CAL POLY

September 2008

MATH 304 Vector Analysis

1. Catalog Description

MATH 304 Vector Analysis (4) GE B6

Differential and integral calculus of vector-valued functions. Green's Theorem, Stokes' Theorem, and the Divergence Theorem. Applications and generalizations. 4 lectures. Prerequisite: MATH 206 or MATH 244, and MATH 241, or consent of instructor.

2. Required Background or Experience

MATH 206 or MATH 244, and MATH 241.

3. Learning Objectives

The student should be:
a. able to formulate mathematical statements in the language of vector analysis.
b. able to apply vector algebra and vector calculus to problems in science and engineering.
c. ready to take a course on differential geometry

4. Text and References

Recommended texts:

Colley, Susan J., Vector Calculus, 3rd ed., Prentice Hall, 2006.
Marsden, Jerrold E. and Tromba, Anthony J., Vector Calculus, 5th ed. , W. H. Freeman & Co, 2003.
Munkres, James R., Analysis on Manifolds, Westview Press, 1997 (print on demand availability).
Schey, H. M., Div, Grad, Curl and All That, 3rd ed., W. W. Norton & Co., 1996.
Shifrin, Theodore., Multivariable Mathematics, John Wiley & Sons, 2005.

5. Minimum Student Materials

Paper, pencils, and notebook.

6. Minimum University Facilities

Classroom with ample chalkboard space for class use.

7. Content and Method

Course topics may vary at the discretion of the instructor; however, the following topics should be covered:

1) Review of cylindrical and spherical coordinates, gradients, directional derivatives, vector fields, divergence and curl, path and line integrals from the viewpoint of Math 241
2) The derivative as a linear map, matrix form of the chain rule
3) Determinant; area and volume
4) Inverse and implicit function theorems (statements and examples)
5) Change of variables formula for multiple integrals
6) Parametrized surfaces and surface integrals of scalar and vector fields
7) The integral theorems of vector analysis
   a) Green's Theorem
   b) Stokes' Theorem
   c) Conservative fields
   d) Gauss' Theorem
8) Applications such as electromagnetism, mechanics and fluid dynamics
9) Differential forms and higher dimensions (*optional*)
10) Exterior differentiation and relation to grad, curl and div operators (*optional*)
11) Orientation and the integration of forms (*optional*)
12) Generalized Stokes' theorem (*optional*)

8. Methods of Assessment

The primary methods of assessment are, in decreasing order of importance: essay examinations, quizzes and homework. Typically, there will be one or two hour-long examinations during the quarter, and a comprehensive final examination. Students are required to show their work, and are graded not only on the correctness of their answers, but also on their understanding of the concepts and techniques. Quizzes and frequent homework provide a spot check of student learning.