Hoboken Public Schools

AP Calculus Curriculum

AP Calculus

HOBOKEN PUBLIC SCHOOLS

Course Description

An Advanced Placement (AP) course in calculus consists of a full high school academic year of work that is comparable to a calculus course in colleges and universities. AP Calculus will follow the topics outlined by the College Board, along with additional topics that the instructor deems fit to include. Each student will complete a simulated AP exam at the end of April that will be counted as the final exam for the course. AP Exam is usually conducted in first week of May . During the last weeks of spring semester (after the official AP exam), advanced topics will be covered. The course is primarily concerned with developing students' understanding of the concepts of calculus and providing experience with its methods and applications. The course emphasizes a multi-representational approach to calculus, with concepts, results, and problems being expressed graphically, numerically, analytically, and verbally. The connections among these representations are demonstrated through the unifying themes of derivatives, integrals, limits, approximation, applications, and modeling. A major objective of the class is to prepare students for the AP Calculus AB exam to be given in the spring. Most universities award credit to students based upon their scores on this exam.

Course Resources

Online Text-book,
Vocabulary Practices Q uizzes,
www.KhanAcademy.org ,
www.Desmos.com
www.kutasoftware.com
TI-89 Texas info site
www.njctl.org,
www.mastermathmentor.com

Pacing Guide

Unit Titles	Time Frame
Unit One: Limits and Continuity	**3-4 Weeks**
Unit Two: Differentiation and Application of Differentiation	**8-10 Weeks**
Unit Three: Anti-differentiation (Integration) and Application of Integration	**5-6 Weeks**
Unit Four: Differential Equations **AP Practice Examination**	**3-4 Weeks**

Unit 1 – Limits and Continuity

Three-Four Weeks

Unit 1 Overview

In this unit, students will evaluate limits using a variety of techniques. Students will learn how to use limits to evaluate horizontal and vertical asymptotes. Students will develop the definition of a derivative using the limit of the slope of a tangent line. Students will apply to properties of limits to help evaluate them.

Essential Questions

- How is limit defined?
- How are continuous functions described?
- How are one sided and two sided limits defined?
- How do you determine limits at infinity?
- How do you use limits to find asymptotes?

Essential Learning Outcomes

- Students will evaluate limits using a variety of techniques.
- Students will learn how to use limits to evaluate horizontal and vertical asymptotes.
- Students will develop the definition of a derivative using the limit of the slope of a tangent line.
- Students will apply to properties of limits to help evaluate them.

Technology Infusion

- 8.2.12.E.1Demonstrate an understanding of the problem-solving capacity of computers in our world.
- 8.1.12.F.1 Critical Thinking, Problem Solving, Decision Making Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.

Standards Addressed:

- APc1 : Analysis of graphs: With the aid of technology, graphs of functions are often easy to produce. The emphasis is on the play
- 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.
- APC.2 The student will define and apply the properties of limits of functions. Limits will be evaluated graphically and algebraically. APC.3 The student will use limits to define continuity and determine where a function is continuous or discontinuous.
- A PC.5 The student will investigate derivatives presented in graphic, numerical, and analytic contexts and the relationship between continuity and differentiability. The derivative will be defined as the limit of the difference quotient and interpreted as an instantaneous rate of change.

Differentiation

- **Time**: Extra time for assigned tasks, adjust length of assignment, timeline with due dates for reports and projects, communication system between home and school and provide lecture notes/outline.
- **Processing**: Extra Response time, verbalize steps, repeat, clarify or reword directions, Mini-breaks between tasks, Provide a warning for transitions, and partnering.
- **Recall**: Teacher-made checklist, Use visual graphic organizers, reference resources to promote independence and visual/verbal reminders
- **Tests/Quizzes/Grading:** Extended time, Study guides, shortened tests, and read directions aloud.
- **Behavior/Attention:** Consistent daily structured routine, simple and clear classroom rules, and frequent feedback.
- **Organization:** Individual daily planner, display a written agenda, note-taking assistance, and Color code materials.

