

MAT 1412-201

Calculus I

Summer 2024 | CRN: 60668 | Four Credits

Last Updated: July 18, 2024
Instructor: Dachao Sun
Meeting Times: M-Th 3:20–6:00 P.M.
Location: Online-Synchronous

Syllabus



Yeshiva University

Course Summary

In this course, we will discuss and examine the topics of mathematical functions, limits, continuity, derivatives, relevant applications to graphing, maxima and minima in optimization problems, related rates, the Mean Value Theorem, integration, the Fundamental Theorem of Calculus, and integration by substitution.

These are all with respect to single-variable, real-valued functions. In addition, in accordance with the “Lecture & Lab” type, along-side with theoretical derivations and computational, forward-reasoning exercises, the instructor also try to design and introduce a few (bi-weekly) computer programming assignments, with the first lab in PASCAL, the second in Python, and a potential third one in C.

Instructor Information

This course is instructed by Mr. Sun with email address dsun1@mail.yu.edu, offices at Katz School’s cubicle on the sixth floor of 215 Lexington Avenue (Beren Campus) but more likely at **Belfer 326** on Wilf Campus, as well as cell phone number 267-881-3798; tentatively, **five Tuesdays 1–2:45 P.M.** are **office hours** of this course, starting Tuesday July 9th.

Class and Recitation

Meetings are at the same time 3:20-6 P.M. on Monday, Tuesday, Wednesday, and Thursday from July 8th (Mon.) to August 8th (Thurs.), i.e., five weeks (twenty individual days) combined; this includes quizzes/tests and homework assignments. Recitations of this course will take place on **four Fridays 11–11:50 A.M.**, tentatively, starting Friday July 12th. Canvas (yu.instructure.com) page would provide essential information.

Textbooks

Stewart, J. (2008). *Calculus: Early Transcendentals*, 6e. Cengage Learning.

is the primary text upon which the development of topics are based; a secondary reference text by Tom Apostol (1967) is recommended and might be referred to during class, along-side with other reference texts which are included in the bibliography section, which also played an important role to the instructor during the preparation of the course.

Prerequisite(s) and Corequisite(s)

The prerequisites of this course are not many and are primarily an expectation on your basic reasoning, analytic skills, and a good work-ethic. Students are encouraged to read through the “Program Information” section for the listing of mathematics courses (at www.yu.edu/ug/mathematics) at Yeshiva to get a general idea of where you are. Specifically,

1. had gone through roughly speaking three (3) years of high school mathematics;
2. then, since college, had taken MATH 1160 Precalculus;
3. if without the item above, had taken and passed the “Online Math Placement Test” with a minimum score of twenty out of thirty (20/30). For example, if not passing this minimum score, the student needs to register for MATH 1160 instead;

- otherwise, an exempt from Online Math Placement Test requires: (i) had earned a score of four (4) or five (5) on AP Calculus AB or BC; (ii) have taken any calculus sequence course(s) at the collegiate level, and have earned a grade of C or above.

Schedule and Objectives

This summer session will last for five weeks, the last of which including a final exam evaluation. Therefore, to oversee topics of content, the focus is on the first four and a half weeks with the following components:

Preliminaries: essentials of mathematical functions; mathematical sets (optional); fundamentals of mathematical logic (optional); basic proof techniques (optional); review of trigonometry and transcendental functions.

Limits and Continuity: tangent and velocity; definition(s) of a limit of a function; limit laws; limits of sequences; the Axiom of Continuity; continuous functions; Epsilon-Delta (ϵ - δ) versus “intrinsic” definitions of continuity; limits at infinity and horizontal asymptotes.

Differentiation: rates of change and derivatives; derivatives as functions; differentiation rules; derivatives of polynomials, exponential, trigonometric, logarithmic, and hyperbolic functions; the Product and Quotient rules; the Chain Rule; implicit differentiation; the Mean Value Theorem.

Integration: antiderivatives; areas and distances; definite integrals; the Fundamental Theorem of Calculus; indefinite integrals and the Net Change Theorem; integration by substitution (a.k.a. U-substitution).

Immediate Applications: early methods for **finding tangents**; **rates of change** in natural and social sciences; exponential growth and decay; related rates; **linear approximation and differentials**; **Taylor polynomials**; basics of optimization; **intermediate forms and l’Hôpital’s Rule**; **more graphing and curve sketching**; Newton’s method; **areas between curves**; volumes and work; **average value of a function**; and **applications in finance and economics**. *[adjustments needed if necessary]*

among which the first component “preparation” may take approximately the first two days; afterwards, **about one component per week** until the last day of class for the test. This above collection of objectives are what the instructor expects, throughout the beginning stage of the class this summer, although the priority would end up being how to maximize learning outcomes by (i) the standard, well-known Calculus One curriculum, (ii) common final exams of this topic taught at Yeshiva University and other close institutions, and (iii) students’ comprehension and readiness in the class.

