2007 ~ 2008 AP CALCULUS AB SYLLABUS

Teacher: Mr. Leckie
Room: 201
Course: AP Calculus AB
Textbook: *Calculus: Graphical, Numerical, Algebraic, 3rd edition*

***COURSE CONTENT*:** Calculus is the mathematics of change – velocities and accelerations. Calculus is also the mathematics of tangent lines, slopes, areas, volumes, arc lengths, centroids, curvatures, and a variety of other concepts that have enabled scientists, engineers, and economists to model real – life situations. Although precalculus mathematics also deals with velocities, accelerations, tangent lines, slopes, and so on, there is a fundamental difference between precalculus mathematics and calculus. Precalculus mathematics is static, whereas calculus is more dynamic. The idea that separates calculus from precalculus mathematics is the limit process. You may or may not have already studied some limit properties. We will begin with those ideas and build upon them to lead us to a new calculus formulation, such as derivatives and integrals.

Every student taking AP Calculus is expected to take the Advanced Placement exam in May.

COURSE OUTLINE
1 day = one 1.5 hour block

FIRST SEMESTER

Chapter 1: Prerequisites for Calculus (10 days)

1.1 Lines
1.2 Functions and Graphs
1.3 Exponential Functions
1.4 Parametric Equations
Extension: Parent Functions and Their Graphs
1.5 Functions and Logarithms
1.6 Trigonometric Functions

Chapter 2: Limits and Continuity (8 days)

2.1 Rates of Change and Limits
- Graphically
- Analytically
- Numerically

2.2 Limits Involving Infinity
- Graphically
- Analytically
- Numerically
- How it relates to asymptotic behavior
- How to evaluate by comparing relative magnitudes of functions

2.3 Continuity
- Intermediate Value Theorem
- Extreme Value Theorem
- Using the limit definition of continuity to show functions (usually piecewise) are continuous

2.4 Rates of Change and Tangent Lines
- Instantaneous Rate of Change vs. Average Rate of Change

Chapter 3: Derivatives (14 days)

3.1 Derivative of a Function
- Graphically
- Analytically
- Numerically – See Worksheet (Instantaneous Rate of Change)
- Introduction to Slope Fields

3.2 Differentiability
- Graphically
- Analytically
- Numerically

3.3 Rules for Differentiation

3.4 Velocity and Other Rates of Change
- Graphically
- Analytically

3.5 Derivatives of Trigonometric Functions

3.6 Chain Rule

3.7 Implicit Differentiation

3.8 Derivatives of Inverse Trigonometric Functions

3.9 Derivatives of Exponential and Logarithmic Functions

Chapter 4: Extreme Values of Functions (12 days)

4.1 Extreme Values of Functions
- Absolute vs. Relative

4.2 Mean Value Theorem
- Graphically
- Analytically
- Numerically

4.3 Connecting f' and f'' with the Graph of f
- Using graph of f' to determine properties of f

4.4 Modeling and Optimization

SECOND SEMESTER

4.5 Linearization and Newton's Method

4.6 Related Rates

Chapter 5: The Definite Integral (8 days)

5.1 Estimating with Finite Sums
- Riemann Sums
- Left, Right, and Midpoint approximations
  - Graphically
  - Numerically

5.2 Definite Integrals
- Basic Properties

5.3 Definite Integrals and Antiderivatives
- Average Value of a Function

5.4 Fundamental Theorem of Calculus
- Used to Evaluate Definite Integrals
- Used in the definition of function
  - Graphically
  - Analytically
  - Numerically

5.5 Trapezoidal Rule

Chapter 6: Differential Equations and Mathematical Modeling (9 days)

6.1 Antiderivatives and Slope Fields
- Solving differential equations using initial conditions

6.2 Integration by Substitution

6.3 Integration by Parts

6.4 Exponential Growth and Decay
- Using differential equations in context
- Separate and Integrate

Chapter 7: Applications of Definite Integrals (10 days)

7.1 Integral as Net Change
- Displacement vs Distance Traveled
- Integral of a Rate of Change gives accumulated change.

7.2 Areas in the Plane

7.3 Volumes
- Solids with known cross sections
- Solids of revolution
  - Disc Method
  - Washer Method
  - Shell Method

Chapter 8: L'Hopital's Rule, Improper Integrals, and Partial Fractions (2 days)

8.1 L'Hopital's Rule

8.2 Relative Rates of Growth

TEACHING STRATEGIES

Contextual situations are used to apply many of these concepts, including, but not limited to, position, velocity, and acceleration, average value, related rates, optimization, and volumes of solids (known perpendicular cross sections and rotated). Students often work in groups when investigating a new topic graphically or numerically and when working on problems given during class.

The "Rule of 4" (graphical, numerical, analytical, and verbal) is used as a broad outline for the course. The textbook supports graphical, numerical, and algebraic exploration and problem solving. Students are also required to correctly use mathematical syntax both in written and oral form in explaining their solutions. The ability to correctly speak the language of mathematics is valued. This is done both in class and on exams.

