PUBLIC SCHOOLS OF EDISON TOWNSHIP

OFFICE OF CURRICULUM AND INSTRUCTION

AP Calculus BC/AB/Honors/Accelerated

Length of Course:	Term
Elective/Required:	Elective/Required
Schools:	High School
Eligibility:	Grade 11-12
Credit Value:	5 Credits
Date Approved:	August 15, 2023

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Statement of Purpose

This course of study has been designed for

- ***AP CALCULUS AB:*** This college-level course stresses elementary functions and analytic geometry as well as the concepts and applications of differential and integral calculus via the use of analytic methods and technology. It prepares students for the AB Advanced Placement Examination as well as more advanced mathematical study at the college level. The use of technology is an integral part of this course as are advanced problem solving strategies and methods

- ***AP CALCULUS BC:*** This is a college-level course, which is considerably more extensive and rigorous than the Calculus AB course. It prepares the student to take the BC Advanced Placement Examination as well as more advanced mathematical and scientific study at the college level. All the topics of the Calculus AB course are included, along with additional topics such as differential equations and sequences and series. The use of technology is an integral part of this course as are advanced problem solving strategies and methods.

- ***CALCULUS HONORS/ACCELERATED:*** This is a full year study of the Calculus of algebraic, trigonometric, exponential, and logarithmic functions. Topics include limits, differentiation and its applications, integration and the applications of the definite integral. This course also affords students the opportunity to gain experience with college level material and expectations while still enrolled in high school.

Course Objectives

The student will be able to:

- Define and Identify functions and their behaviors
- Define and calculate limits for function values and apply the properties of limits
- Understand the relationship between functions and their derivatives as well as apply basic rules to find derivatives of functions.
- Apply the use of basic derivative rules to more advanced techniques of differentiation.
- Apply knowledge of derivatives to analyze and interpret graphs as well as completing real-life application problems.
- Understand the process of integration as it relates to finding the area under a curve and accumulation as a fundamental interpretation of the integral as well as to establish the connection between differential and integral calculus.
- Find antiderivatives of functions analytically through a variety of methods.
- Apply the use of the definite integral to net change, areas and volumes
- Work with sequences and limits as foundations to evaluate improper integrals.
- Determine the convergence and behavior of a series.
- Manipulate and work with parametric, vector and polar functions. Students will be able to apply differential and integral calculus to these functions as needed for modeling.

Suggested Timeline
AP Calculus BC

UNIT	**# of periods**
Unit 0: Chapter 0: Prerequisites for Calculus	4
Unit 1: Chapter 1: Limits and Continuity	7
Unit 2: Chapter 2: Derivatives	13
Unit 3: Chapter 3: More Derivatives	10 estimated end of mp1
Unit 4: Chapter 4: Applications of Derivatives	15
Unit 5: Chapter 5: The Definite Integral	16
Unit 6: Chapter 6: Differential Equations and Mathematical Modeling	20 estimated end of mp2
Unit 7: Chapter 7: Applications of Definite Integrals	15
Unit 8: Chapter 8: Sequences, L'Hopital's Rule, and Improper Integrals	8 estimated end of mp3
Unit 9: Chapter 9: Infinite Series	23
Unit 10: Chapter 10: Parametric, Vector and Polar Functions	14
AP exam review	15
total class periods	**160**

Suggested Timeline
AP Calculus AB

UNIT	**# of periods**
Unit 0: Chapter 0: Prerequisites for Calculus	11
Unit 1: Chapter 1: Limits and Continuity	11
Unit 2: Chapter 2: Derivatives	19 estimated end of mp1
Unit 3: Chapter 3: More Derivatives	13
Unit 4: Chapter 4: Applications of Derivatives	26 estimated end of mp2
Unit 5: Chapter 5: The Definite Integral	26
Unit 6: Chapter 6: Differential Equations and Mathematical Modeling	17 estimated end of mp3
Unit 7: Chapter 7: Applications of Definite Integrals	20
Unit 8: Chapter 8: Sequences, L'Hopital's Rule, and Improper Integrals ● section 8.2 only	2
AP exam review	15
total class periods	**160**

Suggested Timeline
Calculus Honors

UNIT	**# of periods**
Unit 0: Chapter 0: Prerequisites for Calculus ● sections 1,2,3,5,6	18
Unit 1: Chapter 1: Limits and Continuity	16
Unit 2: Chapter 2: Derivatives	25 estimated end of mp1(section 2.3)
Unit 3: Chapter 3: More Derivatives	25 estimated end of mp2
Unit 4: Chapter 4: Applications of Derivatives	42 estimated end of mp3
Unit 5: Chapter 5: The Definite Integral	30
Unit 6: Chapter 6: Differential Equations and Mathematical Modeling ● sections 2 and 4	8
Unit 7: Chapter 7: Applications of Definite Integrals ● Sections 1 and 2	6
total class periods	**170**

Suggested Timeline
Calculus Accelerated

UNIT	**# of periods**
Unit 0: Chapter 0: Prerequisites for Calculus ● Sections 1,2,3,5,6	23
Unit 1: Chapter 1: Limits and Continuity ● Sections 1,2,3,4	20 estimated end of mp1
Unit 2: Chapter 2: Derivatives • Sections 1,2,3,4,5	42 estimated end of mp2
Unit 3: Chapter 3: More Derivatives ● Sections 1,2,4	16
Unit 4: Chapter 4: Applications of Derivatives ● Sections 1,3,4,5	26 estimated end of mp3
Unit 5: Chapter 5: The Definite Integral ● Sections 1,2,3,4,5	35
Unit 6: Chapter 6: Differential Equations and Mathematical Modeling ● Section 2	8 estimated end of mp4
Total class periods	**170**

