Math 120: Calculus II

Course Basics

Instructor	Claudio Gómez–Gonzáles	**Class Time**	3a
Email	cgonzales@carleton.edu	**Class Location**	CMC 209
Office	CMC 321	**Office Hours Location**	CMC 301, CMC 328, and Zoom

Websites: Moodle and Google Drive.

Textbook: *Calculus: Early Transcendentals, 9th Edition*, by Stewart, Clegg, and Watson.[1]

Prerequisites:

- Math 101 or Math 111;
- a score of 4 or 5 on the Calculus AB Exam or a score of 5, 6, or 7 on the Math IB exam;
- or assignment via the Carleton placement exam.

Description: What we call calculus—the mathematical study of continuous change—is fundamental to virtually every subfield of the physical sciences, but also to computer science, statistics, engineering, economics, actuarial science, medicine, and countless other endeavors. Math 120 builds on what you learned in Calculus I and is a prerequisite for Linear Algebra, Probability, Calculus III, and more. Topics include integration methods, improper integrals, differential equations, vectors, functions in two variables, partial derivatives, Lagrange multipliers, and iterated integrals. An important aspect of this course involves using software to carry out computations, visualize problems, and communicate ideas. The course will also highlight various applications, alongside space to reflect on how math relates to the world.

Learning objectives. The successful Math 120 student should be able to:

- define and give examples of key concepts listed above;
- identify techniques relevant to given problems;
- reason through applications of theory not explicitly formulated in class; and
- effectively communicate mathematical concepts, including via computer-generated graphs.

How to succeed (curated from past student feedback):

- **pre-read actively**, **come to class with questions**, and **begin homework early**,
- work with each other and work towards building a supportive community,
- visit my drop-in hours frequently and ask lots of questions!

Talk to me: If you need help, or even if you don't and just have suggestions or thoughts, please come to my office! I promise to treat your problems with respect and to keep any sensitive conversations as confident as I can, but note that (under Title IX) I am a mandatory reporter of sexual misconduct.

[1] If the price of this textbook is an obstacle to you, come see me.

Course Outline

Schedule is subject to change! While the material we learn is building up a coherent and interrelated set of ideas, colors are used to indicate the primary content that will be evaluated in the associated exam.

	Monday	Wednesday	Friday
Week 1: Warm-up			
Topic	**Review.** Syllabus review, concepts from Precalculus and Calculus I.	**A world of math.** Calculus and epistemology. How do we think about math? **Practice Quiz.**	**L'Hôpital's rule.** Limits of indeterminate form and the power of linearization. §4.4
Due	**Sign up to take notes!**		**Homework 0; Journal 1** by Saturday
Week 2: Integration			
Topic	**Integration by parts.** A new perspective on the product rule. **Quiz 1.** §5.2–5.5, 7.1	**Partial fractions.** Algebra and integration of rational functions. §7.4	**Improper integrals.** Infinite domains, discontinuities, and convergence. §7.8
Due		**Homework 1**	**Quiz 1; Journal 2** by Saturday
Week 3: ODEs and Modeling			
Topic	**Differential equations.** Quantities and their derivatives; initial-value problems. **Quiz 2.** §9.1	**Slope fields & separable equations.** Techniques for solving ODEs. §9.2–9.3	**Models for population growth.** Differential equations and modeling. §9.4
Due	**Homework 2**		**Quiz 2; Journal 3** by Saturday
Week 4: Introduction to Vectors			
Topic	**Vectors & dimension.** Coordinates and directions in 3D. §12.1–12.2	**Dot products.** Angles, orthogonality, magnitudes, and projections. §12.3	**Midterm 1.**
Due	**Homework 3**		**Journal 4** by Saturday
Week 5: Geometry in 3D			
Topic	**Cross products.** The right-hand rule and the algebra of three-dimensional vectors. §12.4	**Lines & planes.** Parametric and symmetric forms; vector and scalar forms. §12.5	**Surfaces and functions in two variables.** Tracing, level curves, and 3d plots. §12.6, 14.1
Due	**Homework 4**		**Journal 5** by Saturday

