PUBLIC SCHOOLS OF EDISON TOWNSHIP

OFFICE OF CURRICULUM AND INSTRUCTION

Applied Calculus

Length of Course:	Term
Elective/Required:	Elective
Schools:	High School
Eligibility:	Grade 12
Credit Value:	5 Credits
Date Approved:	September 23, 2019

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Modifications will be made to accommodate IEP mandates for classified students.

STATEMENT OF PURPOSE

Applied Calculus is designed for those students who have completed the honors level program prior to their senior year so that they are able to satisfy the Edison Township School District's four-year requirement in mathematics.

It extends the **Calculus-AP** course by including those topics that are normally covered in a first-year college calculus course, but are not required by the current edition of the College Entrance Examination Board for Advanced Placement Calculus examination. The course then continues with topics that are usually found in a third-semester college calculus course and beyond.

Students taking this course will extend and enhance their knowledge of the theoretical concepts and practical applications in differential and integral calculus, as well as learning and incorporating the technology of the graphing calculator for further assistance when analytic solutions are neither feasible nor possible.

This curriculum guide was revised and updated by: Matthew Hrevnak - JPSHS

Coordinated by: Elizabeth Lell, Supervisor of Mathematics

COURSE OBJECTIVES

The student will demonstrate proficiency in:

1. recognizing and using the terminology, symbols and notation which are related to **<u>Calculus</u>**.

2. creating and using mathematical models involving calculus concepts to describe various physical, social, and economic problem situations.

3. solving a variety of problems analytically where possible and using appropriate technology when an analytical solution is impossible or not feasible.

4. solving problems involving applications of the definite integral.

5. modeling problem situations involving the hyberbolic functions.

6. representing differential equations with slope fields, solving differential equations analytically and numerically.

7. determining convergence of a series and use polynomials to approximate functions.

8. analyzing plane and space curves and their metrical properties by means of a parametric or polar representations.

9. using vectors and vector-valued functions to solve problems relating geometry and motion in space.

10. determining partial derivatives and multiple integrals of a function of two or more variables and solving problems involving multivariable functions.

11. This curriculum will meet the goals set forth by the College Board for the AP Calculus, BC Curriculum as listed below; topics beyond the AP Calculus, BC Curriculum as listed.

SUGGESTED TIME SCHEDULE

	UNIT	# CLASS PERIODS
1.	Further Applications of Definite Integrals Unit !A, 1B, 2A, 2B	20
2.	The Hyperbolic Functions – Unit 3	16
3.	Techniques of Integrations – Unit 4, 5	15
4.	Solutions of Differential Equations – Unit 6,7,8	32
5.	Polynomial Approximation and Series – Unit 9, 10, 11	23
6.	Plane Curves in Parametric and Polar Form – Unit 12	13
7.	Vectors and Analytic Geometry in Space – Unit 13,14	20
8.	Vector-Valued Functions and Motion in Space – Unit 15, 16	24
9.	Functions of Two or More Variables and Partial Derivatives Unit 17	7
10.	Tests, Quarterly Exams, AP Testing, Other Testing	10
	Total Class Periods	**180**

1) Spy Problem – 3 per Marking Period (25 points each) – Group Project

2) Tests – 4 per Marking Period (25 points each) – Given every couple of sections (Chapter tests are too lengthy)

3) Homework – 25 points

Total of 200 points

Quarterly Assessments
1) Length of Curve/Centroids – 25 points
2) Hyperbolic Functions – 50 points
3) Differential Equations – Interest problem – 25 points
4) Exam based on MP 4 material – Vectors, MultiVariable concepts

Topic Outline for Calculus BC

The topic outline for Calculus BC includes all Calculus AB topics. Additional topics are found in paragraphs that are marked with a plus sign (+) or an asterisk (*). The additional topics can be taught anywhere in the course that the instructor wishes. Some topics will naturally fit immediately after their Calculus AB counterparts. Other topics any fit best after the completion of the Calculus AB topic outline. (See AP Central for sample syllabi.) Although the exam is based on the topics listed here, teachers may wish to enrich their courses with additional topics.

I. Functions, Graphs, and Limits

A. Analysis of graphs. With the aid of technology, graphs of functions are often easy to produce. The emphasis is on the interplay 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.

B. Limits of functions (including one-sided limits)

1. An intuitive understanding of the limiting process.
2. Calculating limits using algebra.
3. Estimating limits from graphs or tables of data.

C. Asymptotic and unbounded behavior

1. Understanding asymptotes in terms of graphical behavior.
2. Describing asymptotic behavior in terms of limits involving infinity.
3. Comparing relative magnitudes of functions and their rates of change (for example, contrasting exponential growth, polynomial growth, and logarithmic growth).

D. Continuity as a property of functions

1. An intuitive understanding of continuity. (The function values can be made as close as desired by taking sufficiently close values of the domain.)
2. Understanding continuity in terms of limits.
3. Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem).

E. Parametric, polar, and vector functions. The analysis of planar curves includes those given in parametric form, polar form and vector form.

II. Derivatives

A. Concept of the derivative

1. Derivative presented graphically, numerically, and analytically.
2. Derivative interpreted as an instantaneous rate of change.
3. Derivative defined as the limit of the differentiability and continuity.

B. Derivative at a point

1. 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.
2. Tangent line to a curve at a point and local linear approximation.
3. Instantaneous rate of change as the limit of average rate of change.
4. Approximate rate of change from graphs and tables of values.

C. Derivative as a function

1. Corresponding characteristics of graphs of f and f'.
2. Relationship between the increasing and decreasing behavior of f and the sign of f'.
3. The Mean Value Theorem and its geometric interpretation.
4. Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa.

D. Second derivatives

1. Corresponding characteristics of the graphs of f and f' and f''.
2. Relationship between the concavity of f and the sign of f''.
3. Points of inflection as places where concavity changes.

E. Applications of derivatives

1. Analysis of curves, including the notions of monotonicity and concavity.
2. Analysis of planar curves given in parametric form, polar form, and vector form, including velocity and acceleration.
3. Optimization, both absolute (global) and relative (local) extrema.
4. Modeling rates of change, including related rates problems.
5. Use of implicit differentiation to find the derivative of an inverse function.
6. Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration.
7. Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations.
8. Numerical solution of differential equations using Euler's method.
9. L'Hospital's Rule, including its use in determining limits and convergence of improper integrals and series.

F. Computation of derivatives

1. Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions.
2. Derivative rules for sums, products, and quotients of functions.
3. Chain rule and implicit differentiation.
4. Derivatives of parametric, polar, and vector functions.

