Course Outline: Math 53
Multivariable Calculus
University of California, Berkeley, Fall 2012

Course instructor:	Sean Fitzpatrick
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Email address:	sean@math.berkeley.edu
Office hours:	MWF 1:30 - 2:30 pm and TT 1:00 - 2:30 pm, or by appointment.
Course website:	Available via bSpace.berkeley.edu
Lectures:	Monday-Friday 12:00 - 1:00 pm in 155 Dwinelle.
Discussion:	Please consult the Online Schedule of Classes.

Note: Lectures and discussion sections begin at ten minutes **after** the hour, following the "Berkeley time" convention.

Course Description

This is a first course in multivariable calculus. The focus will be on functions of two and three variables, and using calculus to analyze the geometry of curves and surfaces in three-dimensional space. The official description from the Department of Mathematics is as follows:

> Parametric equations and polar coordinates. Vectors in 2- and 3-dimensional Euclidean spaces. Partial derivatives. Multiple integrals. Vector Calculus. Theorems of Green, Gauss, and Stokes.

Prerequisite: Math 1B

Course textbook: Stewart, Multivariable Calculus, Early Transcendentals for UC Berkeley (Custom edition).

The text is available either for purchase or rent at the UC bookstore. Note that a new edition is out; I'll try to accommodate those of you who already own the previous edition.

Students wanting a secondary resource may want to consider the "open source" textbook *Vector Calculus* by Michael Corral, which is available for free online at http://www.mecmath.net. It's not the greatest book, but it's free. A quick Google search will also lead you to a several other options of varying degrees of difficulty.

Course Objectives

Above all, in this course our goal will be to master the techniques of calculus in two and three variables, such as finding and analyzing critical points, and evaluating multiple integrals. More broadly, we will attempt to develop an underlying geometric intuition that will allow us to understand the problems on a qualitative (as well as quantitative) level. For the most part our focus will be more on the practical than the theoretical, in that we will not spend a lot of time on rigorous proofs of theorems. We will spend a bit of time discussing applications but will be more concerned with ensuring that we've developed the necessary mathematical toolkit to understand such problems whenever they are encountered outside of this course.

Evaluation

Your grade in this course will be determined as follows:

Component	Number	Total value
Assignments	12	(Best 10 will count.) 20%
Quizzes	10	10%
Midterms	2	30%
Final exam	1	40%

The grade on the final exam may replace the score on **one** of the midterm tests, in the event that the final exam score is higher, or a student is forced to miss one of the midterms for a valid reason. Any student who cannot attend a midterm must either obtain prior permission from the instructor or, in the case of illness, provide a doctor's note as soon as possible afterwards.

Course policies

Lecture:

Lectures will be used to present course material, highlight important points, and clarify areas of difficulty. Lectures will focus primarily on concepts rather than mechanics. Material to be covered will be announced in advance (see the tentative schedule below). Students will derive maximum benefit from both lectures and discussion section if they have read the corresponding textbook section in advance.

Discussion Section:

The discussion section will consist mainly of worked examples from the material covered in class, and will focus more on computations. Students will be expected to *participate* in solving these problems, and are strongly encouraged to ask questions about any of the lecture content they wish to have clarified.

Quizzes:

Each Friday (except for test days) in discussion section there will be a short 15-20 minute quiz. The purpose of the quizzes is to allow each student to monitor their own progress in the course, and your quiz grade will be based according to the following guideline: a score of 0 for those who do not write the quiz or do not indicate any understanding of the material, and a score of 1 for those who write the quiz and come reasonably close to the correct solution. (A score of 0.5 may sometimes be awarded at the discretion of your GSI.)

Homework:

Suggested homework problems will be added to the course website on a weekly basis. Students are encouraged to attempt the problems in advance according to the course schedule. Assignment and Quiz questions will be chosen from the suggested problems (or even-numbered problems similar to assigned odd-numbered problems), and similar problems may appear on the midterms and final exam.

Tests:

There will be two 45-minute term tests, to be written in lecture. The test dates and (tentative) topics are as follows:

- Test #1: Friday, 5^{th} October. Test covers Sections 10.1 - 14.6.
- Test #2: Monday, 5^{nd} November. Test covers sections 14.7-14.8 and Chapter 15.

Assignments:

Every Friday (except possibly on test weeks), students will be assigned a set of about a dozen problems to be submitted for grading; these will be due the following Friday. Among all solutions submitted each week, two or three will be graded. There will be no make-up opportunities for missed homework; however, only the best ten out of twelve problem sets will count towards your grade.

Submission of assignments: Assignments should be submitted directly to your GSI during discussion. If for some reason you miss discussion on the due date, each GSI has a mailbox on the 9th floor of Evans Hall. Note however that the GSI mailboxes are **not** secure. Assignments submitted later than 5 pm on the due date will be considered late. Late assignments will be penalized by 25%, and will be accepted until the following Monday. Assignments submitted any later will not be accepted.

