San Bernardino Valley College
Curriculum Approved: SP99

I. **CATALOG DESCRIPTION**

Mathematics; Math 252; Multivariable Calculus
Lecture: 5 hours per week = 5 units
A third course in calculus including vectors, lines, and simple surfaces in 3 dimensional space, some linear algebra topics, vector-valued functions, partial derivatives, multiple integrals, line integrals and Green's Theorem, surface integrals and the theorems of Gauss and Stokes.
Prerequisite: Math 251.

NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: One

II. EXPECTED OUTCOMES FOR STUDENTS

**Upon completion of the course, the student should be able to**:

A. Use vectors to find the equations of lines and planes in 3-space.
B. Identify and draw simple quadric surfaces
C. Apply the concepts of vector valued functions to the study of motion along a curved path in 2-space or 3-space.
D. Apply the concepts of partial differentiation to problems involving tangent planes, directional derivatives, gradients and relative extreme.
E. Apply the concepts of multiple integrals to problems involving area and volume in rectangular, cylindrical and spherical coordinates systems.
F. Evaluate line integrals, determine independence of path, apply Green's Theorem, evaluate surface integrals, apply the Divergence Theorem and Stokes' Theorem.
G. Use Gauss-Jordan elimination to solve systems of linear equations, work with vectors in Euclidean N-space, use transformations and the Jacobian to evaluate double and triple integrals.

IV. CONTENT

Unit I 3-space and Vectors
- A. Rectangular coordinates in 3-space
- B. Vectors, dot product, cross products
- C. Equations of lines and planes
- D. Quadric surfaces
- E. Cylindrical and spherical coordinates

Unit II Linear Algebra.
- A. Addition, subtraction, scalar multiplication of matrices
- B. Gaussian elimination
- C. Multiplication of matrices
- D. Change of variables in multiple integrals, the Jacobian

Unit III Vector-valued functions
- A. Vector-valued functions
- B. Limit, derivative and integration of vector-valued functions
- C. Unit tangent, unit normal vectors
- D. Applications

Unit IV Functions of several variables
- A. Domain, range, limits, continuity
- B. Partial derivatives, chain rule
- C. Tangent planes, directional derivatives, gradient
- D. Functions of n variables
- E. Maxima, minima of functions of two variables, Lagrange multipliers

Unit V Multiple Integrals

A. Double integrals over rectangular and non-rectangular regions
B. Double integral in polar coordinates
C. Triple integrals, volume
D. Triple integrals in cylindrical or spherical coordinates

Unit VI Vector Calculus
A. Line integrals
B. Line integrate independent of path
C. Green's Theorem
D. Surface integrals
E. Divergence Theorem
F. Stokes' Theorem

V. METHODS OF INSTRUCTION:
Instructors will utilize lecture and discussion. Graphing calculator technology will be used where applicable.

VI. TYPICAL ASSIGNMENTS:
A. At the end of each section there is a set of problems. These start with problems that require the student to recognize and apply the principles covered in the section. The problems then graduate into those requiring the application of two or more principles and the student must recognize the principles to apply and the correct order in which to apply them. Typical problem sets end with application problems in which the student must translate the words in the problem into appropriate mathematical symbols, analyze which principles must be applied, the student must then formulate and apply a solution strategy.
B. Written assignments will include solutions of various problems illustrative of the appropriate mathematical concepts and processes.

VII. EVALUATION(S)
A. There are a minimum of five regularly scheduled exams with questions designed to evaluate comprehension of the learning goals.
B. There is a final exam.

VIII. TYPICAL TEXT(S)
Anton, Larson and Hostetler, Multivariable Calculus,
5th edition, and Linear Algebra Supplements to accompany Anton, Wiley, 1995

IX. OTHER SUPPLIES REQUIRED OF STUDENTS: TI-85 calculator