University of International Business and Economics

University of International Business and Economics
International Summer School

MAT 110 Calculus I

Term: June 15 - July 16, 2020
Instructor: TBD
Home Institution: TBD
Email: TBD
Class Hours: Monday through Thursday, 120 minutes each day (2,400 minutes in total)
Office hours: TBD
Discussion sessions: TBD

Total Contact Hours: 66 contact hours (45 minutes each, 48 hours in total)
Location： WEB
Credit: 4 units

Course Description

The course covers the following concepts: Functions of a real variable; Basics functions such as polynomial, exponential, logarithmic, and trigonometric functions; Limits and continuity; The derivative of a function of a real variable; The derivative as a function; Continuous and differentiable functions; Rules of differentiation; Implicit functions and their derivatives; Extreme values of a functions; The mean value theorem; First and Second derivative tests; Analyzing the shape of a graph of a function using derivatives; l'Hospital's rule for computing limits; Tangent line to the graph of a function; Taylor polynomials of a function; Analyzing the behavior of a function near a point using Taylor polynomials; Antiderivatives; Definite integral of a function; Geometrical significance of the definite integral of a continuous function over an interval; Indefinite integrals; The fundamental theorem of Calculus; Basic methods to compute integrals; The substitution rule.

Course Goals

A student who satisfactorily completes this course should be able to:
1. Differentiate and integrate basic functions;
2. Analyze the shape of the graph of a function using derivatives of the function;
3. Investigate the extreme value problem for a function of a real variable;
4. Approximate a function by its Taylor polynomials near a point

Required Text

M. Bona and S.V. Shabanov, Concepts in Calculus I, Second Edition, ISBN 978-1-61610-160-6, University Press of Florida, 2012.

A free PDF file of the latest 2014 edition of the textbook will be provided to all students enrolled into the course. Please do not buy a beta version of the book available online.

Prerequisites

Students are expected to be familiar with basic algebra and trigonometry studied in high school.

Grading Policy

In five written assignments, there are total 40 problems. Each problem is worth a point if it is solved correctly. So, the perfect score is 40 for regular problems (and 45 with all extra credit problems). There is a small partial credit for incomplete solutions (a fraction of a point). If P is the total number of points, then the course score G=100(P/40), that is, G=100 if P=40 and G=50 if P=20, etc.

Grading Policy

If G is the course score as defined above, then the grade thresholds are

A	90 and above	**C+**	65-69
A-	85-89	**C**	60-64
B+	80-84	**C-**	55-59
B	75-79	**D**	50-54
B-	70-74	**F**	below 50

It should be noted that in many US colleges **C-** is not a passing grade if the course is required for a major.

General expectations

Students are expected to:

- *Do the homework regularly, even though the homework is not to be turned in. Remember that to get points toward your grade, every week you have to solve 5-6 problems randomly chosen from homework problems and 3-2 problems very similar to those in the homework or Examples in the textbook. So, read Examples in the textbook while doing the homework and review your solutions before exams.*
- *Review class notes and, if necessary, read the corresponding sections in the textbook, clarify questions about basic concepts of the course during office hours.*
- *Complete required written work on time.*

Course schedule, topics, and homework assignments

The planned schedule sketched out below may be modified to suit the interests or abilities of the enrolled students or to take advantage of special opportunities or events that may arise during the term. There will be a discussion session every week on Wednesday evening to discuss homework problems. The students are also encouraged to organize a chat group supervised by TAs to get help on homework problems and avoid multiple discussions of the same problem.

WEEK ONE: Functions

Mon: Sections 1-3. Functions. Functions of a real variable. Graph of a function. Classes of functions. Power function. Polynomials. Rational functions. Trigonometric functions. Periodic functions. Algebraic functions. Transcendental functions. Operations on functions. Adding and multiplying functions. Composition of two functions.
Assignment: 1.1 (1-4, 6-8, 13-19), 2.7 (1-4, 7, 9, 10, 12, 16), 3.3 (1-3, 5, 6, 13, 19, 20),
Tues: Sections 4-5. Graphs of basic functions (power, trigonometric, and exponential functions). The inverse function. Graph of the inverse functions. Logarithmic function. Properties of the logarithmic function.
Assignment: 4.2 (12-16, 19, 20), 5.3 (1-3, 5, 8-12)
Wed: Sections 5-6. Inverse trigonometric functions. Velocity problem and the tangent line problem. The average and instantaneous velocities of a motion.
Assignment: 5.3 (1-3, 5, 8-12, 15-17), 6.3 (1, 3, 7, 19, 20)
Thurs: Section 7-8. Limit of a function at a point. Precise definition of the limit. One-sided limits. Relation between one-sided limits and the limit at a point. Infinite limits. Limit laws. The squeeze principle. Limit of a polynomial at a point.
Assignment: 7.5 (1-7, 13, 14, 18), 8.4 (2, 4, 7, 10, 11, 16, 17)