Rubrics for Grading, and Study Suggestions

Given the mild intensity of a compact summer course with only five weeks to run, only a final test will be planned on the last day of class (August 8) for 40% of the grade; meanwhile, class and recitation (which is optional) participation will contribute to 5%. Approximately five to up to nine homework problem sets, organized by content (e.g., functions and set theory, differentiation rules), will be expected throughout the course of four and a half weeks, which counts for 15% of grade, by primarily *completion* but also the **quality of mathematical writing** which is important for technical, quantitative communications in students’ future works.

Quizzes count for 25% and will be given weekly (likely to skip the last week) which are similar to homework. The remaining 15% portion corresponds to programming assignments including, and may be substituted by, a brief final project of the students’ own choices (sufficient guides and suggestions will be provided).

Component	Percentage of Grades
Participation (Class, Recitation, and Programming Assignments)	10%
Homework Problem Sets	25%
Quizzes	25%
Final Exam	40%

Make up tests and assignments are possible when needed, for instance with a note from physician, where grades would be adjusted accordingly. There is no curving. MAT 1412 is not a competition.

At the same time, the instructor assumes the necessity of attendance, along with recitations, which are in fact all highly recommended. Homework will be collected and commented for the student as a reference of learning and mathematical communication.

To prepare, the instructor expects to post, prior to start of each class, any **required and optional readings** from both the textbook and external materials, and please allocate some enough time to read these passages, and further try problems and short proofs if possible. In addition, as sometimes suggested by the educational circle, sketching “concept maps” may be helpful as a pre-exam activity, or as a “post-exam reflection.”

Auxiliary Bibliography

This bibliography list can be beneficial for students’ self-study to (i) either lay groundwork, prior to entering the Calculus sequence, or (ii) refreshing memory and different perspectives of the topics in our class:

(*Related Courses*)

Gidea, M. & Yeshiva University. (Fall 2022). MATH 1412: Calculus I (course description). Available at <https://repository.yu.edu/items/31e9d359-1880-46fc-81ef-19f2389b96a3>

Hendricks, K. (Fall 2019). Math 135, Sections 61-63: Calculus I (course webpage). Available at <http://sites.math.rutgers.edu/~kh754/Math135.html>

Hunter, J. K. (n/a). Introduction to Analysis (course webpage). Available at http://www.math.ucdavis.edu/~hunter/intro_analysis_pdf/intro_analysis.html

IntelliPro, Inc. (1992). *The Calculus Explorer*. Addison-Wesley Publishing Company.

Marsden, J. E., & Weinstein, A. J. (1985). Calculus I, II, and III (Second Edition, resource website on Caltech’s website). Springer-Verlag. Available at <https://www.cds.caltech.edu/~marsden/volume/Calculus>

McDougal, S. (Spring 2019). Mathematics 3A: Calculus I (course syllabus). Available at <https://www.berkeleycitycollege.edu/smcDougal/files/2019/01/Syllabus-3A-S19.pdf>

Princeton University. (2018). MAT214: Numbers, Equations, and Proofs (course description). Available at <https://www.math.princeton.edu/undergraduate/placement/MAT214>

Princeton University. (2018). MAT215: Single Variable Analysis with an Introduction to Proofs (course description). Available at <https://www.math.princeton.edu/undergraduate/placement/MAT215>

Princeton University. (2023). MAT210: One-Variable Calculus with Proofs (course description). Available at <https://www.math.princeton.edu/undergraduate/placement/MAT210>

University of Florida. (Summer B 2008). EFTP: Calculus I (course syllabus). Available at https://www.phys.ufl.edu/~marcet/work/eftp_calc1_syllabus08.pdf

Yeshiva University (Fall 2020). “The Online Math Placement Exam.” Retrieved at http://www.yu.edu/sites/default/files/inline-files/Math%20Placement%20Test%20Instructions%20FINAL_0.pdf

(*Books*)

Apostol, T. M. (1967). *Calculus: One-Variable Calculus, with an Introduction to Linear Algebra (Volume I)*, Second Edition. Blaisdell Publishing Company. ISBN: 0-471-00005-1

