Calculus Math 1a, Spring 2012 Harvard College/GSAS: 8434

Course organization

My name is Oliver Knill ("Oliver"). Office hours are Tuesdays and Thursdays at 4 and by appointment (good times for the later are early in the morning, shortly before noon or Tuesday and Thursday from 3-4.

Lectures

Lectures take place Monday Wednesday and Friday from 10 AM to 11 AM in SC 309. Make it to lectures. It will save you time and any possible contribution of yours earns admiration.

Course assistant

Jeanine Sinanan-Singh (jsinanan-singh@college.harvard.edu)

Problem Sessions

Weekly problem section will be arranged by the course assistant. Jeanine will announce.

Exam Group

This course is in the exam group 1. This is only important if you want to check about possible final exam conflicts.

General Education

This course, when taken for a letter grade, meets the General Education requirement for **Empirical and Mathematical Reasoning** or the Core Area requirement for **Quantitative Reasoning**.

Prerequisites

A solid pre-calculus background is required. This course is recommended for students who score 18 or higher on the first part of the Harvard Math Placement Test. You are not expected to have taken calculus in high school. However, even if you have seen some calculus, we expect that Math 1a will provide you with a deeper, more conceptual understanding of the subject.

Synopsis

The development of calculus by Newton and Leibniz is one of the biggest achievements of the past millennium. The core of the course introduces differential and integral calculus. Differential calculus studies "rate of change", integral calculus treats "accumulation". The fundamental theorem of calculus links the two. The subject will be applied to problems from other scientific disciplines

in homework as well as in lectures.

Calculus is not only important because of its content and applications which currently make billions in medicine (example: tomography), internet (example: complex network analysis with calculus methods), geography (example: google earth, location based services), movie industry (animated or CGI enhanced pictures), game development (also under the hood like in artificial intelligence agents). Your phone uses tons of calculus when recognizing voice commands or faces in images). Often, the ideas of calculus only enter in disguised form. One point I want to make in this course is that calculus can appear in different forms. Actually, in the first lecture we look at calculus on integers and prove the fundamental theorem of calculus in a form which the Egyptians already could have done.

Course Policies

Class attendance is expected. In case of religious holidays, conflicts like a sports competitions or concert, please send a brief email to the course head.

Computers

The use of computers and computer algebra systems or online tools to experiment with the mathematical structures is encouraged. We do not have a lab component in this course. The use of laptops or tablets in class to take notes is fine. No kind of computers are permitted however during exams. If you get computer assistance for homework, it needs to be acknowledged in the paper. I do recommend that you work out most of the work on paper. The material sinks in better when writing it and you are better prepared for exams.

Pass Fail

The course may be taken pass/fail or for graduate credit after talking to Oliver. Note that there is **no** GenEd credit for Pass/Fail.

Textbook

I do not follow a particular book. A popular choice is "Single Variable Calculus: Concepts and Contexts, 4th Edition" by James Stewart (ISBN-10: 0495559725 ISBN-13: 9780495559726). The Cabot library has a desk copy available. It is recommended to read in some book but course material and homework is posted on the website http://www.math.harvard.edu/~knill/teaching/math1a_2012/

Grades

- 20 percent midterm 1
- 20 percent midterm 2
- 20 percent homework
- 40 percent final exam

As in every course, the numerical score needs to be converted to a letter grade. This is called the "curve". The cutoffs are determined when the final distribution is known. A common question is whether the course is "curved". By definition, one has to apply a curve to determine the cutoff. If the question means whether there are particular quotas, the answer is "no".

Math Question Center

The mathematics question center MQC is open from Sunday through Thursday in SC 309a, 8:30-10:30 PM. The rooms are reserved from 7:30 PM on. This drop-in help service is staffed by calculus course assistants who can answer questions for homework. You may also stop by the MQC to find other students in the course. While staffed from 8:30 on, the room should be available from 7:30 PM on in the spring.

Bureau of Study Counsel BSC

The bureau of Study councel at 5 Linden Street is a resource outside the math department. The BSC offers one-on-one peer tutoring for a minimal fee study skills and test-taking workshops, counseling, and many other services. The website of the BSC is http://bsc.harvard.edu.

Exams

We have 2 midterm exams and one final exam. You can already mark the calendars for the exam dates. Since day, time and room are determined:

- 1. Midterm: Tuesday, March 1: 7-8:30, Hall E
- 2. Midterm: Thursday, April 5: 7-8:30, Hall D

Exams focus on the mathematics done in the course. Calculus is a large area. The syllabus will walk along an efficient and interesting path, which focuses on stuff which is really needed in the sciences. Many calculus books can be overwhelming in this respect.

Homework

Homework is due at the beginning of **every** class. So, it is easy. Bring every time some homework to class. This course has a "no late homework policy". This makes it possible for the course assistants to return the homework in a timely manner. But we will discard the least 3 homework scores.

Academic Integrity

Collaboration policies are the ones established by FAS. Collaboration is permitted or even encouraged for homework but not in exams. I recommend to attack each homework problem first on your own. This helps you to develop independent thinking and problem solving skills.

Accessible education:

Students who need academic adjustments or accommodations because of a documented disability should provide me with a letter from the Accessible Education Office (AEO). Please talk to me personally about this.

Hour by hour syllabus

The following plan is subject to smaller changes. The website will have the latest syllabus.

1. What is calculus?	Date	Day
1. What is Calculus?	Jan 23	Mon
2. Functions	Jan 25	Wed
3. Limits	Jan 27	Fri
4 Continuity	Jan 30	Mon
5 Intermediate value theorem	Feb 1	Wed
6. A fundamental theorem	Feb 3	Fri
7. Rate of Change, tangent	Feb 6	Mon
8. Derivative as a function	Feb 8	Wed
9. Product and Quotient rules	Feb 10	Fri
2. The derivative		
1. Chain rule	Feb 13	Mon
2. Critical points and extrema	Feb 15	Wed
3. Optimization problems	Feb 17	Fri
Pesidents day, no class	Feb 20	Mon
4. L'Hopital rule	Feb 22	Wed
5. Newton method	Feb 24	Fri
6 Review for first midterm 3/1/11	Feb 27	Mon
7. Rolles theorem	Mar 1	Wed
8. Castastrophe theory	Mar 3	Fri
3. The integral		
1. From sums to integrals	Mar 7	Mon
2. The fundamental theorem	Mar 9	Wed
3. Antiderivatives	Mar 11	Fri
4. Computing areas	Mar 20	Wed
5. Volume of solids	Mar 22	Fri
6. Improper integrals	Mar 24	Mon
7. Applications of integration	Mar 27	Mon
4. Calculus Techniques		
1. Related rates	Mar 29	Wed
2. Implicit differentiation	Apr 31	Fri
3 Review for second midterm 4/5/11	Apr 2	Mon
4. Substitution	Apr 4	Wed
5. Integration by parts	Apr 6	Fri
6. Numerical integration	Apr 9	Mon
7. Partial fractions	Apr 11	Wed
8. Trig substitutions	Apr 13	Fri
5. Calculus and the world		
1. Calculus and music	Apr 18	Mon
2. Calculus and statistics	Apr 20	Wed
3. Calculus and economics	Apr 22	Fri
4. Calculus and computing	Apr 25	Mon

5. Outlook Apr 27 Wed