PASSAIC COUNTY TECHNICAL INSTITUTE
45 Reinhardt Road
Wayne, NJ

Calculus
Course # 127
5 Credits
2019

I. Course Description

This course is an introduction to calculus intended for those studying business, economics, and the social and life sciences. The following calculus topics are presented with applications in the business world: evaluating limits, methods of finding derivatives, methods of definite and indefinite integration and the calculus of exponential and logarithmic functions. The course stresses applications in business, economics, finance and investment, as well as the life, health, and environmental sciences. This course is intended to give students the appropriate conceptual and computational mathematical background for future study in business.

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 apply techniques of evaluating limits to solving application problems in the fields of business, economics, finance and investment, as well as the life, health, and environmental sciences.* **P.** Algebra Review 1. Inequalities, Interval Notation, Absolute Values (2 days) 2. Exponents and Roots (2 days) 3. Operations with Polynomials, Factoring Polynomials (2 days) 4. Solving Equations by factoring, completing the Square, and the Quadratic Formula (2 days) 5. Solving Systems of Linear and Quadratic Equations (2 days)		

I. Functions and Graphs

1. Functions (5 days)
   -- Identify the domain and range of a function, and evaluate a function from an equation
   -- Gain familiarity with the piece-wise functions
   -- Functions used in economics
   -- Production process
   -- Evaluation a Cost function
   -- Expressing Cost as a Composite function
   -- Use a composite function to study air pollution
   -- Apply the graph of a function to: Business, Economics, Life and Social Science problems
2. Graph of a Function (2 days)
   --Apply the graph of a function to: Business, Economics, Life and Social Science problems
3. Lines and Linear Functions (2 days)
   -- Review properties of lines: slope, horizontal and vertical lines, and forms for the equation of a line
   -- Apply Lines and Linear Functions to: Business, Economics, Life and Social Science problems Science problems
4. Functional Models (5 days)
   -- Modeling procedures + Formulation, Analysis, Interpretation, Testing and Adjustments
   -- Finding the Maximum Profit
   -- Modeling Construction Cost
   -- Modeling with Proportionality
   -- Modeling Market Equilibrium + Supply, Demand, Shortage, Surplus
   -- Break-Even Analysis
   -- Comparative Cost Analysis
   -- Apply Functional Models to: Business, Economics, Life and Social Science problems

II. Limits, Their Properties, and Their Applications

1. Limits. (8 days)
2. One-Sided and Limits Continuity. (8 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. What are different methods of solving polynomial equations?
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?

Anchor Text

Calculus for Business, Economics, and the Social and Life Sciences Authors: Laurence D. Hoffmann and Gerald L. Bradley
ISBN 978–0–07–353238–7

Informational Texts (3-5)

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Authors: Raymond A. Barnett, Michael R. Ziegler, Karl E. Byleen, and Christopher J. Stocker
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ISBN 13: 978-0-13-331161-7

Short Texts (1-3)

Schaum's Outline of Calculus for Business, Economics, and The Social Sciences 1st Edition, Author: Edward T. Dowling

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
https://www.aleks.com/highered
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://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:	**40 Days**

Unit 2

Content Area:	**Derivative**	**Grade(s)**	**10, 11, 12**
Unit Plan Title:	**Unit 2 – Differentiation: Basic Concepts** *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 how derivatives can be applied to solve real-life applications in business, economics, finance and investment, as well as the life, health, and environmental sciences.* **III.** Differentiation and Their Applications 1. The Derivative. (8 days) 2. Techniques of Differentiation Basic Differentiation Rules and Rates of Change. (8 days) 3. The Product and Quotient Rules and Higher-Order Derivatives. (8 days) 4. The Chain Rule. (8 days) 5. Marginal Analysis and Approximations Using Increments. (8 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?
2. How do you find the derivatives of basic algebraic functions?
3. How do you find the derivatives of functions involving products and quotients?
4. What is related rate and how do you find it?

Anchor Text

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Summative Assessment

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https://www.cengagebrain.com/shop
https://login.cengage.com/cb/
http://www.larsoncalculus.com
https://www.calcchat.com/
https://www.calcview.com/calculus-for-ap-1e/P/1/#CVV_NJtWMN2d6ck
Use a graphing calculator to:

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- 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

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 the derivative can be used in the fields of business, economics, finance and investment, as well as the life, health, and environmental sciences.* **IV.** Applications of Differentiation 1. Increasing and Decreasing Functions; Relative Extrema (8 days) 2. Concavity and Points of Inflection. (8 days) 3. Curve Sketching. (8 days) 4. Optimization; Elasticity of Demand. (8 days) 5. Additional Applied Optimization. (8 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. How can you determine the intervals on which a function is increasing or decreasing and the location of the function's relative extrema?
3. How do you determine the concavity of a function and find its inflection points?
4. How do you maximize or minimize quantities?