III. Integrals

A. Interpretations and properties of definite integrals

1. Definite integral as a limit of Riemann sums.
2. Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval:

$$\int_a^b f'(x)\,dx = f(b) - f(a)$$

3. Basic properties of definite integrals (examples include additivity and linearity).

B. *Applications of integrals. Appropriate integrals are used in a variety of applications to model physical, biological, or economic situations. Although only a sampling of applications can be included in any specific course, students should be able to adapt their knowledge and techniques to solve other similar application problems. Whatever applications are chosen, the emphasis is on using the method of setting up an approximating Riemann sum and representing its limit as a definite integral. To provide a common foundation, specific applications should include 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.

C. Fundamental Theorem of Calculus

1. Use of the Fundamental Theorem to evaluate definite integrals.
2. Use of the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined.

D. Techniques of antidifferentiation

1. Antiderivatives following directly from derivatives of basic functions.
2. Antiderivatives by substitution of variables (including change of limits for definite integrals), parts, and simple partial fractions (nonrepeating linear factors only).
3. Improper integrals (as limits of definite integrals).

E. Applications of antidifferentiation

1. Finding specific antiderivatives using initial conditions, including applications to motion along a line.
2. Solving separable differential equations and using them in modeling (including the study of the equations $y' = ky$ and exponential growth).
3. Solving logistic differential equations and using them in modeling.

F. Numerical approximations to definite integrals. Use of Riemann sums (using left, right, and midpoint evaluation points) and trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by tables of values.

*IV. Polynomial Approximations and Series

A. *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.

B. *Series of constants

1. Motivating examples, including decimal expansion.
2. Geometric series with applications.
3. The harmonic series.
4. Alternating series with error bound.
5. 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.
6. The ratio test for convergence and divergence.
7. Comparing series to test for convergence or divergence.

C. *Taylor series

1. Taylor polynomial approximation with graphical demonstration of convergence (for example, viewing graphs of various Taylor polynomials of the sine function approximating the sine curve).
2. Maclaurin series and the general Taylor series centered at $x = a$.
3. Maclaurin series for the functions e^x, $\sin x$, $\cos x$, and $\frac{1}{1-x}$
4. Formal manipulation of Taylor series and shortcuts to computing Taylor series, including substitution, differentiation, antidifferentiation, and the formation of new series from known series.
5. Functions defined by power series.
6. Radius and interval of convergence of power series.
7. Lagrange error bound for Taylor polynomials.

Unit of Study – 1B : Moments, Centers of Mass, Centroids

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to understand the definition of mass and find the moment and center of mass in a one- dimensional, two-dimensional and 3-dimensional system.
Essential Questions: What is the difference between weight and mass? How do you convert from weight to mass? How do you find the center of mass in a linear system? How does this extend to find the center of mass to a 2- or 3- dimensional system?
Unit Assessment: Test 1 Arclength, Surface Area of Revolution and Centers of Mass

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
II.F1 II.F.2 II.F.3 III.A.1 III.A.2 III.B III.C.1 III.D.1 III.D.2 III.F	Students will know: a) The difference between weight and mass b) Understand what is meant by system equilibrium c) Where to place a fulcrum as a balancing point at the center of mass d) What is meant by the center of mass for a one, two and three dimensional system	Students will be able to: a) Convert weight to mass b) Find the moment and center of mass for a one-dimensional object c) Use integrals to find the center of mass for a 2-dimensional object as an extension of a linear system in both the x and y dimension. d) Use integrals to find the moment and center of mass for a planar lamina	a) Model problems with a centering a ruler on a pencil; placing a pencil under a sheet of paper to balance, etc. b) Identify practical examples, such as a seesaw, boomerang and a diver or gymnast, on how center of mass can be practically applied	a) Homework problems b) Test 1 c) Quarterly 1
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Textbook – Calculus II – Section 7.6 – P. 498 – 506 Whiteboard, multi-colored markers, graphing calculator, overhead projector, pencil, ruler, paper			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings Students need to make sure of appropriate units of measure	

Unit of Study – 2A: Work

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to find work done by both constant and variable forces.
Essential Questions: Is the mathematical definition of work the same as the real-life definition of work? How does work done by a constant force lead to the determination of work done by a variable force?
Unit Assessment: Test 2 on Work of Pumping Fluids and Fluid Pressure and Fluid Forces

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
II.F1 II.F.2 II.F.3 III.A.1 III.A.2 III.B III.C.1 III.D.1 III.D.2	Students will know: a) The mathematical definition of work as a force applied to displace an object. b) How the constant force formula is extended to variable force by use of the Reimann sum. c) Appropriate units of measure for work	Students will be able to: a) Set-up and solve integrals that represent work done by variable forces b) Solve work problems involving combinations of constant and variable forces, such as lifting a bucket of water when water is leaking out of the bucket	a) Applications of work to science areas, including springs(Hooke's Law), Newton's Law of Gravitation, Coulomb's Law for charged particles, pumping of fluids b) Use of graphing calculator to solve definite integrals c) Demonstration of work with student pushing against, but not moving wall and the student moving a desk	a) Example problems for students to work on and review of these problems b) Review of homework assigned c) Test 2

Resources: Essential Materials, Supplementary Materials, Links to Best Practices Textbook – Calculus II – Section 7.5 – P. 487 – 495 Whiteboard, multi-colored markers, smartboard, graphing calculator, overhead projector	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings Emphasize the difference between what is practically considered work, such as mental work, and the mathematical definition of work.

Unit of Study – 2B: Fluid Pressure and Fluid Forces

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to find fluid pressure and fluid forces
Essential Questions: What is the difference between fluid pressure and fluid force? How do you find the fluid force on the base of and object? The sides of an object? A submerged plate on the wall of an object? What if the entire plate is not submerged?
Unit Assessment: Test 2 on Work of Pumping Fluids and Fluid Pressure and Fluid Forces

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
II.F1 II.F.2 II.F.3 III.A.1 III.A.2 III.B III.C.1 III.D.1 III.D.2	Students will know: a) The definition of pressure and the appropriate unit(weight-density per unit volume) b)The constant fluid force formula as pressure times area c) The difference between the constant and variable fluid force	Students will be able to: a) Evaluate the fluid pressure on a surface b) Find the constant fluid force on the base of an object. c) Represent fluid forces that are variable by setting up integrals and solving for the fluid forces. d) Find fluid forces on various submerged floodgates based on different geometric shapes.	Discuss the building of objects, such as swimming pools, sheds, milk cartons, etc., and why the material used for the base is of stronger, thicker material than the wall of the object.	a) Classroom examples and student assigned problems b) Homework problems c) Student questions

Resources: Essential Materials, Supplementary Materials, Links to Best Practices Textbook – Calculus II – Section 7.6 – P. 507 - 512 Whiteboard, multi-colored markers, graphing calculator, overhead projector, pencil, ruler, paper	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings How to represent integral and adjustments made based upon placement of the axis.

