ATLANTIC CAPE COMMUNITY COLLEGE
Math and Science Department

MATH255 Calculus III
Credits: 4-0-4

COURSE DESCRIPTION and PREREQUISITE:

Prerequisite: Completion of Math 156 or equivalent with a grade of C or better.

Topics of study include vectors in the plane, analytic geometry three-dimensional space, vectors in three-dimensional space, differentiation and integration of vector-valued functions, functions of several variables, Lagrange multipliers, multiple integration, applications of multiple integrals, Jacobians, vector analysis, Greens Theorem, Divergence Theorem and Stoke's Theorem.

LEARNING GOALS:

Students will:

- Expand their understanding of analytic geometry, vectors and the Geometry of Space.
- Understand the Differentiation, Integration and application of Vector-Valued Functions.
- Expand their knowledge of graphing, limits, differentiation and integration to include functions with several variables.
- Learn to apply multiple integration techniques and the geometry of space to appropriate applications including Jacobians.
- Expand their knowledge of vector analysis to include vector fields, line integrals, conservation and independence of paths, Green's Theorem, Surface Area, Divergence Theorem and Stokes Theorem.

STUDENT LEARNING OUTCOMES:

Students will be able to:

- Demonstrate an understanding of analytic geometry, vectors and the Geometry of Space.
- Evaluate real-world applications with Differentiate, Integrate and apply Vector-Valued Functions.
- Apply their knowledge of graphing, limits, differentiation and integration to functions with several variables.
- Solve real-world problems with gradients, differentials and Lagrange multipliers.
- Apply multiple integration techniques and the geometry of space to appropriate applications including Center of Mass, Moments of Inertia, and Jacobians.
- Demonstrate an understanding of vector analysis to include vector fields, line integrals, parametric surfaces, conservation and independence of paths.
- Construct real-world models using Green's Theorem, Divergence Theorem and Stokes Theorem to investigate Work, Flux and Curl.

LEARNING OBJECTIVES:

Chapter 11: Vectors and the Geometry of Space

11.1 Vectors in the Plane

- Students will be able to write the component form of a vector.
- Students will be able to perform vector operations and interpret the results geometrically.
- Students will be able to write a vector as a linear combination of standard unit vectors.
- Students will be able to use vectors to solve problems involving force or velocity.

11.2 Space Coordinates and Vectors in Space

- Students will be able to plot points in the three-dimensional rectangular coordinate system.
- Students will be able to analyze vectors in space.
- Students will be able to use three-dimensional vectors to solve real-life problems.

11.3 The Dot Product of Two Vectors

- Students will be able to use properties of the dot product of two vectors.
- Students will be able to find the angle between two vectors using the dot product.
- Students will be able to find the direction cosines of a vector in space.
- Students will be able to find the projection of a vector into another vector.
- Students will be able to use vectors to find the work done by a constant force.

11.4 The Cross Product of Two Vectors in Space

- Students will be able to find the cross product of two vectors in space.
- Students will be able to use the triple scalar product of three vectors in space.

11.5 Lines and Planes in Space

- Students will be able to write a set of parametric equations for a line in space.
- Students will be able to write a linear equation to represent a plane in space.
- Students will be able to sketch the plane given by a linear equation.
- Students will be able to find the distance between points, planes, and lines in space.

11.6 Surfaces in Space

- Students will be able to recognize and write equations for cylindrical surfaces.
- Students will be able to recognize and write equations for quadratic surfaces.
- Students will be able to recognize and write equations for surfaces of revolution.

11.7 Cylindrical and Spherical Coordinates

- Students will be able to use cylindrical coordinates to represent surfaces in space.
- Students will be able to use spherical coordinates to represent surfaces in space.

Chapter 12: Vector-Valued Functions

12.1 Vector-Valued Functions

- Students will be able to analyze and sketch a space curve given by a vector-valued function.

- Students will be able to extend the concepts of limits and continuity to vector-valued functions.

12.2 Differentiation and Integration of Vector-Valued Functions

- Students will be able to differentiate a vector-valued function.
- Students will be able to integrate a vector-valued function.

