

COURSE OUTLINE

Calculus I with Analytic Geometry

Course Description

MA 151. Calculus I with Analytic Geometry. 5 hours credit. Prerequisite: Placement score or MA 131 or MA 135 with a C or better, and MA 140 or MA 145 with a C or better. This course will enable the student to solve problems involving limits, derivatives and some types of definite and indefinite integrals both analytically and graphically, and use them in physical applications.

Course Relevance

The student will be able to use calculus in engineering, physics, chemistry, math and other technical fields.

Required Materials

Larson, R. and Edwards, B. H. (2010). *Calculus with analytic geometry* (9th ed.). Belmont, CA,: Brooks/Cole, Cengage Learning

A graphing calculator is required for this course. The TI 83/84 is recommended, and calculators that perform symbolic differentiation and integration (such as the TI-89) may not be allowed on some exams.

Learning Outcomes

The intention is for the student to be able to:

1. Solve problems using calculus concepts of limits, derivatives and integrals both analytically and graphically.
2. Use calculus concepts in physical applications.

Learning PACT Skills that will be developed and documented in this course

Through involvement in this course, the student will develop ability in the following PACT skill area(s):

Analytical Thinking Skills

1. Problem solving
 - Through the solution of multi-step calculus scenarios, the student will develop increased ability to analyze and solve problems.
2. Critical thinking
 - Through the formation of mathematical models, the student will develop solutions to real-world situations.

Major Summative Assessment Tasks

These learning outcome(s) and the Learning PACT skill(s) will be demonstrated by:

1. Solution of problems involving limits, derivatives and integrals, including those that involve physical applications, that synthesize the material covered in the course.

Course Content

- I. Skills or Competencies—Actions that are essential to achieve the course outcomes:
 - A. Manipulate functions
 - B. Evaluate limits and identify discontinuities
 - C. Find explicit and implicit derivatives of algebraic and transcendental functions
 - D. Use derivatives in applications of rates of change, optimization and to analyze graphical characteristics
 - E. Evaluate basic integrals directly and with u-substitution
 - F. Use integrals in applications of area and rectilinear motion
- II. Themes—Key recurring concepts that run throughout this course:
 - A. Limits
 - B. Derivatives
 - C. Applications, including graphing
 - D. Integration
- III. Issues—Key areas of conflict that must be understood in order to achieve the intended outcome:
 - A. Application of basic mathematics skills to advanced mathematics courses
 - B. Analytical problem-solving vs. solving with technological tools
 - C. Recognizing when a solution is reasonable
- IV. Concepts—Key concepts that must be understood to address the issues:
 - A. Basic arithmetic, algebra and trigonometry
 - B. Choosing effective methods to solve problems

Learning Units

- I. Preparation for calculus
 - A. Review of trigonometric functions (Appendix C3, online)
 - B. Graphing, using symmetry and intercepts
 - C. Lines and slope
 - D. Identifying functions, finding function values, operations with functions, domain and range of functions
 - E. Data sets and regression
- II. Limits and continuity
 - A. Limits from graphs and from a table
 - B. Computing limits using properties of limits
(The more rigorous definition of limits is left to the discretion of the instructor.)
 - C. Discontinuities, removable and nonremovable, and one-sided limits
 - D. The Intermediate Value Theorem
 - E. Infinite limits and vertical asymptotes
- III. Derivatives
 - A. The definition of derivative
 - B. Basic rules of finding derivatives including the chain rule

- C. Implicit differentiation
- D. Problems involving related rates

IV. Derivatives in applications

- A. Extrema on an interval
- B. Rolle's Theorem and the Mean-Value Theorem
- C. Intervals where functions are increasing and decreasing
- D. Intervals where functions are concave up and concave down, and points of inflection
- E. Relative extrema using the first and second derivative tests
- F. Limits at infinity and horizontal and slant asymptotes
- G. Graphs of functions both with and without the use of technology
- H. Applied optimization problems
- I. Newton's method
- J. Differentials

V. Basic integrations

- A. Antiderivatives
- B. Approximating area using rectangles
- C. Definite integrals
- D. Evaluating integrals by substitution
- E. The Mean-Value Theorem for Integrals and the average value of a function
- F. Numerical integration

VI. Logarithmic, exponential and other transcendental functions

- A. Review of logarithmic properties and the derivative of the natural logarithmic function
- B. Integration of the natural logarithmic function
- C. Inverse functions
- D. Differentiation and integration of exponential functions
- E. Bases other than e with applications
- F. Differentiation of inverse trigonometric functions
- G. Integration of inverse trigonometric functions
- H. Hyperbolic functions (optional, if extra time is available)

Learning Activities

Independent and collaborative learning activities will be assigned to assist the student in achieving the intended learning outcomes. Activities identified in the syllabus, such as class discussion, lecture, reading, in-class presentations, group work or projects will also contribute to learning.

Grade Determination

Grade determination will be based on assessment tasks and other activities such as exams or assignments that the instructor identifies in the syllabus.