PASSAIC COUNTY TECHNICAL INSTITUTE
45 Reinhardt Road
Wayne, NJ

Calculus Honors
Course # 075
5 Credits
2019

I. Course Description

Calculus is a college prep course that introduces students to the four major concepts in calculus: The Limit, The Derivative, The Definite Integral and The Indefinite Integral. This course will prepare students for further study in all branches of higher mathematics, science and related fields.
By the end of the course students will have learned algebraic, numerical and graphical methods for differentiating and integrating various algebraic functions and a variety of elementary transcendental functions. The numerical and graphical procedures students learn can be apply to any kind of function they have encountered in their previous courses. The use of technology reinforces these approaches to confirm and interpret the results.
Calculus is a transition course linking the mathematical and algebraic procedures taught in previous classes with the higher-level skills required in post-secondary technical programs.

PREREQUISITES
Before studying Calculus, all students must have successfully completed coursework for Algebra 1, Geometry, Algebra 2, and Pre-Calculus. Students must be familiar with properties of functions, the algebra of functions, the graphs of functions and the language of functions.

II. PCTI Curriculum Units

Unit 1

Content Area:	**Limits and Continuity**	**Grade(s)**	**10, 11, 12**
Unit Plan Title:	**Unit 1 – Limits** *Students will review prerequisites skills that they need for a successful experience in Calculus. Students will learn the concepts of a limit and how to evaluate limits. Students will find the limit of polynomial, absolute value, rational, radical, exponential, logarithmic, trigonometric, and inverse trigonometric functions.* **P.** Review 1. Summer Packet Review (5 days)		

	2. Trigonometric Identities (3 days) 3. Graphing Trig Functions (5 days) 4. Solving Trigonometric Equations (3 days) **I.** Limit and their Properties 1. Finding Limits Graphically and Numerically. (6 days) 2. Evaluating Limits Analytically. (7 days) 3. Continuity and One-Sided Limits. (5 days) 4. Infinite Limits. (4 days) 5. Limits to Infinity. (4 days)

NJSLS Standard(s) Addressed in this unit

A.APR.3 Understand the relationship between zeros and factors of polynomials. Identify zeros of polynomials when suitable factorizations are available and use the zeros to construct a rough graph of a function defined by the polynomial.
F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
F.IF.C.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
F.IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
F.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes
F.LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions
F.BF.B.3 Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Essential Questions (3-5)

1. How do you find the slope of a line and use the slope to write an equation of the line?
2. What is a limit and how can you determine the limit of a function as x approaches c?
3. What algebraic techniques can you use to evaluate a limit?
4. What is continuity and how does it apply to the Intermediate Value Theorem?
5. What is an infinite limit?

Anchor Text

Calculus for AP Authors: Ron Larson and Paul Battaglia
ISBN 13: 978-1-305-67491-2

Informational Texts (3-5)

Precalculus with Limits A Graphing Approach Author: Ron Larson
ISBN 13: 978-1-305-07171-1
Calculus Early Transcendentals Author: George B. Thomas, Jr.
ISBN 13: 978-0-13-460513-5
Calculus Graphical, Numerical, Algebraic Authors: Finney, Demana, Waits, Kennedy, Bressound
ISBN 13: 978-0-13-331161-7

Short Texts (1-3)

MULTIPLE-CHOICE & FREE-RESPONSE QUESTIONS IN PREPARATION FOR THE AP CALCULUS (AB) EXAMINATION - 10TH ED.
Preparing for the AP Calculus AB and Calculus BC Examinations (Fast Track to a 5) Authors: Sharon Cade, Rhea Caldwell, Jeff Lucia

Formative & Summative Assessments

Formative Assessment

- Instructor's observations of note-taking, and organization of notebooks and assignments
- Class Participation
- Cooperative learning activities
- Observing citizenship and appropriate social responses
- Instructor's observations of time management skills
- Trimester Pre-Test

Summative Assessment

- Homework
- Trimester Post Test
- Project
- Final Exam
- Quiz
- Chapter Test

Resources (websites, Canvas, LMS, Google Classroom, documents, etc.)

