



## COURSE SYLLABUS

Course: Applied Calculus

Number: MAT 2110

Credit-Hours: 4 Credits

**Course Description:** An introduction to differential and integral calculus emphasizing applications to business and the life sciences. Topics covered will include limits, rules of differentiation, extreme value problems, curve sketching, exponential and logarithmic functions, techniques of integration, and area between curves. Includes a thorough review of high school algebra.

**Prerequisite:** MAT 1110 (high school Algebra II), or departmental consent.

Detailed Syllabus:

### 0. Getting Started

1. Email and Chat
2. Learning About the Course
3. Required Hardware
4. Software Fundamentals

### 1. The Big Picture

1. Solving (easy) equations in 1 variable.
2. What if you can't solve for  $x$ ?
3. Finding solutions numerically
4. Finding solutions graphically
5. Solving equations of more than 1 variable

### 2. Functions

1. Function notation.
2. Data sets
3. Graphing functions
4. Data sets and smooth curves
5. Domain and Range
6. Algebraic combinations of functions

### 3. Linear Functions

1. Algebraic definition
2. Slope
3. Graphing linear functions by hand
4. Properties of linear functions
5. Linear data sets

## 4. Quadratic Functions

1. Algebraic definition
2. Graphing and Properties of Quadratic Functions
3. Solving quadratic equations algebraically: Factoring
4. Solving quadratic equations algebraically: Quadratic formula
5. Solving quadratic equations numerically and graphically
6. Complex Numbers
7. Quadratic data sets

## 5. Power and Polynomial Functions

1. Algebraic definition
2. Graphing and Properties of Polynomial Functions
3. Solving polynomial equations algebraically: factoring
4. Solving polynomial equations numerically and graphically
5. Fundamental Theorem of Algebra
6. Radicals and fractional exponents

## 6. Rational Polynomial Functions

1. Algebraic definition
2. Graphing and Properties of Rational Polynomial Functions
3. Solving rational polynomial equations algebraically: factoring
4. Solving rational polynomial equations numerically and graphically

## 7. Exponential Functions

1. Algebraic definition
2. Graphing and Properties of Exponential Functions
3. Solving exponential equations numerically and graphically
4. Exponential Growth and Applications
5. Data sets and exponential functions.

## 8. Logarithmic Functions

1. Inverse Functions
2. Algebraic Definition
3. Graphing and Properties of Logarithmic Functions
4. Solving exponential and logarithmic equations algebraically
5. Solving logarithmic equations numerically and graphically
6. Logarithmic Growth and Applications
7. Data sets and logarithmic functions.

## 9. Modern Motivations for Calculus

1. Analysis of Graphical Data: Live Stock Price Data
2. Predicting: Using small changes in price to predict
3. Limits & Continuity: Is the stock price being nice and calm?
4. Concavity: Buy low, sell high.
5. Accumulation: How much money did we make?
6. Classical Motivations
  - a. Position, Velocity, Acceleration
  - b. Slope of Tangent Line at a Point on Function Plot
  - c. Area Under a Function Plot

## 10. Numerical Derivatives

1. Delta Y: Measuring Output Change: Raw & Percent
2. Comparing Output Change
3. Describing Change
4. Delta X: Varying Input Change: Non-Uniform Inputs
  - a. Application: E-Bay auctions
5. Largest Increment vs Smallest Increment
6. Rates of Change
7. Comparing Rates of Change

## 11. The Derivative

1. Geometry of Rates of Change
2. Left, Right, & Centered Derivatives
3. Collecting Data in Virtual Experiments
  - a. Vertical Projectile Flight
  - b. Foxes and Rabbits (dynamic system)
  - c. Interest Rate fluctuations
  - d. Business Application: Analyzing a Coffeehouse Operation
  - e. Instantaneous Velocity: The Radar Gun and the Speeding Car

## 12. Relationship Between Data Function and Its Derivative

1. Linear growth, exponential growth
2. Derivative Changing Signs: Extrema
3. Graphical Derivatives
  - a. Given Graph, Draw Derivative
  - b. LiveMath Slope Finder
  - c. Manually with Ruler
4. Drawing Estimates for Derivatives
  - a. Find where derivative changes signs
5. Increasing Resolution: Better Data?
6. Graphical Second Derivative
  - a. Placing Approximating Parabolas
  - b. Derivative of Data Derivative
  - c. Concavity & Inflection Points
7. Data & Continuity: Infinite Data Samples?

## 13. Algebraic Derivatives

1. Infinitely-Precise Resolution
2. Going from Algebra to Data
3. Going from Data to Algebra
4. Limits
  - a. Data Derivative with Increasing Resolution
  - b. Finite to Infinite Jump
5. Algebraic Miracles: The Simplicity of the Algebraic Derivative Calculus
6. Derivative Calculus
7. Manual Computations

## 14. Classical Derivative Problems

1. Limits
2. First Derivative Test
3. Curve Sketching
4. Maximizing Functions
5. Velocity, Speed & Acceleration

## 15. Modern Derivative Problems

1. Steady State (Infinite Limits)
2. Percentage Growth Rates
3. Data, Interpolate, Differentiate, Predict

## 16. Numerical Accumulation

1. Accumulating Rates: Car Gas Mileage
2. Numerical Integral
3. Derivative of Numerical Integral

## 17. Graphical Accumulation

1. Area Accumulation
2. Graphical Integral
3. Graphical Relationships

## 18. Algebraic Integration

1. Numerical Integral Miracles
2. Integral Calculus (Easy Functions)
3. Properties of Integrals
4. Fundamental Theorem of Calculus

## 19. Classical Integration Problems

1. Area
2. Distance, Velocity, Acceleration