Appoquinimink High School
AP Calculus BC Syllabus

Vision Statement: Developing critical thinkers and effective communicators for a global society.

Mission Statement: Achievement

- Promote an engaging learning environment every day in every classroom.
- Honor students' unique strengths and needs.

Honor

- Model positive character attributes.
- Recognize acts of integrity and leadership.

Service

- Increase students' awareness of the global society.
- Emphasize the individual's role in the community.

Instructor: Mr. Craig Ford craig.ford@appo.k12.de.us

Textbook: Calculus 6th ed by Larson and Edwards (not required)

Course Description:
AP Calculus BC is a one-year course (an extension of AB) that covers 2nd year college-level single-variable differential calculus, integral calculus, and infinite sequences and series, with particular emphasis on those topics that form the Advanced Placement Calculus BC curriculum. Course concepts will be approached from graphical, numerical, analytical, and verbal points of view in order to provide experience with its methods and applications. Emphasis will be placed on the themes that unify calculus, including derivatives, integrals, limits, infinite sequences and series, polynomial approximations of functions, and applications and modeling. These themes can be separated into four sub-topics:

I. Functions, graph, and limits
II. Derivatives
III. Integrals
IV. Polynomial approximation and Series

In each of these branches, students will use graphing calculators to not only solve problems, but also to experiment and interpret results and support conclusions. Students who successfully complete the course and AP examination may receive credit, advanced placement, or both (according to each individual institution's local policies).

The first semester will be devoted to discussing topics learned in AB Calculus while the second semester will be committed to learning the new concepts that BC Calculus offers. (60% AB vs. 40% BC on the AP Exam)

Course Objectives:
Upon the successful completion of this course, the student will 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.

- 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.
- 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.
- Understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus.
- Communicate mathematics and explain solutions to problems both verbally and in written sentences.
- Model a written description of a physical situation with a function, a differential equation, or an integral.
- Use technology to help solve problems, experiment, interpret results, and support conclusions.
- Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement.
- Develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment.
- Use graphing calculators to solve problems, experiment, interpret results, and support conclusions.

Course Outline and Timelines:

I. Functions, Graphs, and Limits (5 – 6 weeks)

- **Analysis of graphs**
- **Limits of functions**
  - An intuitive understanding of the limiting process. Language of limits, including notation and one-sided limits. Calculating limits using algebra. Properties of limits. Estimating limits from graphs or tables of data. Estimating limits numerically and graphically.
- **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.
- **Continuity as a property of functions**
  - An intuitive understanding of continuity. Understanding continuity in terms of limits. Types of discontinuities. Geometric understanding of graphs of continuous functions. Intermediate Value and Extreme Value Theorem.
- **Parametric, polar, and vector functions**

II. Derivatives (5 – 6 weeks)

- **Concept of the derivative**
  - Derivative presented graphically, numerically, and analytically. Derivatives 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, including 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.
- **Derivative 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 interpretation. 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 the notions of monotonicity and concavity.
  - Analysis of planar curves given in parametric form, polar form, and vector form, including velocity and acceleration.
  - Optimization, both absolute (global) and relative (local) extreme.
  - Modeling rates of change, including related rate problems.
  - Use of implicit differentiation to find the derivative of an inverse function.
  - Interpretation of the derivative as a rate of change in diverse applied contexts, including velocity, speed, and acceleration.
  - Geometric interpretation of differential equation via slope fields and the relationship between slope fields and solution curves for differential equations.
  - Numerical solution of differential equations using Euler's method.
  - L'Hospital's Rule, including its use in determining limits and convergence of improper integrals and series.
- **Computation of derivatives**
  - Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions.
  - Derivative rules for sums, products, and quotients of functions.
  - Chain rule and implicit differentiation.
  - Derivatives of parametric, polar, and vector functions.

III. Integrals (8 – 10 weeks)

- **Interpretation and properties of definite integrals**
  - Summation notation. Definite integral as a limit of Riemann sums. Basic properties of definite integrals. Linearity properties of definite integrals.
- **Applications of integrals**
  - A variety of applications to model physical, biological, or economic situations. Finding the area of a region (including a region bounded by polar curves), the volume of a solid with known cross sections, the average value of a function, the distance traveled by a particle along a line, the length of a curve (including a curve given in parametric form), and accumulated change from a rate of change.
- **Fundamental Theorem of Calculus**
  - Use of the Fundamental Theorem of Calculus to evaluate definite integrals. Use of the Fundamental Theorem of Calculus to represent a particular antiderivative, 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). Improper integrals (as limits of definite integrals).
- **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 (including the study of the equation: $y' = ky$ and exponential growth). Solving logistic differential equations and using them in modeling.
- **Numerical approximation to definite integrals**
  - Use of Riemann sums and trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by tables of values.

IV. Polynomial Approximation and Series (10 – 12 weeks)

- **Concept of series**
  - A series is defined as a sequence of partial sums, and convergence is defined in terms of the limit of the sequence of partial sums. Technology can be used to explore convergence and divergence.
- **Series of constants**
  - Motivating examples, including decimal expansion.
  - Geometric series with applications.
  - The harmonic series.
  - Alternating series with error bound.
  - Terms of series as areas of rectangles and their relationship to improper integrals, including the integral test and its use in testing the convergence of *p*-series.
  - The ratio test for convergence and divergence.
  - Comparing series to test for convergence or divergence.
- **Taylor series**
  - Taylor polynomial approximation with graphical demonstration of convergence (for example, viewing graphs of various Taylor polynomials of the sine function approximating the since curve).
  - Maclaurin series and the general Taylor series centered at $x = a$.
  - Maclaurin series for the functions e^x, $\sin x$, $\cos x$, and $1/(1 - x)$.
  - Formal manipulation of Taylor series and shortcuts to computing Taylor series, including substitution, differentiation, antidifferentiation, and the formation of new series from known series.
  - Functions defined by power series.
  - Radius and interval of convergence of power series.
  - Lagrange error bound for Taylor polynomials.