Unit of Study: Chapter 0 - Prerequisites for Calculus

Unit Objectives/Enduring Understandings: Students will be able to understand functions and their behaviors

Unit Assessment: www.mymathlab.com , teacher generated assessments, Quick Quizzes, Standardized Test Questions and AP Examination Preparation questions

Core Content		**Instructional Actions**	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Students will know: • the definitions for the following terms: a. Increments b. Slope of a line c. Parallel and perpendicular lines d. Equations of lines e. Functions f. Domain and Range g. Even and Odd Functions h. Piecewise Functions i. Absolute Value Functions j. Composite Functions k. Exponential Growth and Decay l. Relations m. Circles n. Ellipses	Students will be able to: • use increments to calculate slope • find a linear equation and sketch a graph of a line given specific information • identify the relationship between parallel and perpendicular lines • solve two linear equations simultaneously • identify the domain and range of a function using its graph or equation • recognize odd and even functions using equations or graphs • write and evaluate compositions of two functions • determine domain, range, and graph exponential functions • solve problems using exponential growth or decay • solve compound interest problems • graph curves described using parametric equations • find parameterizations of circles, ellipses, line segments, and other curves • identify a one-to-one function • use parametric equations to graph inverse functions • apply properties of logarithms • use logarithms to solve exponential equations • convert between radians and degrees and find	• Discussion of slope of horizontal lines and vertical lines • Use of graphing utility to understand the concept of viewing window to see all relevant information of the graph • Discuss examples of real world functions • Review interval notation • Explain how to use Boolean logic tests in graphing utility • Discussion on radioactive half life • Discussion of $y = x^3 + x$ can enhance appreciation for parametric graphing of an inverse function • Review values of trig functions of angles such as 0, $\pi/3$, $\pi/2$, $2\pi/3$, etc.	• 0.1 exercises # 3-36 multiples of 3, 37, 41, 55 and AP Prep # 42-44, 58 • 0.2 exercises # 3-33 multiples of 3, 35, 36, 39, 42, 45, 51, 55, 61 • 0.3 exercises # 3-21 multiples of 3, 23-27, 32, 36 • 0.4 exercises # 3-30 multiples of 3, 48 • 0.5 exercises #3-42 multiples of 3, 43, 48, 60 • 0.6 exercises # 3-21 multiples of 3, 24, 27-29, 42, 46, 59

o. One-to-one Functions p. Trigonometric Functions q. Even and Odd Trigonometric functions ● Applications of Linear functions ● Viewing and interpreting graphs ● Applications of Inverse and Logarithmic functions ● Transform trigonometric functions	arc length ● identify the periodicity and even-odd properties of trigonometric functions ● find values of trigonometric functions ● generate graphs of trigonometric functions and explore various transformations of these graphs ● use the inverse trigonometric functions to solve problems		
Resources: Essential Materials, Supplementary Materials, Links to Best Practices ● TEXTBOOK: Calculus (Graphical, Numerical, Algebraic AP edition) 5th edition, Finney ● textbook: Calculus of a Single Variable, 9th edition, Larson ● www.mymathlab.com ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (AB) Examination ● Multiple Choice & Free-Response questions in students reparation for the AP Calculus (BC) Examination ● http://apcentral.collegeboard.com		**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings ● Before students begin to calculate slope using two points, have them plot and visually estimate the slope, then compare the estimate with the calculated answer ● When using a grapher, students sometimes forget to enclose algebraic expressions in parentheses when they are part of a radical, quotient, or rational expression ● Students often forget to convert percentages to decimals before completing calculations ● Students may confuse the parameter interval with the with the values that govern the viewing size of the window ● Students should be reminded that the -1 in f^{-1} is to be interpreted as inverse and not an exponent ● Students should be sure to know whether their calculator is in degree or radian mode during trigonometric calculations	

Unit of Study: Chapter 1 - Limits and Continuity

Unit Objectives/Enduring Understandings: Students will be able to define and calculate limits for function values and apply the properties of limits

Unit Assessment: www.mymathlab.com , teacher generated assessments, Quick Quizzes, Standardized Test Questions and AP Examination Preparation questions

Core Content		**Instructional Actions**	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Students will know: ● the definitions for the following terms: a. Average Speed b. Instantaneous Speed c. Definition of Limit d. Properties of Limits e. One Sided Limits f. Two Sided Limits g. Squeeze Theorem h. Finite Limits i. Infinite Limits j. End Behavior k. Continuity at a pt l. Continuous Function m. Algebraic Combinations n. Composites	Students will be able to: ● calculate average speed and instantaneous speed ● define and calculate limits for function values and apply the properties of limits ● find and interpret one-sided limits ● apply the Squeeze Theorem to find certain limits indirectly ● find and verify end-behavior models for various functions ● calculate limits as x approaches infinity and identify vertical and horizontal tangents ● identify intervals upon which a function is continuous and understand the meaning of continuity ● remove removable discontinuities by extending or modifying a function ● apply the Intermediate Value Theorem and the properties of algebraic combinations and composites of continuous functions ● directly apply the definition of a slope of a curve in order to calculate slopes ● find the equation of a tangent line and normal line to a curve at a given point ● find the average rate of change of a function ● determine and use sensitivity to approximate	● Use $y = sinx/x$ as an example of limits. Calculate limit using graphing utility ● $y = int\, x + int\,(4 - x)$ using grapher to have a discussion of the properties of limits ● Discuss the function $y = 1/x$ to introduce limits approaching infinity ● Discuss the three types of rational function end behavior ● Use pencil and paper to trace a continuous function over any interval without lifting the pencil ● Discuss continuity at an endpoint versus continuity at an interior point. ● Remind students that there can be points of discontinuity outside the domain of the function.	● 1.1 exercises # 3-30 multiples of 3, 22, 36, 38, 47, 49-50,55-56, 61, 64 and AP Prep # 43-50 ● 1.2 exercises # 3-54 multiples of 3, 59, 68, 70 and AP Prep # 53-54 ● 1.3 exercises # 3-30 multiples of 3, 42, 45, 51, 63 and AP Prep # 47-50 ● 1.4 exercises # 1-33 odd and AP Prep 27, 30, 33-36

