Class Syllabus

MATH 1420, Calculus I

Dr. Ken W. Smith
Sam Houston State University

Spring 2018, Section 07 (CRN 21004)
MWF 3:00-4:20 in LDB 400

1 An important course!

Welcome to MATH 1420, Calculus 1, at Sam Houston State University! This is an important course, possibly one of the most significant classes in your academic career.

1.1 The beginnings of modern mathematics

The essential concepts of algebra and geometry were known to the Greeks over two thousand years ago and were later modified by Arab and Chinese civilizations over a thousand years ago. That material is the typical subject of the high school math curriculum. But the concepts of calculus, appearing in the seventeenth century, revolutionized society and were the foundations for the industrial and technological revolutions.

This course will examine mathematical concepts, developed during the 1600s and 1700s, which created modern science and changed the world! As your instructor, I will attempt to show you how useful and exciting this material is! We will focus on understanding and applying the major concepts of differential calculus and integral calculus.

As we focus on understanding these concepts, we will also focus on understanding the concepts leading up to calculus.

1.2 Introduction to Differential Calculus

This course introduces the basics of differential calculus, including limits, continuity, and the derivative. We develop techniques for differentiation of algebraic, logarithmic, exponential and trigonometric functions. We will explore applications of the derivative. Finally, we will develop the antiderivative and the integral.

Course objectives: Students completing this course will demonstrate mastery of the following concepts:

1. the definition of the derivative, including its geometric interpretation,
2. limits and continuity,
3. the derivative as rate of change,
4. methods of differentiation of elementary functions,
5. applications of the derivative to optimization problems,
6. the integral as the anti-derivative,
7. the definite integral and the Fundamental Theorem of Calculus.

1.3 Prerequisite Material

The prerequisite for this class is MATH 1410 (Precalculus/Elementary Functions) with a grade of at least a C.[1]

[1] MATH 1316 (Trigonometry) or the equivalent, with a grade of C, may also be an acceptable prerequisite; please talk to me *immediately* if you do not have MATH 1410 as a prerequisite.

A good understanding of both algebra and trigonometry is essential for this course. Students entering this course should be comfortable with function notation, the circular trig functions, the exponential function and its inverse. The prerequisite material is covered in chapter 1 of the textbook by Larson & Edwards and chapter 1 of the Open Stax textbook. There are also precalculus notes and video podcasts available on my Google Drive precalculus site.

1.4 No magic!

The power of mathematics is in its *concepts*; *understanding* concepts is much more important than mechanical procedures!

Some view mathematics as a collection of "magical" formulae, understood only by wizards and thoughtlessly memorized by everyone else. This view of mathematics, as "magical" formulas to be memorized, is harmful to learning math!

In this class we will avoid "magic"! We will avoid mechanical memorized formulas and thoughtless procedures. There is very little to memorize in this class!

If you understand the concepts, you do *not* need to memorize! I will help you achieve the understanding of these concepts. So, Harry Potter – and Hermione Granger – put away those wands and those memorized spells! ☺

2 Class Structure

2.1 Daily routine

Homework will be collected (almost) every day. The class period will begin with submission of homework (please put it on the front desk as you arrive) followed with the taking of a few questions over recent material. Most days will involve two lectures, each 20-30 minutes long, with a work break in the middle. The lectures are informal; feel free to ask questions or make comments. However, during lectures, students should put cell phones away and have both textbook and notebook on their desks.

Education research shows that students learn best by active note-taking. It is important to take notes and not merely watch the lecture! Note-taking is a bit of an art – practice and improve on this art!

After the lecture, feel free to post questions on the class discussion board. I will attempt to answer those questions as quickly as possible. Also feel free to post links to good resources (Khan Academy videos, for example) on the discussion board.

On Fridays there will be a 25-point quiz, intended as a quide to typical questions on the next exam.

2.2 Professional commitment

Please treat this class as you would any professional commitment. If you miss a class, please contact me (Dr. Smith) as quickly as possible, preferably by sending email to KenWSmith@shsu.edu. (Or you may leave voice mail at 936-294-4869.) *If you were to miss a day of work, you would contact your employer before your work day begins; in the same manner, contact me if you must miss class.* In your email, give a brief explanation for why you will have to miss the upcoming class. In most cases, I do not need further documentation.

