Syllabus for Calculus I, MAC2311

Last Revised: 12 August 2005

Course Coordinator: D. L. Ritter

I. Objectives/Learning Outcome(s)/Major Topics

A. General Course Objective:

Students will learn to correctly comprehend, use, and manipulate the symbols, ideas, and language of Elementary Single Variable Differential Calculus using spoken and written English. Ideally this should be done in such a fashion as to increase the depth of understanding of the student regarding the behaviors of the algebraic and transcendental functions that the student had previously encountered in prerequisite courses together with a significant mastery of mathematical techniques.

B. Major Topics/Desired Learning Outcomes:

i. Topic: Limits

Desired Learning Outcomes:

By the end of the course, the student will

(a) understand the various sorts of limits graphically;
(b) know the basic elementary limits and how to use the theorem that deals with the arithmetic of limits;
(c) know how to transform simple indeterminate form limits to determine whether the limit exists, and if it does, what its value is;
(d) be able to use the squeeze theorem to determine the value of simple indeterminate limits;
(e) know the ’hard’ indeterminate trig limits involving sine, cosine, and tangent and be able to use them appropriately;
(f) be able to correctly write the epsilon-delta definition for the two-sided limit and at the very least, use this definition to prove assertions concerning the limits of simple linear functions;
(g) know and be able to apply the various forms of L’Hopital’s rule to evaluate indeterminate limit forms;

ii. Topic: Continuity

Desired Learning Outcomes:

By the end of the course, the student will

(a) be able to write the definition for continuity at a point and be able to determine whether a function is continuous at a particular point;

(b) understand what it means for a function to be continuous on an interval;

(c) understand the relationship between the continuity of a function and the continuity of its inverse, if the function has an inverse;

(d) know the Intermediate Value Theorem and be able to use it to prove that a continuous function assumes a particular value within a certain interval; [This may very from text to text. In its simplest form it is this: If f is a continuous function defined on a closed interval [a,b] and $f(a)f(b) < 0$, then there is a number c in [a,b] with $f(c) = 0$.]

(e) know and be able to use the Extreme Value Theorem; [In its simplest form this asserts the following: If f is a continuous function defined on a closed interval [a,b], then f assumes both its maximum and minimum values on the interval [a,b]. In particular, the importance of satisfying the hypotheses must be recognized when using the theorem in conjunction with the derivative to find the extreme values of simple functions. The student should understand how much this theorem simplifies the task of finding absolute extrema.]

iii. Topic: The Derivative

Desired Learning Outcomes:

By the end of the course, the student will

(a) know the definition of the derivative as a limit in several equivalent forms;

(b) be able to use the definition to compute the first derivative of very simple polynomials, rational functions, and algebraic functions.

(c) understand the standard interpretations of the derivative geometrically and physically;

(d) know and be able to apply appropriately the standard theorems dealing with the derivatives of sums, products, quotients, and compositions in computing derivatives;

(e) be able to deal with the derivatives of simple piecewise defined functions;

(f) know the derivatives of the basic trigonometric, logarithmic, exponential, and inverse trigonometric functions;

(g) know the definition of the differential and its connection with the first derivative, its geometric interpretation, and how to apply it to do simple approximations.

iv. Topic: Function Properties Loosely Associated with the Mean Value Theorem

Desired Learning Outcomes:

By the end of the course, the student will

(a) understand what it means for a function to be increasing, decreasing, or constant on an interval graphically;

(b) understand and be able to apply the theorem providing a sufficient condition, in terms of the sign of the first derivative, for a function to be increasing, decreasing, or constant on an interval;

(c) understand the definition of concavity for differentiable functions in terms of their graphs;

(d) understand and be able to apply the theorem providing a sufficient condition, in terms of the sign of the second derivative, for a function to be concave up or down on an interval;

(e) understand the definition of an inflection point; [This varies from text to text. Nevertheless, the student must know that the vanishing of the second derivative at a point is not sufficient.]

(f) understand relative extrema graphically;

(g) know the definition of critical point, and be able to distinguish between critical points and inflection points;

(h) know and be able to use the theorem providing a necessary condition, given in terms of the first derivative, for a function to have a relative extremum;

(i) know and be able to use the first and second derivative tests for relative extrema; [They must also clearly understand the limitations of the second derivative test.]

(j) be able to use the information from the first derivative, second derivative, and limit behavior to sketch simple polynomials and rational functions.

(k) clearly understand the difference between a relative or local extremum and an absolute extremum; [This should include graphic interpretation.]

