

SELECTED TOPICS IN
ADVANCED CALCULUS I

Ma 620

1. Course Description

Prefaced by a careful examination of the foundations of calculus, this course provides an extension of the fundamental concepts of the calculus that are taught in undergraduate calculus courses. Topics include generalized mean value theorem, functions of several variables, partial differentiation, transformation, and mappings.

2. Goals of the Course

1. To provide a foundation for the calculus that is both rigorous and significant to teachers of secondary-school mathematics.
2. To provide insight into the fundamental concepts of the calculus. (e.g. sequence, limit, continuity, derivative, integral, etc.)
3. To extend and apply further the concepts of undergraduate calculus.

3. Instructional Procedures

1. Lecture/discussion
2. Small group and independent study
3. Use of computer software and graphing calculators

4. Course Content

1. Fundamentals of Elementary Calculus
 - a. Functions
 - b. Limits
 - c. Continuity
 - d. Derivatives
 - e. Maxima and Minima
 - f. Mean Value Theorem for Derivatives
 - g. Differentials
 - h. Inverse of Differentiation
 - i. Definite Integrals
 - j. Mean-Value Theorem for Integrals
 - k. Variable Limits of Integration
 - l. Integral of a Derivative
 - m. Limits of Functions of a Continuous Variable
 - n. Limits of Sequences
 - o. Limit Defining a Definite Integral

- p. Definition and Properties of a Double Integral
- 2. Real Number System
 - a. Field of Real Numbers
 - b. Inequalities
 - c. Absolute Value
 - d. Principle of Mathematical Induction
 - e. Axiom of Continuity
 - f. Rational and Irrational Numbers
 - g. Axis of Reals
 - h. Least Upper Bounds
 - i. Nested Intervals
- 3. Continuous Functions and Their Properties
 - a. Bounded Functions
 - b. Attainment of Extreme Values
 - c. Intermediate-Value Theorem
- 4. Extensions of the Mean-Value Theorem
 - a. Cauchy's Generalized Law of the Mean
 - b. Taylor's Formula with Integral Remainder
 - c. Other Forms of the Remainder
 - d. An Extension of the Mean-Value Theorem for Integrals
 - e. L'Hopital's Rule
- 5. Functions of Several Variables
 - a. Functions and their Regions of Definition
 - b. Point Sets
 - c. Limits
 - d. Continuity

5. Evaluation Measures

- 1. Homework
- 2. Written Examinations

6. Bibliography

A. Required Text

Taylor and Mann, Advanced Calculus, John Wiley & Sons, Inc., 1983

Note: In mathematics courses it is usually preferable to have a designated textbook which helps to focus the discussion and standardize the language and symbolism.

B. Additional Required Readings

None

C. Supporting Bibliography

Kaplan, W., Advanced Calculus, Addison-Wesley, 1991

Mathematical Association of America, Resources For Calculus Collection, Vol. 2: Calculus Problems for a New Century, M.A.A., 1993

Olmstead, John M.H., Advanced Calculus, Prentice Hall, 1961

Simmons, George, Calculus Gems, McGraw-Hill, 1992

Spiegel, Murray R., Schaum's Outline Series; Theory and Problems of Advanced Calculus, McGraw Hill, 1968

D. Relevant Periodical Sources

None

E. Relevant Software

Derive

F. Other

TI-82 or TI-83 Graphing Calculator