straighterline

Syllabus

MAT251 | **Calculus II**

Course Text

This course does not require a text.

Course Description

This course is designed to further acquaint students with the principles of Calculus. This includes techniques of integration; application of integration; exponential and logistic models; parametric equations and polar coordinates; sequence and series; and vector and geometry.

Learning Outcomes

After completing this course, students will be able to:

1. Solve integration problems using different techniques of integration: integration table, u-substitution, trigonometric functions, partial fraction, trigonometric substitution, and Trapezoidal rule
2. Apply integral calculus to compute average value of function, volumes, arc lengths, surface of revolution, work, and moments; centers of mass
3. Use various tests to determine the convergence and divergence of sequences and series
4. Apply Taylor and Maclaurin series for polynomial approximations
5. Demonstrate convergence and divergence of power series
6. Solve homogenous differential equations
7. Use differential equations to solve 'Grow and Decay' problems
8. Sketch parametric and polar curves
9. Apply differentiation and integration to parametric equations and polar functions
10. Apply dot product and cross product to vectors in R2 and R3
11. Apply differentiation to vector functions

Course Prerequisites

Calculus I is a required prerequisite for this course. If you enroll, the assumption is made that you have previously completed Calculus I for credit with a passing score.

Academic Integrity Statement

Academic integrity is the pursuit of scholarly activity in an honest, truthful and responsible manner. Violations of academic integrity include, but are not limited to, plagiarism, cheating, fabrication and academic misconduct. Failure to comply with the Academic Integrity Policy can result in a failure and/or zero on the

attempted assignment/examination, a removal from the course, disqualification to enroll in future courses, and/or revocation of an academic transcript.

Course Completion Policy

In order for a course to be considered complete, **all required coursework must be attempted, submitted, and graded.** Required coursework consists of graded assignments. Any Academic Integrity Policy violations may prevent a course from being considered complete.

Assessment Types

StraighterLine courses may include any combination of the assessment types described below. Review the descriptions to learn about each type, then review the Course Evaluation Criteria to understand how your learning will be measured in this course.

Benchmarks

Benchmarks test your mastery of course concepts. You have 3 attempts, and your highest score counts.
Note: Cumulative Benchmarks (final exams) only allow 1 attempt.

Capstones

Capstones are project-based assessments that help you apply concepts to real-world scenarios. You have 2 attempts, and your highest score counts.

Checkpoints

Checkpoints are quick knowledge checks on important course concepts. All are open-book, and most have 1-3 attempts.

AI Use-Case Policies

StraighterLine Capstone assessments operate under one of three AI Use-Case Policies. These designations are selected intentionally to support learners in developing digital literacy, ethical reasoning, and authentic communication skills. Each model requires students to engage meaningfully with the course outcomes while adhering to academic standards.

Independent Work Requirement: Capstones with this designation must be completed independently without using AI tools. The goal is for learners to showcase their own understanding and skills without AI assistance. Students are expected to generate and submit original work developed solely through their own reasoning and effort.

AI-Assisted Planning Option: Capstones with this designation may allow AI tools to support brainstorming and assessment planning. If allowed, students will be asked to document any AI assistance by noting how it informed their work. Documentation must be included within the assignment or in a designated reflection field. Examples include describing how an AI tool helped organize an outline, generate ideas, or surface sources for further exploration.

AI-Integration Requirement: Capstones with this designation require AI tools as part of the learning process. Students will be asked to reflect upon their AI interactions and AI contributions to the assessment. Reflections must include which tools were used, how they were used, and what insights students gained from the process. This promotes transparency, ethical use, and metacognitive skill-building.

Course Evaluation Criteria

Your score provides a percentage score and letter grade for each course. A passing percentage is 70% or higher.

There are a total of 1000 points in the course:

Assessment	Points	Learning Outcomes
Checkpoint 1: An Introduction to Calculus II	0	N/a
Benchmark 1: Checkpoint 1	30	Review
Checkpoint 2: Techniques of Integration	0	N/a
Benchmark 2: Checkpoints 1-2	75	1
Checkpoint 3: Applications of Integral Calculus	0	N/a
Benchmark 3: Checkpoints 1-3	125	1-2
Checkpoint 4: Sequences and Series	0	N/a
Benchmark 4: Checkpoint 4	35	3-4
Checkpoint 5: Sequences and Series (cont.)	0	N/a
Benchmark 5: Checkpoints 4-5	75	3-4
Checkpoint 6: Improper Integrals	0	N/a
Benchmark 6: Checkpoints 4-6	125	3-5
Checkpoint 7: Differential Equations	0	N/a
Benchmark 7: Checkpoint 7	35	6-7
Checkpoint 8: Parametric Equations and Poor Coordinates	0	N/a
Benchmark 8: Checkpoints 7-8	75	6-9
Checkpoint 9: Vectors and the Geometry of R^2 and R^3	0	N/a
Benchmark 9: Checkpoints 7-9	125	6-11
Benchmark 13: Checkpoints 1-12	300	1-11
Total	1000	

Course Roadmap

This roadmap provides an overview of the checkpoints and lessons covered in this course.

