MATH 251Z, DIFFERENTIAL CALCULUS, SPRING 2026, PHILLIPS: SYLLABUS, COURSE INFORMATION, AND RESOURCES

Contents

Date: 29 March 2026.

This is a preliminary version of the syllabus. Some small changes are possible if requested in class discussion. **Not enough proofreading has been done!** (I don't have a printer at home.)

1. Basic information

1.1. **Course number.** Math 251Z [formerly Math 251].

1.2. **Course title.** Differential Calculus.

1.3. **CRN.** 32854 (9:00–9:50 am); 32855 (10:00–10:50 am).

1.4. **Time and place.** MTuWF 9:00–9:50 am (CRN 32854); MTuWF 10:00–10:50 am (CRN 32855), B005 University Hall (same room for both).

1.5. **Instructor.** N. Christopher Phillips, 319 University Hall.

1.6. **Course home page (same for both sections).**
`https://pages.uoregon.edu/ncp/Courses/Math251_Sp26_Web/Math251_Sp26_Web.html`.
(Depending on your pdf reader, this might be an active link.)

1.7. **Email.** See the course home page. It is not included here because spammer address harvesters read pdf files.

- Send plain text **only**; no html only messages. See the links on the course home page. (Both Canvas and WeBWorK generate email messages which contain plain text. UO email is at least able to send plain text.)
- The subject line of your message should start with "M251Z", followed by your last name, then first initial. (Otherwise, your message might get lost.)
- No Microsoft Word or PowerPoint files.
- I often read email only a couple of times per day, sometimes even only once per day. For example, it will not work to send a request for an appointment by email an hour before the intended time of the appointment. However, if you don't get a response to an important email message within about a day, **email me again.** Sometimes messages get overlooked, then forgotten in the ongoing flood.

- Assignments etc. will normally not be accepted by email, because each individual submission is awkward to deal with. If I make an exception (very rare), see the separate file "Emailing files to N. C. Phillips".

1.8. **Course description.** This course explores limits, continuity, derivatives, and their applications to real valued functions of a single variable. These topics will be explored graphically, numerically, and symbolically in real life applications. This course emphasizes abstraction, problem-solving, modeling, reasoning, communication, connections with other disciplines, and the appropriate use of technology. Previously MATH 251.

Students cannot receive credit for more than one of MATH 241, MATH 246, MATH 251Z.

Prerequisites: MATH 112Z or satisfactory placement test score.

Required: a programmable calculator capable of displaying function graphs.

(This description is taken almost verbatim from the Catalog of Courses.)

1.9. **Textbook.** *OpenSTAX Calculus Volume I*, An electronic edition of this text is available for free at `http://openstax.org/details/books/calculus-volume-1`. (Warning: don't give them your email address. They send spam.)

1.10. **Office Hours.** Mondays 1:00–1:50 pm, Tuesdays 11:00–11:50 am (right after the second class), Wednesdays 11:00–11:50 am (right after the second class), or **by appointment**, in 319 University Hall. (I have a regular Zoom meeting right after the second class on Mondays.)

1.11. **Extra credit for finding errors.** Extra credit will be given for identifying errors and misprints in any course materials, with more extra credit for mathematical errors. (You must say what the correct version is supposed to be, and only the first two people to catch an error can get extra credit.)

1.12. **Academic Conduct.** The code of student conduct and community standards is at `https://dos.uoregon.edu/conduct`. In this course, it is appropriate to help each other on homework and in class worksheets, as long as the work you are submitting is your own and you understand it. It is not appropriate to help each other on exams or quizzes, to look at other students' exams or quizzes, or to bring unauthorized material to exams. It is not appropriate to use AI of any kind to produce answers or assist with any work that is turned in for credit, including WeBWorK and exams. It is also inappropriate to get tutors or other third parties to solve course problems for you and turn in their answers. It isn't prohibited, but it will destroy your exam performance, to use AI or tutors to solve practice exam problems without doing them yourself first. It is appropriate to use AI to generate practice problems that are similar to but differ from homework etc. problems, and to use it to check your solutions to such problems.

