Chapter 1: A Review of Functions and Graphs

1.1 Review of Functions
- Functions, Function Notation, and Domain and Range
  - Evaluate a function using function notation and determine the domain and range (20)
  - Represent functions using tables, graphs, or formulas
- Symmetry of Functions, Absolute Value, and Function Composition
  - Combine functions using mathematical operators or function composition (20)
  - Understand the symmetry of functions and the absolute value function

1.2 Basic Classes of Functions
- Graphing Lines, Parabolas, and Polynomials
  - Find the slope and equation of lines (20)
  - Use tools such as the quadratic formula and end behavior to graph polynomial functions
  - Understand the difference between algebraic and transcendental functions and find the domain of algebraic functions
- Piecewise Functions and Transformations of Functions
  - Understand and graph piecewise-defined functions
  - Perform transformations of functions

1.3 Trigonometric Functions
- Radian Measure and Evaluating Trigonometric Functions
  - Understand radian measure and convert between radians and degrees (20)
  - Evaluate trigonometric functions
- Trigonometric Identities, Equations, and Graphs
  - Understand trigonometric identities and use them to solve trigonometric equations
  - Graph periodic functions

1.4 Inverse Functions
- Finding an Inverse Graphically and Algebraically
  - Determine when a function is one-to-one
  - Find the inverse of a function
  - Graph an inverse function
  - Restrict the domain of a function to find an inverse function
- Inverse Trigonometric Functions
  - Evaluate expressions involving inverse trigonometric functions

1.5 Exponential and Logarithmic Functions
- Evaluating and Graphing Exponential Functions
  - Identify and evaluate exponential functions (20)
  - Graph an exponential function
  - Simplify expressions using the law of exponents (20)
  - Understand the base e and use it for application problems
- Logarithmic Graphs and Properties of Logarithms
  - Convert between logarithmic and exponential form and evaluate logarithmic expressions (20, 20)
  - Graph a logarithmic function
- Understand the properties of logarithms
- Exponential and Logarithmic Equations
  - Solve equations involving exponential functions (20)
  - Solve equations involving logarithmic functions (20)
  - Use the change-of-base formula to evaluate logarithms (20)

Chapter 2: Limits and Continuity
2.1 A Preview of Calculus
  - A Preview of Differential and Integral Calculus
    - Preview the tangent problem by using secant lines and average rates of change
    - Preview the area problem by using rectangles to approximate area (5)
2.2 The Limit of a Function
  - Limits From a Graph or Table
    - Understand the limit of a function and evaluate a limit from a table
    - Evaluate limits graphically (6)
    - Understand the properties of limits
  - Limits Analytically for Continuous and Piecewise Functions
    - Evaluate two-sided limits analytically for continuous functions
    - Evaluate limits analytically for piecewise functions (5)
    - Evaluate limits analytically for absolute value functions
2.3 Calculating Limits Using Limit Laws
  - Limits Analytically for Functions with Removable Discontinuities
    - Evaluate two-sided limits analytically for rational functions with removable discontinuities by factoring
    - Evaluate two-sided limits analytically for rational functions with removable discontinuities through expansion
    - Evaluate two-sided limits analytically for complex fractions with removable discontinuities
    - Evaluate two-sided limits analytically for rational functions that contain radicals with removable discontinuities
  - Limits Analytically for Trigonometric Functions
    - Evaluate trigonometric limits using direct substitution
    - Evaluate trigonometric limits using special limits
    - Evaluate trigonometric limits using identities (5)
  - Infinite Limits
    - Evaluate limits analytically for functions with essential discontinuities (6)
    - Evaluate limits analytically for trigonometric functions with essential discontinuities (5)
2.4 Continuity
  - Continuity and the Intermediate Value Theorem
    - Understand the definition of continuity
    - Distinguish between types of discontinuity
    - Understand and apply the intermediate value theorem
  - Continuity of Piecewise Functions
    - Determine whether a piecewise function is continuous
2.5 Formal Limits
- Precise Definition of a Limit
  - Understand the notation in finding the formal definition of a limit
  - Determine a delta for an arbitrary epsilon given a linear function (5)
  - Determine a delta for an arbitrary epsilon given a quadratic function (5)