o. Intermediate Value Theorem p. Average rate of change q. Tangent to a curve r. Slope of a curve s. Normal to a curve t. Sensitivity	the change in a quantity	• Summarize the lesson by showing how to find the equation of the line tangent to and normal to $y = x^2 + x$ at (-3, 6)	
Resources: Essential Materials, Supplementary Materials, Links to Best Practices • TEXTBOOK: Calculus (Graphical, Numerical, Algebraic AP edition) 5th edition, Finney • textbook: Calculus of a Single Variable, 9th edition, Larson • www.mymathlab.com • Multiple Choice & Free-Response questions in preparation for the AP Calculus (AB) Examination • Multiple Choice & Free-Response questions in preparation for the AP Calculus (BC) Examination • http://apcentral.collegeboard.com		**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings • Older calculators may connect the two branches of a function such as $f(x) = 1/x$ suggesting the function is continuous for the domain even though there is a discontinuity at x=0. • Students may have difficulty dealing with the indeterminant form. L'Hopitals Rule will deal with evaluating these limits is covered in chapter 8 • Students may have trouble with continuity at an interior point versus an endpoint • Students are prone to calculation errors when calculating the slope of a curve. Encourage students to find their own mistakes so they will be less likely to repeat these errors in the future	

Unit of Study: Chapter 2 - Derivatives

Unit Objectives/Enduring Understandings: Students will be able to understand the relationship between functions and their derivatives as well as apply basic rules to find derivatives of functions.

Unit Assessment: www.mymathlab.com , teacher generated assessments, Quick Quizzes, Standardized Test Questions and AP Examination Preparation questions

Core Content		**Instructional Actions**	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Students will know: ● the definitions for the following terms: a. derivative b. one-sided derivatives c. local linearity d. Intermediate Value Theorem for derivatives e. positive integer powers, multiples, sums and differences f. products and quotients g. second and higher order derivatives h. instantaneous rate of change i. derivatives in economics j. derivative of the sine functions	Students will be able to: ● understand the meaning of the derivative of a function. ● calculate slopes and derivatives, using the definition of a derivative ● graph *f* from the graph of *f'*, graph *f'* from the graph of *f*, and graph the derivative of a function given numerically with data ● find where a function is not differentiable and distinguish between corners, cusps, discontinuities, and vertical tangents ● see how differentiability implies continuity ● approximate derivatives numerically and graphically ● use the rules of differentiation to calculate derivatives, including second and higher order derivatives ● use the derivative to calculate the instantaneous rate of change ● use derivatives to analyze straight line motion and solve other problems involving rates of change ● use the rules for differentiating the six basic trigonometric functions	● Present a graph to the students and show how the slopes of secant lines approach a limit corresponding to the slope of a tangent line. ● Discuss the different notations for derivatives. ● Have students discuss what it means for a function to be differentiable or nondifferentiable at a point. Give several examples to illustrate corners, cusps, vertical tangents and discontinuities. ● Start with differentiating linear functions and then have students differentiatie all polynomial and rational functions. ● Have the students repeat the product and quotient rules out loud together in	● 2.1 exercises #1-33 odd and AP Prep #14,16,42,44 ● 2.2 exercises #1-25 odd and AP Prep # 39 ● 2.3 exercises #3-45 multiples of 3, and AP Prep #38,40,55 ● 2.4 exercises #1,9,10,14,15 ,18,19,21,24, 25,27,32,34,3 5,38,47 and AP Prep #5,8,12,18,26 ● 2.5 exercises #3-33 odd, 35,37,43 and AP Prep #30,40,46 ● Chapter Review

k. derivative of the cosine function l. jerk m. derivatives of other basic trigonometric functions ● relationships between the graphs of *f* and *f'* ● graphing the derivative from data ● how $f'(a)$might fail to exist ● differentiability implies local linearity ● numerical derivatives on a calculator ● differentiability implies continuity ● motion along a line		order for them to memorize the two. ● Discuss position, velocity and acceleration. Emphasize that velocity is the rate of change of position and acceleration is the rate of change of velocity. ● Use a graph of the sine function and examine the slopes at different points to have students come up with the derivative graph and for them to realize it is the graph of the cosine function. ● Use identities to show the rules for differentiating the other basic trigonometric functions.	exercises for AP Prep: #59-64,79, 81-83
Resources: Essential Materials, Supplementary Materials, Links to Best Practices ● TEXTBOOK: Calculus (Graphical, Numerical, Algebraic AP edition) 5th edition, Finney ● textbook: Calculus of a Single Variable, 9th edition, Larson ● www.mymathlab.com ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (AB) Examination ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (BC) Examination ● http://apcentral.collegeboard.com		**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings ● Have students check their numerator in the difference quotient for errors with evaluating and simplifying. ● Stress that a piecewise function must be checked for continuity before checking the differentiability at a point. ● Have students repeat the quotient rule so that errors are not made with the order of the numerator. ● DIscuss the difference between speed and velocity. ● In order to avoid mistakes when finding derivatives of trig functions, make sure to review the reciprocals, Pythagorean, angle sum and half angle identities.	