Specifically on exams and quizzes: It is not appropriate to help each other on exams, to look at other students' exams while the exam is in progress, or to bring unauthorized material to exams. On most exams and quizzes, you may use a 3 by 5 file card of notes, written on both sides. (Exception: Not permitted on Midterm Zero.) The following are

all prohibited: calculators (of any kind), cell phones, laptops, iPods, electronic dictionaries, and any other electronic devices or communication devices. All electronic or communication devices you have with you must be turned completely off and put inside something (pack, purse, etc. and out of sight.

See Section 6 for further general information.

2. Learning Outcomes

The most important single learning objective is that a successful student in this course **should be able to model and solve a wide class of optimization and other modelling problems that are accessible to differential calculus.** Much of the other material covered in this course is necessary for that objective. So subgoals include:

(1) A successful student should be able to differentiate. This is necessary to use calculus to solve optimization problems (or any other kind of problem—see the additional objectives below).
(2) A successful student should be able to sketch graphs of functions. This is necessary to help identify where to search for local and global extremums when trying to optimize.
(3) A successful student should understand some basic facts about limits. This is needed for two reasons: to incorporate an understanding of the geometric interpretation of the derivative as the slope of the tangent line of a graph, and also to aid in sketching graphs of functions exhibiting asymptotic or discontinuous behavior.
(4) A successful student should be able to solve related rates problems.
(5) A successful student should be able to find the linear approximation to a function at a specific value of the variable, graph the linear approximation and the function on the same pair of axes, and use the linear approximation to find approximations to values of the function near the point at which the approximation is taken.

In more detail, a successful student should be able to the following. In all cases, a successful student should be able to write the solution in a well organized manner, showing a sufficient number of steps, written using fully correct notation and terminology, and correctly showing what the steps are.

(1) Evaluate limits using the algebraic limit laws.
(2) Identify limits at $\pm\infty$ for rational functions and similar functions.
(3) Identify limits of rational functions involving cancellation of linear factors from numerator and denominator.
(4) Compute left and right limits for a function (or decide they do not exist), given an expression for the function.
(5) Identify the points where common functions are continuous or differentiable, and the same for functions given graphically.
(6) Identify the points where graphically given functions are continuous or differentiable.
(7) Identify limits, as well as left and right limits, for functions given graphically.
(8) State and use the product rule, quotient rule, chain rule, and linearity rules for derivatives.

(9) State the definition of the derivative in terms of a limit of difference quotients.
(10) Interpret, including units, the derivative as an instantaneous rate of change of a quantity defined in an applied context.
(11) Recognize the derivative as the slope of the tangent line.
(12) Use calculus to approximate the value of a function near a point p, given information about the function and its derivatives at p.
(13) Compute derivatives of functions involving polynomials, exponentials, logarithms, trigonometric functions, and inverse trigonometric functions, using a combination of theorems, differentiation rules, and definitions.
(14) Find the equation for the tangent line of a curve at a given point.
(15) Calculate derivatives using implicit differentiation
(16) Use the methods of calculus to find asymptotes, local minimums and maximums, intervals of concavity, intervals where the function is increasing or decreasing, and inflection points. Relate these properties to the graph of the function.
(17) Find extremums of a function on open and closed intervals.
(18) Solve optimization problems, including word problems.
(19) Solve related rates problems, including word problems.
(20) Use L'Hopital's rule to evaluate indeterminate forms of limits, including cases requiring multiple applications.
(21) Use the Intermediate Value Theorem to prove that roots of a function exist in a given closed interval.
(22) Use Newton's method to approximate solutions to equations that they cannot solve explicitly.
(23) Correctly use the notation and terminology of the course. Correct use of terms and symbols is taken as evidence of understanding of their meaning. In addition, correct use of terms and symbols is like using correct grammar and spelling in an essay or term paper. Here is an incomplete list of examples:
    (a) Using correct notation for derivatives.
    (b) Putting the symbol $\lim_{x\to a}$ in places where it belongs, and not putting this symbol in places where it doesn't belong.
    (c) Putting the symbol $=$ in places where it belongs, and not in places where it doesn't belong. (This course provides new contexts in which this is important.)
    (d) Using parentheses when needed. (This course provides new contexts in which this is important.)
    (e) Recognizing that expressions like $\frac{\infty}{\infty}$, $\frac{0}{0}$, $\frac{0}{\infty}$, $0\cdot\infty$, $17\cdot\infty$, $\frac{17}{\infty}$, etc. are not numbers and therefore may not appear in equations.

