Math 1311-04 Accelerated Engineering Calculus I

FALL 2017

Instructor: Qing Xia,
Teaching Assistant: Ryan Dickmann,

Lecture Time and Location: MTWF, 10:45 am-11:35 am, AEB 320 (MWF) and WEB L110 (T)

Lab Time and Location: Thursday, 10:45am-11:35am/11:50am-12:40pm LS 107

Email: xia@math.utah.edu

Office Hours & Location: JWB 107, Time TBD. Help can also be found in the tutoring center.

Dates

- Final, Thursday, Dec 14, 2017, 10:30 am–12:30 pm, AEB 320.
- Last day of class: Thursday, Dec 7, 2017.

Textbook


Homework

- Homework is assigned each lecture and collected weekly. The assignments will be due on Fridays at the beginning of class.
- Late homework is not accepted.
- Homework solutions that are not stapled will not be accepted.
- Homework with spiral bound notebook fringe will not be accepted.
- Solving and writing out solutions to homework problems is where most of your learning will take place. Take pride in your work.

Quizzes

15-20 minutes Quiz will be on Friday at the end of class.
Grading Policy

The grades will be calculated as follows: Lab (15%) and Attendance (5%) 20%, Homework 15%, Quizzes 10%, 2 Midterm 30%, Final Exam 25%.

The grade scale will be: A (93-100), A- (90-92), B+ (87-89), B (83-86), B- (80-82), C+ (77-79), C (73-76), C- (70-72), D+ (67-69), D (63-66), D- (60-62), E (0-59).

There will be no extra credits, partial credits, rounding up, late homework or makeup exams.

Prerequisite

AP Calculus AB score of 4, or AP Calculus score of 3.

Course Description

Math 1311 and 1321 together are equivalent to the three semester sequence Math 1210, Math 1220, and Math 2210. This sequence is intended for engineering majors. Review of introductory calculus, applications of differential and integral calculus, introduction to differential equations, conic sections and polar coordinates, numerical approximation, sequences and series, power series.

Learning Objectives

The goal of Math 1311 is to master the basic tools for the study of functions \( f(x) = y \), termed the calculus, and become skilled in its use for solving problems in science and engineering. These basic tools and problem solving skills are described below.

- Students will understand how to transform functions into other functions through \( x \)- and \( y \)- translations and rescaling, re-parameterizations, and function composition. Students will also know the properties of special classes of functions including logarithms, exponential functions, polynomials, and rational functions; and know how to obtain function inverses \( f^{-1}(y) = x \) when they exist.

- Students will master the concept of a limiting value of a function \( f(x) = y \) when \( x \) approaches a value \( c \), know when limits exists, utilize limit laws, how the property of continuity of a function at \( c \) relates to its limiting value, how asymptotic behavior can be described by limits, and how limiting values can be specified even when the \( f(c) \) is not defined.

- Students will understand how to use limits to compute the derivative of a function \( f' \) that describe or rate of change of a function \( f \). Students will be able to utilize derivatives to model how two related quantities change with respect to each other, including motion of objects by in terms of velocity and acceleration. Students will also learn the methods of differentiation for different classes of functions including exponential and logarithmic functions, trigonometric and inverse trigonometric functions, power functions, and compositions, sums, products, and quotients of functions, as well as differentiating functions that are only implicitly defined by an equation.

- Students will also be able to utilize the derivative in applied contexts, including function approximation, and how the average slope of a function relates to the derivative through the mean value theorem. If two quantities are related by an equation, students will be able to obtain the derivative of one quantity by knowing the derivative of the other. Students will know how to utilize linear approximations to perform numerical/algorithms equation solving via Newton’s method. Also, students will be able to
utilize the derivative to find maximum, minimum, or otherwise "optimal" input values for equations important in science, business, and engineering.

- Students will understand the definition of the integral of a function as the limiting value of an increasingly large average of function values. They will be able to relate the integral to anti-differentiation, when appropriate, through the fundamental theorem of calculus. Students will also be able to relate the integral to the area under the function’s curve, know how to approximate the integral by a finite sum, and how to integrate over infinite-length domains. Specific integration techniques will also be mastered, including substitution, integration-by-parts, and partial fractions. Finally, students will understand the key concept underlying integration, that it computes the net accumulation of a quantity through summation of the change in the quantity amount per unit of time or space, over an specified interval of time or space.

- Students will be able to utilize methods of integration to compute volumes of objects with circular-shaped aspects, and compute lengths of curves. These applications introduce a higher-level concept of integration, involving the summation of small volume segments $dV$ or small length segments $ds$, which are computed by performing an appropriate parameterization to a real-number-line integral in terms of $dx$.

- Students will be skilled in using integration to compute problems important in physics and engineering. Students will know how to compute of an average value of a function using the mean value theorem for integrals, the center of mass for objects, and the computation of energy as a force integrated over a distance. Students will also be able to utilize physical laws to formulate differential equations that solve for the motion of masses by forces of gravitation, friction, electrostatics, to name a few. Students will also become familiar with the phenomenon of exponential growth and decay in science and engineering contexts.

**Tentative Week-by-week guide of topics and textbook sections**

We will adjust pace though the lectures.

- Week 1: 1.3, 1.5, 1.6, 1.7: Functions, Compositions, Exponential Function, Logarithms, Inverse Functions, Parametric Curves
- Week 2: 2.1, 2.2, 2.3, 2.4, 2.5: Velocity, Limits, Limit Laws , Continuity
- Week 3: 2.6, 2.7, 2.8, 3.1: Derivatives, Relationship between a Function and its Derivative. Derivatives of Polynomials and Exponential
- Week 4: 3.2-3.6 , Product and Quotient Rules, Derivatives of Trig Functions, Chain Rule, Implicit Differentiation, Inverse Trig Functions
- Week 5: 3.7, 3.8, 3.9, 4.1, 4.2: Log Functions, Log Derivatives, Linear Approximation, Differentials, Applications, Linear Approximation, Differentials, Related Rates, Max and Min Values
- Week 6: 4.3, 4.5: Derivatives and Shapes of Curves, lHopitals Rule,
- Week 8: 5.2, 5.3, 5.4, 5.5: The Definite Integral, Evaluating Definite Integrals, Fundamental Theorem of Calculus, Substitution Rule
• Week 9: 5.6, 5.7, 5.8, 5.9: Integration by Parts. Additional Techniques of Integration. Approximate Integration

• Week 10: 5.10, 6.1, 6.2: Improper Integrals, Areas Between Curves, Volumes.

• Week 11: 6.2, 6.3, 6.4: Volumes, Volumes by Shells, Arc Length

• Week 12: 6.5, 6.6: Average Values; Applications to Physics and Engineering

• Week 13: 6.6, 6.7, 6.8 7.1, 7.2, 7.3 Modeling with Differential Equations, Direction Fields, Separable Differential Equations

• Week 14: 7.3, 7.4, 7.5, 7.6, 8.1, 8.2: Exponential Growth and Decay, Sequences and Series, Review

• Week 15: Review

Other Policies

• Cheating: You’ll receive 0 points if caught cheating in homework or exams; The act of cheating in exams will be reported.

• Behavior in class is required.

• Attendance is encouraged.

ADA Statement

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services (CDS), 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and me to make arrangements for accommodations. All information in this course can be made available in alternative format with prior notification to CDS.

Student Responsibilities

All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. You have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, collusion, fraud, theft, etc. Students should read the Code carefully and know you are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee. http://regulations.utah.edu/academics/6-400.php