Chapter 3: Differentiation
3.1 Defining the Derivative
- Secant Lines and Average Rates of Change
  - Find the average rate of change given a function (40)
  - Find the average rate of change given a table or graph (40)
  - Find the average rate of change given a function and variable intervals (5)
- Tangent Lines and Instantaneous Velocities
  - Determine the sign of the slope of a line tangent to a function at a given point (5)
  - Estimate the slope of the line tangent to a point on a curve
  - Estimate the instantaneous rate of change of a function from successively closer approximations (5)
- The Definition of the Derivative
  - Find the derivative of a function at a point using limits (40)
  - Use the limit definition to find the derivative of a polynomial function (40)
  - Use the limit definition to find the derivative of a rational function
  - Use the limit definition to find the derivative of a function with a radical (40)
- Applications Using the Definition of the Derivative
  - Solve application problems using the definition of the derivative
3.2 The Derivative as a Function
- The Graph of the Derivative Function
  - Estimate the value of a derivative at a point on a graph using a tangent line (5)
  - Determine the open intervals where the first derivative is positive or negative from a graph (5)
  - Determine the graph of the derivative function given the graph of a polynomial function (5)
- Differentiability
  - State the connection between derivatives and continuity
  - Describe three conditions for when a function does not have a derivative (5)
  - Find the constants that make a piecewise function differentiable (5)
  - Determine the graph of the derivative function given the graph of any function (5)
3.3 Basic Differentiation Rules
- The Power Rule and the Sum and Difference Rules
  - Use the constant, constant multiple, and power rule for monomials
  - Apply the sum and difference rules to combine derivatives
- Use the Power Rule to Explore Tangent Lines
  - Find the equation of the line tangent to a polynomial at a point (40)
● Determine where a function has a horizontal tangent (40)
● Determine the points on a function when tangent lines have a given slope (40)

● The Product and Quotient Rules
   ● Use the product rule to find the derivative of a function in the form f(x)g(x) (40)
   ● Use the quotient rule to find the derivative of a function in the form f(x)/g(x) (40)
   ● Use the product rule to find the derivative of a function in the form f(x)g(x)h(x) (40)
   ● Combine the product and quotient rules with polynomials (40)

● Extensions of the Power Rule
   ● Extend the power rule to functions with negative exponents
   ● Extend the power rule to functions with rational exponents
   ● Simplify algebraic expressions in order to use the power rule (5)
   ● Use the extension of the power rule to explore tangent lines

3.4 Derivatives of Trigonometric Functions and the Chain Rule
● Derivatives with Trigonometric Functions
   ● Find the derivative of a function with sine or cosine (40)
   ● Use the product or quotient rule to find a derivative with sine or cosine (40)
   ● Find the derivative of a function involving tangent, cotangent, secant, or cosecant
   ● Find the equation of a line tangent to a trigonometric function (5)

● The Chain Rule
   ● Use the chain rule with the power rule (6)
   ● Use the chain rule with trigonometric functions (40)
   ● Use the chain rule with the product rule (6)
   ● Differentiate a composite of three functions

3.5 Derivatives as Rates of Change and Higher Order Derivatives
● Relate Velocity and Acceleration to Position Functions
   ● Find the second derivative with the power rule
   ● Find the velocity and acceleration function from the position function (5)
   ● Determine when a particle is moving left or right

● Higher Order Derivatives
   ● Find a higher-order derivative for sin(x) (5)
   ● Determine higher order derivatives requiring the chain rule (6)

● Other Applications Involving Rates of Change
   ● Solve application problems involving rates of change

3.6 Derivatives of Inverse Functions and Inverse Trigonometric Functions
● Derivatives of Inverse Functions
   ● Find an inverse derivative function value for a polynomial function (5)
   ● Find an inverse derivative function value for a rational function (5)
   ● Find an inverse derivative function value for a square root function (5)

● Derivatives of Inverse Trigonometric Functions
   ● Find the derivative of arcsine or arccosine functions
   ● Find the derivative of arctan or arccot functions
   ● Find the derivative of arcsec or arccsc functions

3.7 Implicit Differentiation
● Use Implicit Differentiation
3.8 Derivatives of Exponential and Logarithmic Functions

- Derivatives of Exponential Functions with Base e
  - Find the derivative of an exponential function with base e
  - Use product and quotient rules to find the derivative of exponential functions with base e (40)

- Derivatives of Exponential Functions with Any Base
  - Find the derivative of an exponential function with any base (40)
  - Use product and quotient rules to find the derivative of exponential functions with any base (40)

- Derivatives of Natural Log Functions
  - Find the derivative of a natural logarithmic function (40)
  - Use properties of logarithms to find the derivative of a natural logarithmic function (40)

- Derivatives of Logarithmic Functions of Any Base
  - Find the derivative of a logarithmic function that is not base e (5)
  - Use properties of logarithms to find the derivative of a logarithmic function that is not base e (40)

- Logarithmic Differentiation
  - Use logarithmic differentiation with only the power property of logarithms (40)
  - Use logarithmic differentiation with all properties of logarithms (40)

Chapter 4: Applications of Differentiation

4.1 Related Rates

- Related Rates for Volume or Area Problems
  - Use related rates to solve problems involving volume (40)
  - Use related rates to solve problems involving area (40)

- Related Rates in Other Applications
  - Use related rates to solve problems involving distance (40)
  - Use related rates to solve problems involving angles or shadows (40)