Also see the separate file "Math 251: summary of topics".

3. Coverage and schedule

We will cover most of Chapters 2–4 from the book, but topics will not be done in the same order as there.

This schedule is *approximate*, and is subject to change. Some material on infinite limits will be postponed from where it appears in this schedule.

I hope to put at least one optimization problem already in Week 3.

See the separate file "Math 251: summary of topics" for a systematic list of topics, arranged in mathematically logical order (not the order either here or in the book), with a special section on methods of finding limits.

3.1. **Week 1: Sections 2.1–2.4.** Limits and continuity. Midterm 0, first version.

3.2. **Week 2: Sections 3.1–3.4.** Introduction to derivatives, differentiation rules except the chain rule, and a first look at the meanings of the derivative. Midterm 0, second version.

3.3. **Week 3: Sections 4.3, 4.7.** Higher derivatives, maximization and minimization, first look at optimization problems.

3.4. **Week 4: Sections 3.5, 3.6.** Derivatives of trigonometric functions, chain rule, Midterm 1.

3.5. **Week 5: Sections 3.8, 3.7.** Implicit differentiation, derivatives of inverse functions (including arcsin, arctan, etc).

3.6. **Week 6: Sections 3.9, 4.1, 2.4.** Derivatives of exponential and logarithmic functions. Related rates. More on limits, especially one sided limits and infinite limits.

3.7. **Week 7: Sections 4.6, 4.7.** Limits at infinity, more optimization.

3.8. **Week 8: Sections 4.5, 4.2, 3.4.** Shapes of graphs, linear approximation, more on the meanings of the derivative, Midterm 1.

3.9. **Week 9: Sections4.8, 2.4, 4.4.** L'Hopital's Rule, Intermediate Value Theorem, Mean Value Theorem.

3.10. **Week 10.** Catch up, review (if time).

4. Technology

For some homework, WeBWorK, and in class worksheet problems, and for visualization purposes, you will want a graphing calculator. However, it will not be necessary.

It is not appropriate to use AI to assist with any work that is turned in.

No calculators of any sort will be allowed on exams or quizzes. This means that you will be expected to do some arithmetic by hand. See the separate file "Math 251–252: arithmetic expected without calculators" for what this means. Be aware that bad choices can convert an easy arithmetic problem into a hard one, and that calculating things that are not asked for may result in hard arithmetic.

5. Coursework

Course grades will be based on the following items. See the separate handout "General Instructions for Written Homework and Exams" about showing work correctly.

Complaints about the grading of any exam or quiz must be submitted in writing by the beginning of the first class period after the class in which that exam or quiz is returned.

5.1. **Class participation and worksheets.** Most days, there will be in class worksheets. Work on them will usually be interspersed with lecture presentation and discussion. Worksheets will not be graded on the correctness of your work, but evidence of serious effort is necessary to receive credit for this portion of your grade. Each person must turn in a separate worksheet, but group work or discussions with your neighbors is allowed, in fact, encouraged. Exams and quizzes (except Midterm Zero; see Subsection 5.5 below) will permit at 3×5 file card, written on both sides.

You cannot make up worksheets, but your lowest three worksheet grades will be dropped.