Unit of Study – 3: Hyperbolic Functions

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to gain an understanding of the hyperbolic functions, the calculus of hyperbolic functions and the applications of hyperbolics to hanging cables.
Essential Questions: What are Hyperbolic functions? What properties do they hold? What calculus can be applied, such as derivatives and integrals? What applications do they encumber?
Unit Assessment: Test 3 on all concepts of Hyperbolics; Topic for Quarterly 2

	Core Content		**Instructional Actions**	
I AP-BC Curriculum ndicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
I.A I.C.3 I.D.1 II.A.1 II.B.1 II.B.2 II.C.1 II.C.2 II.E.4 II.E.5 II.F.1 II.F.2 II.F.3 III.A.1 III.A.2 III.B III.C.1 III.C.2 III.D.1 III.D.2 III.E.1 III.E.2	Students will know: a) The definition of e^x as a sum of the hyperbolic functions sinh x and cosh x b) The graphical representation of, and domain restrictions for, the hyperbolic and inverse hyperbolic functions. c) The derivation of the hyperbolic identities, derivatives and integrals of hyperbolic and inverse hyperbolic functions d) The uses of the hyperbolic functions	Students will be able to: a) Graph, evaluate and manipulate(using identities) hyperbolic and inverse hyperbolic functions b) Find derivatives of hyperbolic and inverse hyperbolic functions c) Integrate and evaluate integrals involving hyperbolic and inverse hyperbolic functions d) Model a hanging cable's shape as a hyperbolic cosine function (catenary) and use to find such concepts as sag and tension on the cable.	a) Use of graphing calculator in graphing and evaluating hyperbolic and inverse hyperbolic functions b) Model hanging cables using such objects as hanging draperies, bridge cables and telephone wires	a) Homework problems b) In-Class Derivation of Identites and calculus procedures c) Worksheets on hanging cables d) Quarterly 2 on manipulations through the "Gudermannian"
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Text – Thomas/Finney Calculus – 8th Edition – Hyperbolic Packet,Graphing Calculator, Overhead Projector, Whiteboard, markers			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings; Assimilate, but distinguish, the Hyperbolic functions to the Trig functions	

Unit of Study – 4: Methods of Integration(Basic, Parts, Partial Fractions)

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to find antiderivatives that follow from basic functions, substitution method, algebraic manipulations, integrate by parts and integrate by partial fractions methods.
Essential Questions: How do we find antiderivatives of functions that are not the known antiderivatives? Composite functions? How do you "undo" the product rule? How do you integrate rational functions when substitution doesn't work?
Unit Assessment: Test 4 on Basic Integration, Parts and Partial Fractions

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
II.F.1 II.F.2 II.F.3 III.A.3 III.C.1 III.C.2 III.D.1 III.D.2 III.D.3 III.E.1 III.E.2	Students will know: a) The basic antiderivatives of powers, trig functions, hyperbolics, exponentials, logs b) How to manipulate, by completing the square, separating fractions, long division and trig identities, to get in an integrable form. c) That you can only integrate proper fractions.	Students will be able to: a) Solve definite and indefinite integrals using the methods of long division, separating fractions, completing the square and other algebraic manipulations. b) Integrate products of functions by the 3 methods of integration by parts: basic parts, tabular integration and repetitive parts c) Integrate rational functions by the use of partial fraction decomposition	Use of the graphing calculator to evaluate and check definite integrals	a)Classroom problems b) Homework problems c) Worksheet problems

Resources: Essential Materials, Supplementary Materials, Links to Best Practices Textbook – Calculus II – Section 8.1, 8.2, 8.5 – P. 517 – 523; P. 525 – 533; P. 552 - 560 Whiteboard, markers, graphing calculator	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings * These topics were covered in the AP Calculus class; this acts as a review of these concepts, leading into other forms of integration and the concept of Differential Equations.

Unit of Study – 5: Methods of Integration (Trig Powers, Trig Substitution, Integral Tables

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to integrate expressions with powers of trig functions, by use of the trig substitution method and using the table of integrals in the index of the textbook.
Essential Questions: How do you integrate expressions involving trig functions of higher power? How do you use the tables of integrals listed in the back of the text?
Unit Assessment: Test 5 on Methods of Integration

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
II.F.1 II.F.2 II.F.3 III.A.3 III.C.1 III.C.2 III.D.1 III.D.2 III.D.3 III.E.1 III.E.2	Students will know: a) How the trig substitutions evolve from the right triangle and how the substitution works. b) How to use trig identities to transform and reduce power of trig functions c) That there are reduction formulas to reduce powers of various functions	Students will be able to: a) Integrate functions that involve higher powers of trig functions; these include tan, cot, sec and csc. b) Integrate functions by the trig substitution method c) Use Integral tables to integrate other types of functions, as well as reduction formulas from tables.	Graphing calculator to check the answers to definite integrals.	a) Classwork examples and problems b) Homework problems from text c) Worksheets d) Four Corners groupwork for review
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Textbook – Calculus II – Section 8.3, 8.4, 8.6 – P. 534 – 542; P. 543 – 551; P. 561 - 566 Whiteboard, markers, graphing calculator *Improper integrals will be reviewed prior to the Series Chapter			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings Students will realize that many of these integrals can be done by different methods	

Unit of Study – 6: Solutions of Differential Equations

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to understand the terms associated with Differential Equations and solve Separable Differential Equations, 1st Order Linear Differential Equations and Homogeneous Differential Equations.
Essential Questions: What are Differential Equations and how do you solve them? What if you cannot separate variables? How do you find the integrating factor? Now that we can solve these types of equations, how can we apply them?
Unit Assessment: Test 6; Quarterly 3; SPY PROBLEM

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
II.B.1 II.B.3 II.E.4 II.E.6 II.E.7 II.E.8 III.A.2 III.A.3 III.B III.D.1 III.D.2 III.E.1 III.E.2	Students will know: a) How to classify differential equations as linear/non-linear, order of the diff eq and the difference between general and specific solutions. b) How to use differential equations to model physical situations c) How to make use of the constant of integration d) What an integrating factor is	Students will be able to: a) Solve differential equations by separation of variables b) Solve initial value problems given conditions c) Solve 1st Order, Linear differential equations d) Set-up differential equations to practical applications, such as compound interest, R-L Circuits and other applications	Applications of Differential Equations to Science and Engineering(R-L Circuits, Brine solution problem) and Economics(Principal/Interest) *Spy Problems will involve the solving of differential equations	a) Classwork problems b) Homework problems c) Test 6 d) SPY Problems e) Topic for Quarterly 3

