DISTANCE CALCULUS @ RWU ROGER WILLIAMS UNIVERSITY

COURSE SYLLABUS

Course Title: **Multivariable Calculus and Vector Analysis**

Abbreviated Title As Appears on Transcript: `Multivariable Calculus IV`

Course Number: DMAT 355

Credit Hours: 4 credits [semester credit hours]

Course Description: A first course in multivariable differential and integral calculus, with emphasis on computational techniques, vector field analysis, and the generalized Fundamental Theorem of Calculus giving insight to the classical theorems of Green, Gauss, and Stokes. Topics include geometric analysis of multivariable functions, partial derivatives, level curves and surfaces, optimization, properties of vector fields, gradients, potential functions, path integrals and independence, field singularities, divergence and rotation, multiple integration, integral coordinate Jacobian transforms.

Prerequisite: Successful completion (C- or higher) of Calculus II or equivalent, or consent of instructor.

Course Workload: 4 semester credit hours • 3 student work hours per credit hour • 14 week Carnegie semester = 168 hours student course workload average

Examination Requirements: Proctored written and oral final examination must be passed at 70% or higher to earn passing grade in course. "B" and "A" grade paths have additional examinations and assignments. See https://www.distancecalculus.com/grades/ for more information.

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Accredited by New England Commission of Higher Education (NECHE).
See https://www.rwu.edu/academics/accreditation/ for more information.

E-Textbook:

Vector Calculus & LiveMath by Robert R. Curtis, Ph.D., adapted from Davis/Porta/Uhl *Vector Calculus&Mathematica* courseware series

Mathematical Software: LiveMath™ Computer Algebra & Graphing System

ADA ACCOMMODATIONS

Roger Williams University has a continuing commitment to providing reasonable accommodations for

students with documented disabilities. Students with disabilities who need accommodations in order to fully participate in this class are urged to contact Student Accessibility Services, as soon as possible, to explore the arrangements needed to be made to assure access. Student Accessibility Services is open Monday through Friday from 8:00AM to 5:00PM Eastern Time; Email: sas@rwu.edu or Voice: 401-254-3841. For more information about SAS, visit https://www.rwu.edu/undergraduate/academics/student-academic-success/student-accessibility-services-sas

COURSE RULES

Academic Honesty

Academic Dishonesty in a Distance course includes copying or relying upon another person's work. Working with other students is good and encouraged, but the work you submit for this course must be genuinely your own work. Private tutors are allowed, but you must notify the instructor that you have obtained a private tutor to aid in your studies. Any documented instance of Academic Dishonesty will be grounds for immediate failure in this course.

Final (and Other) Examinations

A written and oral proctored final exam will occur at the student's location over video with the course professor; The student must score 70% or higher on this final exam to be eligible to earn a passing grade in the course.

Communication

Communication is the key to success in a Distance course. It is the student's responsibility to keep good communication channels with the instructors during the course; failure to participate in the course does not constitute "dropping" the course (Withdrawal from the course must be requested in writing to the instructors before the completion date deadline)

Roger Williams University Policies & Procedures

Roger Williams University has Policies & Procedures that all students must follow, including the Roger Williams University Student Handbook. Student must agree to follow all stated rules governing student conduct listed on the Roger Williams University website, and at the Roger Williams University Course Catalog

Course Completion 1 Year Rule

All Distance Calculus students are afforded 1 Year to finish their course from the Date of Enrollment. Students will be placed in the Academic Semester based upon their Date of Enrollment for academic records purposes. If a student does not finish the course, and does not request a Course Withdrawal for a W, then an "F" grade will be issued.

No Chatbots / AI

Students must pledge to **not** use any Chatbot/AI at all - **period**. Student must pledge to **limit** use of search engines (Google, Bing, etc) to a minimal level. Student must pledge to not engage in dishonest disguise of any Chatbot/AI/Search Engine source of information as student's own honest academic work. Verified chatbot usage will result in an "F" course grade, and will be referred to the Roger Williams University Academic Integrity Committee.

Learning Outcomes for DMAT 355 - Multivariable Calculus and Vector Analysis

1. To understand the core geometrical elements of Euclidean space
2. To understand and compute vector operations and their geometrical interpretations
3. To understand and compute partial derivatives and gradient functions
4. To understand and compute curves, level curves, surfaces, and level surfaces to multidimensional functions
5. To understand and compute vector-valued functions and their geometric representations
6. To understand and compute the classical optimization procedure of Lagrange Multipliers
7. To understand, compute, and graph vector fields and their associated metrics
7. To understand and compute path integrals of vector fields
8. To understand, compute, and graph sources, sinks, and singularities of vector fields
9. To understand and compute the divergence of a vector field, and its associated computations
10. To understand and compute the rotation and curl of a vector field, and its associated computations.
11. To understand and compute path integrals in the presence of singularities
12. To understand and compute multiple integrals, and their associated geometrical interpretations
13. To understand and utilize Fubini's Theorem for reordering integrations
14. To understand and compute Jacobian transformations of multiple integrals
15. To understand and compute cylindrical, spherical, and other coordinate systems, and their associated measurments with derivatives and integrals
16. To understand an introduction to the Generalized Fundamental Theorem of Calculus, and its variations in the Divergence Theorem, and the Theorems of Gauss, Green, and Stokes.

Syllabus Topics Outline for DMAT 355 - Multivariable Calculus and Vector Analysis

1. Getting Started
   - 1.1 Email and Chat
   - 1.2 Learning About the Course
   - 1.3 Required Hardware
   - 1.4 Software Fundamentals

2. Vectors
   - 2.1 Geometry of Vectors
   - 2.2 Tangent Vectors; Velocity Vectors; Acceleration Vectors
   - 2.3 Vector Length
   - 2.4 Dot Products
   - 2.5 Vector Projection
   - 2.6 Perpendicularity
   - 2.7 Lines
   - 2.8 Normal Vectors
   - 2.9 Cross Products
   - 2.10 Planes in 3D Space
   - 2.11 Normals, Binormals, Curvature, Torque

3. The Derivative
   - 3.1 Partial Derivatives
   - 3.2 Gradient
   - 3.3 Level Curves and Surfaces
   - 3.4 Linearization
   - 3.5 Total Differential
   - 3.6 Lagrange Multipliers

4. Vector Fields
   - 4.1 Plotting and Trajectories
   - 4.2 Flow-Along and Flow-Across Curves
   - 4.3 Differential Equations and Vector Fields
   - 4.4 Path Integrals
   - 4.5 Gradient Fields
   - 4.6 Sources, Sinks
   - 4.7 Divergence Theorem
   - 4.8 Singularities
   - 4.9 Rotation and Curl
   - 4.10 Introduction to Potential Functions

5. Multiple Integrals
   - 5.1 Basic Computation
   - 5.2 u–v Transformations; Jacobians
   - 5.3 Measurement of Volume, Mass, Density
   - 5.4 3D Integrals
   - 5.5 Average Value
   - 5.6 Fubini's Theorem

6. Other Coordinate Systems
   - 6.1 Cylindrical Coordinates
   - 6.2 Spherical Coordinates
   - 6.3 Integration in Other Coordinate Systems

7. Gauss, Green, Stokes Theorems
   - 7.1 Green's Theorem
   - 7.2 Stokes' Theorem
   - 7.3 Divergence Theorem
   - 7.4 Generalized Fundamental Theorem of Calculus
   - 7.5 Sources, Sinks, and 3D Gauss's Formula
   - 7.6 Surface Integrals