AP Calculus AB Syllabus

Welcome!

In this course students will be embarking on a challenging yet wonderful journey into the world of calculus. Calculus is filled with ideas and applications that are rich and varied, and that differ dramatically from what one normally studies in other mathematics courses. Calculus is filled with mysteries, new and intriguing, and its concepts captivating but difficult. No doubt calculus is hard, and takes supreme effort and tenacity to truly understand its mysteries, but I am confident that together we can successfully discover the true power and beauty of calculus.

Course Overview

This is a comprehensive year-long course in the study of both differential and integral calculus and is intended to be the equivalent of a college level Calculus I course. Students will be studying the ideas of functions, graphs, limits, derivatives and integrals as outlined in the AP Calculus Course description (as it appears on the AP Central website). The intent is for students to master the fundamentals of calculus in order to succeed on the AP Calculus AB exam and be adequately prepared to be successful in higher mathematics courses.

Students should have mastery of material including the study of algebra, geometry, coordinate geometry, trigonometry, analytic geometry, and elementary functions (linear, polynomial, rational, exponential, logarithmic, trigonometric, inverse trigonometric, and piecewise-defined functions). Students must also be familiar with the properties, algebra, graphs, and language of functions (domain and range, odd and even, periodic, symmetry, zeros, intercepts, and so on). Additionally, students should know the values of the trigonometric functions at the standard intervals (and their multiples).

Students should already have the ability to use a graphing utility to perform basic operations (graph a function in an appropriate viewing window, approximate zeroes, approximate extrema, find points of intersection, identify asymptotes, etc). Material will be presented using the TI-84 Plus Silver Edition calculator and students are encouraged to use this model, or another equivalent model approved for use on the AP exam. If a student cannot afford a graphing calculator they will be assigned one for the year. Calculators must be brought to class every day as its use is an integral part of the course. By the end of the year, students should be able to use a calculator (or graphing utility) to graph a function in any window, determine the value of a derivative at a specified point, find the value of a definite integral, solve an equation, and intelligently analyze and interpret results.

Students will have to work and "think" hard in this course. Some concepts students may not get when first introduced, that's normal. The expectation is that students ask questions, and more importantly, maintain the motivation and dedication to truly understand these new concepts. Remember, as the saying goes "math is not a spectator sport". With that said, the focus of this course is neither manipulation nor memorization of functions, curves, theorems, or problem types. The ultimate goal of this course is to <u>understand the power of calculus and to be able to apply calculus in the real-world.</u>

Grading Information

Grading Scale (county-wide)
90% A, 80% B, 70% C, 60% D, <60% F

Semester Grade Breakdown (Honors scale)

- **Semester 1**
  - 42.5% 1st Quarter
  - 42.5% 2nd Quarter
  - 15% Semester Exam
- **Semester 2**
  - 42.5% 3rd Quarter
  - 42.5% 4th Quarter
  - 15% Semester Exam

Grading Categories
75% Evidence of Mastery (Tests, Quizzes, Projects, Flashcard quizzes, Warm-ups, etc.)
25% Participation (Homework, Notebook Checks, etc.)

Teaching Strategies

This course will emphasize a multi-representational approach to calculus, with concepts, results, and problems being expressed according to the "rules of four" (numerically, graphically, analytically, and verbally). The classroom will be a balanced mix of lecture, discussion, and cooperative learning.

Course goals

After successfully completing this course:

- Students should be able to work with functions represented in a variety of ways: graphical, numerical, analytical, or verbal. They should understand the connections among these representations.
- Students should understand the meaning of the derivative in terms of a rate of change and local linear approximation and should be able to use derivatives to solve a variety of problems.
- Students should understand the meaning of the definite integral both as a limit of Riemann sums and as the net accumulation of change and should be able to use integrals to solve a variety of problems.
- Students should understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus.
- Students should be able to communicate mathematics and explain solutions to problems both verbally and in written sentences.
- Students should be able to model a written description of a physical situation with a function, a differential equation, or an integral.
- Students should be able to use technology to help solve problems, experiment, interpret results, and support conclusions.
- Students should be able to determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement.
- Students should develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment.