A student who misses three class days has missed a significant portion of the class. A student who does not follow the professional commitment steps above will be required to meet with the instructor to discuss their progress in the class before returning to class. (Class material will not be graded until this meeting occurs.) The student may also have their semester grade lowered one letter in this case.

Except for extreme cases of a serious emergency, a student who misses more than three class days without contact with the professor will be presumed to have dropped the class and future material will not be graded.

2.3 Textbook and Course Notes

The textbook for Spring 2018 is Larson and Edwards, Calculus, *Early Transcendental Functions*, sixth edition c. 2015. We will cover chapters 2 through 5 of this textbook in calculus 1 and additional chapters in calculus 2. This textbook is $300 at the university bookstore and a little less at several local bookstores that *also* process student loans. But the textbook is *much* cheaper (just $35 to $100) purchased used through Amazon.com or other booksellers. (See this link at Amazon.com.)

In addition to the textbook, I will also provide *both* personal lecture notes (created by me, your professor) and a free online textbook provided by OpenStax, out of Rice University. The class lecture notes, with accompanying podcasts, are available both on Blackboard and publicly available on my Google Drive. The free Open Stax textbook is available at OpenStax Calculus Volume 1. The textbook comes in webview or PDF format, and you may use whichever format you wish. Webview is recommended – that design supposedly works seamlessly on any device.

We will cover parts 1 through 4 of my personal lecture notes available on Blackboard and Google Drive. This material parallels chapters 2 through 5 of the Larson & Edwards (LE) textbook and chapters 2 through 4 of the Open Stax (OS) textbook. Most homework questions will be from the Larson & Edwards textbook.

2.4 Blackboard and Google Drive

We will also use the Blackboard online learning system at Sam Houston State University. Daily materials will be posted on Blackboard, along with class announcements. Students should check Blackboard and their email daily. Important course announcements will be given by email using Blackboard.

The class Lecture Notes are also publicly available on both Blackboard and my Google Drive folder.

2.5 Office hours and contact information

My e-mail address is KenWSmith@shsu.edu. Please feel free to contact me by email. My office is LDB 421E and my office phone number is 936-294-4869. (Please leave voice mail; I do not answer that phone but voicemail is sent to my computer and I listen to it there.)

Scheduled office hours are Friday afternoons, 2-3 pm and 4:30-4:45. There may be additional office hours announced in class. Feel free to send a private email to set up an office appointment for another time.

2.6 Daily homework

The homework sets are critical to success in the course. For this reason, a homework grade of *at least 50%* is required to receive a grade on Quizzes 1-5 (January 26-March 2).

2.7 Quizzes

There will be a quiz most Fridays. (See the schedule which accompanies this syllabus.) The quizzes are worth 25 points each. A homework grade of at least 50 % is required to receive a grade on quizzes 1-5.

Calculators may not be used until after Exam 2.

2.8 Exams

There are four exams. Exam 1, worth 100 points, is Friday **February 9**. The midterm exam, worth 200 points, is Friday **March 9**. This exam is the Friday immediately before spring break. Exam 3, worth 100 points, is Friday, **April 13**. The final exam is Monday, **May 7.** Like the midterm exam, the final exam is worth 200 points.

2.9 Calculators

Calculators can be a great aid to mathematical computations but they can also act like a "magic wand", providing answers *without understanding*. In this course we will emphasize the *understanding* of mathematical concepts in place of "magic", so the use of these magical wands will be restricted. Students should not use a calculator with a computer algebra system (CAS).

Calculators will not be allowed on quizzes or exams until *after* the second exam.

3 Class Grading System

3.1 Consistent regular study

Students should spend two to three hours of outside study between class days. A successful study routine outside of class is important for success in MATH 1420.

Success in a college level calculus class involves both a solid understanding of the precalculus ideas (algebra, trigonometry, elementary functions, including exponential functions and logarithms, etc.) and mature study habits. One might diagram the possibilities of success in calculus with the following table.

