

Dear AP institute participant,

As the AP Calculus instructor, it is my pleasure to welcome you to the College Board AP Calculus Summer Institute at Wake Forest University.

This year's institute is designed for beginning AP Calculus teachers and will focus on the three major themes in Calculus: Limits, Derivatives, and Integration. This year's institute will be an intensive study of the topics covered in an AP course, with special emphasis on the effects of reform on those topics as well as new approaches in teaching challenging concepts. Strategies and pedagogy to effectively present the calculus concepts covered under the AB curriculum will be discussed. Using numerous Free Response questions, we will discuss the scoring rubrics and how the exam is scored. We will also discuss in detail the AP Calculus exam and how these calculus topics are tested. A course syllabus is attached. One of my major goals is to help beginning AP teachers in strengthening the skills to develop and present an effective AP Calculus course. Teachers will need to bring a TI-83 or TI-84 calculator for use during this week.

This week-long conference is an excellent opportunity for you to meet with beginning Calculus teachers from all over the southeast, share experiences, and create an opportunity for networking, collaboration, sharing of materials and the building of professional relationships. As always, we extend a warm welcome to all our colleagues who share our interest in improving instruction.

Please feel free to email me at kautrey@greenville.k12.sc.us and to check out my websites at <http://teachers.greenville.k12.sc.us/sites/kautrey/default.aspx> and www.kautrey.webs.com. I look forward to working with you at Wake Forest University.

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Advanced Placement Calculus AB Institute

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Topical Outline for Calculus AB

This outline of topics is intended to indicate the scope of the course, but it is not necessarily the order in which the topics are to be taught.

I. Functions, Graphs, and Limits (4 hours)

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 a function (including one-sided limits). An intuitive understanding of the limiting process is sufficient for this course.

- 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. The central idea of continuity is that close values of the domain lead to close values of the range.

- Understanding continuity in terms of limits.
- Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem).

II. Derivatives (12 hours)

Concept of the derivative. The concept of the derivative is presented geometrically, numerically, and analytically, and is 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, included 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.

Derivate 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 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 derivatives of implicitly defined functions

Computation of derivatives

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

III. Integrals (12 hours)

Riemann Sums

- Concept of a Riemann sum over equal subdivisions
- Computation of Riemann sums using left, right, and midpoint evaluation points

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

$$\text{over the interval } \int_a^b f'(x)dx = f(b) - f(a)$$

- Basic properties of definite integrals

Applications of integrals. Appropriate integrals are used in a variety of applications to model physical, social, 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 integral of a rate of change to give accumulated change or 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 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 the Fundamental Theorem to evaluate definite integrals
- Use the Fundamental Theorem to represent a particular antiderivatives, and the analytical and graphical analysis of functions so defined.

Techniques of antidifferentiation

- Antiderivatives following directly from derivatives of basic functions
- Antiderivatives by substitution of variables (including change of limits for definite integrals, parts, and simple partial fractions (nonrepeating linear factors only))

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 of $y' = ky$ and exponential growth.

Numerical approximations to definite integrals. Use Riemann sums and the Trapezoidal Rule to approximate definite integrals of functions represented algebraically, geometrically, and by table of values.

Additional: (4 hours)

Participants will receive many teacher-made materials including worksheets, examinations, quizzes, tests, and projects.

Instruction will be given on the graphing calculator and calculator programs will also be shared.

Participants will develop rubrics for grading AP free response questions.

Participants will discuss best practices from their classrooms.

Participants will review the grading rubrics for the 2008 and 2009 AP AB Calculus examinations.

Participants will work practice problems and work on a practice AB examination.