Assessments

- Class discussion and group work
- Do Nows, Quizzes, and Assessments
- Homework
- Exit tickets
- Unit tests
- Required District/State Assessments
- Short/Extended Constructed Response Items
- Homework
- Quick-Writes(index cards with formulas and concepts)
- Vocabulary Check
- AP Practice Exams
- Khan Academy Assignments

21st Century Learning Connection

- 9.1.12.C.8 Identify the types and characteristics of predatory lending practices (e.g;payday loans, car title loans, high-risk mortgages
- 9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
- 9.4.12A.16 Employ critical thinking skills independently and in teams to solve problems and make decisions, (e.g., analyze, synthesize, and evaluate).
- 9.4.12A.17 Employ critical thinking and interpersonal skills to resolve conflicts.

Unit 2 Differentiation and Application of Differentiation
Eight to Ten Weeks

Unit 2 Overview

In this unit, students will be to discover how to find the derivative of a function using the limit definition and understand the relationship between differentiability and continuity. Students will explore how to find the derivative of a function using basic differentiation rules. Students will learn how to find the derivative of a function using the Product and Quotient Rules. Students will learn how to find the derivative using implicit differentiation. Students will be able to independently distinguish between linear and exponential functions of an equation; situation or graph. Students will be able to review the analysis of curves including the notions of monotonicity and concavity. Students will learn the Optimization, both absolute (global) and relative (local) extrema. Students will understand the importance of modeling rates of change, including related rates problems. Students will learn the use of implicit differentiation to find the derivative of an inverse function. Students will understand the interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed and acceleration. Students will learn the importance of the geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations.

Essential Questions

- How can we use derivatives solve problems?
- How is IVT theorem defined?
- How is differentiating implicitly important in the concept of Calculus?
- How do you differentiate sum, product and quotient of functions?
- How can a function be transformed prior to differentiation in to apply a simpler differentiation rule?
- How can derivatives be applied to solving motion problems?
- What information do the first and second derivatives of a function give one about the function itself?
- How can differentiation techniques be used in estimation problems?
- What information do the first and second derivatives of a function give one about the function itself?

Essential Learning Outcomes

- Students will be to discover how to find the derivative of a function using the limit definition and understand the relationship between differentiability and continuity.
- Students will explore how to find the derivative of a function using basic differentiation rules.
- Students will learn how to find the derivative of a function using the Product and Quotient Rules.
- Students will learn how to find the derivative using implicit differentiation.

- Students will be able to independently distinguish between linear and exponential functions of an equation; situation or graph.
- Students will be able to review the analysis of curves including the notions of monotonicity and concavity. Students will learn the Optimization, both absolute (global) and relative (local) extrema.
- Students will understand the importance of modeling rates of change, including related rates problems. Students will learn the use of implicit differentiation to find the derivative of an inverse function.
- Students will understand the interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed and acceleration.
- Students will learn the importance of the geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations.

Technology Infusion

- 8.2.12.E.1Demonstrate an understanding of the problem-solving capacity of computers in our world.
- 8.1.12.F.1 Critical Thinking, Problem Solving, Decision Making Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.

Standards Addressed:

- APC.7 The student will analyze the derivative of a function as a function in itself.
- APC.8 The student will apply the derivative to solve problems.
- APC.7 The student will analyze the derivative of a function as a function in itself.
- APC.8 The student will apply the derivative to solve problems.
- APC.9 The student will apply formulas to find derivatives
- APC.10 The student will use Riemann sums and the Trapezoidal Rule to approximate definite integrals of functions represented algebraically and graphically.

Differentiation

- **Time**: Extra time for assigned tasks, adjust length of assignment, timeline with due dates for reports and projects, communication system between home and school and provide lecture notes/outline.
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Assessments

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- 9.1.12.C.8 Identify the types and characteristics of predatory lending practices (e.g;payday loans, car title loans, high-risk mortgages
- 9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
- 9.4.12A.16 Employ critical thinking skills independently and in teams to solve problems and make decisions, (e.g., analyze, synthesize, and evaluate).
- 9.4.12A.17 Employ critical thinking and interpersonal skills to resolve conflicts.