TI Nspire Cas Graphing Calculator
Canvas
http://www.webassign.net/
https://www.khanacademy.org/math/calculus-1

https://www.desmos.com/calculator
http://www.state.nj.us/education/cccs/2016/math/standards.pdf
http://www.state.nj.us/education/cccs/2014/tech/
https://www.cengagebrain.com/shop
https://login.cengage.com/cb/
http://www.larsoncalculus.com
https://bookshelf.vitalsource.com/#/user/signin
https://www.calcchat.com/
https://www.calcview.com/calculus-for-ap-1e/P/1/#CVV_NJtWMN2d6ck

Use a graphing calculator to:

- Plot the graph of a function within an arbitrary viewing window.
  http://www.youtube.com/results?search_query=how+to+plot+the+graph+of+a+function+within+an+arbitrary+viewing+window
- Find the zeroes of a function.
  http://www.youtube.com/results?search_query=how+to+find+the+zeroes+of+a+function+using+a+graphing+calc
- Find points of intersection of two graphs.
  http://www.youtube.com/results?search_query=how+to+find+points+of+intersection+of+two+graphs+using+a+graphing+calculator
- Fit the linear, quadratic, or trigonometric model to a real-life data set.
  http://www.youtube.com/results?search_query=how+to+fit+the+linear%2C+quadratic%2C+or+trigonometric+model+to+a+real-life+data+set.+using+a+graphing+calculator
- Find the limit of a function graphically.
  http://www.youtube.com/results?search_query=how+to+find+the+limit+of+a+function++using+a+graphing+calculator
- Determine continuity of a function from its graph.
  http://www.youtube.com/results?search_query=how+to+determine+continuity+of+a+function+using+a+graphing+calculator
- Determine infinite limits of a function from its graph.

http://www.youtube.com/results?search_query=how+to+determine+infinite+limits+of+a+function+using+a+graphing+calculator

Suggested Time Frame:	**42 Days**

Unit 2

Content Area:	Derivative	Grade(s)	10, 11, 12
Unit Plan Title:	**Unit 2 – Differentiation** *Students will be able to find the rates of change of not only linear functions, but also more complex functions. This gives students the opportunity to explore the way many real-life phenomena behave. Students will differentiate polynomial, absolute value, rational, radical, exponential, natural logarithmic, trigonometric, and inverse trigonometric functions.* **II.** Differentiation 1. The Derivative and the Tangent Line Problem. (5 days) 2. Basic Differentiation Rules and Rates of Change. (6 days) 3. The Product and Quotient Rules and Higher-Order Derivatives. (5 days) 4. The Chain Rule (6 days) 5. Implicit Differentiation. (5 days) 6. Derivatives of Inverse Functions (3 days) 7. Related Rates (10 days)		

NJSLS Standard(s) Addressed in this unit

F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Essential Questions (3-5)

1. What is a derivative and what is its relationship to continuity?
2. How do you find the derivatives of basic algebraic functions, trigonometric functions, and exponential functions?
3. How do you find the derivatives of functions involving products and quotients?
4. How do you find the derivatives of composite functions and natural logarithmic functions?
5. How do you find the derivative of implicit defined functions?
6. What is related rate and how do you find it?

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Formative Assessment

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- Class Participation
- Cooperative learning activities
- Observing citizenship and appropriate social responses
- Instructor's observations of time management skills
- Trimester Pre Test

Summative Assessment

- Homework
- Trimester Post Test
- Project
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- Quiz
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Resources (websites, Canvas, LMS, Google Classroom, documents, etc.)

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http://www.state.nj.us/education/cccs/2016/math/standards.pdf
http://www.state.nj.us/education/cccs/2014/tech/
https://www.cengagebrain.com/shop
https://login.cengage.com/cb/
http://www.larsoncalculus.com
https://bookshelf.vitalsource.com/#/user/signin
https://www.calcchat.com/
https://www.calcview.com/calculus-for-ap-1e/P/1/#CVV_NJtWMN2d6ck

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  http://www.youtube.com/results?search_query=how+to+plot+the+graph+of+a+function+within+an+arbitrary+viewing+windowusing+a+graphing+calculator
- Numerically calculate the derivative of a function
  http://www.youtube.com/results?search_query=how+to+numerically+calculate+the+derivative+of+a+function++using+a+graphing+calculator
- Use the graph of a function to determine differentiability at a point.
  http://www.youtube.com/results?search_query=how+to+determine+differentiability++using+a+graphing+calculator
- Estimate the rate of change of a graph at a specific point.
  http://www.youtube.com/results?search_query=how+to+estimate+the+rate+of+change+of+a+graph+at+a+specific+point++using+a+graphing+calculator
- Graph a function and its derivative at a given point
  http://www.youtube.com/results?search_query=how+to+graph+a+function+and+its+derivative+at+a+given+point++using+a+graphing+calculator

