Department of Natural Sciences and Mathematics
Calculus I: LMTH 2040 A
Monday and Wednesday; 10:15 - 11:30 a.m.
63 5^{th}ave. Room 205.
Dr. Jacob Frias Koehler
koehlerj@newschool.edu
Office Hours: Monday and Wednesday 1:00 - 3:00 p.m. Lang Cafe.

Course Description

This class covers traditional first semester content in Calculus. We will investigate the ideas of integration, differentiation, and their interrelatedness through the fundamental theorem of calculus. We will also investigate problems involving basic differential equations that model natural phenomena.

Learning Outcomes

The following are general goals for all students in the class. A daily schedule follows.

- Understand the operation of Integration
- Understand the operation of Differentiation
- Understand certain applications of Integration
- Understand certain applications of Differentiation
- Understand how Integration and Differentiation are connected
- Understand some basic examples of Differential Equations
- Use technology to solve Calculus problems
- Explore connections of Calculus to individual areas of interest

Course Overview

Our primary textbooks for the class will be *Calculus and Its Origins* by David Perkins and *Calculus* by Gilbert Strang. Both are freely available online. The Perkins text can be found through The New School's library and the Strang text can be found at MIT's website: `http://ocw.mit.edu/resources/res-18-001-calculus-online-textbook-spring-2005/textbook/` We will also

have numerous other readings provided on the canvas course page.

The mathematical content of the class is divided into three sections. First, we begin by reviewing some of the basic ideas of representation through number of magnitude and quantity. This brief review sets the stage to look at some of the earliest ideas in calculus dealing with problems of quadrature and summations, connecting them to more modern ideas of integration. In the second segment of the course, we will discuss problems dealing with tangent lines motivated by discussions around the study of motion. Finally, we will look at the fundamental theorem and how this connects the two ideas of integration and differentiation. Primary to the last part of the class will be the consequences for solving differential equations, but we will also encounter problems in three dimensions.

Assignments

You will have weekly homework assignments that will include problems and problem write ups as well as readings. We will have three in class examinations that each deal with the individual topics. Also, we will have a final project that culminates with a paper and presentation on a topic developed from students' personal interests.

Topic A: Summations, Quadratures, Computing

Summations and Representation

Proof and Algorithms

Sums and Area Problems

Sums and the Definite Integral

Sums and Solids of Revolution

Topic B: Tangent Lines, Derivative, Interdisciplinary Applications

Tangents and Derivatives

Applications dealing with Motion

Applications dealing with Optimization

Applications dealing with Regression

Applications dealing with Social Science and Arbitrating Disputes

Topic C: Differential Equations and 3-D Problems

The Fundamental Theorems of Calculus

Differential Equations and Applications

Partial Derivatives

Optimization in 3D and Applications

Attendance and Grading

Attendance and participation are important parts of this class. After 2 unexcused absences, a half of a letter grade will be deducted from a student's grade. Arriving more than 15 minutes late to class will be considered 1/2 an absence. Together with attendance and participation, we will have weekly homework assignments, 3 examinations, and a final paper and presentation that will account for the grading of the class. Percentages follow:

- Attendance and participation 20%
- Homework 30%
- Examinations 25%
- Final Paper and Presentation 25%

Daily Schedule

Day 1, Monday August 29: Course Overview

- Download Anaconda `https://www.continuum.io/downloads`
- Access Perkins textbook through library website

To Do: Read Chapter 1 of Perkins text. Optional reading: *Resolving Zeno's Paradox* by William McLaughlin

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Day 2, Wednesday August 31: Representing Number

- Representing Integers
- Summations
- Additional Problems from Nelson and Asini's *Visual Mathematics*

To Do: Write up Problems from Class.

Day 3, Wednesday September 7: Algorithms and Areas

- Square Roots

- Pythagoras
- Approximating Pi
- Summations on Computer

To Do: Read Chapter 2 in Perkins.

Day 4, Monday September 12: Definite Integrals and Volumes

- Al Haytham's Paraboloid
- Riemann's Integral

To Do: Complete Problem Set.

Day 5, Wednesday September 14: Definite Integral

- Riemann's Approach
- Modern Notation
- Areas

To Do: Area Problems

Day 6, Monday September 19: Volumes

- Al Haytham Revisited
- Revolutions
- More problems on the computer

To Do: Volume and Area Problems from Advanced Placement Examinations with Commentary.

Day 7, Wednesday September 21: Applications

- Levers
- Centers of Mass
- Computer Vision
- Classifying Documents

To Do: Listen to Joe Strummer *The Only Band that Matters*, Rage Against the Machine's *Take the Power Back*, and Royce da 5'9 *Layers*. Optional: Read a history of the examination through Michel Foucault's *Discipline and Punish* pp. 170 - 194.

Day 8, Monday September 26: Examination?

- In Class Problems
- Writing up Solutions Workshop
- Constructing Exams

To Do: Read Chapter 3 of Perkins.

Day 9, Wednesday September 28: Motion

- Displacement, Velocity, Acceleration
- Aristotle, Oresme, and Galileo
- The Inclined Plane

To Do: Problem Set write up. Optional: Read *The vis viva dispute: A controversy at the dawn of dynamics* by George E. Smith.

Monday, October 3 No Class

Day 10, Wednesday October 5: The Derivative

- Tangent Lines
- Descartes vs. Fermat
- An algorithmic approach to differentiation and extreme values.

To Do: Begin Problem Set on Applications.

