SOUTHERN UNIVERSITY AND A&M COLLEGE
DEPARTMENT OF MATHEMATICS

MATH 264
CALCULUS I

Course Description: Calculus I is the first course of a three-course sequence. The concept of limit is introduced, and is used to develop the concepts of continuity and derivative. These are studied from a symbolic, graphic, and numeric perspective for a wide variety of basic functions and combinations thereof. Applications are included. Definite and indefinite integrals, and the Fundamental Theorem of Calculus are introduced.

Instructor's Emphasis: Special emphasis will be placed on the following:

a) the meaning and relationship among the fundamental concepts of limit, continuity, and derivative,
b) the interpretation of derivative as a rate of change and as the slope of a tangent line,
c) the various techniques of finding the derivative of a function, especially using the definition, and
d) the application of the derivative in solving a variety of real-life problems.

Intended Audience: This course is designed primarily for students in the sciences, engineering, and mathematics.

Course Credit: 4 semester hours

Prerequisites: Math 135 and 140 with a grade of C or better, or the designated placement test score.

General Goals:

1) The students will learn that limit, continuity, and derivative are the fundamental concepts of differential calculus.
2) The student will learn that limit is the concept that makes calculus different from algebra.
3) The student will learn that the principal concept of interest, the one word summary of differential calculus, is derivative.
4) The student will learn that the rules (sum/difference, product, quotient, power, etc) for finding derivatives were all derived from the definition of derivative.

5) The student will learn that the derivative may be used to solve a variety of real-life problems.
6) The student will take one more step in understanding that mathematics is the language of science and the finest of the fine arts!

Learning Outcomes:

1. Given a function defined by a formula, graph, or table, the student will find the average rate of change over a given interval.
2. Given a function defined by a formula, the student will estimate the instantaneous rate of change at a given point.
3. The student will determine limits (including infinite limits and limits at infinity) algebraically, graphically, and numerically.
4. The student will use the laws of limits to find limits of sums, differences, products and quotients of functions.
5. The student will use limits to find asymptotes.
6. The student will demonstrate his understanding of the epsilon/delta definition of limit in the following way:
   Given $\lim_{x \to x_0} f(x) = L$, and a value of ε, the student will find the largest value of δ, such that
   $0 < |x - x_0| < \delta \quad \Rightarrow \quad |f(x) - L| < \varepsilon$,
   where f is a given function and, x_0 is a given limiting value.
7. The student will use the definition of continuity to determine if a given function is continuous at a given point (especially rational and piecewise functions).
8. The student will write and use the definition of derivative to find the derivatives of selected polynomial, rational, and trigonometric functions.
9. The student will use the sum, difference, product, quotient, and chain rules to find derivatives of elementary functions.
10. The student will recognize equivalent derivative notations for a function, $y = f(x)$
    $$y' = \frac{dy}{dx} = f', \quad y'' = \frac{d^2y}{dx^2} = f'', \quad y^{(n)} = \frac{d^n y}{dx^n} = f^{(n)}$$
11. The student will use derivatives to find standard features of the graph of a function (local extrema, inflection points, intervals of increase/decrease, and intervals of concavity).
12. The student will use implicit differentiation to find derivatives of functions defined implicitly.
13. The student will find the maximum and minimum value of a continuous function on a closed interval.
14. The student will find limits using L'Hôpital's Rule.
15. The student will use derivatives to solve a variety of application problems, including: related rates, optimization, velocity/acceleration, and marginal analysis.
16. The student will find the local linearization of a function f at x_0, and use it to estimate values of f at points near x_0.
17. The student will find the differential of a function $y = f(x)$, and use it to estimate the change in y at a point, x_0, caused by "a small change" in x.

18. The student will demonstrate his understanding of Newton's Method by using a sequence of tangent lines to estimate the zeros of a function.
19. The student will write the definition of the antiderivative of a function, and use it with known derivative formulas to create antiderivative formulas.

COURSE CONTENT:

UNIT 1 Chapter 2: Limits and Continuity

2.1 Rates of Change and Limits
2.2 Calculating Limits Using Limit Laws
2.3 The precise definition of a limit
2.4 One-Sided Limits and Limits at Infinity
2.5 Infinite Limits and Vertical Asymptotes
2.6 Continuity
2.7 Tangents and Derivatives

UNIT 2 Chapter 3: Differentiation

3.1 The Derivative as a Function
3.2 Differentiation Rules for Polynomials, Exponentials, Products, and Quotients
3.3 The Derivative as a Rate of Change
3.4 Derivatives of Trigonometric Functions
3.5 The Chain Rule and Parametric Equations
3.6 Implicit Differentiation
3.7 Derivatives of Inverse Functions and Logarithms
3.8 Inverse Trigonometric Functions
3.9 Related Rates
3.10 Linearization and Differentials
3.11 Hyperbolic Functions

Unit 3 Chapter 4: Applications of Derivatives

4.1 Extreme Values of Functions
4.2 The Mean Value Theorem
4.3 Monotonic Functions and the First Derivative Test
4.4 Concavity and Curve Sketching
4.5 Applied Optimization Problems
4.6 Indeterminate Forms and L'Hôpital's Rule
4.7 Newton's Method

Required Textbook and Materials:

- Textbook: University Calculus by Hass, Weir, and Thomas
- Graphing Calculator

Course Expectations and Supplements:

1) Students are expected to have the prerequisites for this course. A skills deficit may be remedied by:
   a) using the pre-calculus tutorials in the Math Lab, room 318, T.T. Allain,
   b) using the student tutors in the Math Lab, room 318, T.T. Allain,
   c) using the student tutors in Center for Student Success, room 107, Stewart Hall, and
   d) getting help from the course instructor during his office hours.
2) Computer tutorials are also available for this course, some of which maybe given to students to put on their personal computers. Student tutors and course instructors are also available, as indicated in item #1 above.
3) Regular and punctual class attendance is expected. Mathematics, by its very nature, is very difficult to learn on a hit or miss basis. If you have some difficulty in meeting this condition discuss the matter with your teacher!

Examinations:

a) Departmental Comprehensive Examination
b) Teacher made tests and quizzes, homework, recitation.

Electronic Communication Devices:

All such devices (cell phones, beepers, radios) should be in the off mode when you enter the classroom. Even your leaving the classroom to use such a device is a distraction to your teacher and classmates. All such distraction (the noise the device makes, leaving classroom, returning to classroom) pollutes the learning environment, derails trains of thought, destroys continuity of communication, infringes on the rights of others, and is down right disrespectful of your teacher and classmates!

Student Evaluation:

Grades are determined by performance on tests, quizzes, homework, recitation in class, and final examination.

Some Important Dates

Mid-Semester Examination Period
Concentrated Study Period
Final Examination Period
Deadline for withdrawing from classes
Last Class Day

DISABILITY STATEMENT

If you have a documented disability, then please discuss it with personnel at 771-3546 in Room 246 Blanks Hall. Learners that are considered having a disability, are to provide the professor with a letter from Professor P. Hebert through the Office of Disability Service stating the appropriate accommodations required of this course.

DISCLAIMER: These activities and assignments are tentative. Changes may occur due to assessment of learners by the professor and due to the professor.