Checkpoint 1: An Introduction to Calculus II

- Checkpoint 1: Pre-Reading: What Do You Think?
- Welcome to Calculus II

- Review: Calculus I in 20 Minutes

Checkpoint 2: Techniques of Integration

- Checkpoint 2: Pre-Reading: What Do You Think?
- An Introduction to the Integral Table
- Making u-Substitutions
- An Introduction to Integrals with Powers of Sine and Cosine
- Integrals with Powers of Sine and Cosine
- Integrals with Even and Odd Powers of Sine and Cosine
- Integrals of Other Trigonometric Functions
- Integrals of Odd Powers of Tangent and Any Power of Secant
- Integrals with Even Powers of Secant and Any Power of Tangent
- Repeated Linear Factors: Part One
- Repeated Linear Factors: Part Two
- Distinct and Repeated Quadratic Factors
- Partial Fractions of Transcendental Functions
- Converting Radicals into Trigonometric Expressions
- Using Trigonometric Substitution to Integrate Radicals
- Trigonometric Substitutions on Rational Powers
- An Overview of Trigonometric Substitution Strategy
- Trigonometric Substitution Involving a Definite Integral: Part ONe
- Trigonometric Substitution Involving a Definite Integral: Part TWo
- Deriving the Trapezoidal Rule
- An Example of the Trapezoidal Rule

Checkpoint 3: Applications of Integral Calculus

- Checkpoint 3: Pre-Reading: What Do You Think?
- Finding the Average Value of a Function
- Finding Volumes Using Cross-Sectional Slices
- An Example of Finding Cross-Sectional Volumes
- Solids of Revolution
- The Disk Method Along the y-Axis
- A Transcendental Example of the Disk Method
- The Washer Method Across the x-Axis
- The Washer Method Across the y-Axis
- Introducing the Shell Method
- Why Shells Can Be Better Than Washers
- The Shell Method: Integrating with Respect to y
- An Introduction to Arc Length
- Finding Arc Lengths of Curves Given by Functions
- An Introduction to Work
- Calculating Work
- Hooke's Law
- Center of Mass
- The Center of Mass of a Thin Plate
- Pathfinder: Equations in Action

Checkpoint 4: Sequences and Series

- Checkpoint 4 Pre-Reading: What Do You Think?
- The Limits of a Sequence
- Determining the Limit of a Sequence

- The Squeeze and Absolute Value Theorems
- Monotonic and Bounded Sequences
- An Introduction to Infinite Series
- The Summation of Infinite Series
- Geometric Series
- Telescoping Series
- Properties of Convergent Series
- The nth-Term Test for Divergence
- An Introduction to the Integral Test
- Examples of the Integral Test
- Using the Integral Test
- Defining p-Series
- An Introduction to the Direct Comparison Test
- Using the Direct Comparison Test
- An Introduction to the Limit Comparison Test
- Using the Limit Comparison Test
- Inverting the Series in the Limit Comparison Test

Checkpoint 5: Sequences and Series (cont.)

- Checkpoint 5: Pre-Reading: What Do You Think?
- Alternating Series
- The Alternating Series Test
- Estimating the Sum of an Alternating Series
- Absolute and Conditional Convergence
- The Ratio Test
- Examples of the Ratio Test
- The Root Test
- Polynomial Approximations of Elementary Functions
- Higher-Degree Approximations
- Taylor Polynomials
- Maclaurin Polynomials
- The Remainder of a Taylor Polynomial
- Approximating the Value of a Function
- Taylor Series
- Examples of the Taylor and Maclaurin Series
- New Taylor Series
- The Convergence of Taylor Series
- The Definition of Power Series
- The Interval and Radius of Convergence
- Finding the Interval and Radius of Convergence: Part One
- Finding the Interval and Radius of Convergence: Part Two
- Finding the Interval and Radius of Convergence: Part Three
- Differentiation and Integration of Power Series
- Finding Power Series Representation by Integration
- Integrating Functions Using Power Series
- Pathfinder: Convergence Explorer

Checkpoint 6: Improper Integrals

- Checkpoint 6: Pre-Reading: What Do You Think?
- The First Type of Improper Integral
- The Second Type of Improper Integral
- Infinite Limits of Integration, Convergence, and Divergence

Checkpoint 7: Differential Equations

- Checkpoint 7: Pre-Reading: What Do You Think?
- Solving Separable Differential Equations
- Finding a Particular Solution
- Direction Fields
- Euler's Method for Solving Differential Equations Numerically
- First-Order Linear Differential Equations
- Change of Variables
- Exponential Growth
- Logistic Growth
- Radioactive Decay
- Differential Equations

Checkpoint 8: Parametric Equations and Poor Coordinates

- Checkpoint 8: Pre-Reading: What Do You Think?
  Parametric Equations and Polar Coordinates
- An introduction to Parametric Equations
- The Cycloid
- Eliminating Parameters
- Derivatives of Parametric Equations
- Graphing the Elliptic Curve
- The Arc Length of a Parameterized Curve
- Finding Arc Length of Curves Given by Parametric Equations
- The Polar Coordinate System
- Converting Between Polar and Cartesian Forms
- Spirals and Circles
- Graphing Some special Polar Functions
- Calculus and the Rose Curve
- Finding the Slopes of Tangent Lines in Polar Form
- Heading Toward the Area of a Polar Region
- Finding the Area of a Polar Region: Part One
- Finding the Area of a Polar Region: Part Two
- The Area of a Region Bounded by Two Polar Curves: Part One
- The Area of a Region Bounded by Two Polar Curves: Part Two
- Pathfinder: Vector's Quest

Checkpoint 9: Vectors and the Geometry of R^2 and R^3

- Checkpoint 9: Pre-Reading: What Do You Think?
- Coordinate Geometry in Three-Dimensional Space
- Introduction to Vectors
- Vectors in R^2 and R^3
- An Introduction to Dot Product
- Orthogonal Projections
- An Introduction to the Cross Product
- Geometry of the Cross Product
- Equations of Lines and Planes in R^3
- Introduction to Vector Functions
- Derivatives of Vector Functions
- Vector Functions: Smooth Curves
- Vector Functions: Velocity and Acceleration

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