12.4 Tangent Vectors and Normal Vectors

- Students will be able to find a unit tangent vector at a point on a space curve.
- Students will be able to find the tangential and normal components of acceleration.

12.5 Arc Length and Curvature

- Students will be able to find the arc length of a space curve.
- Students will be able to use the arc length parameter to describe a plane curve or space curve.
- Students will be able to find the curvature of a curve at a point on the curve.
- Students will be able to use a vector-valued function to find frictional force.

Chapter 13: Functions of Several Variables

13.1 Introduction to Functions of Several Variables

- Students will be able to understand the notation for a function of several variables.
- Students will be able to sketch the graph of a function of two variables.
- Students will be able to sketch level curves for a function of two variables.
- Students will be able to sketch level surfaces for a function of three variables.
- Students will be able to use *Mathematica* to sketch the graph of a function of two variables.

13.2 Limits and Continuity

- Students will be able to demonstrate an understanding of the definition of a neighborhood in a plane.
- Students will be able to demonstrate an understanding of the definition of the limit of a function of two variables.
- Students will be able to extend the concept of continuity to a function of two variables.
- Students will be able to extend the concept of continuity to a function of three variables.

13.3 Partial Derivatives

- Students will be able to find and use a partial derivative of a function of two variables.
- Students will be able to find and use a partial derivative of a function of three variables.
- Students will be able to find higher-order partial derivative of a function of two or three variables.

13.4 Differentials

- Students will be able to demonstrate an understanding of the concepts of increments and differentials.
- Students will be able to extend the concept of differentiability to a function of two variables.
- Students will be able to use a differential as an approximation.

13.5 Chain Rules for Functions of Several Variables

- Students will be able to use the Chain Rules for functions of several variables.
- Students will be able to find partial derivatives implicitly.

13.6 Directional Derivatives and Gradients

- Students will be able to find an use directional derivatives of a function of two variables.
- Students will be able to find the gradient of a function of two variables.
- Students will be able to use the gradient of a function of two variables in applications.
- Students will be able to find directional derivatives and gradients for functions of three variables.

13.7 Tangent Planes and Normal Lines

- Students will be able to find equations of tangent planes and normal lines to surfaces.
- Students will be able to find the angle of inclination of a plane in space.
- Students will be able to compare the gradients $f(x, y)$ and $F(x, y, z)$.

13.8 Extrema of Functions of Two Variables

- Students will be able to find the absolute and relative extrema of a function of two variables.
- Students will be able to use the Second Partials Test to find relative extrema of a function of two variables.

13.10 Lagrange Multipliers

- Students will be able to demonstrate an understanding of the Method of Lagrange Multipliers.
- Students will be able to use Lagrange Multipliers to solve constrained optimization problems.
- Students will be able to use the Method of Lagrange Multipliers with two constraints.

Chapter 14: Multiple Integration

14.1 Iterated Integrals and Area in the Plane

- Students will be able to evaluate an iterated integral.
- Students will be able to use an iterated integral to find the area of a plane region.

14.2 Double Integrals and Volume

- Students will be able to use a double integral to represent the volume of a solid region.
- Students will be able to use properties of double integrals.
- Students will be able to evaluate a double integral as an iterated integral.

14.3 Change of Variables: Polar Coordinates

- Students will be able to write and evaluate double integrals in polar coordinates.

14.5 **Surface Area**

- Students will be able to use a double integral to find the area of a surface.

14.6 Triple Integrals and Applications

- Students will be able to use a triple integral to find the volume of a solid region.
- Students will be able to find the center of mass and moments of inertia of a solid region.

14.7 Triple Integrals in Other Coordinates

- Students will be able to write and evaluate a triple integral in cylindrical coordinates.
- Students will be able to write and evaluate a triple integral in spherical coordinates.

14.8 Change of Variables: Jacobians

- Students will be able to demonstrate an understanding of the concept of a Jacobian.
- Students will be able to use a Jacobian to change variables in a double integral.

