J. Sargeant Reynolds Community College
Course Content Summary

Course Prefix and Number: MTH 265 **Credits:** 4

Course Title: Calculus III

Course Description: Prepares students for further study in calculus. Focuses on extending the concepts of function, limit, continuity, derivative, integral, and vector from the plane to the three dimensional space. Topics include vector functions, multivariate functions, partial derivatives, multiple integrals, and an introduction to vector calculus. Designed for mathematical, physical, and engineering science programs. This course replaces MTH 277 or MTH 178 and is the third course in a three-course sequence. Prerequisite: Placement in MTH 265 or completion of MTH 264 or equivalent with a grade of C or better. Lecture 4 hours per week.

General Course Purpose: Students intending to pursue an undergraduate degree in engineering, mathematics, or physical sciences would benefit from this course.

Course Prerequisites and Co-requisites:
Prerequisite: Placement in MTH 265 or completion of MTH 264 or equivalent with a grade of C or better

Course Objectives:
Upon completing the course, the student will be able to

1. (Vectors and the Geometry of Space)
   - Identify and apply the parts of the three-dimensional coordinate system, distance formula and the equation of the sphere;
   - Compute the magnitude, scalar multiple of a vector, and find a unit vector in the direction of a given vector;
   - Calculate the sum, difference, and linear combination of vectors;
   - Calculate the dot product and cross product of vectors, use the products to calculate the angle between two vectors, and to determine whether vectors are perpendicular or parallel;
   - Determine the scalar and vector projections;
   - Write the equations of lines and planes in space;
   - Draw various quadric surfaces and cylinders using the concepts of trace and cross-section;

2. (Vector Functions)
   - Sketch vector-valued functions;
   - Determine the relation between these functions and the parametric representations of space curves;
   - Compute the limit, derivative, and integral of a vector-valued function;
   - Calculate the arc length of a curve and its curvature; identify the unit tangent, unit normal and binormal vectors;
   - Calculate the tangential and normal components of a vector;
   - Describe motion in space;

3. (Partial Derivatives)
   - Define functions of several variables and know the concepts of dependent variable, independent variables, domain and range;
   - Calculate limits of functions in two variables or prove that a limit does not exist;
   - Test the continuity of functions of several variables;

- Calculate partial derivatives and interpret them geometrically, calculate higher partial derivatives;
- Determine the equation of a tangent plane to a surface; calculate the change in a function by linearization and by differentials;
- Determine total and partial derivatives using chain rules;
- Calculate directional derivatives and interpret the results;
- Identify the gradient, interpret the gradient, and use it to find directional derivative;
- Apply intuitive knowledge of concepts of extrema for functions of several variables, and apply them to mathematical and applied problems; Lagrange multipliers;

4. (Multiple Integrals)
   - Define double integral, evaluate a double integral by the definition and the midpoint rule, and describe the simplest properties of them;
   - Calculate iterated integrals by Fubini's Theorem;
   - Calculate double integrals over general regions and use geometric interpretation of double integral as a volume to calculate such volumes. Some applications of double integrals may include computing mass, electric charge, center of mass, and moment of inertia;
   - Evaluate double integrals in polar coordinates to calculate polar areas, evaluate Cartesian double integrals of a particular form by transforming to polar double integrals;
   - Define triple integrals, evaluate triple integrals, and know the simplest properties of them. Calculate volumes by triple integrals;
   - Transform between Cartesian, cylindrical, and spherical coordinate systems; evaluate triple integrals in all three coordinate systems; make a change of variables using the Jacobian;

5. (Vector Calculus)
   - Describe vector fields in two and three dimensions graphically; determine if vector fields are conservative, directly and using theorems;
   - Identify the meaning and set-up of line integrals and evaluate line integrals;
   - Apply the connection between the concepts of conservative force field, independence of path, the existence of potentials, and the fundamental theorem for line integrals. Calculate the work done by a force as a line integral;
   - Apply Green's theorem to evaluate line integrals as double integrals and conversely;
   - Calculate and interpret the curl, gradient, and the divergence of a vector field;
   - Evaluate a surface integral and understand the concept of flux of a vector field;
   - State and use Stokes Theorem; and
   - State and use the Divergence Theorem.

Major Topics to Be Included

1. Vectors and the Geometry of Space
2. Vector Functions
3. Partial Derivatives
4. Multiple Integrals
5. Vector Calculus

Effective Date of Course Content Summary: August 8, 2017