5.2. **In class quizzes.** Many Fridays, there will be a short in class quiz. (The schedule will be different in the first three weeks.) Quizzes will be based on problems from lectures, homework, the worksheets from that week and a lille further back. No calculators of any kind will be allowed on any quiz. There will be no quizzes during midterm exam weeks (except the weeks of Midterm 0). Quizzes cannot be made up, but your lowest two quizzes will be dropped.

5.3. **Written homework.** Written homework will be assigned and collected irregularly, but averaging about once per week. It will be submitted in class, on paper. Written homework cannot be made up, but your lowest two written homework scores will be dropped.

5.4. **WeBWorK.** Homework will be collected through WeBWorK, typically two times per week: 8:00 pm Wednesday and Friday, but there will be variations on this schedule. Reduced credit for late WeBWorK homework assignments will be available: up to one week late, or until several days before the next exam, whichever is earlier. Canvas counts all WeBWorK assignments at the same value, regardless of the number of problems. Otherwise, makeups will not be possible. The three lowest WeBWorK scores will be dropped.

See the separate handout, "Making effective use of WeBWorK" and the math depasrtment web page `https://blogs.uoregon.edu/mathresources/webwork/`.

5.5. **Midterm Zero.** Midterm Zero is review. It is 25 minutes long. It will be given Friday of the first week of classes, and repeatable Friday of the second week of classes. It will have 10 problems designed to expose common algebra mistakes in the course. See the samples (separate files), including one as part for the first week's homework. Unlike other quizzes and exams, work need not be shown, no note card is allowed, and there is no partial credit, not even if the only mistake is notation. **I have never seen anyone pass this course who got a score of** 3 **or less out of** 10 **on the first administration of Midterm Zero.**

5.6. **Two ordinary midterms.** Midterm exams will be cumulative, with the second midterm emphasizing material since the first. They will be on Fridays in weeks 4 and 8. No calculators of any kind will be allowed on any midterm.

If doing so improves the course grade, I will replace the lower of the two midterm grades with the equivalent grade from the final exam.

No makeups for midterms. If one midterm is missed, the rule above will be applied. If both midterms are missed, please see me, but expect to be advised to drop the course. In the past, the University of Oregon has allowed retroactive withdrawals in cases of ongoing medical or other problems, but I can make no promises.

5.7. **Final exam.** The final exam will have the same format as the midterms. It will cover the entire course, with emphasis on later material. No calculators of any kind will be allowed on the final exam.

The following information is subject to change. I have been told that the final exam will be Tuesday 9 June 2026 (the same for both sections; **not** what the schedule of classes says for the course time), but have not yet been given a time. The last time I had a common final exam, I din't have either a room or a time until about the 9th week of classes.

No final exams will be given at any time other than the scheduled time, except according to official University of Oregon procedures for documented exam conflicts. If you make a plane reservation to leave town for the summer before the time of the final exam, you will get an F in the course.

If you miss the final exam for a legitimate reason, you can request an incomplete. It will be granted based on the criteria on this page: `https://registrar.uoregon.edu/current-students/incomplete-policy`.

5.8. **Weighting.** The components will be weighted as follows:

Worksheets	4%
Written homework	4%
Quizzes	10%
Webwork	8%
Midterm Exam 0	10%
Midterm Exam 1	17%
Midterm Exam 2	17%
Final Exam	30%

6. Further information

This section contains further important information.

6.1. **Learning resources for calculus students.** The following sources of help are available. Remember that it is inappropriate to turn in homework as your own that was actually done by a tutor or other third party (or by AI).

Please let me know of anything else I should list here. Also, some information may be out of date; again, please let me know.

Warning; The resources listed here have mostly not been checked, and in many cases I don't know how reliable they are.

6.1.1. *Instructor's office hours.* Office hours are made to be used. Use them! Disadvantage: Only a limited amount of time is available.