Unit of Study: Chapter 3 - More Derivatives

Unit Objectives/Enduring Understandings: Students will be able to apply the use of basic derivative rules to more advanced techniques of differentiation.

Unit Assessment: www.mymathlab.com , teacher generated assessments, Quick Quizzes, Standardized Test Questions and AP Examination Preparation questions

Core Content		**Instructional Actions**	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Students will know: ● derivatives of the following: a. inverse functions b. composite functions c. arcsine d. arccosine e. arctangent f. arccotangent g. arcsecant h. arccosecant *i.* e^x j. a^x k. $\ln x$ l. $\log_a x$ ● "outside-inside" rule ● repeated use of the Chain Rule ● power Chain Rule ● implicitly defined functions ● lenses, tangents and normal Lines ● derivatives of Higher	Students will be able to: ● differentiate composite functions using the Chain Rule ● find derivatives using implicit differentiation ● find derivatives using the Power Rule for Rational Powers of *x* ● calculate derivatives of functions involving the inverse trigonometric functions ● calculate derivatives of exponential and logarithmic functions	● Use the "outside-inside" rule in order for students to use the Chain Rule automatic. ● Use a graphing utility to start a discussion about graphs of the form F(*x,y*) = *c* in order to understand the concept of implicit differentiation. ● Introduce derivatives of inverse functions by discussing the relationship between the slopes of linear functions and their inverses. ● Review the properties of logarithms before learning the derivatives of logs and exponentials and using log differentiation.	● 3.1 exercises #3-69 multiples of 3, and AP Prep #58 ● 3.2 exercises #3-51, multiples of 3, 54, 58 and AP Prep #49, 50, 56 ● 3.3 exercises #3-48 multiples of 3, and AP Prep #29 ● 3.4 exercises #3-48 multiples of 3, 53, 54, 56, 64 and AP Prep #49 ● Chapter Review exercises for AP Prep: #61-67, 81,

Order ● rational powers of differentiable functions ● Power Rule of arbitrary real powers			82, 83
Resources: Essential Materials, Supplementary Materials, Links to Best Practices ● TEXTBOOK: Calculus (Graphical, Numerical, Algebraic AP edition) 5th edition, Finney ● textbook: Calculus of a Single Variable, 9th edition, Larson ● www.mymathlab.com ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (AB) Examination ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (BC) Examination ● http://apcentral.collegeboard.com		**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings ● in applying the outside-inside rule to differentiate *f(g(x))*, a common mistake is to omit the "derivative of the inside". ● stress the importance of using the Product Rule of *xy* within an implicit differentiation problem. ● point out that the Power Rule has only been approved for rational powers until now when they learn the Power Rule for Arbitrary Real Powers. ● Calculus Honors will require a formula sheet of derivatives to be given as they are not required to memorize all of the derivatives for the transcendental functions.	

Unit of Study: Chapter 4 - Applications of Derivatives

Unit Objectives/Enduring Understandings: Students will be able to apply knowledge of derivatives to analyze and interpret graphs as well as completing real-life application problems.

Unit Assessment: www.mymathlab.com , teacher generated assessments, Quick Quizzes, Standardized Test Questions and AP Examination Preparation questions

Core Content		**Instructional Actions**	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Students will know: • definitions for the following terms: a. absolute(global) extreme values b. local(relative) extreme values c. increasing and decreasing functions d. first derivative test for local extrema e. concavity f. points of inflection g. second derivative test for local extrema h. learning about functions from derivatives i. linear approximation	Students will be able to: • determine the local or global extreme values of a function • determine the applicability of the Extreme Value Theorem • apply the Mean Value Theorem • find the intervals on which a function is increasing or decreasing • use the first and second derivative sign tests to determine the local extreme values of a function • determine the concavity of a function and locate the points of inflection by analyzing the second derivative • use the graph of f using information f' • solve application problems involving finding maximum or minimum values of functions • find linearizations and use Newton's method to approximate the zeros of a function • solve related rate problems	• Sketch an arbitrary function and discuss the local and global minima and maxima of the function. • Emphasize the terminology so that students truly understand the language of calculus. • Complete a simple application of the Mean Value Theorem in order to introduce the lesson. • Discuss graphs of functions, first derivative and second derivatives for students to be able to understand the connection and be able to analyze the graphs. • Use *Desmos* to have students analyze and match graphs of derivatives. • Have students suggest situations where a	• 4.1 exercises #3-30, multiples of 3, 35, 37, 40, 43, 54 and AP Prep #43, 51, 52 • 4.2 exercises #3-33 multiples of 3, 37, 43, 45, 48 and AP Prep #43 • 4.3 exercises #1-11 odd, 15-30 multiples of 3, 42, 46 and AP Prep #23, 29, 47, 49, 50 • 4.4 exercises #1,5,9,12,17, 19,20,27,31,36,40,41,43,45,46,48,50,57, 60 and AP