	Good math background	Poor math background
Good study skills	A	C
Poor study skills	C	F

I am willing to help you improve (or catch up) on your mathematics background. But good study habits are your responsibility! ☺

3.2 Grade Rubrik

There are ten quizzes, each worth 25 points, totalling 250 points. There will be daily homework totaling about 150 points. The four exams are worth 600 points. So the total number of points available across the semester is 1000 points.

A student who meets the class requirements and who achieves 90% or higher will receive an A grade for the semester.[2] A student who meets the class requirements and achieves at least 80% will receive at least a B. Similarly 70% gives a C grade. In order to receive a D grade, a student should achieve at least 65%.

A grade of C or better in this class is required to continue on to MATH 1430, Calculus 2.

3.3 Make-up policy

Students who must miss a class day are expected to email me as soon as possible, preferably before the missed class. View each class period as you would any other professional experience; do not miss it without at least sending a brief explanatory email.

Homework is due on a MWF schedule by 3 pm. A student may turn in *two* homework assignments late for full credit. After that, late homework is graded for 50% of its value.

Missed quizzes are not made up. However, after each exam, I will use the percentage grade on that exam to replace the *lowest* quiz grade to date. This quiz improvement plan is intended to replace a missed quiz (due to illness) but it can also be used to replace a poor quiz grade if a student has not missed any quizzes.

At rare times, due to a significant personal emergency, a exam grade will be made-up. This occurs only after sufficient communication of the emergency by the student. When this happens, the make-up exam will usually be given at the end of the semester, during Finals Week.

[2] I reserve the right to *lower* these cutoff grades a little, allowing, for example, an 88% for an A or a 79% for a B.

3.4 Collaboration & Plagiarism

On homework it is acceptable to receive tutoring from the instructor. Students are also encouraged to discuss the problems with other students. However, anything a student submits for grading must be in their own words, with their understanding of the material. To turn in material that is someone else's understanding or written in someone else's words is **plagiarism**.

On in-class exams or quizzes, all the work a student turns in must be their own, without any aid from anyone else. Giving or receiving aid on in-class quizzes and exams will be considered plagiarism (cheating.) The penalties for plagiarism will include at least a zero grade on the submitted material and most likely a failing (F) grade in the course with a referral to a disciplinary committee.

3.5 Writing mathematics

Scientists should write well. Please do not abbreviate, unless we have agreed on some common abbreviations. Please write with good grammar, in complete sentences. Spell correctly. Write so that others will find your work easy to read.

Display your work in correct mathematical notation, with equal signs, appropriate symbols and function notation. Put equal signs (=) *only* between quantities that are equal. Use an arrow ($\Longrightarrow$) to signify "the next step is...". Please do *not* confuse = and $\Longrightarrow$!

As your instructor, I will try to help you improve your math writing. Standards for mathematical writing will rise throughout the semester.

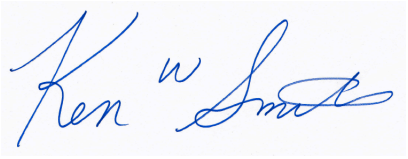
3.6 Final Comments

I am on Facebook at https://www.facebook.com/kenwsmith54/. I am happy to accept your friend requests.[3]

A separate schedule accompanies this syllabus. That schedule includes drop dates, quiz dates and exam dates.

If you are interested in Honors credit for this class, please see me during the first or second week of class.

Please feel free to talk to me. I want you to enjoy this class and I want you to do well!



Dr. Ken W. Smith,
Tuesday, January 9, 2018

[3]But *you* may not want to share Facebook posts with your professors...?! ☺

MATH 1420 Schedule

Spring 2018
(Tentative)

This schedule is organized by daily class lecture notes, labeled 1.1, 1.2, ..., etc.. The daily lecture notes are also linked to sections in the Larson and Edwards (LE) textbook and also the OpenStax (OS) textbook. *Textbook sections differ in numbering from the lecture notes sections.*

Part 1, The Derivative Concept

1.1 **Wednesday, Jan 17**, The Slope of a Function

We explore the main theme of this course, applying the slope concept to functions other than just lines. (See Larson & Edwards 1.2 & 2.1 and OpenStax 2.1)

