Scope and Sequence
Mathematics
Multivariable Calculus(400)

Description: This is a college level course which follows AP Calculus BC. Topics include parametric, vector and polar functions, vectors and analytic geometry in space, multivariable functions and their derivatives, partial differentiation, differential equations, multiple integrals, integration in vector fields, vector valued functions, and motion in space. Expectations: Students are expected to have a high level of commitment to completion of all class work and to demonstrate the ability for independent work, to complete projects and presentations and to do well on periodic assessments.

Unit Name/Description	Content and/or Skills
Parametric and Polar Equations	An introduction to parametric equations and parametric curves. Finding tangent lines, area and length of parametric curves. Determining the surface area of a solid . Converting between polar coordinates and Cartesian coordinates . Finding tangent lines, area and length of polar curves. Finding the area enclosed by a polar curve. Determining the surface area of a solid obtained by rotating a polar curve about an axis.
Vector Operations	An introduction to some of the basic concepts about vectors Basic arithmetic operations for vectors. The dot product and cross production for vectors. Applications and real world connections with vectors.

Three Dimensional Space	An introduction to the concepts and notation for the three-dimensional coordinate system. The development of various forms for equations of lines and planes in three-dimensional space. Analytic and geometric representation of three dimensions including dot product and cross product of vectors, parallelism, perpendicularity, and angles in space.
Quadric Surfaces	Visualize and identify the six basic types of quadric surfaces: ellipsoid, hyperboloid in one sheet, hyperboloid in two sheets, elliptic cone, elliptic paraboloid, and hyperbolic paraboloid. Utilize technological resources to confirm the identification of quadric surfaces. Visualize and analyze the traces of quadric surfaces using technological support. Evaluate and compare the properties of various quadric surfaces.
Functions of Several Variables	Investigate limits, continuity, and differentiation of functions of two independent variables.
Vector Functions	Apply previous knowledge of limits, derivatives, and integrals to vector functions. Define the tangent, normal and binormal vectors. Revisit applications of derivatives with velocity and acceleration. Connect previous conceptual knowledge of velocity and acceleration to the concept of a vector function.
Alternative Coordinate Systems	Applications of alternative coordinate systems to the earth. Investigation of finding the distance between two cities on earth using the spherical

	coordinate system.
Partial Derivatives	Introduce the idea of partial derivatives as well as the standard notations and how to compute them. Investigate important interpretations of partial derivatives. Examine higher order partial derivatives. Extend the idea of differentials to functions of several variables.
Applications of Partial Derivatives	Introduce the concept of directional derivatives in this section. Define and apply the total differential to real-world phenomena. Represent the partial derivatives of a system of two functions in two variables. Applying partial differentiation to problems of optimizations. Exploring applications to economics using the Lagrange multiplier and partial derivatives.
Multiple Integrals	Define the double integral. Evaluating double integrals using polar coordinates. Define the triple integral as well as how we evaluate them. Evaluate triple integrals using cylindrical coordinates and spherical coordinates.
Applications of Multiple Integrals	Students will understand, apply and interpret the theorems of Green, Stokes, and Gauss. Applications of double integrals to the real world. Apply line and surface integrals to functions representing real-world phenomena. Recognize, understand and use line integrals. Define and apply the gradient, the divergence, and the curl in terms of integrals of vectors.

Final Exam	Departmental review and final exam