Preparation of assignments: The assignments will be graded based on both the validity of the solutions and the quality of the writing - solutions should be clear and fully explained. (Assume that your target audience is a classmate, not the instructor.) Students should submit a good copy of their work for grading. It does not have to be typed, but should be neat and legible. All multiple-page assignments must be **stapled**.

NOTE: It is acceptable, and in fact encouraged, for you to discuss the assignment problems with classmates. However, students **must** take care to avoid plagiarism. To avoid the temptation for outright copying, students are advised to write up their good copy on their own, and will be required to list any sources (persons or texts) used to compete the assignment. Instances of copying tend to be more obvious than students might think, and once detected, result in all sorts of trouble for both the students involved and the instructor. Accordingly, everyone generally ends up happier if copying is avoided in the first place.

Special arrangements:

Students with recognized disabilities will be accommodated as best as possible. If you require accommodations, please make arrangements through the Disabled Students Program office.

Incompletes:

The grade of "incomplete" is rarely, if ever granted for this course. In the event of extraordinary circumstances preventing the completion of the course, the student should inform the instructor of their situation as early as possible.

Tentative course schedule

Aug. 24$^{\text{th}}$	Handout	Introduction and some notation
Aug. 27$^{\text{th}}$	10.1	Parametric curves
Aug. 29$^{\text{th}}$	10.2	Calculus with parametric curves
Aug. 31$^{\text{st}}$	10.3, 10.4	Polar coordinates
Sept. 3$^{\text{rd}}$	Holiday	No class
Sept. 5$^{\text{th}}$	12.1, 12.2	Coordinates and vectors in three dimensions
Sept. 7$^{\text{th}}$	12.3, 12.4	Dot and cross products
Sept. 10$^{\text{th}}$	12.5	Lines and planes in $\mathbb{R}^3$
Sept. 12$^{\text{th}}$	10.5, 12.6	Conic sections and quadric surfaces
Sept. 14$^{\text{th}}$	13.1, 13.2	Parametric curves in $\mathbb{R}^3$
Sept. 17$^{\text{th}}$	14.1, 14.2	Functions of two and three variables
Sept. 19$^{\text{th}}$	14.3	Partial derivatives
Sept. 21$^{\text{st}}$	14.4	Tangent planes and differentiability
Sept. 24$^{\text{th}}$	14.5	The Chain Rule
Sept. 26$^{\text{th}}$	14.6	The gradient and directional derivatives
Sept. 28$^{\text{th}}$	14.7	Local maxima and minima
Oct. 1$^{\text{st}}$	14.7, 14.8	Global maxima and minima
Oct. 3$^{\text{rd}}$	14.8	Lagrange multipliers
Oct. 5 $^{\text{th}}$	Midterm #1	Midterm covers material up to Sept. 26$^{\text{th}}$ (14.6)
Oct. 8$^{\text{th}}$	15.1, 15.2	Double integrals over rectangles
Oct. 10$^{\text{th}}$	15.3	Double integrals over general regions
Oct. 12$^{\text{th}}$	15.4	Double integrals in polar coordinates
Oct. 15$^{\text{th}}$	15.5	Applications of double integrals
Oct. 17$^{\text{th}}$	15.6	Surface area as a double integral
Oct. 19$^{\text{th}}$	15.7	Triple integrals
Oct. 22$^{\text{nd}}$	15.8, 15.9	Cylindrical and spherical coordinates
Oct. 24$^{\text{th}}$	15.10	Change of variables I
Oct. 26$^{\text{th}}$	15.10	Change of variables II
Oct. 29$^{\text{th}}$	16.1	Vector fields
Oct. 31$^{\text{st}}$	16.2	Line integrals I
Nov. 2$^{\text{nd}}$	16.2, 16.3	Line integrals II
Nov. 5$^{\text{th}}$	Midterm #2	Midterm covers 14-7-14.8 and Chapter 15
Nov. 7$^{\text{th}}$	16.3	Line integrals III
Nov. 9$^{\text{th}}$	16.4	Green's Theorem I
Nov. 12$^{\text{th}}$	Holiday	No class
Nov. 14$^{\text{th}}$	16.4	Green's Theorem II
Nov. 16$^{\text{th}}$	16.5	Divergence and Curl
Nov. 19$^{\text{th}}$	16.6	Parametric surfaces
Nov. 21$^{\text{st}}$	16.7	Surface integrals
Nov. 23$^{\text{rd}}$	Holiday	No class
Nov. 26$^{\text{th}}$	16.8	Stokes' Theorem
Nov. 28$^{\text{th}}$	16.9	Divergence Theorem
Nov. 30$^{\text{th}}$	16.8, 16.9	More on Stokes and Divergenge Theorems
Dec. 3 - 7: RRR Week (Review sessions)		