• Mean Value Theorem • learning about functions from derivatives • linear approximation • Newton's Method • Related Rate Equations		maximum or minimum need to be found. • Stress the six-step "Strategy for Solving Max-Min Problems". • Review the Chain Rule and implicit differentiation to help the students solve related rates problems.	Prep #15,22,24,27, 30,35,36 • 4.5 exercises #3, 5, 53, 54 and AP Prep #41 • 4.6 exercises #3-43, multiples of 3 and AP Prep 29-33, 42 • Chapter Review exercises for AP Prep: #32,35-39,52, 55,57,61,69-71
Resources: Essential Materials, Supplementary Materials, Links to Best Practices • TEXTBOOK: Calculus (Graphical, Numerical, Algebraic AP edition) 5th edition, Finney • textbook: Calculus of a Single Variable, 9th edition, Larson • www.mymathlab.com • Multiple Choice & Free-Response questions in preparation for the AP Calculus (AB) Examination • Multiple Choice & Free-Response questions in preparation for the AP Calculus (BC) Examination • http://apcentral.collegeboard.com		**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings • Students should be exposed to examples of critical points that are not local extreme values so that the assumption that a critical point is always an extreme value is not made. • Make sure students understand that $f'(c)=0$ does not guarantee that f has a local extremum at $(c,f(c))$ as well as $f''(x)=0$ does not guarantee a point of inflection. • Students may overlook endpoints as possible candidates for optimal values. • For Newton's Method, students may stop after finding one zero or may not choose appropriate values for the initial guess x_1. • Emphasize that evaluation is the final step in the six-step strategy for Solving Related Rates Problems.	

Unit of Study: Chapter 5 - The Definite Integral

Unit Objectives/Enduring Understandings: Students will be able to understand the process of integration as it relates to finding the area under a curve and accumulation as a fundamental interpretation of the integral as well as to establish the connection between differential and integral calculus.
Unit Assessment: www.mymathlab.com , teacher generated assessments, Quick Quizzes, Standardized Test Questions and AP Examination Preparation questions

Core Content		**Instructional Actions**	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Students will know: • definitions for the following terms: a. rectangular approximation method(RAM) b. volume of a sphere c. Riemann Sums d. terminology and notation of integration e. constant functions f. discontinuous integrable functions g. average value of a function h. Mean Value Theorem for definite integrals i. Fundamental Theorem, antiderivative part	Students will be able to: • approximate the area under a graph of a nonnegative continuous function by using rectangular approximation methods • interpret the area under a graph as a net accumulation rate of change • express the area under a curve using a definite integral and as a limit of Riemann sums • compute the area under a curve using a numerical integration procedure • apply rules for definite integrals and find the average value of a function over a closed interval • apply the Fundamental Theorem of Calculus. • understand the relationship between the derivative and definite integral as expressed in both parts of the Fundamental Theorem of Calculus • approximate the definite integral by using the Trapezoidal Rule and by using Simpson's Rule, and estimate the error in using the Trapezoidal and Simpson's Rule	• Have students graph a curve and shade the desired interval to visualize the area being sought. Use either *Desmos* or the graphing calculators. • Use a RAM program to help students understand what happens as *n* increases and converge to a limit. • Review sigma notation with students. • Introduce Riemann sums with nonnegative functions and then introduce negative functions. • Emphasize the LRAM, RRAM and MRAM are examples of Riemann sums. • Begin teaching the FTC with letting $f(x) = c$and $F(x) = cx$.	• 5.1 exercises #1-10,17,20,26,27,30,32 and AP Prep #18,25 • 5.2 exercises #3-27 multiples of 3, 33,35,37-39,41,44 and AP Prep #39,40,49,50 • 5.3 exercises #1,3,4,6,10,11,14,15,18,19,22,23,28,29,34,36,40 and AP Prep #16,47,48,50 • 5.4 exercises #3-51 multiples of 3, 58, 64, 74 and AP Prep #57-60,75 • 5.5 exercises #1,4,7,9,10,1

j. Fundamental Theorem, evaluation part k. trapezoidal approximations l. error analysis ● accumulation problems as area ● definite integral and area ● definite integral as an accumulation function ● integrals on a calculator ● properties of definite integrals ● connecting differential and integral calculus ● graphing the function $\int_a^x f(t)$ ● area connection ● analyzing antiderivatives graphically		● Introduce the Trapezoidal Rule by having students discuss the relative accuracy of LRAM, RRAM and MRAM. Have the students think of ways to increase the accuracy without increasing the number of intervals used.	3,16,39 and AP Prep #11,12,33 ● Chapter Review exercises for AP Prep: #46, 51,54,58-60
Resources: Essential Materials, Supplementary Materials, Links to Best Practices ● TEXTBOOK: Calculus (Graphical, Numerical, Algebraic AP edition) 5th edition, Finney ● textbook: Calculus of a Single Variable, 9th edition, Larson ● www.mymathlab.com ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (AB) Examination ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (BC) Examination ● http://apcentral.collegeboard.com		**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings ● Students may assume the MRAM estimate is the average of LRAM and RRAM estimates. Use an example of a quadratic to show this is not the case. ● Stress the importance of not forgetting the *dx*. ● Algebraic mistakes are often made when finding antiderivatives. Have students get in the habit of differentiating their answer to verify that they found the correct antiderivative. ● Make sure students pay attention to functions that are both above the *x*-axis and below the *x*-axis and to be careful with positive and negative definite integrals. ● Students may assume that the Trapezoidal Rule is equivalent to MRAM. Use a function such as $f(x)=x^2$ to show how the two rules differ.	

Unit of Study: Chapter 6 - Differential Equations and Mathematical Modeling

Unit Objectives/Enduring Understandings: Students will be able to find antiderivatives of functions analytically through a variety of methods.