TECHNOLOGY AND COMPUTER SOFTWARE

As the name of the textbook implies, students are asked to explore many of the concepts in this course graphically, analytically, and numerically. When appropriate, the use of a graphing calculator is used to explore, to solve, or to confirm the student's work. All students are required to have a graphing calculator (most use a TI-83+ or the TI-84+). Demonstration and instruction on the use of the calculator is done using a TI-83+ on either a TI-Presenter through the TV or on a SmartBoard.

Students are expected to be able to graph a function within a given window, find the zeros of functions and where two functions intersect, calculate the derivative at a point, and calculate a definite integral. We also spend time discussing when the calculator cannot be relied upon for accurate information, including asymptotic behavior and finding derivatives of certain functions, like $|x|$ at $x = 0$. Other functions of the calculator are taught in order to use the calculator more efficiently, including, but not limited to, using tables to help with the numerical exploration of concepts, storing calculated values for future use, and using the "*y*-vars" values. Emphasis is put on using the correct mathematical notation and vocabulary in order to use the calculator to justify their responses.

Derive5 software and various websites are used to demonstrate concepts that use graphs of implicitly defined functions, volumes of solids of revolution, and volumes of solids with known cross sections, just to name a few.

STUDENT EVALUATION

Both formative and summative evaluations are used during this course. Summative evaluations are chapter exams and semester finals. Formative evaluations occur daily during class in the form of class discussion, problems worked on the board, previous AP problems given to the students to work on in groups, quizzes, problems of the week, warm ups, and homework. All of these evaluations reinforce the use of graphical, numerical, and analytical techniques.

Grading: You will be given points for all assignments, but your 18 – week grade will be weighted with the following percentages:

- Homework/Projects: 10%
- Quizzes/Problems of the "Week": 15%
- Tests: 75%

Final:

- The Final exam will be cumulative and worth 25% of your semester grade.

SCALE: Grades will be posted as often as possible

- 85 - 100% A
- 70 - 84% B
- 55 - 69% C
- 50 - 54% D

Homework:

- There will be assignments assigned for EVERY section. If you do not practice the concepts outside of class you are only hurting yourself.
- Homework will be corrected based on completeness only, but it is only beneficial if you make sure it is correct.
- There are solutions guides available for purchase. The solutions provide one step by step solution to every problem in the textbook.

Quizzes/Problems of the "Week":

- The number of quizzes per chapter will vary.
- Every so often (weekly) you will be given an additional problem (or problems) that either tie together multiple topics and/or review key concepts. These questions will typically be more conceptual in nature.
- Your response will be graded based on correctness of procedures, explanations, organization, and completeness.
- The more you explain, the better chance you have of earning full credit.

Tests:

- Tests will usually be given after the completion of each chapter. However, longer chapters (like chapter 3) may be broken into two smaller sections.
- A review sheet/problem set will typically be given for each test. It is highly suggested that you understand all topics listed.
- Each test will consist of free-response and multiple-choice questions for each chapter and could include review questions from previous chapters. Tests will be given in two parts (with and without a calculator).
- Each chapter (or partial chapter) test will be weighted the same.

Classroom Expectations:

#1: You are expected to be ON TIME. There are no bells, but the clocks are set to the exact time. Be here early, so you are ready to start at the right time.

#2: You are expected to treat EVERYONE in the class with the same attitude of respect you expect to treated. This includes the language you use, the attitude you bring to class, and the way you respond when asked to do something in class.

#3: You are expected to complete EVERY assignment to the best of your ability BEFORE you get to class. Once in class, you are expected to ask questions on anything that you have not yet been able to understand. If necessary, you may need help outside of class time, and you are expected to come talk with me so we can arrange a time that will work for both of us. I am available during Academy hours as well as after school in the library or in my room.

#4: You are expected to use the entire block productively. This means paying attention/taking notes during times of lecture, actively participating in group work, using any extra time given to you in class to complete your daily work, start your homework, or review for upcoming quizzes and/or tests.

Absences:

- All assignments are online. Homework is posted in the classroom and online. If you are absent, you should check the website from home or as soon as you return.
- Daily Classwork may be completed for credit. (you get one day for every day absent to make up daily work)
- It is ***YOUR*** responsibility to find out what you missed!!!!!!!!!
- If you are absent on the day of a test, you have **1 week** from when you return to make up the test. Exceptions will be made only for extended absences.
- No make-up tests/quizzes will be given during class time. It is YOUR responsibility to make an appointment during Academy or after school.

