

Department of Natural Sciences and Mathematics  
Calculus I: LMTH 2040 B

Tuesday and Thursday 12:00 p.m. - 1:15 p.m.

63 5<sup>th</sup> ave. Room 620.

Dr. Jacob Frias Koehler

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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.

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#### **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

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**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, Tuesday August 30:** 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, Thursday September 1:** Representing Number

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

To Do: Write up Problems from Class.

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**Day 3, Tuesday September 6:** Algorithms and Areas

- Square Roots

- Pythagoras
- Approximating Pi
- Summations on Computer

To Do: Read Chapter 2 in Perkins.

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**Day 4, Thursday September 8:** Definite Integrals and Volumes

- Al Haytham's Paraboloid
- Riemann's Integral

To Do: Complete Problem Set.

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**Day 5, Tuesday September 13:** Definite Integral

- Riemann's Approach
- Modern Notation
- Areas

To Do: Area Problems

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**Day 6, Thursday September 15:** Volumes

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

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

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**Day 7, Tuesday September 20:** 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.

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**Day 8, Thursday September 22:** Examination?

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

To Do: Read Chapter 3 of Perkins.

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**Day 9, Tuesday September 27:** 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.

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**Day 10, Thursday September 29:** The Derivative

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

To Do: Begin Problem Set on Applications.

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**Day 11, Tuesday October 4:** 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.

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**Day 12, Thursday October 6:** Newton's Method

- Finding Zeros
- Problematic Behavior

To Do: Problem Set.

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**Day 13, Tuesday October 11:** Examination?

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

To Do: Write up Problems.

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**Day 14, Thursday October 13:** Trigonometric Functions

- Modeling Harmonic Motion
  - Solving problems with sine and cosine
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**Day 15, Tuesday October 18:** The Logistic Model

- Populations
  - Direct Proportions and rates of change
  - Linear Proportion and rates of change
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To Do: Reading on project.

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**Day 16, Thursday October 20:** Ordinary Differential Equations

- Graphing ODE's
  - Slope Fields and Graphical Solutions
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**Day 17, Tuesday October 25:** Solving Separable Equations by Hand

- Separation of Variables
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**Day 18, Thursday October 27:** Euler and Approximation

- Intuition
  - Reading Euler
  - Using his Method
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**Day 19, Tuesday November 1:** Differential Equations on Computer

- Slope Fields by Machine
  - Euler's method as algorithm
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**Day 20, Thursday November 3:** Cooling and Heating

- Intuition
  - Newton's Law of Cooling
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**Day 21, Tuesday November 8:** Predator Prey Systems

- Dynamical Systems
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**Day 22, Thursday November 10:** Exam?

- Differential Equations and Applications Problems

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**Day 23, Tuesday November 15:** Three Dimensions

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

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**Day 24, Thursday November 17:** Applications of Three Dimensional Calculus

- Partial Differential Equations
- Contour Plots
- Lagrange Multipliers

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**Day 25, Tuesday November 29:** Solving PDE's with Separation of Variables

- Wave Equation
- Heat Equation
- Graphing Solutions

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**Day 26, Thursday December 1:** Exam

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

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**Day 27-28, Tuesday December 6 and Thursday December 7:** Review

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

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

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## **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/student-services/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 one's 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>