1.2 **Friday, Jan 19**, The ARC & IRC

The slope of a function is expressed as "rate of change", as the IRC. If the function describes distance with respect to time, then the IRC is velocity. The IRC, the"slope" of a function and the "derivative of a function at a point", the velocity of a particle – all these represent the same concept. (LE 2.1, OS 2.1 & 3.4)

1.3 **Monday, Jan 22**, An Introduction to Limits

We explore the limit concept in two different ways. (LE 2.2,OS 2.2)

1.4 **Wednesday, Jan 24**, Limit Laws and Continuity

Continuity allows us to develop an algebra of limits. (LE 2.3, 2.4, OS 2.3 & 2.4)

1.5 **Friday, Jan 26**, Limits and Infinity

We study limits *at* infinity and limits that are *equal* to infinity. Along the way, we discover that number e. (LE 2.5, 4.5, OS 2.2) **Quiz 1**

1.6 **Monday, Jan 29**, Precise Definitions of Limits and Derivatives

We give a precise "ϵ-δ" definition of a limit. We also (finally) write out the precise definition of the derivative. (LE 3.1, OS 2.5 & 3.1)

1.7 **Wednesday, Jan 31**, The IRC of Powers of x

It is easy to compute the derivative of a polynomial. (LE 3.2, OS 3.3)

$\Longrightarrow$ **Thursday, Feb 1, Last day to drop the class and get full tuition refund.**

1.8 **Friday, Feb 2**, The IRC of Transcendental Functions

We look at derivatives of $\sin x, \cos x$ and $\exp x$. (LE 3.2, OS 3.5 & 3.9) **Quiz 2**

1.9 **Monday, Feb 5**, Complex numbers and Euler's Marvelous Identity

We review complex numbers. We also review some basic limit results, while showing off a remarkable result of Euler. (This lecture not in the LE or OS textbooks.)

Part 2, Computing the Derivative

2.1 **Wednesday, Feb 7**, The Derivative as a Function

The derivative of a function is itself a function. What functions have we created (so far) by replacing f by f'? (LE 3.2, OS 3.2)

EXAM **Friday, Feb 9, Exam 1, over Part 1**

2.2 **Monday, Feb 12**, Product and Quotient Rules

The product and quotient rules greatly extend the functions we can differentiate. (LE 3.3, OS 3.3)

2.3 **Wednesday, Feb 14**, Derivatives of Trig Functions

The product and quotient rules, along with the derivatives of $\sin x$ and $\cos x$, allow us to differentiate the six basic trig functions. (LE 3.3, OS 3.5)

2.4 **Friday, Feb 16**, The Chain Rule

The chain rule is the most powerful tool for computing derivatives. (LE 3.4, OS 3.6) **Quiz 3**

2.5 **Monday, Feb 19**, The Chain Rule for Transcendental Functions

The chain rule helps us differentiate both trig and exponential functions. (LE 3.4, OS 3.9),

2.6 **Wednesday, Feb 21**, Derivatives of Inverse Functions

Interchanging input, x, with output, y, gives us the concept of inverse function. If we know the derivative of a function, we can find the derivative of its inverse. (LE 3.6, OS 3.7)

2.7 **Friday, Feb 23**, Implicit Differentiation

The chain rule helps us compute derivatives of functions defined implicitly. (LE 3.5, OS 3.8) **Quiz 4**

2.8 **Monday, Feb 26**, Higher Derivatives

If the derivative of a function is itself a function, then it also has a derivative. But what does the derivative of a derivative *mean*? (LE 3.3, OS 3.2),

2.9 **Wednesday, Feb 28**, Hyperbolic Trig Functions and their Derivatives

The interplay between exponential and trigonometric functions, suggested by Euler's identity, leads us to hyperbolic trig functions. (LE 5.9, OS 1.5, 6.9),

2.10 **Friday, Mar 2**, Mastery of Derivatives

At this time, we should be able to differentiate *anything*! We pause to review our results and learn another trick or two. **Quiz 5**

Part 3, Applications of the Derivative

3.1 **Monday, Mar 5**, Related Rates

The easiest application of the derivative involves two variables changing in relation to each other. (LE 3.7, OS 4.1),

3.2 **Wednesday, Mar 7**, Linearization and the the Differential

The derivative is a ratio of *differentials*, dy divided by dx. These differentials give us another view of the tangent line. (LE 4.8, OS 4.2)

EXAM **Friday, March 9, Midterm Exam, over Parts 1 & 2**

Spring break is March 12-16.