Consequences: Failure to follow the rules and procedures will result in any of the following:

1. Warning … Student – Teacher conference
2. Parent phone call and/or Academy Detention
3. Referral to an Administrator

Supplies: The following is a list of supplies (other than your ***book***) that will be needed throughout the course of the year. For some in-class activities, there is a limited number of supplies in the classroom. However, you will need to use most of these supplies at home. It is in your best interest to obtain as many of them as possible.

- A 3-ring notebook dedicated to this class.
- A TI-83+, TI-84+, or TI-89+ calculator. (or another approved graphing calculator that has the ability to perform the skills listed previously under the "Technology and Computer Software" section)
- Notecards … 3x5 or 4x6 are fine … you will be turning in your notecards every chapter.
- Graph Paper and a ruler (graph paper is available to be printed out online)
- Pencils (I will not be providing pencils at any time)
- ID CARD --- used to check out any supplies that we might use in class.

Resources available:

Mr. Leckie's website: http://www.chaoticgolf.com

Daily Assignments
Review Sheets with Solutions
Class Lecture Notes
Notecards (in progress)
Extra Credit (when available)
Graph paper available to be printed
Syllabus may be read online
Parent Questionnaire may be filled out online
Contact Mr. Leckie through an email form
Limited links to other Math sites on the Internet

Worked Out Solutions Guide Available to be purchased … Cost TBA … (probably in the $18 - $25 range).

The following is the AP Calculus AB Course Description as given by the College Board.
All of these topics are covered in the Course Outline.

I. Functions, Graphs, and Limits

Analysis of graphs
With the aid of technology, graphs of functions are often easy to produce. The emphasis is on the interplay between the geometric and analytic information and on the use of calculus both to predict and to explain the observed local and global behavior of a function.

Limits of functions (including one-sided limits)
- An intuitive understanding of the limiting process
- Calculating limits using algebra
- Estimating limits from graphs or tables of data

Asymptotic and unbounded behavior
- Understanding asymptotes in terms of graphical behavior
- Describing asymptotic behavior in terms of limits involving infinity
- Comparing relative magnitudes of functions and their rates of change (for example, contrasting exponential growth, polynomial growth, and logarithmic growth)

Continuity as a property of functions
- An intuitive understanding of continuity (The function values can be made as close as desired by taking sufficiently close values of the domain.)
- Understanding continuity in terms of limits
- Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem)

II. Derivatives

Concept of the derivative
- Derivative presented graphically, numerically, and analytically
- Derivative interpreted as an instantaneous rate of change
- Derivative defined as the limit of the difference quotient
- Relationship between differentiability and continuity

Derivative at a point
- Slope of a curve at a point. Examples are emphasized, including points at which there are vertical tangents and points at which there are no tangents.
- Tangent line to a curve at a point and local linear approximation
- Instantaneous rate of change as the limit of average rate of change
- Approximate rate of change from graphs and tables of values

Derivative as a function
- Corresponding characteristics of graphs of f and f'
- Relationship between the increasing and decreasing behavior of f and the sign of f'
- The Mean Value Theorem and its geometric consequences
- Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa

Second derivatives
- Corresponding characteristics of the graphs of f, f', and f''
- Relationship between the concavity of f and the sign of f''
- Points of inflection as places where concavity changes

Applications of derivatives

- Analysis of curves, including the notions of monotonicity and concavity
- Optimization, both absolute (global) and relative (local) extrema
- Modeling rates of change, including related rates problems
- Use of implicit differentiation to find the derivative of an inverse function
- Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration
- Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations

Computation of derivatives

- Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric
- Basic rules for the derivative of sums, products, and quotients of functions
- Chain rule and implicit differentiation

III. Integrals

Interpretations and properties of definite integrals

- Definite integral as a limit of Riemann sums
- Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval:

$$\int_a^b f'(x)\,dx = f(b) - f(a)$$

- Basic properties of definite integrals (examples include additivity and linearity)

Applications of integrals

Appropriate integrals are used in a variety of applications to model physical, biological, or economic situations. Although only a sampling of applications can be included in any specific course, students should be able to adapt their knowledge and techniques to solve other similar application problems. Whatever applications are chosen, the emphasis is on using the method of setting up an approximating Riemann sum and representing its limit as a definite integral. To provide a common foundation, specific applications should include using the integral of a rate of change to give accumulated change, finding the area of a region, the volume of a solid with known cross sections, the average value of a function, and the distance traveled by a particle along a line.

Fundamental Theorem of Calculus

- Use of the Fundamental Theorem to evaluate definite integrals
- Use of the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined

Techniques of antidifferentiation

- Antiderivatives following directly from derivatives of basic functions
- Anitderivatives by substitution of variables (including change of limits for definite integrals)

Applications of antidifferentiation

- Finding specific antiderivatives using initial conditions, including applications to motion along a line
- Solving separable differential equations and using them in modeling (in particular, studying the equation $y' = ky$ and exponential growth)

Numerical approximations to definite integrals

Use of Riemann sums (using left, right, and midpoint evaluation points) and trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by tables of values