Resources: Essential Materials, Supplementary Materials, Links to Best Practices

Website: math.college.hmco.com; Text: Thomas/Finney 8th edition, Chapter 15.1 and 15.3
Computer, proxima, smartboard, graphing calculator

Instructional Adjustments: Modifications, student difficulties, possible misunderstandings

*Emphasize the use of the constant of integration

Unit of Study – 7: Solutions of Differential Equations- Higher Order

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to solve linear homogeneous and linear non-homogeneous 2nd Order Linear Differential Equations
Essential Questions: How do you solve a differential equation that is not of 1st order?
Unit Assessment: Test 7 on 2nd Order Differential Equations

	Core Content		Instructional Actions	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
II.B.1 II.B.3 II.E.4 II.E.6 II.E.7 II.E.8 III.A.2 III.A.3 III.B III.D.1 III.D.2 III.E.1 III.E.2	Students will know: a) That there are 3 cases to solving 2nd Order Homogeneous Linear Differential Equations b) That the solution to a 2nd Order Differential Equation is made up of the Homogeneous and non-Homogeneous solutions c) That some differential equations can be solved by multiple methods	Students will be able to: a) Solve Homogeneous Differential Equations when there are 2 distinct, repeated, and complex solutions. b) Solve 2nd Order non-homogeneous differential equations by inspired guessing, variation of parameters, undetermined coefficients, reduction of order and when one solution is known.	None	a) Classwork problems b) Homework problems c) Problems done and verified using different methods

Resources: Essential Materials, Supplementary Materials, Links to Best Practices Website: math.college.hmco.com; Text: Thomas/Finney 8th edition, Chapter 15.4 and 15.5	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings *Combining constants as a single constant

Unit of Study – 8: Numerical/Graphical Solutions of Differential Equations

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to model graphical solutions to differential equations by use of slopefields, numerically solve differential equations by Euler, Improved Euler and Runge-Kutta Method and model Oscillation using 2nd Order Linear Differential Equations
Essential Questions: Even with the learned methods, are there differential equations that still cannot be solved? Are there applications to the solutions of 2nd Order Differential Equations?
Unit Assessment: None – This is a review of slopefields and Euler for the AP Test and an extension of the other concepts

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
II.E.6 II.E.7 II.E.8 III.F	Students will know: a) That a slopefield gives a visual representation of a solution to a differential equation b) That Euler and Improved Euler Method gives a numerical approximation to a differential equation c) That there are situations when an exact solution is not necessary, but approximations are sufficient d) What a damped, undamped and overdamped oscillation is.	Students will be able to: a) Determine a slopefield and solution curve by use of isoclines b) Attain numerical approximations using Euler's Method, Improved Euler Method and the Runge-Kutta Method(one example only)	a) Use of the graphing calculator(TI-89) to graph slopefields. b) Use any calculator in computing numerical values for Euler, Improved Euler and Runge-Kutta c) Oscillation will be linked to spring motion, as studied in physics classes.	a) Examples/student problems b) Homework Problems

Resources: Essential Materials, Supplementary Materials, Links to Best Practices Website: math.college.hmco.com; Text: Thomas/Finney 8th edition, Chapter 15.6 - 15.8	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

Unit of Study – 9: Infinite Series (Sequences, Geometric Series)

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to determine whether a sequence converges/diverges, write a formula for a sequence, understand the meaning of a convergent infinite series and work with Infinite Geometric Series and the nth term test for Divergence of Series
Essential Questions: What is a Series? What is the difference between sequences and series? What is a Geometric series and how can we use it? How do you determine if a sequence or series converges or diverges?
Unit Assessment: Test 8 on Section 9.1 and 9.2

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
IV.A IV.B.1 IV.B.2 IV.B.3	Students will know: a) That a sequence is a listing of numbers, and a series is a sum of the terms of a sequence. b) That a sequence convergence/divergence is determined by evaluating a limit of the sequence c) That a geometric series is an infinite power series with a common ratio d) Geometric series has many applications in the real-world e) The necessary but insufficient condition of the nth term test.	Students will be able to: a) Represent a sequence as the nth term of a function whose domain is the set of integers b) Determine if a sequence converges or diverges c) Use partial fractions to determine convergence of telescoping series d) Find the sum and interval of convergence for Geometric Series e) Apply Geometric Series to repeating decimal problems, bouncing ball and other series applications f) Use the nth term test to determine divergence of series	a) Use calculator/computer to represent sequence of domain of set of integers, whereas functions are set of real numbers. b) Discuss applications of series to taking of medication, injections, economics, and other applications.	a) Classwork problems b) Homework problems c) SPY Problem d) Test 8

Resources: Essential Materials, Supplementary Materials, Links to Best Practices

Textbook – Calculus II – Section 9.1, 9.2 – P. 593 – 605; P. 606 – 616
Whiteboard, markers, graphing calculator/computer, proxima, smartboard

Instructional Adjustments: Modifications, student difficulties, possible misunderstandings

*Verbiage on using seq/series interchangeably
Sums only exist on interval of convergence

Unit of Study – 10: Infinite Series (Convergence/Divergence Tests)

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to use the various tests to determine convergence/divergence of infinite series and alternating series
Essential Questions: How do you determine if series converge or diverge? What if it is an alternating series? Is there more than one test that can be used to determine convergence or divergence?

