ROWAN UNIVERSITY

Department of Mathematics

Syllabus

Math 01.230 - Calculus III

CATALOG DESCRIPTION:

Math 01.230 Calculus III, 4 s.h.
Prerequisite: Math 01.131 (Calculus II) with a grade of C- or better

This course is about the theory and application of functions involving at least three variables, counting both dependent and independent ones. It applies successfully the ideas and methods introduced in Calculus I to the setting under consideration, and in doing so it enables students to better appreciate the methodology of Calculus for the investigation of relationships of continuous variables. Topics include: vector operations, vector valued functions, functions of two or three independent variables, partial derivatives, tangent planes, differentiability, gradients, directional derivatives, multiple integrals, line integrals, Green's theorem and surface integrals. Emphasis is on the geometric intuition in the approach. Student are expected to use a computer algebra system, such as Mathematica, in addition to a graphing calculator.

OBJECTIVES:

Students will demonstrate:

- A firm grasp of the four operations on vectors in terms of geometric meaning, algebraic computation, and applications to lines and planes in the space.
- An understanding of the interpretations of vector valued functions as curves and motions in the space.
- The ability to identify the quadratic surfaces and the graphs of commonly used functions.
- The ability to compute partial derivatives and understand their geometric meanings.
- An understanding of gradients, directional derivatives, and the connections between the two.
- The ability to find local and global extrema, and solve applied optimization problems.
- An understanding of double and triple integrals as limits of Riemann sums, and the ability to evaluate them.
- The ability to compute and apply line integrals, Green's Theorem, and Stokes Theorem.

CONTENT:

1. **Vectors in 3-Dimensional Space**
    - Algebraic representations of vectors in 3-dimensional space
    - The geometric meanings and algebraic calculations of the four operations on vectors: addition, scalar multiplication, dot product and cross product
    - Lines and planes in the space

2. **Vector Valued Functions**
    - The definition and calculus of vector valued functions.
    - Curves in the space, lines tangent to a curve, and arc lengths
    - Motions in the space: positions, velocities, speeds, accelerations, and distance travelled

3. **Partial Derivatives**
    - Functions of several variables, their graphs and limits
    - Partial derivatives
    - Tangent planes, differentiability, and total differentials
    - The chain rules, directional derivatives, and gradients
    - Local extrema, optimization and Lagrange multipliers

4. **Multiple Integrals**
    - Double integrals in rectangular and polar coordinates
    - Triple integrals in rectangular, cylindrical and spherical coordinates
    - Areas, volumes, surface areas, and centers of mass

5. **Topics in Vector Calculus**
    - Scaler Line integrals and vector line integrals
    - Green's Theorem, and 2-dimesional divergence theorem and Stokes Theorem

REMARKS: We will continue our effort to present a fuller account of the subject with its history and legends of the great mathematicians who helped create it. Also, we continue our work with Mathematica as a tool in solving problems.

TEXTBOOK(s):

- Jon Rogawski; Colin Adams; Robert Franzosa, CALCULUS: EARLY TRANSCENDENTALS (4th Edition*), 2019, W.H. Freeman & Co.

Additional textbooks:

- Stewart, James, CALCULUS: EARLY TRANSCENDENTALS (9th Edition), 2021, Cengage Learning.

(Note: There are many suitable texts available that cover the same material at the same level. Among these are those by Anton, Larson, Thomas, Stein, Hunt and Leithold.)