AP Calculus AB
Syllabus

Course Description:
This is a standard first semester college course in the Calculus of elementary functions. In this course students will develop the concepts and skills associated with limits, techniques and applications of differentiation, the introduction to techniques of integration, and the applications of integration. Multiple representations of each concept will be investigated – graphical, analytical, numerical, and verbal. Technology will be integrated throughout to develop and enhance the curriculum. The purpose of this course is to prepare students for the AP Exam as well as future college math courses. Students will be required to work problems from a graphical, numerical or analytical point of view and present their solutions both verbally and in writing. Students are **expected** to perform college level work and are expected to take the Advanced Placement Exam.

Text:
Stewart, James. Single Variable Calculus. Belmont, California: Brooks/Cole – Thomson Learning, 2008, 6th Edition.

Expectations:
Students are expected to:

- Attend class on a daily basis.
- Keep a class notebook of notes, model problems, and homework assignments with noted corrections.
- Read the assigned textbook readings.
- Participate in class, group discussions, and problem solving activities.
- Schedule make-up deadlines with the individual teacher when an absence occurs.

Materials Needed:
- Notebook
- Folder or binder
- Graphing Calculator TI-83, TI-84, or TI-89 recommended

Course Outline
The following outline is a list and sequence of topics that are covered in this course. The time estimates are approximations.

Semester One
FUNCTIONS AND MODELS
(1 week)

1. Four Ways to Represent a Function
2. Mathematical Models: A Catalog of Essential Functions
3. New Functions from Old Functions
4. Graphing Calculators and Computers

5. Local Linearity

Local Linearity Activity from AP Central Website. Students are given a graph and asked to find equations for the two lines graphed. They are then given the scale of the coordinate axes. This launches our discussion of local linearity.

LIMITS

(3 weeks)

Our exploration of limits begins with a graphical and numerical analysis using the graphing calculator. Students are introduced to one-sided limits using the graphing calculator.

1. The Tangent and Velocity Problems
2. The Limit of a Function
3. Calculating Limits Using the Limit Laws
4. The Precise Definition of a Limit
5. Continuity

DERIVATIVES

(6 weeks)

When introducing the derivative, it is presented graphically, as the slope of the tangent to the curve, numerically, as $f'(a)$ at a given point, analytically, as the limit of the difference quotient or as the slope of the secant line, and verbally, as an instantaneous rate of change.

1. Derivatives and Rates of Change
2. The Derivative as a Function.
3. Differentiation Formulas
4. Derivatives of Trigonometric Functions
5. The Chain Rule
6. Implicit Differentiation
7. Rates of Change in the Natural and Social Sciences
8. Related Rates
9. Linear Approximations and Differentials

APPLICATIONS OF DIFFERENTIATION

(6 weeks)

1. Maximum and Minimum Values
2. The Mean Value Theorem
3. How Derivatives Affect the Shape of a Graph

   Matching Activity: Students will be given a set of cards that include graphs of f and f' and equations of f and f'. They will work in groups to match each graph of f and f' to their equations.
4. Limits at Infinity; Horizontal Asymptotes
5. Summary of Curve Sketching
6. Graphing with Calculus and Calculators
7. Optimization Problems
8. Newton's Method.

Semester Exam

ANTIDERIVATIVES AND INTEGRALS

(3 weeks)

The graphing calculator is used to present slope fields. The overhead calculator is placed in Grid Mode and a Grid is projected on the white board. Students are asked to find and graph the slope at different ordered pairs. Students begin their study of Area under a curve by calculating the area of rectangles, using right and left endpoints, and midpoints. After calculating the area using a fixed number of rectangles, we begin to look at the limit of the sum of the rectangles.

1. Antiderivatives and Slope Fields
2. Areas and Distances
3. The Definite Integral.
4. The Fundamental Theorem of Calculus
5. Indefinite Integrals and the Net Change Theorem
6. The Substitution Rule

APPLICATIONS OF INTEGRATION

(3 weeks)

1. Areas between Curves
2. Volume

   Play-Doh Activity: Students work in groups to create a solid using Play-Doh. They use string or dental floss to slice their solid into pieces with equal width. Then they find the area of each piece. On a separate day, students begin with slices and a given base – different groups are assigned different shapes – they work in groups to calculate the area of each slice and then they build their solid with the slices.
3. Volumes by Cylindrical Shells
4. Average Value of a Function

INVERSE FUNCTIONS: EXPONENTIAL, LOGARITHMIC, AND INVERSE TRIGONOMETRIC FUNCTIONS

(3 weeks)

1. Inverse Functions
2. The Natural Logarithmic Function
3. The Natural Exponential Function
4. General Logarithmic and Exponential Functions
5. Exponential Growth and Decay
6. Inverse Trigonometric Functions
7. Indeterminate Forms and L'Hospital's Rule.

DIFFERENTIAL EQUATIONS

(2 weeks)

1. What Is a Differential Equation?
2. Separation of Variables

REVIEW FOR THE AP EXAM

(Time remaining – usually3 – 4 weeks)

Various released exams – multiple choice practice.

Various Free Response Questions as available on AP Central.

AFTER THE AP EXAM

(2 weeks)

TECHNIQUES OF INTEGRATION.

As time permits, the following concepts will be investigated.

1. Integration by Parts.
2. Trigonometric Integrals.
3. Trigonometric Substitution.
4. Integration of Rational Functions by Partial Fractions.
5. Strategy for Integration

Teaching Strategy

Students are expected to investigate multiple representations of each topic covered in class. For the topic of the derivative of a function, students are required to sketch tangent lines and compare the graphs of f and f', approximate the derivative given a table of values, approximate the derivative using the slope of the secant line, use the derivative to find the slope of the tangent line, and be able to present their findings both verbally and in writing.

Each lesson is presented in a class discussion with students being active participants. Students begin the class with a warm-up problem that is usually a multiple choice question from a released exam. When the graphing calculator is used in the presentation of material, a student is asked to be the "class calculator" so that I can circulate and check that students are using their calculators correctly. After the material is introduced, students are given at least one day to practice the skills learned. They often work in groups to complete practice problems and are required to present their solutions to the class. Homework is assigned on a daily basis.

Before the AP Exam, I give students graphing calculator programs that calculate Riemann Sums, area, and volume. They are also given a program that draws a slope field.

Assessment

Tests, quizzes, projects, and in-class activities comprise the majority of the students' grade. Teacher made tests and quizzes are given for each unit. A school-wide midterm and semester exam is given first semester. Most assessments have a calculator and non-calculator section. Students are required to justify and explain solutions to various problems on each assessment. Second semester, students work in groups to complete an open ended released exam instead of a midterm. Each group presents one of the problems to the class. Homework is assigned daily and checked randomly.

Technology

Graphing calculators are used in a variety of ways in the classroom. We use them to investigate topics graphically, solve problems, and visualize concepts. For example, limits and derivatives are done graphically, numerically, and algebraically. Students are required to have a graphing calculator, a TI-83, TI-84, or TI-89 is preferred, in class on a daily basis. Students are required to be able to use their graphing calculator to do the following:

Graph a function in an arbitrary window
Numerically solve an equation (find zeros or points of intersection)
Calculate the numerical derivative of a function
Calculate the value of a definite integral