(l) understand that every absolute extremum is a relative extremum, but not conversely;

(m) be able to obtain the extreme value(s) for simple functions by using the derivative and appropriate limit behavior to analyze the behavior of the function in question in situations where the extreme value theorem does not apply; [In particular, the student should recognize when the ’one relative extremum’ theorem applies and use it appropriately.]

(n) know and be able to apply the various forms of L’Hopital’s rule to evaluate indeterminate limit forms;

iv. Topic: Simple Applications of the Derivative

Desired Learning Outcomes:

By the end of the course, the student will
(a) be able to solve simple related rates problem;
(b) be able to do elementary max-min word problems; [This means being able to obtain the function to be optimized and an appropriate domain. Then doing the analysis of the function, and finally, interpreting the results correctly.]

v. Topic: The Antiderivative or Indefinite Integral

Desired Learning Outcomes:

By the end of the course, the student will
(a) be able to write the definition for an antiderivative for a function. [Yes, this is a question of correct use of language and notation.]
(b) understand that an antiderivative is a solution to a very simple sort of differential equation; [As a consequence, students should be able to solve very simple initial value problems.]
(c) be able to show that there is an antiderivative equation corresponding to each derivative equation; [In doing this, notation must be used correctly.]
(d) be able to use the linearity properties of the antiderivative to evaluate linear combinations of ’simple’ functions, ones whose antiderivatives they should know verbatim;
(e) know the antiderivatives of sufficiently many of the elementary functions; [These include power functions, certain of the trigonometric functions and their inverses, exponential and logarithmic functions.]
(f) be able to recognize when it is appropriate to perform an elementary u-substitution to evaluate an antiderivative and be able to do so correctly.

vi. Topic: Parametric Equations

Desired Learning Outcomes:

By the end of the course, the student will
(a) be able to sketch simple parametric equations by eliminating the parameter. [This includes appropriate use of trigonometric identities.]
(b) understand the definition of the smoothness of a curve defined by a set of parametric equations.
(c) know the relationship between the slope of a line tangent to the graph of a curve defined by parametric equations and the first derivatives of the component functions.
(d) be able to compute the second derivative of y with respect to x in order to deal with the concavity of the curve defined by the parametric equations $x = f(t)$ and $y = g(t)$, say.

II. Textbook(s)

Either of the following is acceptable:

A. Calculus, Early Transcendentals, 8th Edition [Hardcover]
by Howard Anton, Irl Bivens, and Stephen Davis
published by John Wiley & Sons Inc.

B. Single Variable Calculus, Early Transcendentals, 8th Edition [Either Hardcover or Paperback]
by Howard Anton, Irl Bivens, and Stephen Davis
published by John Wiley & Sons Inc.

III. The specific sections of the text that are to be covered are as follows:

Chapter 1:	1.1, 1.3 through 1.6, 1.8 [Omit 1.2 and 1.7.]
Chapter 2:	2.1 through 2.6 [All sections.]
Chapter 3:	3.1 through 3.8 [All sections.]
Chapter 4:	4.1 through 4.4 [All sections.]
Chapter 5:	5.1 through 5.5, and 5.7 [Omit 5.6 and 5.8. If time is a problem, skip 5.3, too.]
Chapter 6:	6.2, 6.3 [The material that depends on the definite integral is to be avoided.]
Chapter 11:	11.2 [Section 1.8 should be done immediately prior to 11.2. The material that deals with the arc length and uses the definite integral must be omitted.]

Notes: (1) Read **Calculus II**, **Calculus I**, **Precalculus**, **Trigonometry**, **and Algebra Instructors: Policies for these courses**. Pay attention to the issue of pacing.

(2) You should give the equivalent of at least three 1.67 hour exams and a comprehensive two hour final exam. To cover the syllabus, it is essential that you lecture on more than one section in a class period whenever it is reasonable and possible to do so. The suggested pacing provides for twenty-four lectures and leaves five classes for exams or tests and review in a 29 class semester. If you are dealing with a term having 27 or 26 classes, plan on omitting 1.8, 11.2 and possibly 5.3.
[Section 5.3 deals with the graphing of more complicated rational and algebraic functions.] *[Keep in mind that we frequently lose class days during hurricane season.]*

(3) Some suggestions on how to cover the relevant sections in Anton’s 8th are provided in the document, ant8how2.pdf, "**How to Use Anton’s 8th**," which may be found on the course coordinator’s web site. This is based on the course coordinator’s use of earlier editions of the Anton text.