	Monday	Wednesday	Friday
Week 6: Differential Calculus in 3D			
Topic	**No class.**	**Derivatives in many variables.** Computing and visualizing partial derivatives. §14.3	**Tangent planes.** Linear approximations in higher dimensions. §14.4
Due		**Homework 5**	**Journal 6** by Saturday
Week 7: Extrema and Critical Values of Surfaces			
Topic	**Multivariable chain rule.** Composition of functions; implicit differentiation. §14.5	**Directional derivatives & gradients.** Change in a specific direction; steepest slopes. §14.6	**Midterm 2.**
Due	**Homework 6**		**Journal 7** by Saturday
Week 8: Optimization Problems			
Topic	**Second derivative test (pt 1).** Minima, maxima, and saddle points. §14.7	**Second derivative test (pt 2).** Lots of examples. **Quiz 3.** §14.7	**Lagrange multipliers (pt 1).** A method for finding extrema subject to constraints. §14.8
Due	**Homework 7**		**Quiz 3; Journal 8** by Saturday
Week 9: Integrals in Many Variables			
Topic	**Lagrange multipliers (pt 2).** Lots of examples. **Quiz 4.** §14.8	**Double integrals on rectangular regions.** Definite integrals in several variables. §15.1	**Double integrals on other regions.** Methods for integration over other shapes. §15.2
Due	**Homework 8**		**Quiz 4; Journal 9** by Saturday
Week 10: Polar Integration			
Topic	**Polar coordinates.** What are coordinates good for; intro to polar integration. §10.3, 15.3	**Polar II & review.** Integration in non-Euclidean coordinates. **Course evaluations.**	**Reading period.**
Due		**Homework 9**	
Week 11: Final Exam			

Grade Details

Grading: This class will be graded on an A–F scale, as detailed below.

A [93%,100%]		**A-** [90%,93%)
B+ [87%,90%)	**B** [83%,87%)	**B-** [80%,83%)
C+ [77%,80%)	**C** [73%,77%)	**C-** [70%,73%)
D+ [67%,70%)	**D** [60%,67%)	
F [0,59%)		

I reserve the right to change this distribution, but will only do so in a way that would make your grade better (never worse). In general, a B indicates that you have learned the key concepts of this course and could reliably apply them in the future. An A indicates that you have demonstrated a deeper understanding not only of how to apply ideas but also in communicating and exploring mathematical concepts beyond the scope of the course.

Grade breakdown: Final marks for the course will be computed using the following weights.

- **Community**, worth 2% of your grade. There are chances to do this every day—by contributing to discussions, working with others on homework, representing your group after breakouts, and contributing to the Notes repository. Your presence benefits you, your classmates, and me!
- **Journaling**, done weekly, in total worth 3% of your grade. These are written assignments due at the end of each week that provide space for self-evaluation, chronicling what you've learned, synthesizing concepts from previous classes, and providing ongoing course feedback.
- **Homework**, nine assignments, in total worth 20% of your grade. These problem sets allow you to exercise techniques that we have discussed in class and also build experience in mathematical communication. You are encouraged to work in groups! Much of the work of this class will happen in these assignments, where you connect with peers and cement your own knowledge. Turn in homework during class or to the course mailbox. Late Homework is accepted with a penalty, detailed in the Late work policy; Homework that is more than a week late will not be accepted. Your lowest assignment will be dropped in computing your final grade.
- **Quizzes**, four in total, worth 20% of your grade. These are take-home medium-stakes group-based activities in which you will design and solve questions to assess concepts we are developing in class, supplemented by graphing software. You will be writing Quizzes! These will push you to think creatively and pedagogically about material as you encounter it and serve as another way to cement core aspects of the course, and will be graded using a provided rubric. Because of the collaborative nature of these projects, Quizzes will contain a peer review component. Quizzes are not Homework; unexcused late submissions are not accepted.
- **Exams**, two midterms and a final, in total worth 55% of your grade. The exams are spaces for you to demonstrate the material that you have mastered on your own. If you require additional accommodations for these forms of assessment, let me know well in advance.

Support and Other Policies

Student hours: These are times that I set aside during my week to be available for you. Just show up! You do not need to make an appointment and you are not annoying me.

Late work: For every day that a Homework assignment is turned in late, the associated grade will be dropped $\frac{1}{2}$ of a letter grade (e.g., an assignment turned in Wednesday that was due Monday and would have received an A would receive a B). You will have 4 Late Credits to apply to late Homework assignments. Each Late Credit is worth 1 day to turn in an assignment late without penalty: e.g., turning in an assignment due Wednesday on the following Friday would use 2 Late Credits. Late assignments will not be accepted beyond a week after the original deadline, except in explicit cases of extension. As per College policy, Late Credits cannot extend deadlines past the last day of class.

