MAT 252 Calculus III

Department of Mathematics
Southern Connecticut State University

I. Catalog Description

Continuation of MAT 151. Vector-valued functions, three-dimensional geometry, functions of several variables, partial differentiation with applications, double and triple integrals with applications, vector calculus.

II. Credit

(A) MAT 252 carries four (4) semester hours of college credit.

(B) MAT 252 is required of all mathematics majors.

(C) MAT 252 does not satisfy the All-University requirement in mathematics.

III. Prerequisite

The student must have passed MAT 151 with a grade of C- or better. Specifically the following material is prerequisite:

(A) Derivatives of all types of functions

(B) Applications of the derivative as a rate of change and to graphs of functions

(C) Integration techniques, including substitution, integration by parts, partial fractions, and integral tables

(D) Applications of the integral to finding area and volume

(E) Graphs and integrals with polar coordinates and parametric curves

(F) Vector geometry and vector arithmetic in two and three dimensions

IV. Format

MAT 252 is primarily a lecture-based course.

V. Technology

Use of a computer algebra system is required.

VI. Course Objectives

Students passing MAT 252 should minimally be able to do each of the following tasks.

By hand (without the use of technology):

(a) Identify the equations of quadric surfaces, basic cylinders, and planes.

(b) Differentiate and integrate vector-valued functions and understand their applications.

(c) Find the partial derivatives of a variety of functions, including the multi-variable chain rule.

(d) Compute gradients and directional derivatives and understand their applications.

(e) Set up optimization problems (in particular, Lagrange multipliers).

(f) Locate extrema and saddle points.

(g) Set up and evaluate simple iterated integrals (both double and triple integrals).

(h) State and use Green's theorem and the divergence theorem.

Using a computer algebra system:

(a) Graph curves and surfaces in $\mathbb{R}^3$ (in particular level curves and surfaces) and use them to help set up calculations of relevant quantities.

(b) Set up and evaluate complicated iterated integrals that represent area, volume, arc length, and other applications.

(c) Find partial derivatives using the symbolic capabilities of a computer algebra system.

(d) Symbolically compute vector and scalar quantities relating to vector-valued functions (such as velocity, acceleration, tangent and normal vectors, or curvature) or functions of several variables (such as gradient or directional derivative).

(e) Compute div, curl and grad for a vector-valued function.

VII. Outline

Instructors and students are expected to use technology to investigate and illustrate concepts from symbolic, graphical, and numerical points of view.

Three-dimensional Geometry (10%)

(a) Curves and motion in space

(b) Length of Curves

(c) Curvature and acceleration

(d) Cylinders, planes, and quadric surfaces

Partial differentiation (30%)

(a) Functions of several variables

(b) Limits and continuity

(c) Partial derivatives

(d) The multivariable chain rule

(e) Directional derivatives and the gradient vector

(f) Lagrange multipliers and constrained optimization

(g) Extrema of functions of two variables with applications

Multiple integrals (30%)

(a) Double integrals

(b) Area and volume as a double integral

(c) Change of variables: polar coordinates

(d) Triple integrals

(e) Cylindrical and spherical coordinates

(f) Change of variables in multiple integrals (optional)

Vector calculus (30%)

(a) Vector fields

(b) Line integrals

(c) The fundamental theorem and independence of path

(d) Green's Theorem

(e) Surface integrals (optional)

(f) The Divergence Theorem

(g) Stokes' Theorem (optional)

VIII. Recommended Text

W. Briggs, L. Cochran, B. Gillett, Calculus, 3rd edition, Pearson.

Recommended sections:

- Chapter 14: Sections 14.1–14.5.
- Chapter 15: Sections 15.1–15.5, 15.7, 15.8

- Chapter 16: Sections 16.1–16.5, 16.7 (optional).
- Chapter 17: Sections 17.1–17.5, 17.6 (optional), 17.7 (optional), 17.8.

IX. Waiver Policy

This course may be waived.

X. Preparation

- Prepared on October 3, 2012. (Therese Bennett, Alain D'Amour, Emmett Dennis, John Scheuermann, Robert Vaden-Goad)
- Approved by the Mathematics DCC on November 6, 2012.
- Approved by the Mathematics Department on November 8, 2012.
- Revised on September 29, 2014 by Therese Bennett and Leon Brin.
- Revisions approved by the Mathematics DCC on November 25, 2014.
- Revised on November 1, 2020 by J. Hong.
- Approved by the MDCC, 9–0–0, November 5, 2020.
- Revised outline prepared by MDTC, November 17, 2020.