Unit Assessment: Test 9 on convergence/divergence of series

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
III.D.3 IV.A IV.B.3 IV.B.4 IV.B.5 IV.B.6 IV.B.7	Students will know: a) What it means for a series to converge/diverge. b) That the harmonic series diverges but the alternating harmonic converges c) The difference between absolute and conditional convergence. d) The criteria of Leibniz Theorem to determine conditional convergence e) That the term of significance in error of truncation is the next term of the series	Students will be able to: a) Use the Integral test to determine the p-series and harmonic series and convergence/divergence b) Use the Comparison Tests (direct and limit comparison) to determine convergence/divergence c) Use the Ratio and Root Test when factorials/exponentials are part of the summand d) Use the Alternating Series Test(Leibniz Thm) to determine convergence e) Use the truncation error to determine sums of series and error	a) Use of calculator in employing the truncation error	a) Classwork problems b) Homework problems c) Worksheets
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Textbook – Calculus II – Section 9.2 – 9.6 – P. 617 - 647 Whiteboard, markers, graphing calculator/computer, proxima, smartboard			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings *Test for absolute convergence; conditional for alternating series only	

Unit of Study – 11: Power, Taylor and MacLaurin Series

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to use Calculus to represent Power and Taylor/MacLaurin Series, find sums of series and intervals of convergence and find the sum and error in using series to approximate values of functions
Essential Questions: What are Power Series? How do you determine the interval of convergence? What is meant by the sum of a series? How many terms of a series do I use to estimate the value of the series?
Unit Assessment: Test 10 on Power and Taylor/MacLaurin Series(AP format); SPY Problem

	Core Content		Instructional Actions	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
II.A.1 II.B.2 II.C.1 II.E.1 II.E.9 II.F.1 II.F.2 II.F.3 III.A.3 III.D.1 III.D.2 III.D.3 IV.C.1 IV.C.2 IV.C.3 IV.C.4 IV.C.5 IV.C.6 IV.C.7	Students will know: a) The Sigma Notation form and the general expansion of the Power, Taylor and MacLaurin Series b) That a MacLaurin is a Taylor Series, centered at 0; and each are Power Series c) The properties of Power Series d) That there are 3 possibilities for intervals of convergence e) That the sum of the series, in general terms, converges to the function f) The expansion of the basic functions, including sin x, cos x, e^x, ln x, etc. g) The Remainder Estimation Theorem and its use.	Students will be able to: a) Use derivatives and integrals to develop Power Series b) Find intervals of convergence using the ratio test(interval, point, all reals) and determine endpoint convergence c) List Taylor/MacLaurin Series expansions given a function and center d) Find polynomial approximations and errors using Taylor's Formula and the LaGrange error bound e) Use the list of Taylor/MacLaurin series and properties to develop other series.	a) Use of computer website/graphing calculator to demonstrate convergence and to show the functional graph vs. the series approximation(truncated after n terms) b) Demonstrate the use of series to scientific areas, such as medicine and release of gases c) Compare use of series to other mathematical processes, such as determining binomial expansion; these include use of logarithms, linearization, combinations from probability, etc. d) Extend the concept of series to complex numbers by deriving Euler Formula and the mathematical significance of the formula(linking 5 most important constants, 4 most important algebraic processes) e) Applications of Series to finding limits and approximating definite integrals when analytic solutions are not possible.	a) Classwork derivations and problems b) Homework assignments b) Worksheets c) d) SPY Problem

Resources: Essential Materials, Supplementary Materials, Links to Best Practices Textbook – Calculus II – Section 9.7 – 9.10 – P. 648 – 692 Reference: Thomas/Finney 8th edition Whiteboard, markers, graphing calculator/computer, proxima, smartboard, overhead projector	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings a) Emphasize the relationship between the function and its related series. b) Make sure to test the endpoints of the series when determining intervals of convergence c) Error is based on the (n+1)st term

Unit of Study – 12: Calculus of Parametrics and Polars

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to apply use calculus to find slopes, lengths of curves, area and surface area of rotations of curves represented by parametric and polar equations.
Essential Questions: Can the learned concepts of calculus be applied to parametric equations? Polars?
Unit Assessment: Test 11 on Parametrics and Polars (AP Format); Spy Problem

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
I.A I.E II.A.1 II.A.2 II.B.1 II.B.2 II.C.1 II.C.2 II.D.1 II.D.2 II.E.2 II.E.6 II.F.1 II.F.2 II.F.3 II.F.4 III.B III.D.1 III.D.2 III.E.1 III.E.2	Students will know: a) That parametrics have been used in circular functions and in the chain rule of calculus b) The conic sections- circle, parabola, hyperbola and ellipse and their basic features. c) How to use the graphing calculator to graph curves in parametric and polar mode d) How to derive the formulas for derivatives, length, area and surface area of revolution in parametric and polar form	Students will be able to: a) Identify and graph conic sections(review from precalculus concepts) b) Graph a curve defined by a parametric or polar equation, convert coordinates and equations to rectangular(and vice-versa), determine direction of motion c) Find the slope of the tangent at a point on a parametric or polar curve; find the 2nd derivative parametrically d) Find the length of a parametric and a polar curve e) Find intersection points and areas contained within a polar region and between polar regions f) Find the surface area of revolution of a parametrically or polar defined curve	a) Link the conic sections to real-life applications, such as parabolic arch, elliptical orbit, satellite dishes, etc. b) Use graphing calculator to graph parametric and polar functions; emphasize the direction of motion and domain restrictions	a) Classwork problems b) Homework problems c) SPY Problem

Resources: Essential Materials, Supplementary Materials, Links to Best Practices	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings
Textbook – Calculus II – Chapter 10 – P. 693 – 760 Handout on Conic Sections Handout on Parametrics/Polars Whiteboard, markers, graphing calculator/computer, proxima, smartboard	Finding points of intersection simultaneously and by use of calculator(since some points on polars do not coincide) Domain restrictions may need to be used to attain the exact curve desired Make sure that the correct region is used when finding area in polars

Unit of Study – 13: Vectors in a Plane, Space Coordinates and Vectors in Space

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to use the terminology and apply the basic vector operations of vectors, first in a plane, then in space.
Essential Questions: What are vectors and why do we learn them? What are the properties of vectors? What is meant by a right-handed system?
Unit Assessment: Test 12 on Section 11.1 and 11.2

	Core Content		Instructional Actions	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
I.A I.C.3 I.E II.B.1 II.B.2	Students will know: a) That vectors are quantities with a length and direction b) That vectors can be broken down to their x and y components c) The properties of vector operations d) What a unit vector is e) How to represent a coordinate in the 3-dimensional coordinate system f) What a right- and left- handed system is	Students will be able to: a) Write the component form of a vector in ai+bj form b) Find the length of a vector and graph vectors, performing operations such as vector addition and subtraction c) Understand and use the properties of vectors d) Find a unit vector and represent a vector as a product of its length and direction e) Represent and extend all processes of planar vectors to spatial vectors f) Apply vectors to topics such as circles, forces and velocity	a) Extend the use of vectors to physics applications b) Use of websites to demonstrate the addition/subtraction of vectors by parallelogram and tip-to-tail methods c) Compare/contrast the use of vectors to such geometric concepts as finding length of diagonal and in geometric proofs to methods learned in a traditional geometry course.	a) Classwork problems/computer applications b) Homework problems c) Proofs

Resources: Essential Materials, Supplementary Materials, Links to Best Practices Textbook – Calculus II – Section 11.1, 11.2 – P. 761-772; P. 773-780 Whiteboard, markers, graphing calculator/computer, proxima, smartboard	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings None anticipated

