

Mathematics 3315 – Vector Calculus

Student Learning Outcomes

- 1. The students will demonstrate an understanding of factual knowledge including the mathematical notation and terminology used in this course.** Students will read, interpret, and use the vocabulary, symbolism, and basic definitions used in vector calculus pertaining to vectors and vector spaces; inner products; cross products; curl; the Del Operator; polar, cylindrical, and spherical coordinate systems; functions of several variables; vector-valued functions; derivatives; vector fields; parametrization of lines and surfaces; line and surface integrals; and fundamental theorems.
- 2. The students will describe the fundamental principles including the mathematical rules and theorems arising from the concepts covered in this course.** Students will identify and apply the laws and formulas that result directly from the definitions; for example, the Cauchy-Schwarz inequality; the divergence/Gauss's theorem; Green's theorem; and Stokes's theorem;.
- 3. The students will apply course material using techniques and procedures covered in this course to solve problems.** Students will utilize the facts, formulas, and the techniques learned in this course to solve problems in mathematics, physics, engineering, and in other areas of application.
- 4. The students will develop specific skills, competencies, and thought processes sufficient to support further study or work in this field or related fields.** Students will acquire a level of proficiency in the fundamental concepts that is necessary for further study; for example, Hilbert Spaces, Manifolds, Functional Analysis, and Operator theory.

Course Content

Textbook: *Vector Calculus*, Fourth Edition, by Susan Jane Colley.

Content consists of the following topics, listed according to the corresponding chapters in the text. (See textbook “Contents.”)

- 1. Vectors:** Vectors in two and three dimensions, More about vectors, The dot product, The cross product, Equations for planes, Distances problems, Some n-dimensional geometry, New coordinate systems.
- 3. Vector-Valued Functions:** Parametrized curves and kepler’s law, Arclength and differential geometry, Vector fields, Gradient, Divergence, Curl, Del operator.
- 6. Line Integrals:** Scalar and vector line integrals, Green’s theorem, Conservative vector fields.
- 7. Surface Integrals and Vector Analysis:** Parametrized surfaces, Surface integrals, Stoke’s and gauss’s theorem, Further vector analysis.

Selected topics from chapters 2, 4, 5, 8, and additional topics not in the book, all as time permits.