Advanced Placement Calculus (AB) Audit

Course description:

Advanced Placement (AP) Calculus is a full-year course that is comparable to calculus courses offered at the college or university level. Many colleges and universities will offer appropriate placement and/or credit in a mathematics track based on student performance or other criteria (search for specific schools at http://collegesearch.collegeboard.com/apcreditpolicy/index.jsp). While there will be many topics that involve investigations into functions and concepts that were introduced in previous classes, the bulk of the course study will be in the foundations and applications of differential and integral calculus.

Expectation for students entering AP Calculus:

Students should have a strong background in mathematics before entering this course. It is expected that students have taken precalculus at the honors (L1) or college (L2) level. Students should already know how to use a graphing calculator to view graphs of functions in an appropriate window and perform basic calculations and operations.

Attendance:

Students should attend class every day. Due to the accelerated nature of the course, missing class for any reason will hinder student progress.

Course goals – At the end of the course, students should be able to...

- Work with functions represented graphically, numerically, analytically, or verbally and understand the connections between them.
- Understand the meaning of the derivative as it applies to rate of change, local linearity, and its use in problem-solving.
- Understand the meaning of the definite integral as a limit of Riemann sums, net accumulation of change, and its use in problem-solving.
- Understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus.
- Be able to effectively communicate mathematics in verbal and written language in complete sentences.
- Be able to effectively model a written description of a physical situation with a function, differential equation, or an integral.
- Effectively use technology to assist in problem-solving, experimentation, interpretation, and drawing conclusions.
- Be able to determine how reasonable a solution is in a real-world context, including sign, size, feasibility, and units.
- Appreciate the beauty and power of calculus as a capstone mathematics course and illustration of human brainpower.
- Be confident that they have the skills necessary for success on the AP Calculus AB exam

Outline of topics to be covered:

I) Functions, graphs, and limits
   a. Analyze graphs of functions and relations with and without technology
   b. Concept of a limit, and assign exact or approximate values to limits from graphs, tables, or equations as applicable
   c. Asymptotic behavior for a variety of functions and analyze asymptotes in the context of limits involving infinity
   d. Concept of continuity as an intuitive idea and as an application of derivatives
   e. Intermediate Value and Extreme Value Theorems as they apply to problem-solving and continuity

II) The Derivative
   a. Conceptually
      i. The derivative presented graphically, numerically, and analytically
      ii. Interpreted as instantaneous rate of change
      iii. Defined as the limit of the difference quotient and related directly to continuity
      iv. When functions are not differentiable.
   b. Derivative at a point
      i. Slope of a curve at a point and tangent lines
      ii. Local linearity as it applies to the derivative
      iii. Average rate of change compared appropriately to the instantaneous rate of change
      iv. Approximate rate of change from graphs and/or tables
   c. As a function
      i. Characteristics of a function *f* as related to its derivative *f'*
      ii. Meaning of the sign of the derivative
      iii. Mean Value Theorem in a geometric interpretation as it applies to the derivative
      iv. Translate verbal descriptions to equations involving derivatives and vice versa
   d. Second derivative
      i. Apply the second derivative as it applies to concavity, points of inflection, and extrema
      ii. Analyze relationship between a function *f, f', and f'*
   e. Applications
      i. Monotonic traits and concavity
      ii. Optimization in both absolute (global) and relative (local) extrema
      iii. Modeling rates of change, including related rates problems.
      iv. Implicit differentiation in find the derivative of an inverse function.
      v. Relating displacement-time graphs to velocity and acceleration
      vi. Slope fields and their relationship to differential equations
   f. Computing derivatives
      i. Basic derivative rules for the library of functions from precalculus
      ii. Product rule and Quotient rule
      iii. Chain rule and implicit differentiation

III) Integrals
   a. As a limit of Riemann Sums
   b. Properties and rules for integration
      i. Rules for integration of basic functions
      ii. Substitution techniques for integration

c. Applications
    i. Average rate of change, accumulated change
    ii. Area under a curve or the area bounded by two curves
    iii. Volume and surface area of solids of revolution or known cross-sections
d. Fundamental Theorem of Calculus
    i. For evaluating definite integrals
    ii. In finding derivatives of functions expressed as integrals
e. Approximation methods for definite integrals using rectangles, trapezoids, or quadratics

Primary Text (to be supplemented with released AP materials and publications):
J. Stewart, *Single Variable Calculus: Early Transcendentals, 7th Ed.*, Cengage Brooks/Cole, 2012, ISBN 0538498676

Technology used in the course:
All students should use a graphing calculator, preferably a TI-83+ or TI-84. Concepts will be presented in class using Java applets, dynamic geometry and algebra software, and graphing calculator using projection. The course website will feature homework assignments, videos, and other useful resources for the student outside of class. However, many calculus techniques will be taught without graphing calculator assistance whenever possible in order to better prepare students for the exam itself.

Special Project:
As a capstone project to the course, students will construct a solid whose volume can be calculated using integral calculus. The project will involve calculations by hand as well as through technology-assisted approximations. This will be completed after the AP Exam.

The AP Calculus (AB) test:
It is expected that all students register to take the test in May. The test consists of:

- Part A multiple choice (no calculators)
    - 28 questions in 55 minutes
- Part B multiple choice (calculators allowed)
    - 17 questions in 50 minutes (some *require* graphing calculator to solve)
- Part A free-response questions (FRQ) (calculators allowed)
    - Two problems in 30 minutes (*require* graphing calculator)
- Part B FRQ (no calculators)
    - Four problems in 60 minutes
    - May return to Part A FRQ questions to continue work, but without calculator

Extra help:
Your instructor will have posted office hours to allow you to seek additional help or answers to additional questions that cannot be answered in class for any reason. It is a good idea to find peers in class that you can work with in practice. Homework is an exercise to prepare for the assessments ahead!

Grading:
Per department policy, 10% of the grade will be from nightly homework. Homework should be completed neatly and completely with appropriate work shown. The remaining 90% of the course grade will be earned from tests and quizzes, weighted appropriately by the amount of content covered on each.