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. A graphing calculator approved by the instructor is required.

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

(A) MAT 252 is primarily a lecture-based course.

(B) A graphing calculator approved by the instructor is required.

(C) Use of a computer algebra system is required.

V. Outline

Instructors and students are expected to use technology including the graphing calculator and a computer algebra system to investigate and illustrate concepts from symbolic, graphical, and numerical points of view.

(A) Three-dimensional Geometry

1. Curves and motion in space
2. Curvature and acceleration
3. Cylinders and quadric surfaces

(B) Partial differentiation

1. Functions of several variables
2. Limits and continuity
3. Partial derivatives
4. Multivariable optimization problems
5. The multivariable chain rule
6. Directional derivatives and the gradient vector
7. Lagrange multipliers and constrained optimization
8. Extrema of functions of two variables

(C) Multiple integrals

1. Double integrals
2. Area and volume as a double integral
3. Change of variables: polar coordinates
4. Triple integrals
5. Change of variables in multiple integrals

(D) Vector calculus

1. Vector fields
2. Line integrals
3. The fundamental theorem and independence of path
4. Green's Theorem
5. Surface integrals
6. The Divergence Theorem
7. Stokes' Theorem

VI. Current Text

G. Thomas, M. Weir, J. Hass, F. Giordano, *Thomas' Calculus, Early Transcendentals*, 11th edition, Addison Wesley, 2007.

Sections covered :

- Chapter 12 : Sections 12.5 (review), 12.6.
- Chapter 13 : Sections 13.1 – 13.5.
- Chapter 14 : Sections 14.1 – 14.9.
- Chapter 15 : Sections 15.1 – 15.7.
- Chapter 16 : Sections 16.1 – 16.5, 16.7 – 16.8.

VII. Outcomes

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 and basic cylinders.

(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, the divergence theorem and Stokes' theorem.

Using technology (Graphing calculator and/or 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.