Syllabus

January 24, 2018

1 LMTH 2040: Multidisciplinary Calculus

Spring 2018
Monday and Wednesday 12:00 p.m - 1:15 p.m.
261 65 West 11th St.
Email: koehlerj@newschool.edu
Office Hours: by appointment

1.0.1 Overview

This class is an introduction to basic ideas and applications of the Calculus. The content focuses on integration, differentiation, and differential equations and how these can be used in several real applications. We will use the computer consistently, introducing the Python computer language to complete our work.

1.0.2 Learning Objectives

- Understand the mathematical concepts and history of Integration
- Use integration to solve problems
- Understand the mathematical concept and history of Differentiation
- Use derivatives and differentiation to solve problems
- Connect Integration and Differentiation through Differential Equations and explore the history of these problems
- Use differential equations to solve problems

1.0.3 Course Requirements

- Complete Weekly Problem Sets
- Ask and answer questions on Piazza or Stack Exchange
- Complete 6 computer labs
- Complete three independent investigations
- Complete Final Project or Problem Set

1.0.4 Final Grade Calculuation

- Participation/Attendance 20%
- Group Problem Sets 20%
- Individual Problem Sets 20%
- Computer Labs 20%
- Final 20%

1.0.5 Course Policies

We will rely heavily on peers and open collaboration on our assignments. We will use a variety of resources for the class, described below:

- Assignments and announcements will be posted on our Canvas Page
- Course Materials from proprietary sources will also be shared through Canvas
- Course Website: http://spring-2018-calc.readthedocs.io/en/latest/
- Students are free to ask and post responses in our Piazza discussion board, available here: https://piazza.com/newschool/spring2018/lmth2040/home.
- Students are free to ask questions on open message boards; StackExchange in particular. Please repost any questions like this in our Piazza page.

1.0.6 Course Reading Materials

We will use two freely available textbooks this semester. Make sure you can locate and access them:

- OpenStax Calculus Textbook (pdf here)
- The Origins of Calculus by David Perkins (ebook in library)

There are many many other freely accessible resources for learning calculus such as EdX, Coursera, Khan Academy, etc. Feel free to make ample use of these through the semester.

1.0.7 Resources

IS Student Support

Rachel Gottlieb, B.A. Candidate in Interdisciplinary Science and Gender Studies gottr694@gmail.com Availability: Mondays & Wednesdays after 3:30 in Room 459 Science Lab, 65 West 11th Street

Marina Delgado, B.A. Candidate in Interdisciplinary Science and Poetry Email: delgm708@newschool.edu Mondays and Wednesdays: 3:30 PM - 5:30 PM (except for Job Talk dates) Tuesdays: 12:30 PM - 3:00 PM, Room 459 Science Lab, 65 West 11th Street Fridays are flexible!

The university provides many resources to help students achieve academic and artistic excellence. These resources include:

- The University (and associated) Libraries: http://library.newschool.edu
- The University Learning Center: http://www.newschool.edu/learning-center
- University Disabilities Service: www.newschool.edu/student-disability-services/ In keeping with the university's policy of providing equal access for students with disabilities, any student with a disability who needs academic accommodations is welcome to meet with me privately. All conversations will be kept confidential. Students requesting any accommodations will also need to contact Student Disability Service (SDS). SDS will conduct an intake and, if appropriate, the Director will provide an academic accommodation notification letter for you to bring to me. At that point, I will review the letter with you and discuss these accommodations in relation to this course.

1.0.8 Schedule

- Monday, January 22. Introduction to Class: What is a number? Investigation integers, rational numbers, irrational numbers, and related historical problems.

- Wednesday, January 24. Number and Algorithm: Continue to work on problem set in groups. Problem write-up workshop.

- **Computer Lab I** Monday, January 29: Sequences, Functions, Summations with Python

- Wednesday, January 31. Summations: Interpret problems with areas. Add rectangles, trapezoids, and parabolas, discuss accuracy.

- Monday, February 5. Definite Integral: Introduce definition of definite integral, basic rules for polynomial, trigonometric, and exponential functions. Use technology and tables.

- ** Computer Lab II** Wednesday, February 7: Discrete and Continuous Distributions with Python.

- Monday and Wednesday, February 12 - 14.

PROJECT I: Statistics of distributions, Voting Power, Work-Force-Center of Mass, Numerical Algorithms for Integration, History of Integration, Consumer/Producer Surplus

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- Wednesday, February 21. Differences and Derivatives: Investigate the discrete case of first and second differences, connect these with average rates of change.

- Monday, February 26. Slopes and a Definition: Use slopes to move to continuous case, discuss approximate and exact solutions, connect first and second derivatives with first and second differences.

- Wednesday, February 28. Lab III. Derivatives with Python.

- Monday March 5. Application of Derivatives I: Historical Problems related to Derivatives.

- Wednesday, March 7. Application of Derivatives II: Vectors, Trigonometry, and Problems from Physics.

- Monday, March 12. Lab IV. Optimization in Python.

- Wednesday, March 14. Differentiation Review: Various problems involving differentiation.

- Week of March 19 and 21.

PROJECT II: Linear Regression, Arbitrating Disputes, Item Response Ideas, Motion of Projectiles, Numerical Differentiation, History of Differentiation, Elasticity of Demand

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- Monday, March 26. Recursion: Using the logistic population, focus on models built recursively using rates of change.

- Wednesday, March 28. Differential Equations: Antiderivates and solving separable differential equations.

- Monday, April 2. Lab V - Modeling Differential Equations with Python

- Wednesday, April 4. Systems: Model population change in time with Lotka-Volterra

- Monday, April 9. Qualitative Analysis of ODE's: Phase Plane Analysis

- Wednesday, April 11. Numerical Approaches: Euler and Runge-Kutta

- Monday, April 16. Lab VI: Solving and Visualizing ODE's with Python.

- Wednesday, April 18. Differential Equations Review.

- Week of April 23 - 25.

PROJECT III: Gradient Descent, Dynamical Systems and Social Theory, Differential Equations and Physics, CobWeb Diagrams in Economics, Advanced Numerical Solutions, History of Differential Equations.

- April 20 - May 9

FINAL PROJECT: Paper or Problem Set.

1.0.9 Technology

We wil use Python and Jupyter Notebooks to complete our work. You should download and install these through the Anaconda program, freely available here.