4.2 Linear Approximations and Differentials

- Linear Approximations
  - Find the linear approximation of a rational function and use it to estimate function values (5)
  - Find the linear approximation of a function involving roots or powers and use it to estimate function values (6)
  - Find the linear approximation of a trigonometric function and use it to estimate function values (5)

- Find Error Using Differentials
  - Compute a differential (40)
  - Estimate the amount of propagated and relative error using differentials (40)
4.3 Maxima and Minima
● Extreme Value Theorem and Absolute Extrema
  ● Understand the extreme value theorem (40)
  ● Locate local and absolute extrema from a graph (5)
  ● Locate critical points using derivatives (40)
  ● Locate absolute extrema (40)

4.4 The Mean Value Theorem
● Rolle's Theorem and the Mean Value Theorem
  ● Understand and apply Rolle’s Theorem
  ● Find values of c guaranteed by the Mean Value Theorem (5)
  ● Use the Mean Value Theorem in velocity problems (5)
  ● Understand the corollaries of the Mean Value Theorem

4.5 Derivatives and the Shape of the Graph
● First Derivative Test
  ● Understand the relationship between the graph of a function and the sign of its derivative (5)
  ● Use the first derivative test to find local extrema from a graph (5)
  ● Use the first derivative test to find local extrema given a function (40)
● Concavity and the Second Derivative Test
  ● Determine concavity and find the inflection points from a graph of f(x) (*18)
  ● Determine concavity and find the inflection points given a function
  ● Use the second derivative test to find local extrema given a function

4.6 Asymptotes and Curve Sketching
● Limits at Infinity
  ● Evaluate limits of polynomial functions at infinity (5)
  ● Evaluate limits of rational functions at infinity (5)
  ● Evaluate limits of trigonometric functions at infinity
  ● Evaluate limits of radical and exponential functions at infinity
● End Behavior of a Power Function or Rational Function
  ● Identify a horizontal asymptote with limits
  ● Determine the end behavior of a power or polynomial function with limits (5)
  ● Determine the end behavior of a rational function with limits
● End Behavior of a Function Involving Radicals or Transcendental Functions
  ● Determine the end behavior of a function involving a radical with limits
  ● Determine the end behavior of a transcendental function
● Sketch the Curve of a Function
  ● Sketch the graph of a polynomial (5)
  ● Sketch the graph of a rational function (5)
  ● Sketch the graph of a function with a cusp (5)

4.7 Optimization
● Applied Optimization Problems
  ● Maximize or minimize area or volume (40)
  ● Minimize travel time (5)
  ● Maximize revenue (40)
- Minimize surface area (5)

- Optimization Problems in the Abstract
  - Maximize the area of an inscribed rectangle (40)
  - Maximize and minimize quantities given an expression with two variables (40)
  - Minimize distance of a function to a point (40)

4.8 L'Hospital's Rule and Indeterminate Forms
- L'Hospital's Rule
  - Apply L'Hospital's Rule in the 0/0 case (40)
  - Apply L'Hospital's Rule in the (infinity/infinity) case (40)
  - Determine when to apply L'Hospital's Rule (40)

- Extensions of L'Hospital's Rule
  - Apply L'Hospital's Rule in the 0*infinity case
  - Apply L'Hospital's Rule in the infinity-infinity case (5)
  - Apply L'Hospital's Rule involving exponents of 0 or infinity
  - Use L'Hospital's Rule to compare the growth rates of two functions (5)

4.9 Newton's Method
- Approximations with Newton's Method
  - Use Newton's method to approximate the root of a polynomial
  - Use Newton’s method to approximate a square root
  - Determine when Newton's method does not work (5)

Chapter 5: Integration
5.1 Indefinite Integrals
- Antiderivatives and the Integral
  - Find the antiderivative of a function (40)
  - Understand integral notation and verify an indefinite integral (40)
  - Understand the properties of indefinite integrals (40)
  - Evaluate indefinite integrals involving constants or powers (40)

- Evaluating Indefinite Integrals
  - Evaluate indefinite integrals involving roots (5)
  - Evaluate indefinite integrals involving e (5)
  - Evaluate indefinite integrals involving rational functions (5)
  - Evaluate indefinite integrals involving trigonometric functions (40)

- Initial-Value Problems
  - Solve an initial-value problem (5)
  - Solve word problems using integrals and initial values (5)

5.2 Riemann Sums
- Evaluating Sums
  - Understand the properties of sigma notation and use to evaluate sums (6)
  - Understand the rules for the sums and powers of integers and use to evaluate sums (7)

- Approximating Areas under a Curve and Riemann Sums
  - Approximate the area under a curve using left-endpoint approximation
  - Approximate the area under a curve using right-endpoint approximation
  - Approximate the area under a curve using midpoint approximation
Approximate the area under a curve using trapezoidal approximation

