AP® Calculus BC - BC Content Only

Course Description:

Our HSML course is designed for students who have had Calculus I or AP® Calculus AB and are ready for the challenge of learning AP® Calculus BC (Calculus II) content. Taking the AP® Calculus BC exam for university credit is not a requirement of this course. Our learning objectives are primarily focused on the AP® Calculus BC (Calculus II) content, which equates to a semester long Calculus II course at most colleges and universities. Our course begins with further exploration of L'Hospital's Rule and additional integration techniques. Then we will move our discussions to sequences and series including Taylor and Maclaurin Series and learn how to represent functions as power series. Euler's Method, logistic growth models, parametric curves, vectors, polar curves will also be discussed. Even though we cover a college level course over an entire school year, the pace is still brisk. This is a challenging course that uses a college level textbook, written by James Stewart, which includes all the necessary concepts to prepare for a rigorous college calculus class and/or the AP exam.

Preparation for the AP® Calculus BC exam will be incorporated throughout the course.

Assignments and Assessments:

Each unit will be completed following this process:

1. Students will attend live and interactive classes or view recorded (At My Pace - AMP) instruction video and participate by answering questions in the live setting or by pausing the AMP instruction video to solve a given problem. Students will have immediate feedback on their current level of comprehension, thus reinforcing learning and providing the opportunity to improve their skills within each lesson.
2. Students will complete one homework assignment before attending or viewing the next instruction session. Students are provided with answers to homework assignments and are expected to self-check their answers. Classes begin with time for students to ask the instructor about homework questions they were not able to complete correctly. Students using AMP recorded instruction can set up time with an instructor, up to 5 hours per course, for individual tutoring.
3. After approximately every two assignments, students complete a quiz (using paper and pencil) that is proctored by an adult and returned to the instructor for grading and feedback. Instructors look at both work and answers to ensure that students are using sound mathematical processes to demonstrate mastery. Students complete a tests over larger sections of material in the same manner. The instructor creates an online personal grading notebook for each student where the student's work, the instructor's feedback, and the grade can be viewed. Access to the notebook is granted to the student and parents, as well as any education advisors.
4. At the end of each semester, students complete a cumulative final exam.
5. Course grades are assigned based on a weighted average of 40% quiz / 60% test. The final exam is weighted the same as the other tests.

Unit 1: L'Hospital's Rule

Description:

Unit 1 revisits from Calculus I, indeterminant limits using L'Hospital's Rule. There are 5 more indeterminant forms that will be discussed that is not usually addressed in Calculus I.

Skills to be demonstrated:

- Discern between various indeterminant limits.
- Select appropriate techniques to evaluate limits using L'Hospital's Rule.

Unit 2: Integration Techniques and Arc Length of a function.

Description:

Unit 2 introduces the additional methods of integration that is not covered in most Calculus I courses. Reviews of previously learned integration techniques will be incorporated into the lessons. Arc Length of a smooth planar curve will be found.

Skills to be demonstrated:

- Evaluate integrals using Integration by Parts.
- Evaluate integrals using Partial Fractions.
- Discern which technique is needed to integrate all functions explored in Calculus I and II.
- Find the arc length of a smooth planar curve defined on a closed interval.

Unit 3: Differentials and Logistic Growth Models

Description:

Unit 3 introduces Euler's Method and differential equations as logistic growth models. Slope fields will be reviewed to show the connection between them and the logistic growth models. Students will find an equation to a particular logistic growth model given an initial condition.

Skills to be demonstrated:

- Use Euler's Method with a given step size to approximate values for the solution of an initial-value problem.
- Use slope fields to model logistic growth.
- Use logistic growth models to find the carrying capacity of populations.
- Use logistic growth models to discern when a population is increasing/decreasing and when the populations growth is the highest.

- Given an initial population of a logistic growth model, find an equation for the population after a given time period.

Unit 4: Improper Integrals

Description:

Unit 4 introduces improper integrals and how to evaluate them.

Skills to be demonstrated:

- Discern the difference between proper and improper integrals.
- Understand why an integral may be improper.
- Evaluate improper integrals using limits.

Unit 5: Sequences and Series

Description:

Unit 5 introduces sequences and series. Convergence and divergence will be explored along with using various tests to determine if a series is convergent or divergent. Error bounds will be found with alternating series. Absolute and conditional convergence will be discussed primarily with the root and ratio tests. Power Series, Taylor and Maclaurin series will be developed to represent functions. Their radius and intervals of convergence will be found. Lagrange Error bound will also be discussed.

Skills to be demonstrated:

- Understand the difference between a sequence and a series.
- Determine when a sequence is convergent or divergent.
- Find nth partial sum of a series.
- Define a geometric series and know when it converges or not.
- Use the nth term test for divergence of a series
- Use the integral test for show convergence/divergence of a series.
- Use the harmonic series and p-series to show convergence/divergence of a series.
- Use comparison tests to show convergence/divergence of a series.
- Use the alternating series test to show convergence of a series.
- Use the ratio and root test to show convergence/divergence of a series.
- Determine absolute or conditional convergence of a series.
- Find the error bound in an alternating series.
- Find Taylor Polynomial approximations of functions.
- Find the Lagrange Error bound.
- Find the radius and interval of convergence of power series.
- Find Taylor and Maclaurin series for a function.
- Represent functions as power series.

Unit 6: Parametric Curves and Vectors

Description:

Unit 6 introduces parametric equations and how to use them to solve calculus problems. Starting with defining and differentiating parametric equation, students then will find equations of tangent lines. Using a graphing tool, students will compare graphs to their calculus computations to confirm slopes of tangent lines including vertical and horizontal tangent lines. The second derivative will be taught and used to show concavity of the parametric curve. Arc Lengths of parametric curves will be explored and compared with arc lengths of smooth planar curves. Defining and differentiating and integrating vector-valued functions will be explored. Students will solve motion problems using parametric and vector-valued functions.

Skills to be demonstrated:

- Define and graph a parametric equation.
- Differentiate parametric equations, both first and second derivatives.
- Find the arc length of curves of parametric equations.
- Find equations of tangent lines including vertical and horizontal tangents.
- Compare written calculus computations for tangent lines to graphs.
- Find concavity intervals for parametric curves.
- Define vector-valued functions.
- Differentiate and integrate vector-valued functions.
- Solve motion problems using parametric and vector-valued functions.

Unit 7: Polar Curves

Description:

Unit 7 introduces polar coordinates and graphing using polar curves. The area of a polar region, the area bounded by a single polar curve, or the area of the region bounded by two polar curves will be discussed.

Skills to be demonstrated:

- Graph polar coordinates and graphs.
- Convert from polar coordinates to rectangular coordinates and vice versa.
- Differentiate a polar equation.
- Use differentiation, to find the equations of tangent lines to a polar curve.
- Find the area of a polar region.
- Find the area bounded by a single polar curve.
- Find the area of the region bounded by two polar curves.