Math UN 1201
Calculus III (Section 004 and 005)
Spring 2023

Time and location: Section 004: TR 1:10-2:25pm in 207 Mathematics. Section 005: TR 2:40-3:55pm in 207 Mathematics.

Instructor: Inbar Klang (email: ik2480@columbia.edu), pronouns: she/her/hers. You can call me Prof. Klang, Dr. Klang, or Inbar.

Office hours: Tuesdays 4:15-5:45pm in 417 Mathematics, Thursdays 4:15-5:45pm in 629 Mathematics, or by appointment (in person or Zoom meetings possible.)

Teaching assistants:

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Their office hours will be held in the math help room; see here for hours.

Textbook: James Stewart, Daniel K. Clegg, and Saleem Watson's *Calculus: Early Transcendentals*, 9th Edition. This is available for purchase at the Columbia bookstore, or you can acquire it as an ebook online.

Prerequisites: Calculus I or equivalent.

Course overview: Welcome to Calculus III! In this class, we will cover the following topics:

- Vectors and the geometry of space (Section 10.5 and Chapter 12)

- Vector functions (Chapter 13)

- Functions of several variables and partial derivatives (Chapter 14)

You can find a detailed outline on the last page of the syllabus.

Alternate classes: Are you wondering whether this is the right class for you? Here are some other options:

- Math UN 1205, Accelerated Multivariable Calculus: a faster-paced multivariable calculus course (covers chapters 12-16 of Stewart's textbook rather than chapters 12-14.)

- Math UN 1207, Honors Math A: the first semester of a rigorous, proof-based sequence of classes on multivariable calculus and linear algebra.

- APMA 2000, Multivariable Calculus: If you are a SEAS student, this is the class you should take.

On help hours: An essential part of learning mathematics is asking questions. Office hours (whether the instructor's, the TAs', or those of other TAs in the help room) are an opportunity to go over material covered in class, get homework help, and ask any other class-related questions. Other academic resources include the Columbia tutoring services, which can match you with a tutor for this course, and Khan academy, which has a variety of multivariable calculus videos and texts.

Structure of the course:
This course will have an "active learning" structure. Students will be responsible for engaging with the course material **before** class sessions, by reading the notes posted on Courseworks, watching the videos posted on Courseworks, or some combination thereof. I highly recommend attempting the exercises given in the notes as you come upon them. Each Monday and Wednesday night, a pre-class reading questionnaire will be due, to help me determine which topics to focus on in class. Class will be devoted to reviewing concepts according to the reading questionnaire, Q & A, and working on problems in small groups. **Please do not attend class if you are unwell or have recently tested positive for COVID-19, the flu, or RSV.** The TAs and I will be happy to help you make up any material you've missed.

Grading policy:
There will be weekly homework, twice-weekly pre-class questionnaires, two midterms, and a final exam (which students may choose to replace by a group project.) Their default weight will be as follows, although there is some flexibility (see "contract weighting" below):

- Homework: 25%

- Pre-class questionnaires: 5%

- Midterm 1: 20%

- Midterm 2: 25%

- Final exam / project: 25%

Contract weighting. You have the opportunity to individualize the weight you would like each component of this course to have, within constraints. To opt in, email me by **Tuesday, January 31**, with subject line "weighting", with your preferred weights. (If you do not email me, your weights will be as above.) The sum of weights must be 100%, subject to these constraints:

- Homework: 10-25%

- Pre-class questionnaires: 2-8%

- Midterm 1: 10-25%

- Midterm 2: at least 15%

- Final exam / project: at least 20%

There will be a "renegotiation" period (March 5-12) in which you can modify the weights of everything except midterm 1.

Homework: There will be 12 homework assignments. The homework grade will be obtained as $0.1\times$(sum of problem set scores), up to a maximum of 100%, so you can miss up to two problem sets and still obtain a full grade on homework. Please submit your homework on Gradescope, as a pdf file if possible, either typed or handwritten clearly and legibly. Homework will be due every Tuesday (except exam weeks) at 11pm.

Late homework is highly discouraged, to avoid placing an undue burden on graders. I recognize, however, that life happens; if you are experiencing extraordinary circumstances, please reach out to me and we will figure out a solution. You are allowed and encouraged to collaborate on homework, but you must write up your own solutions. Please cite any references used, aside from the textbook and course notes (e.g. websites.) Homework assignments may feature more challenging or involved problems that will count for extra credit.

Pre-class questionnaires: Pre-class questionnaires will comprise 3-5 questions about the reading material for the following day's class. A questionnaire will be due every Monday and Wednesday at 11pm, except for the first week (only a Wednesday questionnaire), and exam weeks (no mandatory questionnaire.) The main purpose of these questionnaires is to determine topics to focus on during class. All good-faith attempts (i.e. attempts that indicate thought and effort) will be awarded full points. For example, all partial solutions, progress towards a solution, or reflections on what you don't understand about the question will be awarded full points. Your average on the questionnaires will be multiplied by 1.2 at the end of the semester (up to a maximum of 100%), so that you can miss several questionnaires and still obtain a full score.

