

# TEXT

You do not need a book. If you want a second opinion, take any of the textbooks available. The Stewart Calculus text is a popular option.

# ORGANISATION

Oliver Knill, office: Monday 3:30-5

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# LECTURES

SC Hall E, Tue/Thu 8:30-11:30



# SEMINAR

Lecture room SC 507 Thu at 1 PM



1.EXAM	2.EXAM	FINAL
JULY 12	JULY 26	AUG 9
8:30	8:30 AM	8:30 AM
SC HALLE	SC HALL E	SC HALL E

PART	GRADE 1
1. HOURLY	20
2. HOURLY	20
HOMEWORK	25
LAB	5
FINAL	30

# MATHS 21A

## HARVARD

## SUMMER, 2012

This standard multivariable calculus course extends single variable calculus to higher dimensions. It provides a vocabulary for understanding fundamental processes of nature like weather, planetary motion, waves, heat, finance, or quantum mechanics. It teaches important background needed for statistics, computer graphics, bioinformatics or economics. It provides tools for describing curves, surfaces, solids and other geometrical objects in three dimensions. It develops methods for solving optimization problems with and without constraints. You learn a powerful computer algebra system. The course will enhance problem solving skills and prepares you for further study in other fields of mathematics and its applications.

# Calendar

# Syllabus

# Checklist

SU	MO	TU	WE	TH	FR	SA
24	25	26	27	28	29	30
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	1	2	3	4
5	6	7	8	9	10	11

-  First class
-  Mathematica project due
-  Midterm exams
-  Independence day
-  Final Exam
-  Review

## 1. Week: Geometry / Space

Lect 1-2 6/26 Space, Vectors, Dot Product

Lect 3-4 6/28 Cross product, Lines/Planes

## 2. Week: Surfaces / Curves

Lect 5-6 7/3 Implicit and Parametric Surface

Lect 7-8 7/5 Curves, Chain Rule, Arc Length

## 3. Week: Linearization / Gradient

Lect 9-10 7/10 Partial Derivatives, Review

Lect 11-12 7/12 First hourly. Gradient/Linearization

## 4. Week: Extrema / Double Integrals

Lect 13-14 7/17 Tangents, Extrema

Lect 15-16 7/19 Lagrange . Double integrals

## 5. Week: Triple Integrals /Line Integrals

Lect 17-18 7/24 Double and triple integrals

Lect 19-20 7/26 Second hourly. Line integrals

## 6. Week: Vectorfields /Integral Theorem

Lect 21-22 7/31 Curl, Greens theorem, Flux

Lect 23-24 8/2 Stokes and Divergence theorem

### Geometry:

Trig functions, cos-formula  $c^2 = a^2 + b^2 - 2ab \cos(\alpha)$

Equations of lines, circles, ellipses in the plane

### Functions:

Polynomials, Binomial  $x^n, \sqrt{x}, x^{-3/4} (1+x)^n$

The exponential function  $e^x$  and  $a^x$

The natural logarithm  $\log(x) = \ln(x)$

Trig functions: sin, cos, tan and their inverses

### Algebra:

Solving linear and quadratic equations

Multiply and factor polynomials

Trigonometric identities like  $\sin^2(x) + \cos^2(x) = 1$

Identities:  $\log(xy) = \log(x) + \log(y), \log(a^b) = b \log(a)$

### Derivatives:

Find points of discontinuity

Leibniz, quotient and chain rule

Finding extrema using first derivative test

Nature of critical point using second derivative test

Taylor formula  $f(x) = f(0) + f'(0)x + f''(0)x^2/2 + \dots$

### Integrals:

Integration by parts

Integration by substitution

Convergence of  $x^\alpha$  on  $[0, 1]$  and  $[1, \infty)$

Fundamental theorem

$\int_0^x f'(t) dt = f(x) - f(0), (\int_0^x f(t) dt)' = f(x)$

# Website

[math.harvard.edu/~knill/courses/summer2012/](http://math.harvard.edu/~knill/courses/summer2012/)