WEEK TWO: Limits and Derivatives

Mon: **Exam 1 covers Sections 1-6 (one hour).**
Section 9. Continuity at a point. Continuous functions. Functions that are not continuous at a point. A jump discontinuity. One-sided continuity. Continuity of the sum, product, and ratio of continuous functions. Intermediate value theorem.
Assignment: 9.6 (1-3, 10-14, 17-19)
Tues: Sections 10-11. Limits at infinity. Graphical interpretation of a finite limit at infinity. Infinite limits at infinity. Computing limits at infinity for rational functions. Secant and tangent lines to a graph. Slope of the tangent line. The derivative at a point. Instantaneous velocity as the derivative.
Assignment: 10.4 (1-12), 11.4 (1-3, 6, 7, 11, 19),
Wed: Sections 11-12. The derivative as a function. Derivative of a power function. Derivative of a root function. Differentiability versus continuity. Higher order derivatives.
Assignment: 11.4 (1-3, 6, 7, 11, 19), 12.5 (1-3, 7-10, 12)
Thurs: Sections 13-14. Derivative of the sum of two functions. Derivative of a polynomial. Derivative of an exponential function. The number *e*. Exponential function whose derivative is equal to the function itself. The product and quotient rules.
Assignment: 13.3(3, 4, 6-9, 15, 16, 18), 14.3 (1-12, 14-18)

WEEK THREE: Rules of Differentiation

Mon: Exam 2 covers Sections 7-12 (one hour).
Section 15. Derivatives of the trigonometric functions (sine, cosine, tangent, and cotangent).
Assignment: 15.1 (5-12),
Tues: Sections 16-17. The chain rule. Functions defined implicitly. Implicit differentiation. Tangent lines to implicitly defined curves. Derivatives of the inverse trigonometric functions.
Assignment: 16.4 (1-13, 18-20), 17.3 (1-3, 8-12, 17, 18)
Wed: Sections 18-19. Derivative of logarithmic functions. Logarithmic derivatives. Differentiation of algebraic functions with the help of logarithmic derivative. The number *e* as the limit. Some applications of rates of change to physics and economics.
Assignment: 18.6 (4-10, 15-16), 19.3 (3-6, 8, 12, 17)
Thurs: Sections 20-21. Related quantities. Related rates of change. Tangent line approximation near a point. The differential of a function and its geometric significance. Derivative as a ratio of differentials. The derivative of the inverse function and the differential. Application of the differential to analysis of related errors.
Assignment: 20.7 (2-7, 10, 19, 20), 21.7 (1, 3(i-iii), 4(i-iii), 8(i), 11, 19)

WEEK FOUR: Applications of Differentiation

Mon: Exam 3 covers Sections 13-21 (one hour).
Sections 22. Extreme values of a function. Relative maxima and minima. Derivative at a local extremum. Fermat's theorem.
Assignment: 22.3 (1(i-vii), 2(i-iv), 3(i-iii), 7),
Tues: Sections 23-24. Rolle's theorem. Critical points of a function. The mean value theorem. Properties of the derivative. The increasing-decreasing test. Monotonic functions. The inverse function theorem (a baby version). The first derivative test for local extrema. Properties of the second derivative. Concavity of a function. Inflection points. The second derivative test for local extrema.
Assignment: 23.3 (3,4, 8(i-iii), 9, 18(i-vi), 22, 23(i-ii), 24), 24.3 (1(vi-xii, xix-xxii), 2(i-iii), 7-8)
Wed: Sections 25-26. Linear approximation. Accuracy of a linear approximation near a point. Higher-order differentials at a point. Taylor polynomials about a point. Approximation of a function by Taylor polynomials near a point and its accuracy (Taylor theorem). Taylor polynomial about local extrema. L'Hospital's rule. Indeterminate forms and their resolution by mean of l'Hospital's rule.
Assignment: 25.7 (1,3, 5,6, 9, 14, 17(i-iii), 18(i, ii)), 26.5 (1(i-x, xiii-xv), 2(i-ii, v)
Thurs: Sections 27-28. Asymptotic behavior of a function. Vertical, horizontal, and slant asymptotes of a graph. Comparison of the graphs of power, exponential, and logarithmic functions. General guidelines for how to analyze a shape of the graph. Optimization problems. Extreme values on an interval. Extreme value theorem. The fist derivative test for absolute extreme values on an interval.
Assignment: 27.4 (1(i-x, xxx-xxxii), 28.2 (1-5, 7, 8, 10)

WEEK FIVE: Integration

Mon: Exam 4 covers Sections 22-28 (one hour).

Sections 30. Position of a moving object from its velocity. Antiderivative of a function. Uniqueness of antiderivative. Linearity of antiderivative. The general antiderivative of a function defined on disjoint intervals. Antiderivatives of basic functions. Antiderivatives of higher orders. Application: motion with a constant acceleration (a free falling object).
Assignment: 30.5 (1(i-vii, x-xiv), 3(i-iii, v)),
Tues: Sections 31-33. Distance travelled by an object with a given non-constant speed. Area under a graph of a continuous function. Upper and lower sums. The area as the limit of the upper and lower sums. Geometric sum. Sigma notations for sums. Bounded functions. The definite integral. Riemann integrable functions. Example of a non-integrable function (Dirichlet function). Riemann sums and integrability. Continuity and integrability. Properties of the definite integral. Fundamental theorem of Calculus.
Assignment: 31.7 (1, 2, 5(i-iii), 8(i-iii), 10, 13), 32.9 (2, 3, 9(i-v)), 33.3 (1, 2, 5, 6, 8(i-x)))
Wed: Sections 34-35. Indefinite integral as the most general antiderivative. The net change theorem. Indefinite integrals of basic functions on a single interval of continuity. The substitution rule for indefinite integrals.
Assignment: 34.2 (1(i-vii, x-xv, xix-xxi), 4(I, iv), 5, 6), 35.4 (1(i-x), 2(i-iv), 3(iv-vi, xi-xiii))
Thurs: Discussion and **Exam 5 covers Sections 30-35 (one hour).**