- Berresford, G. C. & Rockett, A. M. (2015). *Brief Applied Calculus* (7th Edition). Cengage Learning. ISBN-13: 978-1305085329
- Bressoud, D. M. (2019). *Calculus Reordered: A History of the Big Ideas*. Princeton University Press. ISBN-13: 978-0-691-21878-6
- Cohen, M. et al. (1991). *Student Research Projects in Calculus*. The Mathematical Association of America (Incorporated). ISBN: 0-88385-503-8
- Connally, E. et al. (2011). *Functions Modeling Change: A Preparation for Calculus* (Fourth Edition). John Wiley & Sons, Inc. ISBN-13: 978-0-470-48474-6
- Hoffmann, L. D. & Bradley, G. L. (2010). *Calculus: For Business, Economics, and the Social and Life Sciences* (Brief Tenth Edition). McGraw-Hill Higher Education. ISBN: 978-0-07-353231-8
- Jevons, W. S. (1958). *The Principles of Science: A Treatise on Logic and Scientific Method*. Dover Publications, Inc.
- Knopp, K. & transl. Bagemihl, F. (1952). *Elements of the Theory of Functions*. Dover Publications Inc. ISBN-10: 0486601544
- Lang, S. (1964). *A First Course in Calculus*. Addison-Wesley Publishing Company, Inc.
- Larson, R. E., Hostetler, R. P. & Edwards, B. H. (1990). *Calculus with Analytic Geometry* (Fourth Edition). D. C. Heath and Company. ISBN: 0-669-16406-2
- Marsden, J. E., & Weinstein, A. J. (1985). *Calculus I* (Second Edition). Springer-Verlag. Available at <https://authors.library.caltech.edu/records/00arw-c5851> ISBN: 0387909745
- Priestley, H. A. (1997). *Introduction to Integration*. Oxford University Press. ISBN: 0-19-850123-4
- Rudin, W. (1976). *Principles of Mathematical Analysis* (Third Edition). McGraw-Hill Book Company.
- Russell, B. (1993). *Introduction to Mathematical Philosophy*. Dover Publications Inc.
- Stein, S. K. (1987). *Calculus and Analytic Geometry*. New York: McGraw-Hill. ISBN-13: 978-0070611627
- Thomson, J. (1849). *An Introduction to the Differential and Integral Calculus—With an Appendix, Illustrative of the Theory of Curves and Other Subjects* (Second Edition). London: Simms and M'Intyre via the Cornell University Library Digital Collections since 1992. ISBN: 9781429700597
- Wallace, D. F. (2010). *Everything and More: A Compact History of ∞* . Atlas Books and W. W. Norton & Company. ISBN: 978-0-393-33928-4
- Whitehead, A. N. & Russell, B. (1927). *Principia Mathematica (Volume III)*, Second Edition. Cambridge at the University Press. ISBN: 0-521-06791
- Wilder, R. L. (1965). *Introduction to the Foundations of Mathematics* (Second Edition). John Wiley & Sons, Inc. ISBN-10: 0486488209

University Policies

Equity Compliance and Title IX

Yeshiva University has a long-standing commitment to equal opportunity and affirmative action. We apply every good faith effort in achieving nondiscrimination and equality of opportunity in employment and in all spheres of academic life. All University-wide decisions with regard to faculty, staff and students are based on equitable and equally applied standards of excellence. Non-Discrimination & Anti-Harassment procedures have been established, both as a legal obligation under applicable law and as a visible and formal expression of institutional policy. — “Notice of Non-Discrimination & Anti-Harassment” retrieved from <https://www.yu.edu/hr/Equity-Compliance-TitleIX>

Special Needs

Students with disabilities who are enrolled in this course and who will be requesting documented disability-related accommodations should make an appointment with the Office of Disability Services, (646) 592-4132, rkohn1@yu.edu, during the first week of class. The office is located at 215 Lexington Ave., Suite 505.

Once you have been approved for accommodations, please submit your accommodation letter to your instructor to ensure the successful implementation of those accommodations.

Academic Integrity

Summer classes abide by Yeshiva University's academic integrity policies. The submission by a student of any examination, course assignment, or requirement is assumed to guarantee that the thoughts and expressions therein not expressly credited to another are literally the student's own. Resources on academic integrity are available here: <https://www.yu.edu/academic-integrity/resources> Meanwhile, academic integrity processes and penalties as outlined in the following documents:

- Students in Stern College for Women, Sy Syms School of Business, and Yeshiva College:
<https://www.yu.edu/academic-integrity>
- Visiting Summer Students:
https://www.yu.edu/sites/default/files/inline-files/AS.AA%20Catalog%204.23.21_0.pdf

In the end, it is the student's responsibility to be aware of behaviors that constitute academic dishonesty.

Normally, the syllabus (rubrics, topics to cover, etc.) will remain intact throughout the course, although in theory the instructor reserves the right to make any changes he considers academically advisable, only when necessary, and such changes will be announced and in some degree discussed with students in class and during office hours.