I. Catalog Information

MATH 12  Introductory Calculus for Business and Social Science  5 Unit(s)

(See general education pages for the requirement this course meets.)

Prerequisites: Mathematics 11.

Five hours lecture.

(CAN MATH 34)

Introduction to limits, differentiation, and integration of single variable functions. Differentiation of multivariate functions. Applications in business, economics, and social science.

II. Course Objectives

A. Identify the domain and range of functions
B. Evaluate limits and use them to determine continuity
C. Evaluate derivatives using the definition and using the sum, difference, product, quotient, power, and chain rules
D. Differentiate implicit and inverse functions, exponential and logarithmic functions
E. Use derivatives to solve minimum and maximum problems
F. Use derivatives to assist in graphing functions
G. Interpret graphs and derivatives for the following real-life functions: demand, supply, cost, revenue, profit, exponential growth, and exponential (radioactive) decay
H. Use antiderivatives to solve first-order differential equations (optional)
I. Integrate functions using antiderivatives, properties of integrals, substitution method, and (optional) integration by parts
J. Apply integration techniques to solve such real-life problems as computation of area, volume, probability, annuities, and consumer/producer surplus
K. Identify convergence or divergence of improper integrals (optional)
L. Differentiate multivariate functions and use partial derivatives for solving maximum-minimum problems and constrained maximum-minimum problems
M. Evaluate basic multiple integrals (optional)
N. Learn the contributions of people of different cultures to the creation and development of Calculus

III. Essential Student Materials

Graphing calculator recommended

IV. Essential College Facilities

None

V. Expanded Description: Content and Form

A. Identify the domain and range of functions
   1. Identify the domain and range of linear functions and their equations
   2. Identify the domain and range of quadratics and higher degree polynomials
   3. Identify the domain and range of absolute value functions
   4. Identify the domain of rational functions
B. Evaluate limits and use them to determine continuity
1. Determine the limit of a function from a computed table of its values
2. Identify the limit of a function from its graph
3. Evaluate the limit of a function algebraically
4. Apply the three-part definition of continuity to determine whether a function is continuous at a point and in an interval
5. Understand the concept of the slope of a tangent line as the limit of slopes of secant lines

C. Evaluate derivatives using the definition and using the sum, difference, product, quotient, power, and chain rules
   1. Compute the average rate of change of a function and the derivative as the limit of the average rate of change
   2. Evaluate derivatives of linear functions, quadratic functions, quotients of two linear functions, and square roots using the definition of the derivative
   3. Compute the first derivatives of polynomials, rational functions, power functions, and their compositions using the sum/difference, power, product, quotient, and chain rules
   4. Evaluate derivatives of higher orders

D. Differentiate implicit and inverse functions, exponential and logarithmic functions
   1. Differentiate functions determined implicitly and inverse functions (optional)
   2. Master properties of exponential and logarithmic functions
   3. Understand the exponential growth and the exponential decay models
   4. Differentiate exponential and logarithmic functions

E. Use derivatives to solve minimum and maximum problems
   1. Solve min/max/inflection-point problems for algebraic functions
   2. Solve max/min real-life problems using the derivatives of algebraic functions
   3. Use derivatives of exponential and logarithmic functions to solve such real-life problems as doubling and half-life problems, Newton's Law of Cooling problems, and elasticity of demand problems

F. Use derivatives to assist in graphing functions
   1. Use derivatives to determine where a function is increasing and decreasing, its relative maxima and minima, where the function is concave up and down
   2. Use limits to determine vertical, horizontal, and oblique asymptotes
   3. Use calculator to assist in graphing with derivatives

G. Interpret graphs and derivatives for the following real-life functions: demand, supply, cost, revenue, profit, exponential growth, and exponential (radioactive) decay
   1. Understand the concepts of marginal cost, marginal revenue, and marginal profit, their relation to cost, revenue, and profit respectively, and their applications to business management problems
   2. Minimize inventory cost (optional)
   3. Apply exponential functions to radioactive analysis

H. Use antiderivatives to solve first-order differential equations (optional)
   1. Identify general anti-derivatives
   2. Find a particular anti-derivative
   3. Solve differential equations with separable variables

I. Integrate functions using antiderivatives, properties of integrals, substitution method, and (optional) integration by parts
   1. Know the table of basic integrals
   2. Use the general power rule
   3. Use the general exponential rule
   4. Use the general logarithmic rule
   5. Integrate by parts

J. Apply integration techniques to solve such real-life problems as computation of area, volume, probability, annuities, and consumer/producer surplus
   1. Evaluate areas and volumes
2. Identify the average value of a function
3. Estimate probabilities
4. Identify the consumer/producer surplus
5. Solve movement problems

K. Identify convergence or divergence of improper integrals (optional)
   1. Identify an improper integral as a limit at infinity
   2. Evaluate basic improper integrals
   3. Determine convergence or divergence of an improper integral

L. Differentiate multivariate functions and use partial derivatives for solving maximum-minimum problems and constrained maximum-minimum problems
   1. Understand the concept of a function of several variables, and (optional) cross sections of its graph and its contour diagram
   2. Compute the partial derivatives of a function of two or three (optional) variables
   3. Use partial derivatives to determine relative minima, relative maxima, and saddle points of a function of several variables
   4. Apply Lagrange multipliers for constrained maximum-minimum problems (optional)

M. Evaluate basic multiple integrals (optional)
   1. Evaluate double and triple integrals over a rectangular region of integration
   2. Evaluate double and triple integrals over a region of integration with a curvilinear boundary

N. Learn the contributions of people of different cultures to the creation and development of Calculus
   1. Learn the ancient Greek roots of Calculus
   2. Identify contributions to the development of Calculus of people of different countries such as China, Japan, and Arabic countries
   3. Identify the most important individual contributors to Calculus such as Fermat, L'Hospital, Newton, Leibnitz, Cauchy, Riemann, Weierstrass

VI. Assignments
   A. Required readings from text
   B. Problem-solving exercises

VII. Methods of Instruction
   None

VIII. Methods of Evaluating Objectives
   A. Homework/quizzes
   B. A minimum of three one-hour written exams or two exams and a project
   C. A two-hour comprehensive final exam

IX. Texts and Supporting References
   A. Examples of Primary Texts and References
   B. Examples of Supporting Texts and References