COURSE SYLLABUS

Course: Calculus II
Number: MAT 2620
Credit-Hours: 4 Credits

Course Description: Further study of the integral, volume of a solid of revolution, length of a curve, area of a surface of revolution, work, moments, and centroids. Applications of differential and integral calculus to improper integrals, infinite series, polynomial approximations of functions, Taylor's Theorem, conics, polar coordinates, and vector analysis.
Prerequisite: MAT 2610 (Calculus I or equivalent).

Detailed Syllabus:

0. Getting Started
    1. Email and Chat
    2. Learning About the Course
    3. Software Fundamentals

1. Review of Differentiation
    1. Derivatives of Basic Functions
    2. Differentiation Rules

2. Review of Integration
    1. Numerical Integrals of Data Functions
    2. Algebraic Integration: Antiderivatives
    3. Fundamental Theorem of Calculus
    4. Computations of Area and Volume

3. Integrable Functions
    1. Algebraic vs Numerical Integrals
    2. Polynomial Functions
    3. Exponential & Trigonometric Functions
    4. Using Computer Integrator
    5. Non-Integrable Functions (No Algebraic Antiderivative)

4. Change of Variables
    1. Geometry of Change of Variables
    2. Trigonometric Change of Variables
    3. Calculus of Differentials
    4. Polar Coordinates
        a. Transforming Coordinates
        b. Conic Sections and Polar Coordinates
        c. Area of Polar Regions

5. Classical Integration Techniques
    1. Integration By Parts
    2. Clever Change of Variables
    3. Partial Fractions
    4. Reduction Formulas
    5. Integration Via Differentiation (Fubini)
    6. Integration Tables

6. Classical Integration Applications
    1. Area & Volume
    2. Area Defined By Parametric Regions
    3. Surfaces of Revolution
    4. Arc Length
    5. Mass and Density
    6. Physical Rates To Accumulations
    7. Area of Surface of Revolution
    8. Work
    9. Improper Integrals and Limits

7. Parametric Curves and Surfaces
    1. Parametric Curves
    2. Derivatives of Parametric Functions
    3. Measuring Area of Parametric Regions
    4. Vectors & Motion
    5. Parametric Surfaces
    6. 2D: Vectors, Lines, Dot Product
    7. 3D: Vectors, Lines, Surfaces, Dot Product, Cross Product

8. Double Integrals
    1. Functions of 2 Variables
    2. Volume Over Rectangular Regions
    3. Rectangularish Regions
    4. Gauss-Green: Non-Rectangularish Regions
    5. Polar Coordinates
    6. Polar Integrals
    7. Moments
    8. Centroids

9. Non-Integrable Functions
    1. Easy Functions That Are Not Integrable
    2. # of Integrable Functions << # of Non-Integrable Functions
    3. What is an Algebraic Approximation?
    4. Algebraic -> Data -> Interpolated Polynomial
    5. Splines
    6. Points of Contact
    7. Taylor's Theorem
    8. Fourier Series

10. Infinite Polynomial Functions
    1. Finite vs Infinite
        a. Decimal Expansions of Numbers
        b. Fractions, roots, algebraic, transcendentals
    2. Finite Polynomials
    3. Jumping to Infinite

11. Formulas for an Infinite Number of Coefficients
    1. Convert Common Functions to Coefficient Functions
    2. Convergence Domain
    3. Convergence of Taylor Polynomials
    4. Barriers
    5. Common Functions as Series
    6. Differentiation and Integration of Series
    7. Tweaked Infinite Series and "Almost" Antiderivatives
    8. Using Expansions To Compute Indeterminant Limits: L'Hopital's Rule

12. Generalizing The Antiderivative: Differential Equations
    1. Thinking in Terms of Differential Equations
    2. Basic Differential Equations
    3. Algebraic Solutions are Limited
    4. Solving Differential Equations Numerically
    5. Using Series to Algebraically Approximate Solutions

13. Classical Sequences and Series
    1. Classical Series
    2. Partial Sums
    3. Numerical Convergence
    4. How Computers Fail
    5. Ratio Test
    6. Other Convergence Tests