Unit Assessment: www.mymathlab.com , teacher generated assessments, Quick Quizzes, Standardized Test Questions and AP Examination Preparation questions

Core Content		**Instructional Actions**	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Students will know: • definitions for the following terms: a. differential equations b. slope fields c. Euler's Method d. indefinite integrals e. product rule in integral form f. law of exponential change g. separable differential equations h. continuously compounded interest i. modeling growth with other bases j. partial fractions k. the logistic differential equation • Leibniz notation and antiderivatives	Students will be able to: • solve initial value problems in the form $\frac{dy}{dx} = f(x), y_0 = f(x_o)$ • be able to construct slope fields using technology and interpret slope fields as visualizations of differential equations • use Euler's Method for graphing a solution to an initial value problem • compute indefinite and definite integrals by the method of substitution • use integration by parts to evaluate indefinite and definite integrals • use tabular integration or the method of solving for the unknown integral in order to evaluate integrals that require repeated use of integration by parts • use integration by parts to integrate inverse trigonometric and logarithmic functions • solve separable differential equations • solve problems involving exponential growth and decay in a variety of applications • solve logistic differential equations using the technique of partial fractions and by the general formula. • solve problems involving exponential or logistic population growth	• Discuss the relationship between a slope field and a differential equation. • Discuss and stress to the students that the solutions to a differential equation given an initial condition is a function. • Have students use *Desmos* to understand a slope field. • As an introduction to integration using substitution, review the Chain Rule since *u*-substitution is a method for "reversing" the Chain Rule. • Make sure to stress the basic steps for finding an antiderivative by substitution and practice with students in order for students to thoroughly understand the process. • Review the double angle formulas need to integrate $sin^2 x$ and $cos^2 x$.	• 6.1 exercises #3-51 multiples of 3, 62 and AP Prep #7,8,19, 47,54,55,71 • 6.2 exercises #1-11 odd, 15-45 multiples of 3, 47, 49, 52 and AP Prep #37,38,40, 61-66, 75,76 • 6.3 exercises #3-30, multiples of 3 and AP Prep #33-35 • 6.4 exercises #3-42 multiples of 3 and AP Prep #4,8,51 • 6.5 exercises #1-33 odd and AP Prep #6,8,42-44

• substitution in indefinite integrals • substitution in definite integrals • solving for the unknown integral • tabular integration • inverse trigonometric and logarithmic functions • logistic growth models		• To introduce integration by parts, use the Product Rule to derive the formula for integration by parts. • Use LIPET to help the students determine what should be *u*. • Discuss why tabular integration works and when it can be used to integrate. • Before completing exponential growth and decay problems, review the algebraic rules for logarithms and exponents. • Review the partial fraction decomposition method and use the "cover up"method where possible. • Complete examples together using differential equations to model physical situations.	• Chapter Review exercises for AP Prep: #13,21,33,35, 38-42,44,59,67-69
Resources: Essential Materials, Supplementary Materials, Links to Best Practices • TEXTBOOK: Calculus (Graphical, Numerical, Algebraic AP edition) 5th edition, Finney • textbook: Calculus of a Single Variable, 9th edition, Larson • www.mymathlab.com • Multiple Choice & Free-Response questions in preparation for the AP Calculus (AB) Examination • Multiple Choice & Free-Response questions in preparation for the AP Calculus (BC) Examination • http://apcentral.collegeboard.com		**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings • Calculus Honors will require a formula sheet of integrals to be given as they are not required to memorize all of the derivatives for the transcendental functions. • Calculus AB will compete integration by parts, tabular integration and integrating by partial fractions after the AP Test. • Algebraic mistakes are common when evaluating antiderivatives. Students should check answers by differentiating. • A very common mistake when integrating by using substitution is to insert the wrong constant multiplier. Stress the mechanical nature of the process. • Have students write the variable name by the bounds when changing bounds for definite integrals. • Encourage students to use LIPET to help choose *u* for integration by parts. • Watch out for sign errors when using integration by parts. • Be careful with units from the given data at the beginning of exponential growth and decay problems.	

Unit of Study: Chapter 7 - Applications of Definite Integrals

Unit Objectives/Enduring Understandings: Students will be able to apply the use of the definite integral to net change, areas and volumes

Unit Assessment: www.mymathlab.com , teacher generated assessments, Quick Quizzes, Standardized Test Questions and AP Examination Preparation questions

Core Content		**Instructional Actions**	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
students will know: ● definitions of the following terms: a. linear motion b. position c. velocity d. acceleration e. area between two curves f. area enclosed by intersecting curves g. boundaries with changing functions h. integrating with respect to y i. volume as an integral j. circular cross sections k. square cross sections l. cylindrical shells m. other cross sections n. length of a smooth curve o. vertical tangents, corners and cusps	students will be able to: ● apply the definite integral to problems involving motion ● use definite the definite integral to solve problems involving accumulation ● use the definite integral to calculate the areas of regions in a plane ● use the definite (by slices or shells) to calculate the volume of solids ● use the definite integral to calculate the length of curves in a plane	● review the concepts of position, velocity and acceleration ● students need to understand that the integral of a rate gives the net change ● Utilize examples that take students beyond the velocity position relationship ● students need to graph the region to decide on function dominance, limits and variable of integration ● emphasis on volumes of rotations vs. solids ● Disk vs. washer method with shells as an alternate method. ● Use websites available for students to see the three dimensional creation of the solids ● For length of a curve discuss the reasoning behind x versus y integration variable	● 7.1 exercises 1-11 odd, 12-17,20-23,25,30,36,43 and AP prep #27, 30 ● 7.2 exercises #3-42 multiples of 3, 46,48,49,58 and AP prep 4,28,41,56 ● 7.3 exercises #1-11 odd, 16,19,21,25,29, 35.36,49,53,57 and AP prep #31,40,44,52,72, 31-34 ● 7.4 exercises #3-24 multiples of 3 and AP prep 7,19,29,20 ● Chapter Review exercises for AP Prep: #2,3,5,15,17,19,22,24,31,39,50,53-55