Day 11, Monday October 10: Optimization Applications

- Economics–How to Arbitrate a Dispute using Calculus
- Regression–How to Fit a Line Using Calculus
- Rainbows–How to Understand a Rainbow Using Calculus

To Do: Complete Problem Set.

Wednesday October 12 No Class

Day 12, Monday October 17: Newton's Method

- Finding Zeros
- Problematic Behavior

To Do: Problem Set.

Day 13, Wednesday October 19: Examination?

- Problem Set
- Individual Meetings to decide on project direction.

To Do: Write up Problems.

Day 14, Monday October 24: Trigonometric Functions

- Modeling Harmonic Motion
- Solving problems with sine and cosine

Day 15, Wednesday October 26: The Logistic Model

- Populations
- Direct Proportions and rates of change
- Linear Proportion and rates of change

To Do: Reading on project.

Day 16, Monday October 31: Ordinary Differential Equations

- Graphing ODE's
- Slope Fields and Graphical Solutions

Day 17, Wednesday November 2: Solving Separable Equations by Hand

- Separation of Variables

Day 18, Monday November 7: Euler and Approximation

- Intuition
- Reading Euler
- Using his Method

Day 19, Wednesday November 9: Differential Equations on Computer

- Slope Fields by Machine
- Euler's method as algorithm

Day 20, Monday November 14: Cooling and Heating

- Intuition
- Newton's Law of Cooling

Day 21, Wednesday November 9: Predator Prey Systems

- Dynamical Systems

Day 22, Monday November 14: Exam?

- Differential Equations and Applications Problems

Day 23, Wednesday November 16: Three Dimensions

- Three Dimensional Problems
- Graphing in 3D
- Partial Derivatives

Day 24, Monday November 21: Applications of Three Dimensional Calculus

- Partial Differential Equations
- Contour Plots
- Lagrange Multipliers

Day 25, Tuesday November 22: Solving PDE's with Separation of Variables

- Wave Equation
- Heat Equation
- Graphing Solutions

Day 26, Monday November 28: Exam

- Solve optimization problems in 3 Dimensions
- Solve Partial Differential Equations by Separation of Variables

Day 27-28, Wednesday November 30 and Monday December 5:Review

Day 29 30, Wednesday December 7 and Monday December 12: Exam

Day 31 32, Wednesday December 14 and Monday December 20: Final Presentations

Student Disability Services

In keeping with the University's policy of providing equal access for students with disabilities, any student requesting accommodations must first meet with Student Disability Services. Jason Luchs or a designee from that office will meet with students requesting accommodations and related services, and if appropriate, provide an Academic Adjustment Notice for the student to provide to his or her instructors. The instructor is required to review the letter with the student and discuss the accommodations, provided the student brings the letter to the attention of the instructor. This letter is necessary in order for classroom accommodations to be provided. Student Disability Services is located at 80

Fifth Avenue - 3rd Floor. The phone number is (212) 229-5626. Students and faculty are expected to review the Student Disability Services webpage.
The webpage can be found at `http://www.newschool.edu/studentservices/disability/` Tutoring: The new school offers free tutoring in Calculus on a limited basis. Information about academic support in mathematics can be found at: `http://www.newschool.edu/writingcenter/mathsupport.aspx?s=3`. Appointments can be booked online using the e-scheduler. The web address for the e-scheduler is: `http://ramon.newschool.edu/ureserve/uwc/ureserve.pl`

The New School Academic Honesty and Integrity Policy:
Compromising your academic integrity may lead to serious consequences, including (but not limited to) one or more of the following: failure of the assignment, failure of the course, academic warning, disciplinary probation, suspension or expulsion.

The New School views academic honesty and integrity as the duty of every member of an academic community to claim authorship for his or her own work and only for that work, and to recognize the contributions of others accurately and completely. This obligation is fundamental to the integrity of intellectual debate, and creative and academic pursuits. Academic honesty and integrity includes accurate use of quotations, as well as appropriate and explicit citation of sources in instances of paraphrasing and describing ideas, or reporting on research findings or any aspect of the work of others (including that of faculty members and other students). Academic dishonesty results from infractions of this accurate use. The standards of academic honesty and integrity, and citation of sources, apply to all forms of academic work, including submissions of drafts of final papers or projects. All members of the University community are expected to conduct themselves in accord with the standards of academic honesty and integrity. Students are responsible for understanding the University policy on academic honesty and integrity and must make use of proper citations of sources for writing papers, creating, presenting, and performing their work, taking examinations, and doing research. It is the responsibility of students to learn the procedures specific to their discipline for correctly and appropriately differentiating their own work from that of others. Individual divisions/programs may require their students to sign an Academic Integrity Statement declaring that they understand and agree to comply with this policy.

Definitions and Examples of Academic Dishonesty Academic dishonesty includes, but is not limited to

- cheating on examinations, either by copying another students work or by utilizing unauthorized materials
- using work of others as ones own original work and submitting such work to the university or to scholarly journals, magazines, or similar publications
- submission of another students work obtained by theft or purchase as ones

own original work

- submission of work downloaded from paid or unpaid sources on the internet as ones own original work, or including the information in a submitted work without proper citation
- submitting the same work for more than one course without the knowledge and explicit approval of all of the faculty members involved
- destruction or defacement of the work of others
- aiding or abetting any act of academic dishonesty
- any attempt to gain academic advantage by presenting misleading information, making deceptive statements or falsifying documents, including documents related to internships
- engaging in other forms of academic misconduct that violate principles of integrity

To read about the steps taken if there is a breach of academic honesty please can be found at `http://www.newschool.edu/WorkArea/DownloadAsset.aspx?id=81698`