Collaboration and academic integrity: Math is a collaborative activity! Even when we publish a paper alone, mathematicians are part of a sociopolitical fabric animated by our roles in institutions of education, research, and industry. You should work with your classmates to learn this material; you will do this in class! However, you may not copy anyone else's work. Rather, you must write up your own solutions and give credit to classmates, Math Skills Center personnel, and other collaborators for important insights. Cases of academic dishonesty are taken seriously by the College and I am required to report them.

Large language models and generative AI: I understand the increasing ubiquity of these technologies, but I discourage their use in this course. While I can imagine some applications—helping you experiment with Mathematica, for example—I encourage you to always critically reflect on whose labor is being replaced or which relationships lose out when you invoke these tools. If you are interested in thinking about sociological dimensions of automation and mathematical labor, here's a good place to start. Remember, I ask you to grapple with complex ideas in this course because we grow from productive struggle.

> In general, I view "generational use" of LLMs as inappropriate for this class, while "assistive use" can be appropriate. You may not ask an LLM to solve a problem for you or ask questions of such a system that you would not ask of a classmate or me. I do not authorize the sharing of my course materials with AI platforms. Moreover, I ask you to only turn to LLMs towards understanding a homework problem (*never* on exams) after working with classmates and me. Transcription software is not allowed in class except with explicit permission via accommodation request.

Sources of support: You should expect to be challenged in this course! If you are stuck, know that you are following in the footsteps of all who came before you. Here is a list of available resources, some of which will be expanded upon below:

- Your classmates and me!
- The Math Skills Center and Quantitative Resource Center tutors.
- The Academic Support Center, Student Health and Counseling, and the Dean of Students Office.

Student health: Your well-being should be your first priority. It is important to recognize stress you may be facing, which can be personal, emotional, physical, financial, or academic. Sleep, exercise, and building a supportive community are important! Please do not come to class if you are sick—instead, stay in communication with me and other students. If you cannot attend class for an extended period of time, reach out to me on how we can make accommodations for missed material and late work.

Department library: If acquiring the textbook is an obstacle, or if you require assistance with other course fees or supplies, reach out to TRIO, CSA, and the Dean of Students Office. If you have exhausted these resources, contact Sue Jandro (sjandro@carleton.edu) to inquire about a department textbook!

Accommodations for students with disabilities: The Office of Accessibility Resources is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations. If you have, or think you may have, a disability (e.g., mental health, attentional, learning, autism spectrum disorders, chronic health, traumatic brain injury and concussions, vision, hearing, mobility, or speech impairments), please contact oar@carleton.edu to arrange a confidential discussion regarding equitable access and reasonable accommodations. The College also makes available assistive technologies including text-to-speech (Kurzweil), speech-to-text (Dragon) software, and audio recording Smartpens.

Math tutoring: The Math Skills Center supports all Carleton students in any mathematics or math-related course they are taking in which they are experiencing difficulty, either with the mathematical concepts or with the mathematical tools needed to succeed in the course. In addition, the Quantitative Resource Center can help you with Mathematica!

Personal electronics: There are no restrictions on phones, tablets, laptops, or other electronic equipment in the classroom, provided that said equipment is being used respectively and non-disruptively. Please silence your devices and be mindful of others, especially in discussions or other collaborative contexts.

Title IX: Please be aware all Carleton faculty and staff members, with the exception of Chaplains and SHAC staff, are "responsible employees." Responsible employees are required to share any information they have regarding incidents of sexual misconduct with the Title IX Coordinator. Carleton's goal is to ensure campus community members are aware of all the options available and have access to the resources they need. If you have questions, please contact Carleton's Title IX Coordinator or visit the Sexual Misconduct Prevention and Response website.

Land Acknowledgement: Carleton derives wealth and prestige through its ownership of ancestral homelands of the Wahpekute and Mdewakanton bands of the Dakota Nation and more broadly as an academic institution in the United States. I urge you to support the organizing work of Indigenous peoples seeking liberation through direct action, advocacy, and education.