Examinations

Unless specifically indicated otherwise, in-class tests are assumed to be closed-book. Collaboration of any sort (other than to ask me questions) will **not** be permitted. Take-home exams will have specific provisions for using books and notes, but, again, you are **not** to discuss the content of the exam with anyone other than me. Any time limits will be indicated with each test.

Honor Pledge

On every assignment that you submit for credit, you are expected to sign the Oberlin College Honor Pledge:

"I have adhered to the Honor Code on this assignment."

If you need clarification of the policies above, please do not hesitate to ask. Should you require some variation in these rules, you must discuss the matter with me well in advance of any assignment.

For general information about the Honor System at Oberlin, consult

<http://www.oberlin.edu/students/links-life/honorcode.html>.

Guidelines for Written Work

Mathematics is not only a means for understanding quantitative issues, but is also provides an effective and efficient notational and conceptual supplement to natural language. Good communication of mathematics requires thoughtful and precise prose writing, especially when trying to convey complex arguments and ideas.

When you attempt any mathematical writing, you should bear the following in mind:

- Mathematical symbols provide an extremely compact and concise form of expression, so it is important that you surround your symbols with words, phrases, and sentences. It is expected that you will write your problem solutions in clear, grammatically correct prose consisting of complete sentences. Remember, you are providing a coherent solution, not just a list of answers. The reader should not have to guess about what you are thinking.
- "2 + 2 = 4" is a symbolic way of writing a sentence. In particular, the symbol "=" means "equals" and is a verb, equivalent to the verb "to be".
- While we're on the subject, you should have the greatest respect and reverence for the equals sign. Use it only to indicate that two quantities are actually equal (to the best of your knowledge), not as punctuation or to fill space on the page.
- You should expect to revise and rewrite your solutions before submission. Do not hand in your rough scratch work. If you cannot solve a problem completely, then write an honest, coherent attempt and indicate where you've had difficulties.
- Homework should be neatly and legibly written, the problems properly labeled (and in order), and the pages stapled. Final answers should be clearly marked as such. Presentation does make a difference and can even help you with your understanding.

It takes time and practice to write mathematics well. If you make the effort, your written presentation is certain to improve.