6.1.2. *Success in math courses.* The University of Oregon math department's web page "Tips for being successful in math courses" is here:

`https://blogs.uoregon.edu/mathresources/tips-for-being-successful-in-math-courses`.

I don't know of anything else good to put here. If you find something, please let me know.

6.1.3. *Video lectures on the web.* Videos (and associated pdf files of lecture notes) on Math 251, given by Dan Dugger, a University of Oregon math department faculty member, are here:

`http://pages.uoregon.edu/ddugger/ma251_resources.html`

I have not looked at them, so please tell me your experiences. I strongly encourage trying them. With anything hard, the second explanation is always better. (I heard this with algebraic geometry textbooks, but it applies everywhere.)

Somebody in the math library staff recommended the Khan Academy (`http://www.khanacademy.org`; link valid Winter 2025.) I have had no time to look at any of its material. A recent department head has looked at a few examples, and believes (based on a small sample) that it often has reasonable explanations of algorithmic procedures, such as using the product and quotient rules for calculating derivatives. I have no information of the quality of what it says about understanding calculus or doing problems which require more than just following an algorithm. The website requires JavaScript, which is a security hazard, and probably also cookies, which are a privacy hazard.

Try (if you are willing to put up with Google's abuses of personal data) "Algebra and calculus help from an MIT graduate". at `https://www.youtube.com/user/mathbff`. The following information is from 2017. The site described still existed in 2025, but seems less organized than the information below suggests. It has about 35 videos, mostly between 15 and 20 minutes each, on an assortment of topics including many of the computations we do in Math 251 (including several kinds of limits, using several of the differentiation rules, and finding tangent lines). The version at `http://mathbff.com` includes text descriptions of the contents of the videos. Ones for Math 251 are mixed with ones for Math 252 and for precalculus. This site was recommended by a student several years ago, who reports that there is more depth than at the Khan Academy, but that the emphasis is still more on how to carry out algorithms, with less about the meaning of what one is doing. I saw nothing about the more complicated applications of calculus that we will do in the later part of the course. As for the Khan Academy, please tell me about your experiences with this site.

As with the Khan Academy, the website probably requires JavaScript, which is a security hazard, and probably also cookies, which are a privacy hazard. It is part of Google, which is

probably the worst corporate abuser of personal information in North America, and which will track everything you do, and correlate it with everything you do on any other Google site.

6.1.4. *UO tutors.* Math tutoring is available at the Tutoring and Academic Engagement Center. (This information is from Spring 2025.) See the heading "Math 251–253" at `https://engage.uoregon.edu/tutoring`. It has limited drop in math tutoring during the first week of classes, with regular service starting in second week of classes. In Fall 2013 it was open through Wednesday of finals week; that may be different now. **Warning:** In the past (around 2013), some math tutors there were not competent to tutor calculus. I have had students tell me they turned out to know more calculus than the person supposedly helping them. I don't know whether that has improved since.

6.1.5. *Math library drop-in homework help.* Drop-in homework help is available at the math library, in Fenton Hall. See `https://library.uoregon.edu/math-homework-help` for information. (This information is from Spring 2025.) I have heard nothing yet about how good the service is. **Warning:** The math department head knows of no quality control on the tutors.

6.1.6. *Paid tutors.* I believe the math department has a list of recommended paid tutors.

6.2. **Learning disabilities.** Students with documented learning disabilities who wish to use the Accessible Education Center to take tests under specifically arranged conditions should let me know as soon as possible, certainly by Monday of the third week of classes. Such students must also be sure to meet the Accessible Education Center's separate deadlines for requests. Normally (procedures may differ now), these are likely to be a week or more in advance of the exam date (much more for final exams). I can't do anything to help a student who misses its deadlines. (I know because I have tried in the past.)

6.3. **Reporting Obligations.** I am a "designated reporter". For information about my reporting obligations as an employee, please see `https://investigations.uoregon.edu/employee-responsibilities`.