MATH004A - Intermediate Calculus

General Information

Author(s): Doonu Barife
Proposal Start: 2017SU
Distance Education Approved: No
TOP Code: 1701.00
TOP Name: Mathematics, General
CIP Code: 27.0101
CIP Name: Mathematics, General
SAM code: E = Non-occupational
Course Control Number: CCC000534425
Curriculum Committee Approval Date: 03/23/2015
Board of Trustees Approval Date: 04/21/2015
External Review Approval Date: 07/01/2015
Course Description: This course covers vector-valued functions, calculus of functions of more than one variable, partial derivatives, differentials, gradients, Lagrange Multipliers, multiple integration, line integrals, surface integrals, Green's Theorem, Stokes' Theorem, and the Divergence theorem.
Submission Rationale:

Faculty Minimum Qualification Requirements

Master Discipline Preferred: Mathematics
Alternate Master Discipline Preferred: No value
<table>
<thead>
<tr>
<th>Bachelors or Associates Discipline</th>
<th>No value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preferred:</td>
<td></td>
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</tbody>
</table>

Additional Bachelors or Associates Discipline: No value

Course Development Options

<table>
<thead>
<tr>
<th>Course</th>
<th>Basic Options</th>
<th>Skill of</th>
<th>Status Retakes</th>
</tr>
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<td></td>
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Course is not a basic skills course.

Allow Students to Gain Credit by Exam/Challenge

Rationale for Retake Policy

Credit Description By Exam/Challenge

No value

Transferability & Gen. Ed. Options

Request Transferability for Status

Transferability

Approved to both UC and CSU

Units and Hours
## Summary

<table>
<thead>
<tr>
<th>Minimum Credit Units</th>
<th>Total Course In-Class (Contact) Hours</th>
<th>Total Course Student Learning Hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>90</td>
<td>270</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Maximum Credit Units</th>
<th>Total Course Out-of-Class Hours</th>
<th>Faculty Load</th>
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<tbody>
<tr>
<td></td>
<td>180</td>
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</table>

## Detail

### Weekly Student Hours

<table>
<thead>
<tr>
<th>In Class</th>
<th>Out Class</th>
<th>Lecture Hours</th>
<th>Lab Hours</th>
<th>Activity Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

### Course Student Hours

- **Course Duration (Weeks)**
- **Course In-Class (Contact) Hours**
  - Lecture
  - Lab
  - Activity
  - Total 90
- **Course Out-of-Class Hours**
  - Lecture
  - Lab
  - Activity
  - Total 180
### Units and Hours - Weekly Specialty Hours

### Requisites

### Entrance Skills

<table>
<thead>
<tr>
<th>Skill</th>
<th>Content Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>No value</td>
<td>No value</td>
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</table>

### Limitations on Enrollment

<table>
<thead>
<tr>
<th>Limitation</th>
<th>Provide Rationale</th>
</tr>
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<tbody>
<tr>
<td>Prerequisite: MATH 003B or qualifying score on Placement Test and proof of Calculus II</td>
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</table>

### Specifications

**Methods of Instruction**
- Lecture
- Demonstration

**Rationale**
- Concepts are enhanced through the use of tables, charts, graphs and/or technology such as graphing calculators or
Maple software.

InstructorThe instructor provides an open discussion on approaches to problem solving and the interpretation of results so that student are active participants in the learning process.

LectureThe instructor will make use of appropriate tools (lecture notes, charts, tables, graphs, PowerPoint slides, applets, and/or technology)
to clearly deliver the lecture content.

Problem Solving

The instructor will present topical problems where appropriate problem-solving methodology is discussed and implemented.

Assignments

Reading/Writing

Read section 12.6 Calculus: Early Transcendentals (Tan) and solve application problems on directional derivatives and gradient vectors. Provide a written
interpretation of your results using appropriate language and units.

B. Out-of-Class

Verify the Divergence Theorem for a given vector field \( \mathbf{F} \) and region \( T \). Verify Stokes' Theorem for a given vector field \( \mathbf{F} \) and surface \( S \), oriented with the normal pointing upward.
C. Critical Thinking

Express a triple integral over T as an iterated integral six different ways using different orders of integration.