Resources: Essential Materials, Supplementary Materials, Links to Best Practices	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings
● TEXTBOOK: Calculus (Graphical, Numerical, Algebraic AP edition) 5th edition, Finney ● textbook: Calculus of a Single Variable, 9th edition, Larson ● www.mymathlab.com ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (AB) Examination ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (BC) Examination ● http://apcentral.collegeboard.com	● students will need clarification on the variable of integration, students should always graph the regions in question to give themselves a working diagram to help choose the correct variable. ● stress the ability to recognize that using a geometry formula may be the easier option than a definite integral or in the case of a semicircle that the only way to find the area by hand. ● The focus of the chapter is to use the definite integral, so to that end students should be writing the definite integral necessary and then using the graphing calculator option FnInt to evaluate. ● Calculus Honors will only be responsible for volumes of rotation by disk and washer method and length of a curve.

Unit of Study: Chapter 8 - Sequences, L'Hopital's Rule, and Improper Integrals

Unit Objectives/Enduring Understandings: Students will be able to work with sequences and limits as foundations to evaluate improper integrals.

Unit Assessment: www.mymathlab.com , teacher generated assessments, Quick Quizzes, Standardized Test Questions and AP Examination Preparation questions

Core Content		**Instructional Actions**	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
students will know: • definitions of the following terms: a. arithmetic sequence b. geometric sequence c. indeterminate forms i. 0/0 ii. $\infty/\infty, \infty\cdot 0, \infty-\infty$ iii. $1^{\infty}, 0^{0}, \infty^{0}$ d. convergence e. divergence • Squeeze Theorem for Sequences • Absolute Value Theorem for Sequences • Infinite Limits of Integration • Integrands with Infinite Discontinuities • Tests for Convergence and Divergence	students will be able to: • define sequences explicitly and recursively • define explicit and recursive rules for arithmetic and geometric sequences • graph sequences using parametric or graphing mode • use properties of limits to find the limit of a sequence • determine whether the a sequence converges or diverges and find its limit using the Squeeze Theorem for Sequences or the Absolute Value Theorem • find limits of indeterminate forms using l'Hopital's Rule. • use limits to evaluate improper integrals • use the comparison test to determine the convergence or divergence of improper integrals	• highlight the differences between defining a sequence explicitly and recursively • graphing sequences highlights the idea of convergence • A review of limits from chapter 2 that were indeterminate forms and evaluated with l'Hopital's • A limit of indeterminate form must be in the form of f/g for l'Hopital's to be used • l'hopital's may require the use of logarithms to convert some of the indeterminate forms to the appropriate rational expression • students should be familiar with $\int_0^{\infty}\frac{1}{x^p}dx$ and $\int_0\frac{1}{x^p}dx$ • Comparison test is a way to test for convergence but will not evaluate an improper integral	• 8.1 exercises #3-45 multiples of 3 and AP prep # 59 • 8.2 # 3-60 multiples of 3 and AP prep # 51,55,56,59,53 • 8.4 # 1-42 multiples of 3 and AP prep 10-11,22,35,43 ,55,46 • chapter review exercises for AP prep # 42,54-58 • targeted skill assessment

Resources: Essential Materials, Supplementary Materials, Links to Best Practices	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings
● TEXTBOOK: Calculus (Graphical, Numerical, Algebraic AP edition) 5th edition, Finney ● textbook: Calculus of a Single Variable, 9th edition, Larson ● www.mymathlab.com ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (AB) Examination ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (BC) Examination ● http://apcentral.collegeboard.com	● defining a sequence explicitly is where the terms of a sequence are defined in terms of *n.* ● defining a sequence recursively is where terms are defined based upon previously defined terms in the sequence ● Clarification may be needed with l'Hopital's for its appropriate usage ● Reinforce the idea that an improper integral converges when the limit exists. ● Students often overlook infinite discontinuities that occur at interior points on the interval of integration

Unit of Study: Chapter 9 - Infinite Series

Unit Objectives/Enduring Understandings: Students will be able to determine the convergence and behavior of a series.

Unit Assessment: www.mymathlab.com , teacher generated assessments, Quick Quizzes, Standardized Test Questions and AP Examination Preparation questions

Core Content		**Instructional Actions**	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
students will know: ● definitions of the following terms: a. Power series b. Taylor Series c. MacLaurin Series d. Taylor polynomials e. alternating series f. Lagrange error bound g. *n*th-term test h. ratio test i. integral test j. harmonic series k. *p*-series l. endpoint convergence m. radius of convergence n. interval of convergence o. absolute convergence p. conditional convergence q. telescoping series ● Remainder Bounding	students will be able to: ● apply the properties of geometric series ● identify a series ● represent a function using a series ● differentiate, integrate or substitute into a known power series in order to find additional power series representations. ● use derivatives to find the MacLaurin series or Taylor series generated by a differentiable function. ● explore the convergence of certain series ● approximate a function with a Taylor polynomial ● bound the truncation error of a series using graphical methods or the Remainder Bounding Theorem ● analyze truncation error in three different ways: geometric series error, alternating series error bound, and Lagrange error bound ● use Euler's Formula to relate the functions sinx, cosx, and e^x ● use the *n*th-term test, direct comparison test and the ratio test to determine the convergence or divergence of a series of numbers or the radius of convergence of a power series ● use the Integral test and the Alternating	● students need to understand that a convergent infinite series is one whose sequence of partial sums converge. ● telescoping series should be discussed (10.4) ● Use the exploration exercises as a way to have students discover elements of power series behavior and the functions that they represent. ● Many power series representations can be derived by algebraically manipulating, differentiating, and integrating known Taylor series representations. ● Use the MacLaurin table in the text for students to memorize the most important series ● to confirm Taylor's Theorem it is necessary to show that : $R_n(x) = f(x) - P_n(x)$ approaches zero as *n* approaches ∞	● 9.1 #1-14, 17-35 odd, 38-40,44,46,48-50, 54,57,63-65, 73-74 and AP prep # 20,24,37,59,60,61 ● 9.2 # 1-35 odd and AP prep #14,22-28,44 ● 9.3 #3-30 multiples of 3, 32-33 and AP prep #20,23,29,34-36, 44 ● 9.4 # 1-5 odd, 9-45 multiples of 3, 51,54,57 and AP prep #11,13,14,16,18,23 ,28, 61-63 ● 9.5 # 1-5 odd, 9-63 multiples of 3, 38,40,58,59,61,62, 72 ● chapter review exercises for AP prep # 56-61,71-73 ● targeted skill

