**Math 354:** Vector Calculus II. **(4-0-4)** 11/21/11

**Catalog Description:** Review of vector functions, space curves, gradients, and directional derivatives. Introduction to vector analysis: vector fields, divergence, curl, line integrals, surface integrals, conservative fields, and the theorems of Gauss, Green and Stokes with applications to force, work, mass, and charge.

**Course Objectives:** After completing this course, students will be able to

1. Perform multi-dimensional integration.
2. Use multi-dimensional integration to solve applied problems.
3. Perform computations with multi-dimensional vector functions.
4. Communicate mathematical ideas using correct and appropriate notation.

**Learning Outcomes and Performance Criteria**

1. Set up and compute multiple and iterated integrals.
   Core Criteria:
   (a) Compute double and triple integrals over a rectangular domain.
   (b) Set-up a double integral over a non-rectangular region.
   (c) Set-up a double integral using polar coordinates.
   (d) Set-up a triple integral in cylindrical coordinates.
   (e) Set-up a triple integral in spherical coordinates.
   (f) Compute an integral by reversing the order of integration (Fubini's Theorem).
   (g) Compute a line integral over planar or space curves.
   (h) Compute a surface integral.
   (i) Compute a double integral by changing variables (Jacobian).
2. Use integral theorems to set up and solve multi-variable integrals.
   Core Criteria:
   (a) Compute the area of a given shape using a double integral.
   (b) Compute the volume of a given shape using a triple integral.
   (c) Compute the length of a curve using a line integral.
   (d) Use a line integral to compute the work done by a vector field.
   (e) Use Stoke's theorem to compute a surface or line integral.
   (f) Use Green's theorem to compute a double or line integral.
   (g) Use Gauss' theorem to compute a surface or volume integral.
   (h) Compute a line integral using the fundamental theorem of line integrals.
   (i) Compute the flux of vector field through a surface.

Additional Criteria:

(a) Use integration to find the centroid of an object.

3. Understand vector functions in two and three-space, and be able to perform associated computations.

   Core Criteria:

   (a) Compute the gradient of a scalar field.
   (b) Compute the Jacobian of a transformation.
   (c) Determine if a vector field is conservative.
   (d) Find the potential of a conservative field.
   (e) Parameterize a surface or curve.
   (f) Compute the curl and divergence of a field.
   (g) Parameterize surfaces using rectangular, cylindrical, spherical, other coordinate systems.

   Additional Criteria:

   (a) Use vector calculus to solve applied problems.
   (b) Compute the curvature of a space-curve.

4. All students are required to give a short presentation on one or more of the fundamental integral theorems.

   Additional Criteria:

   (a) Students may be asked to submit a written technical report that supports their presentation.