Unit of Study – 14: Scalar and Vector Products, Lines and Planes in Space

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to find and apply both the scalar(dot) and vector(cross) products and work with lines and planes in space using vector methods.
Essential Questions: How do you multiply two vectors? What is a Dot product and what does it represent? What is a Cross product and what does it represent?
Unit Assessment: Test 13 on Section 11.3, 11.4 and 11.5; SPY Problem

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
I.A I.E *The topics of this section are Beyond the AP – BC Curriculum	Students will know: a) The formula and geometric interpretation for Dot and Cross Products b) That the Dot product is a scalar product, a numerical value; that the Cross product is a vector product. c) What is meant by orthogonal vectors d) The algebraic properties of Cross products e) How to represent and use points, lines and planes in space	Students will be able to: a) Compute the dot product and use the properties of the dot product of 2 vectors b) Find the angle between 2 vectors using the Dot product formula c) Find the vector projection and apply the dot product to find the work done by a constant force d) Find the cross product and triple scalar product of 3 vectors in space e) Apply the cross product to find volume, torque, area of parallelogram/triangle f) Write parametric equations for line in space g) Write a linear equation to represent a plane in space h) Find distance between points, planes and lines using vectors	a) Use of vectors to explore such geometric concepts as angle between 2 vectors, area of triangles and parallelograms, work with lines and planes in space b) Extend concepts to science/engineering applications of torque, force and work c) Visually demonstrate lines and planes using such devices as pencils, portfolios, paper, etc.	a) Classwork problems b) Homework problems c) SPY Problems

Resources: Essential Materials, Supplementary Materials, Links to Best Practices	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings
Textbook – Calculus II – Section 11.3 – 11.5 – P. 781- 809 Whiteboard, markers, graphing calculator/computer, proxima, smartboard, pencils, folder	*Understand the geometric interpretation of the Dot and Cross Products Working in vector form for the lines and planes in space rather than the traditional methods without vectors

Unit of Study 15: Cylindrical/Spherical Coordinate System, Vector-Valued Functions, Projectile Motion

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to make conversions between the coordinate systems, use the concepts of calculus for motion using vectors and solve problems involving projectile motion
Essential Questions: Why do you need to use other coordinate systems? How do you convert between them? Do the calculus concepts of derivatives and integrals apply to vectors? Can we determine how high, how far, and how long a projectile's motion occurs?
Unit Assessment: Test 14 on Coordinate Systems, Calculus of Vectors and Projectile Motion; SPY Problems

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
I.A I.E II.B.1 II.B.2 II.B.3 II.E.2 II.E.6 III.B III.E.1	Students will know: a)How to use cylindrical and spherical coordinates to represent surfaces in space b) That calculus concepts such as derivatives and integrals apply to vectors and hold properties similar to calculus of functions (velocity, acceleration) c) How to derive the formulas for projectile motion using vectors d) That ideal trajectories are parabolic	Students will be able to: a) Convert coordinates and equations between the rectangular, Cylindrical and Spherical systems. b) Describe surfaces in the cylindrical and spherical systems c) Find derivatives of vector functions and apply to find velocity, speed and acceleration d) Find integrals of vector functions and solve initlal value problems e) Find the height, flight time and range of a projectile	a) Use computer website for the representation of cylindrical and spherical coordinate system and surfaces represented in these systems b) Demonstrate the helix using such physical phenomena as a spiral staircase and off-ramps on highways c) Applications of projectile motion to physics, sports, weaponry will be discussed d) Calculator use for numerical computation when solving projectile motion problems	a) Classwork problems b) Derivation of concepts c) Homework problems d) Spy Problems

Resources: Essential Materials, Supplementary Materials, Links to Best Practices Textbook – Calculus II – Section 11.7 – P. 820 – 826 Packet: Taken from Thomas/Finney 8th edition – Chapter 11.1, 11.2 Whiteboard, markers, graphing calculator/computer, proxima, smartboard	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings a) Student understanding of the derivation of projectile motion b) Orientation of coordinates in Spherical vary by book

Unit of Study 16: Curvature, Torsion and Frenet Frame

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to find and understand the physical interpretation of the concepts of Curvature, Principal Unit Normal and Binormal Vectors, Torsion and the Tangential and Normal scalar components of Acceleration.
Essential Questions: How do we find the curvature of an object? What is meant by the Binormal Vector and the Torsion physically? How do we compute them?
Unit Assessment: Test 15 on Curvature, Torsion, Binormal Vector and Length of a curve in 3- space

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
II.A.2 II.B.3 II.E.2 II.E.4 II.E.6 II.F.1 II.F.2 II.F.3 III.A.2 III.B	Students will know: a) How the curvature, Torsion and Binormal are physically represented by a car moving along a curved path b) That a curve ball really does curve c) That curvature is only dependent upon velocity and acceleration d) That the length of a curve in space is an extension of length in a plane	Students will be able to: a) Find the length and Unit Tangent vector for a curve in space b) Find the curvature and the radius of curvature c) Find the Unit Tangent, Unit Normal, Binormal vectors and the Torsion d) Write the acceleration in terms of the Tangential and Normal Components	a) Derive all formulas from already derived concepts in 2-space and through physical relationships b) Describe the effects of these concepts to physical motion, such as the driving of a car along a ramp, why speed limit declines on a curve or ramp, that a curve ball in baseball does indeed curve(reference Penney/Edwards, p. 657) c) Computer graphics on use of the Frenet Frame to practical objects	a) Class Derivations b) Classwork problems c) Homework Problems

Resources: Essential Materials, Supplementary Materials, Links to Best Practices Packet: Developed primarily from Thomas/Finney 8th Edition – Chapter 11.4 Whiteboard, markers, graphing calculator/computer, proxima, smartboard	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings *Extensive Calculations involved in computing curvature, Binormal and Torsion and Acceleration components.