Theorem ● Euler's Formula ● Taylor's Theorem	Series test to determine the convergence or divergence of a series of numbers. ● determine the convergence or divergence of *p*-series, including harmonic series ● determine the absolute convergence, conditional convergence, or divergence of a power series at the endpoints of its interval of convergence	● The Remainder Bounding Theorem depends on choosing a particular value of x and that it does not give a single bound on the error for the entire interval of the series. ● The Ratio Test is not a good option for determining convergence with the nth term is a rational function of n, but better serves when the nth term includes exponential functions and factorials ● As the chapter comes to section 10.5 there should be active classroom discussion about which test for convergence to use and when, flowchart on page #532 can provide the students with a visual of the logical steps in determining which test to use.	assessment
Resources: Essential Materials, Supplementary Materials, Links to Best Practices ● TEXTBOOK: Calculus (Graphical, Numerical, Algebraic AP edition) 5th edition, Finney ● textbook: Calculus of a Single Variable, 9th edition, Larson ● www.mymathlab.com ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (AB) Examination ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (BC) Examination ● http://apcentral.collegeboard.com		**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings ● highlight the definition of a power series to reinforce the understanding of a function being represented by a function. ● Taylor series notation and definition are important to highlight to the students (section 10.2 ex #1) ● Students may require help with the vocabulary of third-order vs. third term and three non-zero terms ● Students often fail to grasp why the error of approximation as given by $\left\|f(x) - P_n(x)\right\|$, can be less than (instead of equal to) the bound on the error given by the Remainder Bounding Theorem ● Highlight for the students the analogy of the Direct Comparison Test for Integrals and its relationship and use for convergent series. ● Even with all the possible convergence tests it will not always be known as to which function a power series will converge *to*.	

Unit of Study: Chapter 10 - Parametric, Vector, and Polar Functions

Unit Objectives/Enduring Understandings: Students will be able to manipulate and work with parametric, vector and polar functions. Students will be able to apply differential and integral calculus to these functions as needed for modeling.

Unit Assessment: www.mymathlab.com , teacher generated assessments, Quick Quizzes, Standardized Test Questions and AP Examination Preparation questions

Core Content		**Instructional Actions**	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
students will know: ● definitions of the following terms: a. parametric curves b. slope of parametric curve c. concavity of a parametric curve d. arc length e. cycloids f. two-dimensional vectors g. vector operations h. polar coordinates i. polar curves j. slopes of polar curves k. areas enclosed by polar curves	students will be able to: ● find derivatives and second derivatives of parametrically defined functions ● calculate the lengths of parametrically defined curves ● represent vectors in the form <a,b> and perform algebraic computations involving vectors. ● use vectors to solve problems involving the modeling of planar motion, velocity, acceleration, speed, and displacement and distance traveled. ● graph polar equations and determine the symmetry of the polar graphs ● convert some cartesian equations into polar form and vice versa. ● calculate the slopes and areas of regions in the plane determined by polar curves	● a quick overview of parametrics, vectors and polar functions may be necessary before discussing the calculus applications for these functions. ● use examples 4-9 in section 11.2 to model the use of vectors. ● instructional time should be spent with an overview of handling polar and parametric functions on the graphing calculator ● Parametric equations are used in finding a formula for the slope of a polar curve ● in graphing polar functions the interval of θ is important ● to find the area enclosed by a polar curve a graph of the function is helpful to determine the correct limits of integration	● 10.1 # 1-39 multiples of 3 and AP prep #1,4,5,7,25,28 ,51-52 ● 10.2 #3-50 multiples of 3 and AP prep # 35,37,38,46,4 7,49-52 ● 10.3 # 1-60 multiples of 3 and AP prep # 43,44,58,59 ● chapter review for AP prep # 13,38,47,48,5 1-53 ● targeted skill assessment

Resources: Essential Materials, Supplementary Materials, Links to Best Practices ● TEXTBOOK: Calculus (Graphical, Numerical, Algebraic AP edition) 5th edition, Finney ● textbook: Calculus of a Single Variable, 9th edition, Larson ● www.mymathlab.com ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (AB) Examination ● Multiple Choice & Free-Response questions in preparation for the AP Calculus (BC) Examination ● http://apcentral.collegeboard.com		**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings ● notational differences when finding the second derivative of a parametric function. ● The fact that different directed line segments can represent the same vector is a source of confusion to some students. ● Students may need to watch for the differences between dealing with vectors in a physics class versus the calculus class, there could be notational differences. ● Students may struggle with deciding on the interval to graph or integrate a polar function and make mistakes in the integral setup when finding the area.	