Course Description: Multivariable and vector calculus, supplemented with numerical methods.

Students will learn concepts and how to apply them. The course has a weekly problem solving session, students will work in groups to practice solving problems on topics covered during that week; students are expected to attend these sessions. The numerical part can be in Python or MATLAB depending on the student's familiarity.

Some of the topics we will cover:

- **Functions of Several Variables; Graphs and Surfaces; Contour Diagrams; Linear Functions.**
- **Vectors: Displacement Vectors; Properties of Vectors; Vectors in Higher Dimensions; Dot Product; Cross Product.**
- **Integrating Functions of Several Variables: Definite Integral of a Function of Two Variables; Iterated Integrals; Triple Integrals; Double Integrals in Polar Coordinates; Integrals in Cylindrical and Spherical Coordinates; Applications of Probability; Quadrature.**
- **Parameterization and Vector Fields: Parametrized Curves; Uniform Circular Motion; Motion in a Straight Line; Length of a Curve; Vector Fields; The Flow of a Vector Field.**
- **Differentiating Functions of Several Variables: Partial Derivatives; Computing Partial Derivatives Algebraically; Local Linearity; The Differential of a Function; Gradient and Directional Derivatives; Chain Rule.**
- **Line Integrals: What is a line Integral? Computing Line Integrals over Parametrized Curves; Gradient Fields and Path Independent Fields; Path-Dependent Vector Fields and Green's Theorem.**
- **Flux Integrals and Divergence: What is a Flux Integral? Flux Integrals for Different Surfaces (ex. Cylinders, Spheres, etc.); Divergence of a Vector Field; The Divergence Theorem.**
- **The Curl and Stokes' Theorem: The Curl of a Vector Field; Stokes' Theorem.**
- **Differential Equations: What is a Differential Equation? First and Second Order Differential Equations; The Principle of Superposition; Slope Fields; Euler's Method; Separation of Variables; Growth and Decay; Systems of Differential Equations; Analyzing the Phase Plane; Linear Stability Analysis.**
- **Introduction to Partial Differential Equations: What is a Partial Differential Equation? Linear and Non-Linear Partial Differential Equations; Laplacian; The Three Prototypical Types of Second Order Linear Partial Differential Equations.**

Problem Solving Sessions: These sessions will take place on Friday during the official lecture time. Students will practice solving problems in the topics covered during the week. Students will work in groups.

Homework: Weekly homework will be assigned every Friday under â€œFilesâ€ in Canvas, due via electronic submission the following Friday midnight.

Slack: We will use Slack to communicate. Registered students will be added to the course's Slack workplace. Slack will have two channels, "general" and "homework-help". The "general" channel will be used for course announcements, posting course material, etc. Students can post on this channel general course related questions, questions about the course material, etc. The "homework-help" channel, as the name indicates, will be dedicated to homework related questions, students can post any questions they have. Questions will be answered by the instructor and the teaching staff; students are also encouraged to answer each other as well.

Prerequisite: Applied Mathematics 22A.

Instructor: Dina Obeid, office: Pierce Hall 210A, email: dinaobeid@seas.harvard.edu.

Office Hours: **TBD.** Feel free to drop by my office any other time, I will probably be busy but I will do my best to accommodate you. You can also email me to set up an appointment.

Teaching Fellow: Edgar Guzman, Office Hour: Wed: 3:00pm - 4:00pm (after class) and by appointment @SEC**.**

Meeting Time: MWF 01:30 PM - 02:45 PM.

Reference Textbook: Calculus: Multivariable by Deborah Hughes-Hallett, William McCallum, Andrew Gleason, et. al. ; Wiley.

Academic Integrity Policy: Discussion and the exchange of ideas are essential to doing academic work. For assignments in this course, you are encouraged to consult with your classmates as you work on problem sets. However, after discussions with peers (or course instructional staff such as tutors, TF/TAs, course assistants), make sure that you can work through the problem yourself and ensure that any answers you submit for evaluation are the result of your own efforts. In addition, you must cite any books, articles, websites, lectures, etc that have helped you with your work using appropriate citation practices. Similarly, you must list the names of students with whom you have collaborated on problem sets.