COURSE SYLLABUS

Course Title: **STEM Calculus I**

Abbreviated Title As Appears on Transcript: `STEM Calculus I`

Course Number: DMAT 253

Credit Hours: 4 credits [semester credit hours]

Course Description: A first course introduction to differential and integral calculus for engineering and science students, with emphasis on a modern, empirical exposition of the classical subject. Topics include a study of the algebraic, numerical, and graphical aspects of polynomial, exponential, logarithmic, and trigonometric functions, limits, function growth, derivative analysis and optimization, introduction to differential equations, methods and applications of integration, and the Fundamental Theorem of Calculus.

Prerequisite: Successful completion (C- or higher) of Precalculus with Trigonometry 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 final examination must be passed at 60% or higher to earn passing grade in course. "B" and "A" grade paths have additional examinations.
See https://www.distancecalculus.com/grades/ for more information.

Course Professor: Robert R. Curtis, Ph.D.<rcurtis@rwu.edu>, <robert@distancecalculus.com>

University Information: Roger Williams University, University College, 1 Empire Plaza, Providence, RI, USA 02903. Roger Williams University, 1 Old Ferry Road, Bristol, RI 02809. Accredited by New England Commission of Higher Education (NECHE).
See https://www.rwu.edu/academics/accreditation/ for more information.

E-Textbook: "The Primitives of Precalculus" by Robert R. Curtis, Ph.D.; "Calculus & LiveMath" by Robert R. Curtis, Ph.D., adapted from Davis/Porta/Uhl "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

Learning Outcomes for DMAT 253 - STEM Calculus I

1. To identify, manipulate, and understand the algebraic, numerical, and graphical fundamentals of linear, polynomial, exponential, logarithmic, rational polynomial, and trigonometric functions;
2. To understand and compute algebraic, numerical, and graphical limits at finite and infinite values;
3. To understand and compute the fundamental concept of the derivative;
4. To understand and compute various measurements of growth of a function
5. To algebraically compute derivatives of common functions using summation, product, quotient, and chain rules for derivatives;
6. To understand and compute optimization of functions using derivatives, finding critical values;
7. To understand and compute the second derivative;
8. To understand and compute the Mean Value Theorem and related concepts;
9. To understand and compute first order differential equations;
10. To understand and compute implicit differentiation and related rates;
11. To understand and compute parametric equations, including projectile motion;
12. To understand and calculate numerically and graphically the core concepts of the integral for applications to signed area measurements;
13. To compute numerically, algebraically, and graphically integrals of a variety of functions;
14. To algebraically compute integrals of basic polynomial, exponential, and trigonometric functions, with an introduction to the algebraic substitution technique;
15. To use the tools of differential and integral calculus in various applications
16. To understand and compute the Fundamental Theorem of Calculus
17. To understand and compute an integral functions, including inverse trigonometric and logarithmic integrals that do not algebraically resolve;
18. To utilize computer algebra and graphing software to amplify traditional manual computation techniques.

Syllabus Topics Outline for DMAT 253 - STEM Calculus I

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

2. The Big Picture
   - 2.1 Solving (easy) equations in 1 variable.
   - 2.2 What if you can't solve for x?
   - 2.3 Finding solutions numerically

- 2.4 Finding solutions graphically
- 2.5 Solving equations of more than 1 variable

3. Functions
   - 3.1 Function notation.
   - 3.2 Data sets
   - 3.3 Graphing functions
   - 3.4 Data sets and smooth curves
   - 3.5 Domain and Range
   - 3.6 Algebraic combinations of functions

4. Linear Functions
   - 4.1 Algebraic definition
   - 4.2 Slope
   - 4.3 Graphing linear functions by hand
   - 4.4 Properties of linear functions
   - 4.5 Linear data sets

5. Quadratic Functions
   - 5.1 Algebraic definition
   - 5.2 Graphing and Properties of Quadratic Functions
   - 5.3 Solving quadratic equations algebraically: Factoring
   - 5.4 Solving quadratic equations algebraically: Quadratic formula
   - 5.5 Solving quadratic equations numerically and graphically

6. Power and Polynomial Functions
   - 6.1 Algebraic definition
   - 6.2 Graphing and Properties of Polynomial Functions
   - 6.3 Solving polynomial equations algebraically: factoring
   - 6.4 Solving polynomial equations numerically and graphically
   - 6.5 Radicals and fractional exponents