Unit of Study – 17: Functions of 2 or More Variables(Multivariable Calculus)

Targeted State Standards: Not Applicable – Content of course beyond a high school curriculum
Unit Objectives/Enduring Understandings: Students will be able to understand terms and definitions of functions of more than one variable and determine domain/range and graphs of multivariable functions, limits and continuity of multivariable functions and partial derivatives of functions of multivariables
Essential Questions: How do you graph functions of more than one variable? How do you find domain and range restrictions? What is meant by the limit of a function with multiple variables? How do you find the derivative of a function of multiple variables?
Unit Assessment: Test 16 on Domain/Range, Limits and Partial Derivatives; SPY Problem

	Core Content		**Instructional Actions**	
AP-BC Curriculum Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
*The indicators listed are applied to multivariable concepts as an extension to the AP indicators listed I.A I.B.1 I.B.2 I.C.3 I.D.1 I.D.2 I.D.3 II.A.1 II.A.2 II.A.3 II.A.4 II.B.1 II.B.2 II.F.1 II.F.2 II.F.3	Students will know: a) The terms and definitions involving functions of more than one variable b) That most concepts are an extension of functions of a single variable c) The properties of limits of multivariable functions and the test for continuity of multivariable functions d) What the partial derivative represents graphically e) That "mixed" second order derivatives are equal	Students will be able to: a) Find the domain and range of multivariable functions b) Determine the limit of a multivariable function by various methods(sub, factoring, etc) c) Determine if a multivariable function is continuous, and use the 2-path test for Discontinuity d) Find the partial derivative for each variable of a multivariable equation e) Find the 2nd Derivative and the mixed partial derivative for a multivariable function	a) Use a computer algebra system or website to display functions of 2 or more variables b) Describe the partial derivative at a point in practical terms, such as using a roadway approaching a point from 2 different directions	a) Classroom examples/problems b) Homework problems

Resources: Essential Materials, Supplementary Materials, Links to Best Practices

Packet: Developed primarily from Thomas/Finney 8th Edition – Chapter 12.1 – 12.3
Whiteboard, markers, graphing calculator/computer, proxima, smartboard, Computer Algebra System

Instructional Adjustments: Modifications, student difficulties, possible misunderstandings

When taking derivative with respect to a variable, all other variables are treated like constants

Rules established in the AP course for functions of a single variable apply to multivariable functions as well

BASIC TEXTS & REFERENCES

BASIC TEXTS:

Larson, Ron; Hostetler, Robert P. and Edwards, Bruce H. Calculus II, 8th Edition, Houghton Mifflin Company, Boston, Ma. 2006

Thomas, George B., and Finney, Ross L. Calculus and Analytic Geometry, 8th Edition, Addison-Wesley Pub., Co., Reading, Mass. 1992.

REFERENCES:

Bradley, Gerald L. and Smith, Karl J. Calculus, Prentice-Hall, Inc., Upper Saddle River, NJ, 1995.

Edwards, C.H. and Penney, David E. Calculus and Analytic Geometry, 3rd Edition, Prentice-Hall, Inc., Upper Saddle River, NJ, 1990.

Finney, Ross L.; Demana, Franklin D.; Waits, Bert K.; Kennedy, Daniel, Calculus: Graphical, Numerical, Algebraic (Revised), Addison-Wesley Pub., Reading MA, 1999.

Finney, Ross L.; Thomas, George B.; Demana, Franklin D.; Waits, Bert K.; Calculus: Graphical, Numerical, Algebraic, Addison-Wesley Pub. Co., Reading, MA, 1995.

Stewart, James Calculus: Concepts and Contexts, Brooks/Cole Publishing Co., Pacific Grove, CA, 2001.

Stewart, James Calculus 4th Edition, Brooks/Cole Publishing Co., Pacific Grove, CA, 1999.

Thomas, George B and Finney, Ross L. Calculus and Analytic Geometry, 9th Edition Addison-Wesley Pub. Co., Reading, MA, 1996.

Thomas, George B. and Finney, Ross L. Calculus and Analytic Geometry, 7th Edition, Addison-Wesley Pub. Co., Reading MA,1996.

Varberg, Dale and Purcell, Edwin J. Calculus, 7th Edition, Prentice-Hall, Inc., Upper Saddle River, NJ, 1997.

ADDITIONAL RESOURCES:

Finney, Ross L.; Thomas, George B.; Demana, Franklin D.; Waits, Bert K.; Technology Resource Manual for Calculus Vols 1-5, Addison-Wesley Pub. Co., Reading, MA, 1994.

Ward, Frank and Wilberscheid, Doug Insight into Calculus: Using TI Graphing Calculators, Prentice-Hall, Inc., Upper Saddle River, NJ, 1997.

Journey Through Calculus (CD-ROM), Brooks/Cole Publishing Co.,Pacific Grove, CA, 1999.

Tools For Enriching Calculus (CD-ROM), Brooks/ColePublishing Co., Pacific Grove, CA, 2001.

PUBLIC SCHOOLS OF EDISON TOWNSHIP
OFFICE OF CURRICULUM AND INSTRUCTION

COURSE REQUIREMENTS
APPLIED CALCULUS

Grades: 12 **Length of Course**: Term

I. **Course Content** - This course will consist of the following units of study:

A. **Applications of the Definite Integral**: length of a curve, surface area, moments, centers of mass, centroids, work, fluid pressures, hydrostatic forces

B. **Hyperbolic Functions**: definitions, properties, graphs, identities, derivatives and antiderivatives, inverse hyperbolic functions, applications

C. **Techniques of Integration**: substitution and change of variables, integration by parts, trigonometric substitutions, partial fractions, table of integrals and reduction formulas, improper integrals

D. **Solutions of Differential Equations and Applications**: separable differential equations, slopefields, Euler and Runge-Kutta numerical methods, linear first order equations, linear homogeneous and non-homogeneous second order equations, undamped vibrating springs (simple harmonic motion), damped vibrations.

E. **Polynomial Approximation and Series**: sequences, partial sums, geometric series, convergence and divergence tests, alternating series, absolute and conditional convergence, power series, interval of convergence, Taylor polynomials, Maclaurin series, error estimates, applications

F. **Plane Curves in Parametric and Polar Form**: graphing curves parametrically, Cartesian/parametric conversion, slope and concavity of a parametric curve, length of and area enclosed by a parametric curve, graph polar curves, Cartesian/polar conversion, parametric/polar form, slope of and area enclosed by a polar curve

G. **Vectors and Analytic Geometry in Space**: space coordinates, distance, vector addition, subtraction, and scalar multiplication, vector components, unit vectors, length and direction, dot and cross products, triple scalar product, equations of lines and planes, cylinders and quadric surfaces

H. **Vector Functions and Motion in Space**: vector-valued functions, limits, and continuity, derivatives, position, velocity, and acceleration vectors, speed, projectile motion, space curves, directed distance, length, curvature, unit tangent vector, principal unit normal vector, binormal vector, torsion, tangenial and normal components of acceleration, planetary motion

I. **Partial Derivatives**: functions of two or more variables, domain and range, level curves and surfaces, limits and continuity, partial derivatives, tangent planes and normal lines to surfaces, maximums/minimums/saddle points

(Also, career-related topics and information will be presented/reviewed.)