Unit 3 – Anti-differentiation (Integration) and Application of Integration
Five to Six Weeks

Unit 3 Overview

In this unit, students will interpret the definite integral as the limit of a Riemann sum. Students will interpret the meaning of definite integral within a problem. Students will express the limit of a Riemann sum in integral notation. Students will calculate definite integral using areas and properties of definite integrals. Students will evaluate an improper integral or show that an improper integral diverges. Students will learn how to apply Mean Value Theorem to describe the behavior of a function over an interval. Students will analyze differential equation involving general and specific solutions.

Essential Questions

- How is an integral defined?
- How are integrals related to derivatives?
- How is the relationship between an integral and area explained in calculus?
- How can one apply numerical techniques to compute an integral without knowing the associated antiderivative?
- How can integrals be used to find areas of complex figures?
- How are the practical applications of finding such areas described?
- What is an improper integral and under what circumstances do they arise?
- How can integrals be used to find volumes of complex figures?
- How are the practical applications of finding such volumes explored?

Essential Learning Outcomes

- Students will interpret the definite integral as the limit of a Riemann sum.
- Students will interpret the meaning of definite integral within a problem.
- Students will express the limit of a Riemann sum in integral notation.
- Students will calculate definite integral using areas and properties of definite integrals.
- Students will evaluate an improper integral or show that an improper integral diverges.
- Students will learn how to apply Mean Value Theorem to describe the behavior of a function over an interval.
- Students will analyze differential equation involving general and specific solutions.

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- 8.2.12.E.1Demonstrate an understanding of the problem-solving capacity of computers in our world.
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Standards Addressed:

- APC.11 The student will find antiderivatives directly from derivatives of basic functions and by substitution of variables.
- APC.12 The student will identify the properties of the definite integral.
- APC.13 The student will use the Fundamental Theorem of Calculus to evaluate definite integrals
- APC.14 The student will find specific antiderivatives, using initial conditions (including applications to motion along a line).
- APC.15 The student will use integration techniques and appropriate integrals to model physical, biological, and economic situations.

Differentiation

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- Quick-Writes(index cards with formulas and concepts)
- Vocabulary Check
- AP Practice Exams
- Khan Academy Assignments

21st Century Learning Connection

- 9.1.12.C.8 Identify the types and characteristics of predatory lending practices (e.g;payday loans, car title loans, high-risk mortgages
- 9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning

experiences.

- 9.4.12A.16 Employ critical thinking skills independently and in teams to solve problems and make decisions, (e.g., analyze, synthesize, and evaluate).
- 9.4.12A.17 Employ critical thinking and interpersonal skills to resolve conflicts.

Unit 4 – Differential Equations
AP Practice Examination
Three to Four Weeks

Unit 4 Overview

In this unit, students will learn to model with Differential equations. Students will solve differential equation by separation of variables. Students will be able to find Slope Fields; Euler's method. Students will be able to solve first order differential equations apply to the real world situations. Students will analyze differential equation involving general and specific solutions. Students will learn the importance of solving separable differential equations and using them in modeling (including the study of the equation y' = ky and exponential growth).

Essential Questions

- How is a differential equation defined in calculus?
- How can one use differential equations to model real world problems?

Essential Learning Outcomes

- Students will learn to model with Differential equations.
- Students will solve differential equation by separation of variables.
- Students will be able to find Slope Fields; Euler's method.
- Students will be able to solve first order differential equations apply to the real world situations.
- Students will analyze differential equation involving general and specific solutions.
- Students will learn the importance of solving separable differential equations and using them in modeling (including the study of the equation y' = ky and exponential growth).

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Standards Addressed:

- APC.14 The student will find specific antiderivatives, using initial conditions (including

applications to motion along a line). Separable differential equations will be solved and used in modeling (in particular, the equation $y' = ky$ and exponential growth).

Differentiation

- **Time**: Extra time for assigned tasks, adjust length of assignment, timeline with due dates for reports and projects, communication system between home and school and provide lecture notes/outline.
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