Exams: There will be two in-class midterms, on **February 16** and **March 30**, and a University-scheduled final exam during exam week. **Please do not attend an exam if you are unwell or have recently tested positive for COVID-19, the flu, or RSV.** If you are unable to take one of the exams in-person at the scheduled time for health reasons or other unsurmountable reasons, please let me know as soon as possible so that we can figure out a solution.
You may use a formula sheet during the exams, no longer than two sides of an A4 page. The only electronic device you may use is a calculator (e.g. scientific calculator), but programmable or graphing calculators are not allowed. A scientific calculator will be available at the front of the classroom if you do not have one or you did not bring yours. Collaboration during exams is considered cheating and is taken very seriously. Cheating during a midterm or final entails failing the course.

Optional project. Students may choose to replace the final exam with a group project, to be completed in groups of 3-5 students. You can opt-in to this about halfway through the semester, and the projects will be due at the beginning of exam week. Projects will typically include studying and providing a clear exposition on a topic related to course material, and providing detailed solutions to several problems. Projects must be typed, not handwritten.

Academic Honesty Policy: Please read the Columbia University Undergraduate Guide to Academic Integrity.

Accessibility and accommodations: Your success in this class is important to me. We all learn differently. If there are aspects of this course that prevent you from learning or exclude you,

please let me know as soon as possible. We can develop strategies to meet both your needs and the requirements of the course.

To receive disability-related academic accommodations for this course, students must first be registered with their school Disability Services (DS) office. Detailed information is available online for both the Columbia and Barnard registration processes. Refer to the appropriate website for information regarding deadlines, disability documentation requirements, and drop-in hours (Columbia)/ intake session (Barnard).
For this course, students registered with the Columbia DS office can refer to the "Courses that do not require professor signature" section of the DS Testing Accommodations page for more information about accessing their accommodations.

Student well-being: Your well-being is of primary importance. If you are facing challenges related to your physical or mental health, or obstacles like housing or food insecurity, you are encouraged to contact your academic advisor and/or the Student Health Service. If you feel comfortable doing so, please do not hesitate to get in touch with me to discuss ways we can put you in the best possible position to succeed.

Inclusivity: We are part of a learning community and must treat one another with respect at all times. This is especially important with regard to race, religion, nationality, sexual orientation, gender, disability, age, size, immigration status, parental status, and any other aspect of identity. I am committed to ensuring that this class is a supportive, inclusive, and safe environment for all students, and that all students are treated with dignity and respect. See also the Columbia College Notice of Non-Discrimination here.

Tentative Course Outline:

Week	Content
Jan 17, 19	• Overview, coordinate systems, vectors; 10.3, beginnings of sections 15.7 and 15.8, sections 12.1-12.2
Jan 24, 26	• dot product, cross product; 12.3-12.4 • HW 1 due Tuesday Jan 24
Jan 31, Feb 2	• Parametric curves, equations of lines and planes; 10.1, 12.5 • HW 2 due Tuesday Jan 31
Feb 7, 9	• Conic sections, quadric surfaces; 10.5, 12.6 • HW 3 due Tuesday Feb 7
Feb 14, 16	• Review, Midterm 1 • review Feb 14, midterm 1 Feb 16
Feb 21, 23	• Vector functions and their derivatives and integrals, review of limits; 13.1-13.2 and some Chapter 2 • HW 4 due Tuesday Feb 21
Feb 28, Mar 2	• Arc length, curvature, motion in space; 13.3-13.4 • HW 5 due Tuesday Feb 28
Mar 7, 9	• Functions of several variables, limits and continuity; 14.1-14.2 • HW 6 due Tuesday Mar 7
Mar 21, 23	• Partial derivatives, tangent planes; 14.3-14.4 • HW 7 due Tuesday Mar 21
Mar 28, 30	• Review, Midterm 2 • review Mar 28, midterm 2 Mar 30
Apr 4, 6	• Chain rule, directional derivatives and gradient; 14.5-14.6 • HW 8 due Tuesday Apr 4
Apr 11, 13	• Directional derivatives and gradient cot'd, local maxima and minima; 14.6-14.7 • HW 9 due Tuesday Apr 11
Apr 18, 20	• Global maxima and minima, Lagrange multipliers; 14.7-14.8 • HW 10 due Tuesday Apr 18
Apr 25, 27	• Lagrange multipliers cot'd, complex numbers; 14.8 and Appendix H • HW 11 due Tuesday Apr 25; HW 12 due Tuesday May 2