Use GeoGebra to:

- Graph equations in implicit form

http://www.youtube.com/results?search_query=how+to+graph+equations+in+implicit+form++using+GeoGebra

Suggested Time Frame:	**40 Days**

Unit 3

Content Area:	Derivative	Grade(s)	10, 11, 12
Unit Plan Title:	**Unit 3 – Application of Differentiation** *Students will learn how derivative can be use in real-life applications. Students will differentiate polynomial, absolute value, rational, radical, exponential, natural logarithmic, trigonometric, and inverse trigonometric functions.* **III.** Application of Differentiation 1. Extrema on an Interval. (7 days) 2. Rolle's Theorem and the Mean Value Theorem. (5 days) 3. Increasing and Decreasing and the First Derivative Test. (7 days) 4. Concavity and the Second Derivative Test. (7 days) 5. A Summary of Curve Sketching Limits to Infinity. (7 days) 6. Optimization Problems. (10 days)		

NJSLS Standard(s) Addressed in this unit

F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
F.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. *
F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
F.IF.C.8. a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Essential Questions (3-5)

1. What are extrema and how can you find them on open and closed intervals?
2. What is the Mean Value Theorem and how is it used?
3. How can you determine the intervals on which a function is increasing or decreasing and the location of the function's relative extrema?
4. How do you determine the concavity of a function and find its inflection points?
5. How do you analyze a function and sketch its graphs?

6. How do you maximize or minimize quantities?

Anchor Text

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Summative Assessment

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Resources (websites, Canvas, LMS, Google Classroom, documents, etc.)

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Canvas

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http://www.state.nj.us/education/cccs/2014/tech/
https://www.cengagebrain.com/shop
https://login.cengage.com/cb/
http://www.larsoncalculus.com
https://bookshelf.vitalsource.com/#/user/signin
https://www.calcchat.com/
https://www.calcview.com/calculus-for-ap-1e/P/1/#CVV_NJtWMN2d6ck

Use a graphing calculator to:

- Locate absolute max/min of a function
  http://www.youtube.com/results?search_query=how+to+locate+absolute+max%2Fmin+of+a+function++using+graphing+calculator
- Locate relative max/min of a function
  http://www.youtube.com/results?search_query=how+to+locate+relative+max%2Fmin+of+a+function+using+graphing+calculator
- Illustrate the Mean Value Theorem
  http://www.youtube.com/results?search_query=how+to+illustrate+the+Mean+Value+Theorem+using+graphing+calculator
- Find open intervals on which function is increasing/ decreasing using its graph
  http://www.youtube.com/results?search_query=how+to+%E2%80%A2%09Find+open+intervals+on+which+function+is+increasing%2F+decreasing+using+its+graphusing+graphing+calculator
- Find open intervals on which function is concave upward/downward using its graph
  http://www.youtube.com/results?q=how+to+find+open+intervals+on+which+function+is+concave+upward%2Fdownward+using+its+graph+using+its+graph+using+graphing+calculator
- Locate points of inflection of a function
  http://www.youtube.com/results?search_query=how+to+locate+points+of+inflection+of+a+function+using+graphing+calculator
  Find horizontal asymptote(s) of a function from its graph
  http://www.youtube.com/results?q=how+to+find+horizontal+asymptotes%29+of+a+function+from+its+graph+using+graphing+calculator

Suggested Time Frame:	**38 Days**

Unit 4

Content Area:	Integrals	Grade(s)	10, 11, 12
Unit Plan Title:	**Unit 4 – Integrals and Application of Integration** *Students will learn the process of integration. Students will first learn the connection between integration and differentiation. Students will learn how to evaluate simple and difficult integral. Students will learn to apply the concept of integration to real life problems. Students will integrate polynomial, absolute value, rational, radical, exponential, natural logarithmic, trigonometric, and inverse trigonometric functions.* **IV.** Integration 1. Antiderivatives and Indefinite Integrals (5 days) 2. Area (5 days) 3. Riemann Sums and Definite Integrals (5 days) 4. The Fundamental Theorem of Calculus. (5 days) 5. Integration by Substitution (5 days) 6. The Natural Logarithmic Function: Integration (3 days) 7. Inverse Trigonometric Functions: Integration (3 days) **V.** Application of Integration 1. Area of a Region Between Two Curves (4 days) 2. Volume: The Disk and Washer Methods and known Cross Sections (5 days)		