II. **Course Requirements** - To complete this course successfully, students will be required to demonstrate a satisfactory (or higher) level of proficiency in:

A. recognizing and using terminology and symbols which relate to Advanced Calculus.
B. creating and using mathematical models involving calculus concepts to describe various physical, social, and economic problem situations.
C. solving problems involving applications of the definite integral.
D. modeling problem situations with slope fields, solving differential equations analytically and numerically.
E. determining convergence of a series and use polynomials to approximate functions.
F. determining convergence of a series and use polynomials to approximate functions.
G. analyzing plane and space curves and their metrical properties by means of a parametric or polar representation.
H. using vectors and vector-valued functions to solve problems relating to geometry and motion in space.
I. determining partial derivatives of a function of two or more variables and solving problems involving multivariable functions.

III. **Evaluation Process** - Throughout the length of this course, students will be evaluated on the basis of:

A. Tests
B. Homework assignments
C. Spy Problems
D. Quarterly Exams

Public Schools of Edison Township
Division of Curriculum and Instruction

DRAFT 9

Framework For Essential Instructional Behaviors, K-12
Common Threads

Edison's Framework for Essential Instructional Behaviors, K-12, represents a collaboratively developed statement of effective teaching. The lettered indicators are designed to explain each common thread, but do not denote order of importance. This concise statement of instructional expectation is intended as a framework; its use as an observation checklist would be inappropriate.

1. Planning Which Sets The Stage For Learning

Does the instruction show evidence of:

a. long-range and specific short-range planning which shows a direct relationship between student learning needs and the written curriculum.
b. communicating a clearly defined, curriculum-based learning objective based on observation and diagnosis of student needs.
c. setting high standards and expectations and deliberately selecting instructional strategies to help students achieve them.
d. sequencing lesson design.
e. using thematic/interdisciplinary units of fundamental importance to connect science, social studies, language arts, and/or math, which result in integrated learning.
f. integrating reading, writing, listening, speaking, viewing.
g. using available materials, including technology and outside resources, effectively.
h. demonstrating accurate knowledge of subject matter.
i. planning to enable co-teaching in shared teaching situations.
j. allocating nearly all of the available time to learning and activities to accomplish learning objective(s).

2. Productive Learning Climate/Classroom Management

Does the instruction show evidence of:

a. establishing an environment which is learner-centered (content rich and reflective of children's efforts).
b. creating a climate of mutual respect, one that is considerate of and addresses differences in culture, race, gender.
c. providing opportunities for student choice.
d. using proactive rules, routines (which students have internalized) and reactive management strategies effectively.
e. creating a safe, positive and open classroom environment in which children and teachers take risks, use trial and error.

3. Teaching Which Meets The Needs of Individual Differences

Does the instruction show evidence of:

a. demonstrating a belief that all children can learn and learn in different ways.
b. deliberately selecting a variety of grouping strategies (individual conferences, whole class, flexible, small groups, partners, cooperative learning structures).
c. addressing varied learning modalities (visual, auditory, kinesthetic/tactile).
d. deliberately selecting and using graphic organizers, auditory tapes, and manipulatives.
e. intentionally modifying content, strategies, materials and/or assessment during a lesson.

4. Teaching Which Forges Meaningful Connections

Does the instruction show evidence of:

a. helping students interact with concepts/skills/content/knowledge through a variety of planned and, when appropriate, unplanned learning strategies.
b. focusing on strategies for concept building rather than on isolated facts, information, and skills (teacher with students exploring/discovering, not teacher assigning).
c. accessing prior knowledge to build background information (anticipatory set, K-W-L, I wonder list..)
d. building in ample connections, including students' home cultures, to real life.
e. providing students the opportunity to actively process the learning through closure.

5. Teaching Which Promotes Focused Thinking

Does the instruction show evidence of:

a. using questioning strategies that promote discussion, problem solving, divergent thinking, multiple responses, and higher levels of thinking (analysis, evaluation, synthesis).
b. integrating active student participation, individually and collaboratively.
c. using varied writing activities (journals, learning logs, creative pieces, letters, charts, notes, reports) that connect to and extend learning **in all** subjects.

-Over-

6. Student Assessment Which Measures Learning

Does the instruction show evidence of:

a. using assessment to monitor and adjust instruction continually (e.g. researching when necessary).
b. developing multiple means of assessments including performance (students participating in self assessment, projects, demonstrations)
c. assessing student learning before, during, and after the lesson.
d. using appropriate homework assignments that extend learning, coupled with efficient assessment of student performance.

Subject-Specific Behaviors

Language Arts

Does the lesson show evidence of:

a. literature based reading experiences.
b. auditorys, stimulus (teacher reading, tapes, paired reading, choral reading.
c. literacy rich environment including evidence of children's work and variety of writing materials.
d. utilizing a variety of grouping strategies for instruction (whole class, flexible small groups, partners, cooperative learning teams).
e. daily and varied writing experiences (structured writing and free writing).
f. questions which build reading strategies (predicting inference, cause and effect, think alouds, summarizing, developing background knowledge.
g. the teaching of skills (phonics/mechanics) not in isolation but in a meaningful context.

Mathematics

Does the lesson show evidence of:

a. use of manipulatives with all students at **ALL** levels K-5.
b. concept building to start with concrete (where appropriate) and move through linking stage to symbolic.
c. use of Every Day Counts (grades 1-5).
d. use of Problem of the Day to encourage divergent thinking, problem analysis, and interpretation.
e. integration of calculators into the curriculum through problem solving, pattern identification, process reinforcement, etc.
f. emphasis of the use of techniques for mental math and estimation.
g. focus on problem solving strategies -encouraging open ended questions, acceptance of justifiable, reasonable responses.
h. appropriate time allotted for homework review (10 minutes).

Social Studies

Does the lesson show evidence of:

a. frequent and practical use of maps, globes, atlases (supporting literature and projects).
b. multi-cultural references and use of "Cultural Diversity" curriculum (guest speaker, student sharing).
c. evidence of historical perspective, i.e., the present based on past and will influence the future (use of timelines).
d. classroom organization in democratic framework (rules, responsibilities, cooperation, tolerance, equality).
e. adapting lesson plans to address up to the minute events in the news (significant world situations, "Oklahoma," elections).

Science

Does the lesson show evidence of:

a. hands-on activities.
b. encouragement of scientific method (questioning, hypothesizing
c. testing, observing, demonstrating, drawing conclusions, investigation).
d. writing for scientific findings, e.g. note-taking, data collecting, journals.
e. resources beyond the classroom.
f. evidence of scientific awareness in classroom environment.