Review and Preparation for the AP Exam (approximately 3 – 4 weeks)

- Practice exams are given, scored, and analyzed. Some are done in groups while others are completed individually.
- Review will consist of the main topics covered throughout the year.
- **The AP Calculus BC Exam is scheduled for Tuesday, May 4th, 2021 from 8 – 12.**
- **The AP Calculus BC Alternate Exam is scheduled for Friday, May 21st, 2021 from 8 – 12.**

Technology

Graphing calculators come into play in the two courses prior to AP Calculus BC. These courses emphasize the graphing of functions, finding zeros, and points of intersection. In this course students learn to find a numerical derivative and a definite integral using the graphing calculator. You will also use the calculators to find Riemann Sums, slope fields, limits (using tables and graphs), areas, and volumes using the trapezoid rule. Graphing calculators are also used to motivate concepts and illustrate techniques for finding volumes of solids with variable cross sections. The limiting process of the slope of a secant line to the slope of the tangent line comes alive with the calculator as does the polynomial approximation of functions when doing the unit on series.

Students are expected to provide their own calculators as instruction will be given with the TI-84 (a TI-83 will also be acceptable). A graphing calculator will be used daily in the class and all chapter tests are divided in two halves: one without the use of any calculator and the other half requiring the use of a graphing calculator. This resembles the AP Exam which is why I want you to get used to using and not using them.

Teaching Strategies

- Students are expected to follow the syllabus systematically, completing all assignments with adequate time to be prepared for the AP Exam.
- Students will receive materials and course topics on the first day of class.
- Most units consist of one day of lecture followed by one or two days of classroom work. Lessons are presented using PowerPoint lectures and students are encouraged to ask questions at any time during the presentation for clarification. During non-lecture days, students are encouraged to work collaboratively to complete their assignments. Assistance or additional explanations is given as needed.
- The teacher will 'coach' the progress of the students and will work on every point in the course syllabus to achieve the goals of doing well on the AP Exam.
- The teacher and the students are going to spend approximately two weeks at the beginning of the school year to review a variety of Pre-Calculus topics, basically functions and their graphs, in order to familiarize students with the basic functions and be able to represent functions in a variety of ways (graphically, numerically, analytically, and verbally). Students should identify the connection among these representations.
- Students will justify responses and support their conclusions as a typical practice in class. To develop student's communication skills, the course includes a diversity of teaching strategies to encourage students to expand their vocabulary and explanation skills.

Classroom norms:

Rights of the Learner

In my classroom, I believe that all of my students have certain rights as learners. I want us all to exercise and recognize these rights on a daily basis. These include:

- **The right to be confused**
- **The right to make a mistake**
- **The right to say what makes sense to you**
- **The right to share unfinished thinking and not be judged**
- **The right to revise your thinking**

I strive to set a positive learning environment for ALL students. I want my students to feel seen and heard in the classroom at all times.

Student Expectations:

Attendance policy:

Student Attendance will be taken in eSchool each class period. A student is present if they are in the live/synchronized session. If a student is absent for more than 15 minutes from the live session, the student will be considered absent. Students are expected to be active participants during the live sessions. Students should participate in break out room discussions, class discussions, warm-up questions, exit tickets, closure activities, etc.

Grading Policy:

During virtual learning, students in the Appoquinimink School District's secondary schools will be assessed on a portfolio of work. The portfolio will include all summative assessments and may include other formative evidence of learning.

All summative assessments in the portfolio from the MP will be graded and then averaged for the marking period grade.

My gradebook will be updated weekly with everyday evidence of learning and formative assignments which will give students feedback on their progress towards the course learning goals. Though these assignments will not be weighted individually toward the final grade, they will be used to assess student understanding and progress. The final grade in the course will be based entirely based on the summative assessments.

APPOQUINIMINK HIGH SCHOOL

AP Calculus BC

[Access the full Syllabus on www.schoology.com]

Terms of Agreement

Fill this out at the following Google Form by Friday, September 11, 2020:
https://docs.google.com/forms/d/12Dmc3RRY9y2ByHy5Cg3ppEhu1kVZ7YEtkocCBZFWqvA/edit

As a teacher of this course, I am committed to abiding by this syllabus. Timelines are subject to change based on students' assimilation of the material. Any changes will be communicated to the class by the teacher. By signing this "Terms of Agreement," you are affirming that you have read and agree to abide by the guidelines, policies, and agreements stated in this syllabus.

As a student of this course, I have read and agree to abide by the guidelines, policies and agreements stated in this syllabus.

_____
Student Name (printed)

_____ _____
Student Signature Date

As the parent/guardian, I have read and agree to support this student in an effort to follow the guidelines, policies and agreements stated in this syllabus.

_____ _____
Parent/Guardian Signature Date

_____
Parent/Guardian Phone Number

_____
Parent/Guardian Email Address

Which is the best way to get in contact with you? Phone Email

One of my favorite parts of teaching is getting to know my students. Please tell me something unique about your child, or something that would be good for me to know. Maybe a favorite movie, song, or interesting hobby. Tell me what makes your child special!