NJSLS Standard(s) Addressed in this unit

G.GMD.1 Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.
G.GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
G.GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
F.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. *

Essential Questions (3-5)

1. What are antiderivatives and how are they used?
2. How can you approximate the area of a plane region?

3. What is the Fundamental Theorem of Calculus?
4. How do you integrate composite functions?
5. How do you find the area of a region between two curves?

Anchor Text

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Formative & Summative Assessments

Formative Assessment

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- Class Participation
- Cooperative learning activities
- Observing citizenship and appropriate social responses
- Instructor's observations of time management skills
- Trimester Pre-Test

Summative Assessment

- Homework
- Trimester Post Test
- Project
- Final Exam
- Quiz
- Chapter Test

Resources (websites, Canvas, LMS, Google Classroom, documents, etc.)

TI Nspire Cas Graphing Calculator

Canvas
http://www.webassign.net/
https://www.khanacademy.org/math/calculus-1
https://www.desmos.com/calculator
http://www.state.nj.us/education/cccs/2016/math/standards.pdf
http://www.state.nj.us/education/cccs/2014/tech/
https://www.cengagebrain.com/shop
https://login.cengage.com/cb/
http://www.larsoncalculus.com
https://bookshelf.vitalsource.com/#/user/signin
https://www.calcchat.com/
https://www.calcview.com/calculus-for-ap-1e/P/1/#CVV_NJtWMN2d6ck
Use a graphing calculator to:

- Find the value of a definite integral.
  http://www.youtube.com/results?search_query=how+to+find+the+value+of+a+definite+integral+using+graphing+calculator
- Use the summation capabilities of a calculator to find sums.
  http://www.youtube.com/results?search_query=how+to+use+the+summation+capabilities+of+a+calculator+to+find+sums.
- Sketch two graphs and find the points where they intercept.
  http://www.youtube.com/results?search_query=how+to+sketch+two+graphs+and+find+the+points+where+they+intercept+on+a+graphing+calculator

Use GeoGebra to:

- Create a slope field for the given differential equation

http://www.youtube.com/results?search_query=How+to+create+a+slope+field+for+the+given+differential+equation+using+GeoGebra

Suggested Time Frame:	**40 days**

III. Instructional Strategies

- Lecture
- Graphs and other visuals
- Student investigative activities
- Engaging in discussions
- Reading silently and aloud

- Brainstorming
- Listening
- Participating in small and large groups
- Collaborative projects
- Answering questions (oral and written)
- Summarizing
- Debating
- Analyzing data, discussions, etc.
- Peer teaching
- Playing games
- Note taking
- Writing

Differentiated Instruction

- Students will work individually, engage in cooperative learning, and utilize discovery learning on certain activities. Through the use of lectures, the internet, and interactive whiteboards, students will be exposed to various teaching methods to appeal to visual, auditory, and kinesthetic learners.

IV. Methods of Student Evaluation

Assessment can be divided into two general categories: formal (graded) and informal/classroom-based (both graded and ungraded). The key to effectively assessing a student's mastery of skills is to match the assessment method to the learning objective.

Summative Assessments

- Homework
- Quizzes
- Projects
- Chapter Test
- Final Exam
- Trimester Post Test

Formative Assessments

- Instructor's observations of note-taking, and organization of notebooks and assignments
- Class Participation
- Cooperative learning activities
- Observing citizenship and appropriate social responses
- Instructor's observations of time management skills
- Trimester Pre Test

V. Textbooks, Instructional Resources and Software

1. Multivariable Calculus, Authors: Ron Larson and Bruce Edwards, 11th Edition, ISBN 13: 978-1-285-06029-3
2. TI Nspire Calculator
3. Desmos
4. CalcChat
5. VitalSource
6. CengageBrain.com
7. www.webassign.net