Methods of Evaluation

Rationale

Other

A. Homework assignments

B. Problem solving using technology

C. Quizzes

D. Tests
Learning Outcomes and Objectives

Course Objectives

☐ Determine equations of lines and planes.
☐ Demonstrate ability to perform vector operations.
☐ Demonstrate ability to perform analytic geometry in 3-space.
☐ Find the limit of a function at a point and determine where it is continuous.
☐ Graph surfaces in space (including planes, cylinders and quadratic surfaces).
☐ Solve physical problems involving position, velocity, and acceleration including finding and interpreting the normal and tangential components of acceleration.
☐ Compute evaluate and interpret partial derivative both geometrical and physically.
☐ Write the equation of a tangent plane and a normal line at a point.
☐ Determine differentiability and compute differentials.
☐ Find local extrema and test for saddle points.
☐ Solve constraint problems using Lagrange multipliers.
☐ Compute arc length and curvature.
☐ Evaluate double integrals using rectangular and polar coordinates where appropriate.
☐ Evaluate triple integrals using rectangular, cylindrical and spherical coordinates.
☐ Find and interpret the divergence and curl of a vector field.
☐ Determine whether a vector field is conservative and find its potential function if it is conservative.
☐ Apply a change of variables to integrate functions of multiple variables.
☐ Compute line and surface integrals.
☐ Apply Green’s, Stokes’, and the Divergence Theorem where appropriate.

CSLOs
Find limits of, differentiate, and integrate vector-valued functions.

Find limits of, differentiate, and integrate functions of several variables.

Course Outline

A. Vectors and Geometry of Space
   A. Vectors in two and three dimensions
      1. Geometric and algebraic interpretations
      2. Dot products, angle between vectors, direction cosines, scalar and vector projections
      3. Cross products and triple products
      4. Applications to vectors (e.g. force, work, torque, etc.)
   
   B. Three dimensional coordinate systems
      1. Parametric and symmetric equations of a line
      2. Rectangular equation of a plane
      3. Distances and midpoints
      4. Graphs of cylinders and quadric surfaces
   
   C. Cylindrical and spherical coordinates

B. Vector-Valued Functions
   A. Two and three dimensional curves
   B. Vector equation of a line
   C. Parameterizations
   D. Limits and continuity of vector functions
   E. Differentiation and integration of vector functions
   F. Tangent, normal and binormal vectors
   G. Arc length and curvature
H. Position, velocity, and acceleration vectors
I. Normal and tangential components of acceleration

C. Functions of Several Variables
A. Domain of functions of several variables
B. Graphs of functions of two variables
C. Level curves and surfaces
D. Limits and continuity of functions of several variables
E. Partial derivatives and higher-order derivatives of functions of several variables
F. Linear approximations, differentials and applications
G. Chain rules for functions of several variables
H. Implicit differentiation for functions of several variables
I. Directional derivatives, gradient vectors and properties
J. Tangent planes and normal lines
K. Local and global extrema and saddle points
L. Method of Lagrange multipliers
M. Applications pertaining to rates of change and optimization

D. Multiple Integrals
A. Approximating double integrals numerically
B. Double integrals
   1. Iterated integral over rectangles and general regions in rectangular coordinates
   2. Double integral in polar coordinates
   3. Properties of double integrals, changing the order of integration and Fubini's theorem
   4. Applications of double integrals to area, volume, mass, center of mass and moments of inertia
   5. Surface area

C. Triple integrals
   1. Triple integrals in rectangular coordinates including changing the order of integrations.
   2. Triple integrals in cylindrical and spherical coordinates
   3. Applications of triple integrals to volume, mass, center of mass and moments of inertia
   D. Changes of variables theorem, Jacobians, and transformations
E. Vector Calculus
A. Two and three dimensional vector fields
B. Divergence and curl
C. Line integral and applications (e.g. mass, center of mass, area, arc length, and work)
D. Independence of Path, conservative vector fields, and gradient vector fields
E. Fundamental Theorem for Line Integrals
F. Basic topology (simple curves, closed curves, open and closed regions, connected regions, simply-connected regions, orientable surfaces, etc.)
G. Green's theorem
H. Parametric surfaces
   1. Graphs (including vector and parametric equations to a plane, cylinder, sphere and cone)
   2. Tangent planes
   3. Surface area
I. Surface and flux integrals for parametric surfaces and surfaces that are graphs of functions
J. Stokes' theorem
K. Divergence theorem