COURSE OUTLINE

MATH 461 – ADVANCED CALCULUS I

Prepared By: Dan Gagliardi
A. **TITLE:** Advanced Calculus I

B. **COURSE NUMBER:** MATH 461

C. **CREDIT HOURS:** 3

D. **WRITING INTENSIVE COURSE:** No

E. **COURSE LENGTH:** 15 Weeks

F. **SEMESTER(S) OFFERED:** Spring or Fall

G. **HOURS OF LECTURE, LABORATORY, RECITATION, TUTORIAL, ACTIVITY:**
   Three lecture-hours per week

H. **CATALOG DESCRIPTION:** This course is sequel to Calculus III and serves as an introduction to topics in Advanced Calculus. Topics include line, surface and volume integrals in two and three dimensional space; investigations of the gradient of a scalar field, discussion of conservative fields and potential functions; the divergence and curl of vector fields; generalizations of the fundamental theorem of calculus to evaluate integrals; curvilinear coordinates, multiple integrals and transformation of multiple integrals; implicit functions; Jacobians; partial derivatives; higher order partial derivatives; mean value theorems; infinite series; Taylor series and an introduction to Fourier series. Subject applications are given to fluid and solid mechanics, Electrostatics, and Electromagnetism.

I. **PRE-REQUISITES/CO-COURSES:** Calculus III (MATH 263) and Linear Algebra (Math 361) with a grade of C or better, or permission of the instructor.

J. **GOALS (STUDENT LEARNING OUTCOMES):** Students shall be able to:

<table>
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<tr>
<th>Course Objective</th>
<th>Institutional SLO</th>
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<tbody>
<tr>
<td>a. Interpret and draw inferences from mathematical models such as formulas, graphs, tables, and schematics</td>
<td>1. Communication 2. Critical Thinking</td>
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<td>b. Represent mathematical information symbolically, visually, numerically, and verbally</td>
<td>1. Communication 2. Critical Thinking</td>
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<tr>
<td>c. Employ quantitative methods such as, arithmetic, algebra, geometry, or statistics to solve problems</td>
<td>2. Critical Thinking</td>
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<td>d. Estimate and check mathematical results for reasonableness</td>
<td>2. Critical Thinking 4. Inter-Intrapersonal Skills</td>
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<tr>
<td>e. Recognize the limits of mathematical and statistical methods</td>
<td>1. Communication 2. Critical Thinking</td>
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M. **EQUIPMENT:** Technology Enhanced Classroom

N. **GRADING METHOD:** A-F.
O. **MEASUREMENT CRITERIA/METHODS:** Homework, quizzes, exams and projects

P. **DETAILED COURSE OUTLINE:**

ADVANCED CALCULUS I
DETAILED OUTLINE

I. Vectors and Scalars
   A. Vector Algebra
   B. Linear Dependence and Linear Independence
   C. Scalar Fields and vector fields
   D. Vector Spaces
   E. Inner and cross product
   F. Scalar triple product
   G. Inner product spaces
   H. Projections
   I. Angles between vectors

II. Vector Differentiation and Integration
   A. Ordinary derivatives of vector-valued functions
   B. Continuity and differentiability
   C. Partial derivatives of vectors
   D. Introduction to topics in Differential Geometry
   E. Ordinary integrals of vector-valued functions
   F. Line integrals and Green’s Theorem
   G. Surface integrals
   H. Volume integrals

III. Vector Operators
   A. Gradient
   B. Divergence
   C. Curl
   D. Stokes’ Theorem
   E. Divergence Theorem

IV. Multivariable Differential Calculus
   A. Partial Derivatives and differentials
   B. Directional Derivatives in higher dimensions
   C. Optimization and classification of critical points
   D. Lagrange multipliers
   E. Differentiation and integration under the integral sign
   F. Application to errors

V. Integration
   A. Double and triple integrals
   B. Iterated integrals and Fubini’s Theorem
   C. Orthogonal curvilinear coordinates
   D. Change of variables and the Jacobian
   E. Improper integrals and Cauchy principal value
   F. Improper integrals containing a parameter
   G. Uniform convergence of integrals

VI. Fourier Series
   A. Periodic Functions
   B. Orthogonality conditions for sine and cosine
   C. Odd and Even functions
D. Parseval's Identity
E. Differentiation and Integration of Fourier Series
F. Boundary Value problems

Q. **LABORATORY OUTLINE:** N/A