VI. Scope and Sequence

Key: I – Introduced, D-developed in Depth, R-Reinforced

SKILL TO BE LEARNED	9	10	11	12
Students will utilize a graphing calculator to solve problems.		I/D/R	I/D/R	I/D/R
Students will find the limit of a function graphically, numerically & algebraically.		I/D/R	I/D/R	I/D/R
Students will study and use the formal definition of a limit.		I/D/R	I/D/R	I/D/R
Students will determine whether a function is continuous or not continuous at a given value and on an interval.		I/D/R	I/D/R	I/D/R
Students will be able to discuss and apply the relationship between tangent lines, rates of change and derivative.		I/D/R	I/D/R	I/D/R
Students will be able to differentiate polynomial, absolute value, rational, radical, exponential, natural logarithmic, trigonometric, and inverse trigonometric functions.		I/D/R	I/D/R	I/D/R
Students will be able to apply Rolle's Theorem, Mean Value Theorem to appropriate problems.		I/D/R	I/D/R	I/D/R

Students will employ the derivative to solve various problems such as related rates, optimization, and graph sketching.		I/D/R	I/D/R	I/D/R
Students will use sigma notation to write and evaluate a sum.		I/D/R	I/D/R	I/D/R
Students will study the concept of area.		I/D/R	I/D/R	I/D/R
Students will be able to determine the area under a curve of a function using integration techniques.		I/D/R	I/D/R	I/D/R
Students will be able to determine the area under a curve of a function using limits.		I/D/R	I/D/R	I/D/R
Students will be able to apply Riemann Sums to appropriate problems and applications.		I/D/R	I/D/R	I/D/R
Students will be able to determine the area under a curve of a function using trapezoids.		I/D/R	I/D/R	I/D/R
Students will be able to integrate polynomial, absolute value, rational, radical, exponential, natural logarithmic, trigonometric, and inverse trigonometric functions.		I/D/R	I/D/R	I/D/R

VII. Curriculum Correlation Chart with Textbook

CHAPTER 1 Limits and Their Properties
- 1.2 Finding Limits Graphically and Numerically
- 1.3 Evaluating Limits Analytically
- 1.4 Continuity and One-Sided Limits
- 1.5 Infinite Limits
- 1.6 Limits at Infinity

CHAPTER 2 Differentiation
- 2.1 The Derivative and the Tangent Line Problem
- 2.2 Basic Differentiation Rules and Rates of Change
- 2.3 Product and Quotient Rules and Higher-Order Derivatives
- 2.4 The Chain Rule
- 2.5 Implicit Differentiation
- 2.6 Derivatives of Inverse Functions
- 2.7 Related Rates

CHAPTER 3 Application of Differentiation
- 3.1 Extrema on an Interval
- 3.2 Rolle's Theorem and the Mean Value Theorem
- 3.3 Increasing and Decreasing Functions and the First Derivative Test
- 3.4 Concavity and the Second Derivative Test
- 3.5 A Summary of Curve Sketching
- 3.6 Optimization Problems

CHAPTER 4 Integration

VIII. Student Handout

Calculus Honors Course Overview

Calculus is a full year study designed primarily as a preparation course for college, technical school or junior college. Calculus is the mathematics of change-velocities and accelerations. It is also the mathematics of tangent lines, slopes, areas and volumes. It will enable you to model real-life situations.

PROFICIENCES

Upon successful completion of the requirements for this course, the student will be able to:

A) Discuss and apply the basic concepts, properties and theorems of differential and integral calculus including limits, continuity, definite and indefinite integral, Rolle's Theorem, Riemann's Sum, and the Mean Value Theorem.
B) Discuss and apply the relationship between tangent lines, rates of change, and the derivative.
C) Differentiate and integrate polynomial, trigonometric, rational, composite, exponential, natural logarithmic, inverse trigonometry and implicitly-defined functions.
D) Identify and determine critical points, points of inflection, interval of increase, decrease, and concavity.
E) Integrate polynomial, trigonometric, rational, composite, exponential, natural logarithmic, inverse trigonometry and implicitly-defined functions.
F) Employ the derivative to solve various applications problems such as velocity and acceleration, related rates, optimization, and graph sketching.
G) Employ integral to solve various application problems such as area between curves and the volume of a solid of revolution.