Course Planner

Summer Assignment Due — First Friday of school year

Unit One: Functions and Their Graphs — Duration: 1 week

- Review of properties, graphs, transformations

Unit Two: Limits and Their Properties — Duration: 4 weeks

- Finding limits graphically and numerically
- Evaluating limits analytically
- Continuity and one-sided limits
- Intermediate Value Theorem
- Infinite limits

Unit Three: Differentiation — Duration: 5 weeks

- The derivative and the tangent line problem
- Basic differentiation rules and rates of change
- The Product and Quotient Rules and higher order derivatives
- The Chain Rule
- Implicit differentiation
- Related rates

Unit Four: Applications of Differentiation — Duration: 6 weeks

- Extrema on an interval
- Rolle's Theorem and the Mean Value Theorem
- Increasing and decreasing functions and the First Derivative Test
- Concavity and the Second Derivative Test
- Limits at infinity
- A summary of curve sketching
- Optimization problems
- Newton's Method
- Differentials

Unit Five: Integration — Duration: 5 weeks

- Antiderivatives and indefinite integration
- Area
- Riemann sums and definite integrals
- The Fundamental Theorem of Calculus

- Integration by substitution
- Numerical integration

Unit Six: Logarithmic, Exponential, & Other Transcendental Functions
Duration: 7 weeks

- The natural logarithmic function: differentiation and integration
- Inverse functions
- Exponential functions: differentiation and integration
- Bases other than e and applications
- Differential equations: growth and decay
- Differential equations: separation of variables
- Inverse trigonometric functions: differentiation and integration

Unit Seven: Applications of Integration Duration: 2 weeks

- Area of a region between two curves
- Volume: the Disk Method
- Volume: the Shell Method

Unit Eight: AP Exam/Review and Test Preparation Duration: 3 weeks

- Multiple-choice practice
  - Test taking strategies are emphasized
  - Individual and group practice are both used
- Free-response practice
  - Rubrics are reviewed so students see the need for complete answers
  - Students collaborate to formulate team responses
  - Individually written responses are crafted. Attention to full explanations is emphasized

Other important information

Notes
Effective note-taking techniques are an important skill to master and a valuable study method. Students are encouraged to take notes for the class.

Assignments
Assignments come in two forms, homework and problem-sets. Homework is assigned daily and should take about 45 minutes to complete. Problem-sets are generated from past AP Exams and other AP Exam review resources. The primary goal of problem-sets is to allow students to effectively build their free-response writing skills in preparation of the AP Exam. Students are highly encouraged to work with their peers on problem-sets but are required to submit their own work for each problem.

Tests/Quizzes
Quizzes may be announced or unannounced and cover smaller amount of material than tests. Tests come in two varieties, in-class and take-home. In-class tests will be divided into calculator/non-calculator sections to familiarize students with the free-response section of the AP Exam. Take home tests are typically more difficult but students are encouraged to work together to solve the problems.

Projects
Projects will be used to reinforce concepts introduced in class and adhere to the "rules of four" learning model (numerically, graphically, analytically, verbally). Projects will normally be worked on outside of scheduled classroom time and may either be individual or group in nature. These projects will focus on students synthesizing concepts and presenting them (written or oral) in a logical, organized fashion either though media or traditional poster/showboard methods.

Teacher Resources

Primary Textbook
Larson, Robert, Robert Hostetler, and Bruce Edwards. *Calculus of a Single Variable*. 9th ed. Boston, MA: Houghton-Mifflin, 2010.

References
Ryan, Mark. *Calculus for Dummies* 2nd ed. Hoboken, NJ: Wiley Publishing, 2014.

Technology
Texas Instruments Inc.
http://education.ti.com/educationportal/sites/US/homePage/index.html

The College Board's AP Central website
www.apcentral.collegeboard.com