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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://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
- 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
Suggested Time Frame: **40 Days**

Unit 4

Content Area:	**Integrals**	**Grade(s)**	**10, 11, 12**
Unit Plan Title:	**Unit 4 – Exponential and Logarithmic Function and Integration** *Students will learn exponential and logarithmic functions and the process of integration. Students will first learn the connection between integration and differentiation. Students will learn how to evaluate simple integral. Indefinite and definite integration will be applied in solving applications in the fields of business, economics, finance and investment, as well as the life, health, and environmental sciences.* **V.** Exponential Functions, Logarithmic Functions, and Their Applications 1. Exponential Models; Continuous Compounding (5 days) 2. Logarithmic Functions (5 days) 3. Differentiation of Exponential and Logarithmic Functions (6 days) **VI.** Integration and Their Applications 1. Antidifferentiation: The Indefinite Integral (4 days) 2. Integration by Substitution (4 days) 3. The Definite Integral and the Fundamental Theorem of Calculus (4 days) 4. Applying Definite Integration: Distribution of Wealth and Average value (4 days) 5. Applying Applications of Integration to Business and Economics (4 days) 6. Additional Applications of Integration to the Life and Social Science (4 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?
3. What is the Fundamental Theorem of Calculus?
4. How do you integrate using substitution method?

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- Instructor's observations of time management skills
- Trimester Pre Test

Summative Assessment

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

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

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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://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.

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. Calculus for Business, Economics, and the Social and Life Sciences Authors: Laurence D. Hoffmann and Gerald L. Bradley ISBN 978–0–07–353231–8
2. TI Nspire Calculator
3. Desmos
4. CalcChat
5. VitalSource
6. Aleks

VI. Scope and Sequence

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

SKILL TO BE LEARNED	9	10	11	12
Students will identify the domain and range of a function, and evaluate a function from an equation.		I/D/R	I/D/R	I/D/R
Students will gain familiarity with the piece-wise functions and functions used in economics.		I/D/R	I/D/R	I/D/R
Students will gain familiarity with Production process and evaluation of Cost function.		I/D/R	I/D/R	I/D/R
Students will gain familiarity with expressing Cost as a Composite function and use a composite function to study air pollution.		I/D/R	I/D/R	I/D/R
Students will apply the graph of a function to: Business, Economics, Life and Social Science problems.		I/D/R	I/D/R	I/D/R
Students will review properties of lines: slope, horizontal and vertical lines, and forms for the equation of a line.		I/D/R	I/D/R	I/D/R
Students will apply Lines and Linear Functions to: Business, Economics, Life and Social Science problems Science problems		I/D/R	I/D/R	I/D/R
Students will learn about modeling procedures, Formulation, Analysis, Interpretation, Testing and Adjustments.		I/D/R	I/D/R	I/D/R
Students will learn to find the Maximum Profit.		I/D/R	I/D/R	I/D/R
Students will learn about Modeling Construction Cost, Modeling with Proportionality, Modeling Market Equilibrium + Supply, Demand, Shortage, and Surplus.		I/D/R	I/D/R	I/D/R
Students will learn about Break-Even Analysis and Comparative Cost Analysis.		I/D/R	I/D/R	I/D/R
apply Functional Models to: Business, Economics, Life and Social Science problems.		I/D/R	I/D/R	I/D/R
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 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, exponential, and natural logarithmic functions.		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 be able to integrate polynomial functions exponential, and natural logarithmic functions.		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 the substitution method to integrate polynomial functions exponential, and natural logarithmic functions.		I/D/R	I/D/R	I/D/R

VII. Curriculum Correlation Chart with Textbook

CHAPTER 1 Functions, Graphs, and Limits
- 1.1 Functions
- 1.2 The Graph of a Function
- 1.3 Linear Functions
- 1.4 Functional Models
- 1.5 Limits
- 1.6 One-Sided Limits and Continuity

CHAPTER 2 Differentiation: Basic Concepts
- 2.1 The Derivative
- 2.2 Techniques of Differentiation
- 2.3 Product and Quotient Rules; Higher-Order Derivatives
- 2.4 The Chain Rule
- 2.5 Marginal Analysis and Approximations Using Increments

CHAPTER 3 Application of Differentiation
- 3.1 Increasing and Decreasing Functions; Relative Extrema
- 3.2 Concavity and Points of Inflection
- 3.3 Curve Sketching
- 3.4 Optimization; Elasticity of Demand
- 3.5 Additional Applied Optimization

CHAPTER 4 Integration
- 4.1 Exponential Functions; Continuous Compounding
- 4.2 Logarithmic Functions
- 4.3 Differentiation of Exponential and Logarithmic Functions

CHAPTER 5 Integration
- 5.1 Antidifferentiation: The Indefinite Integral
- 5.2 Integration by Substitution
- 5.3 The Definite Integral and the Fundamental Theorem of Calculus
- 5.4 Applying Definite Integration: Distribution of Wealth and Average value
- 5.5 Applying Applications of Integration to Business and Economics
- 5.6 Additional Applications of Integration to the Life and Social Science

VIII. Student Handout

Calculus Course Overview

Calculus is a full year study designed primarily as a preparation course for college, technical school or junior college. This course provides a sound, intuitive understanding of the basic concepts that students need as they pursue careers in business, economics, and the life and social sciences. Students achieve success learning about applied and real-world orientation to concepts, problem-solving approach, straightforward and concise writing style, and comprehensive exercise sets. Students will be introduced to a brief introduction to the concepts and applications of differential and integral calculus. Topics include limits; continuity; differentiation and integration of polynomial, logarithmic and exponential functions with applications to business.

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.
B) Discuss and apply the relationship between tangent lines, rates of change, and the derivative.
C) Differentiate and integrate polynomial, exponential, natural logarithmic functions.
D) Identify and determine critical points, points of inflection, interval of increase, decrease, and concavity.
E) Employ the derivative to solve various applications problems such as optimization.
F) Solve Definite Integral and the Fundamental Theorem of Calculus
G) Integrate using the substitution technique.
H) Apply derivative and integral concepts to business, economics, life and social sciences.