7. Rational Polynomial Functions
   - 7.1 Algebraic definition
   - 7.2 Graphing and Properties of Rational Polynomial Functions
   - 7.3 Solving rational polynomial equations algebraically: factoring

8. Exponential and Logarithmic Functions
   - 8.1 Algebraic definition
   - 8.2 Graphing and Properties of Exponential Functions
   - 8.3 Solving exponential equations numerically and graphically
   - 8.4 Exponential Growth and Applications
   - 8.5 Data sets and exponential functions
   - 8.6 Inverse Functions
   - 8.7 Graphing and Properties of Logarithmic Functions

8.8 Logarithmic Growth and Applications

9 Trigonometric Functions
- 9.1 Graphical Properties of Trigonometric Functions
- 9.2 Amplitude, Phase Shift, Vertical Shift, Period, Frequency
- 9.3 Solving Equations Involving Trigonometric Functions
- 9.4 Data Sets and Trigonometric Functions

10. Growth: Preparing for the Derivative
- 10.1 Growth of Linear Functions
- 10.2 Growth of Power Functions
- 10.3 Growth of Exponential Functions
- 10.4 Dominance of Growth of Functions
- 10.5 Percentage Growth of Functions
- 10.6 Global Scale: Infinite Limits
- 10.7 Data Functions and Interpolation
- 10.8 Approximation of Functions by Linear Functions

11. Continuity
- 11.1 Limits
- 11.2 Continuous Functions
- 11.3 Jump Discontinuities
- 11.4 Piecewise Functions and Continuity
- 11.5 Limit Rules

12. Exponential Functions and Natural Logarithms
- 12.1 e = Euler's Number
- 12.2 Natural Logarithm
- 12.3 Growth Analysis
- 12.4 Applications: Carbon Dating
- 12.5 Percentage Growth and Steady Growth of Exponential Functions
- 12.6 Data Functions and Logarithmic Analysis
- 12.7 Inverse Functions
- 12.8 Applications: Compound Growth Rates
- 12.9 Applications: World Population

13. The Derivative of Polynomial, Exponential, Logarithmic, and Fractional Powers
- 13.1 Instantaneous Growth Rates
- 13.2 Definition of the Derivative
- 13.3 Computing the Derivative Graphically
- 13.4 Computing the Derivative Algebraically
- 13.5 Computing the Derivative Numerically
- 13.6 Average Growth Rate vs. Instantaneous Growth Rate
- 13.7 Applications of the Derivative: Spread of Disease
- 13.8 Finding Maxima and Minima of Functions

13.9 Relating a Function and Its Derivative

14. Computing Derivatives
- 14.1 Sum, Difference, Product, Quotient Rule
- 14.2 Chain Rule
- 14.3 Instantaneous Percentage Growth
- 14.4 Growth Dominance

15. Using Derivatives
- 15.1 Finding Maxima and Minima
- 15.2 Finding Good Representative Plots
- 15.3 Applications: Maximizing Volume
- 15.4 The Second Derivative
- 15.5 Applications: The Space Shuttle Challenger
- 15.6 Parametric Curves and Projectile Motion

16. Differential Equations
- 16.1 Linear Differential Equations
- 16.2 Logistic Equations
- 16.3 Rate Track Principal
- 16.4 Approximations - Introduction to Taylor's Theorem

17. Integration
- 17.1 Measuring Area Under a Curve
- 17.2 Definition of the Integral
- 17.3 Properties of Integrals, Symmetry
- 17.4 Integrals of Data Functions
- 17.5 Numerical Methods: Rectangles, Trapezoids
- 17.6 Undefined Integrals
- 17.7 Numerical Calculation of Integrals

18. Fundamental Theorem of Calculus
- 18.1 Derivative of an Integral
- 18.2 Integral of a Derivative
- 18.3 Fundamental Formula
- 18.4 Distance, Velocity, and Acceleration
- 18.5 Improper Integrals
- 18.6 Properties of Integrals
- 18.7 Applications: Measure Accumulation Totals
- 18.8 Indefinite Integrals and Antiderivatives
- 18.9 u-Substitution
- 18.10 Inverse Circular and Hyperbolic Trigonometric Functions