Peddie Summer School

Course syllabus: Calculus AB Credit
Textbook: Calculus: Graphical, Numerical, Algebraic, Fifth Edition by Finney, Demana, Waits, Kennedy, Bressoud.

Philosophy: I believe that calculus is a course that brings together all of the concepts of mathematics that a student has learned throughout their schooling, and along with the concept of infinity and limits, lays the foundation for a new type of mathematics that allows them to describe and understand the behavior of functions, and as a result, any real-world phenomena that those functions may represent. I stress often that learning calculus is sometimes like learning a new language, and indeed, many students are often intimidated at first by the new terminology, notation, and symbols that they encounter. I also stress that despite all of the new material that they will be introduced to, calculus is really just an intensive course in algebra, and that the skills that they have learned in their pre-calculus, algebra, and geometry courses will be essential to their success in calculus, and will be improved upon as they progress through the course. I design my course to expose students to all aspects of each topic: symbolic, algebraic, graphical, and numerical.

Teaching Strategy: My goal during a lesson is to actually instruct and lecture for as short a time as possible necessary to clearly illustrate a topic. The rest of the students' time in class is spent working together on examples, many from published AP Exams, or exploring and discussing concepts together. My role during this time is to simply oversee and assist. I believe that most students would rather be engaged in an activity rather than simply listen and take notes. My students' performances are assessed by quizzes and tests which model actual AP Exam questions. These assessments are graded using the same type of rubric as AP free response questions, with points for showing work clearly and justifying answers correctly.

Throughout the course, students are required to use multiple approaches to the understanding of functions. Students make daily use of the graphing calculator. Graphs are produced both with the calculator and by hand to assist in the understanding of problems. Students use the graphing calculator to experimentally determine solutions to problems and to interpret the results. Students also learn to use the calculator to support answers and conclusions that they have developed analytically. Numerical solutions are developed both manually and with the calculator. Students are encouraged to check the reasonableness of their numerical solutions by using other approaches. Students use analytical techniques to solve applied problems in differential and integral calculus. They are encouraged to develop general analytical approaches that can be applied to non-traditional problems. Students are asked to explain calculus problems and techniques verbally and in writing.

Course Outline

Unit 1: Limits

- Introduction to limits and limit notation
- Finding limits algebraically and graphically
- Left and right hand limits
- Vertical and horizontal asymptotes as limits involving infinity
- End behavior of functions as limits
- Continuity of a function
- Types of discontinuities, including oscillating discontinuities
- Extended Functions
- The Intermediate Value Theorem and the Extreme Value Theorem
- Average rate of change of a function
- Instantaneous rate of change as a limit
- Tangent and normal lines
- The definition of the derivative

Unit 2: Derivatives

- The derivative as the limit of average rate of change as h approaches zero
- The derivative as instantaneous rate of change
- The derivative as tangent slope to a curve
- Rules of differentiation: power, product, quotient, chain rules
- Relationships between the graphs of a function and its derivative
- Differentiability
- Derivatives of trigonometric functions
- Derivatives of exponential and logarithmic functions
- Higher order derivatives
- L'Hopital's Rule
- Position, velocity, acceleration and other rate of change applications
- Implicit differentiation

Unit 3: Applications of Derivatives

- Extreme points and critical points
- Increasing and decreasing behavior of a function
- Inflection points and concavity of a function
- Using the graphs of f' and f'' to investigate the graph of f
- The Mean Value Theorem
- Modeling and optimization
- Related rates

Unit 4: Integrals

- Finding definite integrals using geometric area formulas
- Approximation methods for definite integrals: Riemann sums, trapezoidal
- Properties of definite integrals
- The Fundamental Theorem of Calculus, Parts I and II
- The substitution method

Unit 5: Applications of Integrals

- Distance and displacement as definite integrals
- Other applications involving definite integrals as accumulated change
- The average value of a function
- Areas in the plane between two curves
- Volumes of rotation by washers
- Volumes of solids with geometric cross sections

Unit 6: Differential Equations

- Visualizing solutions to differential equations as curves in a slope field
- Solving differential equations by separation of variables
- The differential equation $dy/dx = ky$ and its applications