Chapter 15: Vector Analysis

15.1 Vector Fields

- Students will be able to demonstrate an understanding of the concept of a vector field
- Students will be able to determine whether a vector field is conservative
- Students will be able to find the curl of a vector field
- Students will be able to find the divergence of a vector field

15.2 Line Integrals

- Students will be able to demonstrate an understanding and use the concept of a piecewise smooth curve
- Students will be able to write and evaluate a line integral
- Students will be able to evaluate a line integral of a vector field
- Students will be able to write and evaluate a line integral in differential form

15.3 Conservative Vector Fields and Independence of Path

- Students will be able to define and use the Fundamental Theorem of Line Integrals

- Students will be able to demonstrate an understanding of the concept of independence of path
- Students will be able to demonstrate an understanding of the concept of conservation of energy

15.4 Green's Theorem

- Students will be able to use Green's Theorem to evaluate a line integral
- Students will be able to use alternative forms of green's theorem

15.5 Parametric Surfaces

- Students will be able to define a parametric surface, and sketch the surface
- Students will be able to find a set of parametric equations to represent a surface
- Students will be able to find a normal vector and a tangent plane to a parametric surface
- Students will be able to find the area of a parametric surface

15.6 Surface Integrals

- Students will be able to evaluate a surface integral as a double integral
- Students will be able to evaluate a surface integral for a parametric surface
- Students will be able to determine the orientation of a surface
- Students will be able to evaluate and use a flux integral

15.7 Divergence Theorem

- Students will be able to use the Divergence Theorem
- Students will be able to use the Divergence Theorem to calculate a flux

15.8 Stokes's Theorem

- Students will be able to use Stokes's Theorem
- Students will be able to use curl to analyze the motion of a rotating liquid

ASSESSMENT STRATEGIES:

Students Learning Outcomes	Assessment Strategies
• Demonstrate an understanding of analytic geometry, vectors and the Geometry of Space.	• Comprehensive Exam • Classroom Observation
• Evaluate real-world applications with Differentiate, Integrate and apply Vector-Valued Functions.	• Comprehensive Exam • Classroom Observation
• Apply their knowledge of graphing, limits, differentiation and integration to functions with several variables.	• Comprehensive Exam • Classroom Observation
• Solve real-world problems with gradients, differentials and Lagrange multipliers.	• Comprehensive Exam • Classroom Observation
• Apply multiple integration techniques and the geometry of space to appropriate applications including Center of Mass, Moments of Inertia, and Jacobians.	• Comprehensive Exam • Classroom Observation
• Demonstrate an understanding of vector analysis to include vector fields, line integrals, parametric surfaces, conservation and independence of paths.	• Comprehensive Exam • Classroom Observation
• Construct real-world models using Green's Theorem, Divergence Theorem and Stokes Theorem to investigate Work, Flux and Curl.	• Classroom Observation

College Grading Scale (except for Paralegal, Nursing, and Culinary Programs)

Grade	Percentage Range	Grade Point Value
A	93-100%	4.0
A-	90-92%	3.7
B+	87-89%	3.3
B	83-86%	3.0
B-	80-82%	2.7
C+	77-79%	2.3
C	70-76%	2.0
D	60-69%	1.0

TEXTBOOK AND MATERIALS

- Textbook available online on WebAssign: Calculus Of A Single Variable – 11th edition with the student's solution manual by Larson and Edwards.
- A scientific calculator. The TI-84 Graphing Calculator will be used during classroom demonstrations therefore, the TI-84 is strongly recommended. If you choose a calculator other than the TI-84, it is your responsibility to learn the applications by reading your user manual. You will not be permitted to use any other calculator for testing.

ADA Accommodations

As per the Americans with Disabilities Act (ADA), reasonable accommodations can be provided to students who present current documentation (within five years) of a disability to Atlantic Cape Community College's Center for Accessibility, located on the first floor of "J" Building in the Counseling and Support Services department (Mays Landing campus). Reasonable accommodations cannot be provided for a course until the student registers with the Center for Accessibility. For more information, please contact the Center for Accessibility via email at cfa@atlantic.edu or call 609-343-5680.