3.3 **Monday, Mar 19**, Maxima, Minima, Critical Points

The first derivative guides us to critical points of a function. (LE 4.1, OS 4.5, 4.6)

3.4 **Wednesday, Mar 21**, Critical Points and Curve sketching

We use the derivative of $f(x)$ to graph $y = f(x)$. (LE 4.3, OS 4.3)

3.5 **Friday, Mar 23**, Concavity and Curve Sketching

The second derivative, $f''(x)$, tells us the concavity of the graph $y = f(x)$. (LE 4.4, 4.6, OS 4.5, 4.6) **Quiz 6**

3.6 **Monday, Mar 26**, Problem Solving and Optimization

Applied problems often require that we maximize or minimize a certain quantity. (LE 4.7, OS 4.7),

3.7 **Wednesday, Mar 28**, Second Derivative and Optimization

The second derivative helps us distinguish between a maximum and a minimum. (LE 4.7, OS 4.7)

Friday, Mar 30, No class, Good Friday Holiday

3.8 **Monday, Apr 2**, More Optimization

Problem-solving requires critical thinking, not memorization, so we practice this some more! (LE 4.7 & PS, pp 277-278, OS 4.7)

3.9 **Wednesday, Apr 4**, Linearization: Newton's Method and L$\hat{\text{h}}$opital's Rule

It is important to *understand* the slope of a function. The "slope" has many uses and we examine two more here. (LE 3.8, 8.7, OS 4.8),

3.10 **Friday, Apr 6**, A Little Analysis: The MVT and Related Concepts

We look at the Intermediate Value Theorem, the Mean Value Theorem and Rolle's Theorem. (LE 4.2, a little of 2.4, OS 4.4) **Quiz 7**

$\Longrightarrow$ Friday, Apr 6, is the last day to drop the class with a Q grade.

Part 4, The Integral

4.1 **Monday, Apr 9**, Antiderivatives/Indefinite Integrals

We transition into the last part of our course by *undoing* the derivative, recovering $f(x)$ from $f'(x)$. (LE 5.1, OS 4.10, OS 5.6)

4.2 **Wednesday, Apr 11**, Approximating area, Sigma, Riemann Sums

We view a region as a limit of rectangles. (LE 5.2, OS 5.1),

EXAM **Friday, Apr 13, Exam 3, over Part 3.**

4.3 **Monday, Apr 16**, The Signed Area Function as a Limit

Riemann sums give us a mechanism for viewing area as a limit. (LE 5.3, OS 5.1)

4.4 **Wednesday, Apr 18**, Derivatives of Signed Area Functions

The derivative of a signed area function is the original function! So the signed area function is an antiderivative. (LE 5.4, OS 5.3)

4.5 **Friday, Apr 20**, FTC 2

We explore further the Fundamental Theorem, viewing signed area functions as antiderivatives. (LE 5.4, OS 5.3) **Quiz 8**

4.6 **Monday, Apr 23**, Integral as Net Change

Adding up the total change of a function (over, say, an interval of time) is a good way to view the integral. (LE 5.4, OS 5.4),

4.7 **Wednesday, Apr 25**, Mastering Indefinite and Definite Integrals

We pause to review the main concepts of the integral, both indefinite and definite integrals.

4.8 **Friday, Apr 27**, Integration by Substitution

A powerful integration technique involves reversing the chain rule! (LE 5.5, OS 5.5) **Quiz 9**

4.9 **Monday, Apr 30**, Trig Substitution

Substitution is especially powerful if we can associate an expression with a right triangle! (LE 8.4, OS 5.7),

4.10 **Wednesday, May 2**, Reviewing Integrals

We review the techniques developed in Part 4.

* **Friday, May 4**, Reviewing the First Calculus Course

We prepare for our final exam, which covers *everything* in the class. **Quiz 10**

EXAM **Monday, May 7, Final Exam, 3:00-6:00 PM.** This exam is comprehensive.

Last modified on Tuesday, January 9, 2018.