Upper and Lower Riemann Sums
- Find an upper or lower sum given a function
- Determine if a sum will be an underestimate or overestimate (5)

Approximating Areas in Application
- Solve application problems involving approximating areas

5.3 Definite Integrals
- Defining Definite Integrals
  - Explain the terms integrand, limits of integration, and variable of integration, and describe when a function is integrable (40)
  - Evaluate an integral using the definition of the definite integral and left- or right-endpoint approximations (40)

- Calculating Definite Integrals with a Geometric Approach
  - Use a geometric formula to calculate a definite integral (5)
  - Calculate net signed areas under a line using formulas for area of a triangle (40)
  - Calculate total area under a function using geometric formulas (40)

- Properties of Definite Integrals and the Comparison Theorem of Integrals
  - Use the properties of the definite integral (40)
  - Understand the comparison theorem of integrals and use it to compare two functions over a given interval

5.4 The Fundamental Theorem of Calculus
- Integrals and Derivatives with the Fundamental Theorem of Calculus
  - Use the Fundamental Theorem of Calculus to find the derivative of an integral function (40)
  - Use the Fundamental Theorem of Calculus and the chain rule to find a derivative (40)
  - Use the Fundamental Theorem of Calculus with two variable limits of integration (40)

- Evaluating Definite Integrals with the Fundamental Theorem of Calculus
  - Evaluate definite integrals with the Fundamental Theorem of Calculus for functions with positive integer exponents (5)
  - Evaluate definite integrals with the Fundamental Theorem of Calculus for functions with rational exponents (40)
  - Evaluate definite integrals with the Fundamental Theorem of Calculus and the power rule by simplifying (40)

5.5 The Mean Value and Net Change Theorems for Integrals
- The Mean Value Theorem for Integrals
  - Calculate the average value of a linear function using geometric formulas (5)
  - Understand the Mean Value Theorem for Integrals (5)
  - Use the Mean Value Theorem for Integrals to find the average value of a function over an interval (5)
  - Use the Mean Value Theorem for Integrals to find the point on the curve which takes on the average value of the function

- The Net Change Theorem
  - Understand the net change theorem
  - Find the net displacement of a particle given its velocity function (5)
● Find the total distance traveled by a particle given its velocity function

● Applications of the Net Change Theorem
  ● Use the Fundamental Theorem of Calculus in applications with velocity and distance problems (5)
  ● Use the net change theorem to find amounts given rates (5)

5.6 Integrating with Substitution
● Integrating Even and Odd Functions
  ● Integrate an even function (5)
  ● Integrate an odd function (5)

● Substitution and the Power Rule
  ● Use substitution to find an indefinite integral with the power rule (37)
  ● Use substitution to evaluate a definite integral with the power rule (39)

● Substitution and Trigonometric Functions
  ● Use substitution to find an indefinite integral with trigonometric functions (5)
  ● Use substitution to evaluate a definite integral with trigonometric functions (5)

5.7 Integrals Involving Exponential and Logarithmic Functions
● Substitution and Exponential Functions
  ● Use substitution to find an indefinite integral with exponential functions (5)
  ● Use substitution to evaluate a definite integral with exponential functions (5)

● Substitution Involving Rational or Logarithmic Functions
  ● Use substitution to find an indefinite integrals with rational or logarithmic functions (5)
  ● Use substitution to evaluate a definite integral with rational or logarithmic functions (5)

● Application Problems with Integrals of Exponential and Logarithmic Functions
  ● Solve application problems using integrals of exponential and logarithmic functions

● Substitution and Composite Functions
  ● Use substitution to find an indefinite integral of composite functions (5)
  ● Use substitution to evaluate a definite integrals of composite functions (5)

5.8 Integrals of Inverse Trigonometric Functions
● Integrating Inverse Trigonometric Functions
  ● Evaluate an indefinite integral involving arcsine (5)
  ● Evaluate an indefinite integral involving arctan or arcsec (5)
  ● Evaluate a definite integral involving an inverse trigonometric function(5)

Chapter 6: Applications of Integrations
6.1 Area Between Two Curves
● Finding the Area of a Region Bounded by Two Curves
  ● Find the area of a region between two linear functions (40)
  ● Find the area of a region bounded between a linear function and another function (40)
  ● Find the area of a region bounded between two curves (40)

● Finding the Area of Compound Regions
  ● Find the area of a region bounded by two functions that cross (40)
  ● Find the area of a region bounded above by two different functions (40)

● Finding the Area of Regions Defined with Respect to y
  ● Find the area between two curves defined as a function of y (5)
Find the area between two curves by rewriting functions as a function of y

6.2 Determining Volume from Cross Sections
- Determining Volume by Slicing
  - Determine the volume of a solid by integrating a cross-section with a circle or semicircle
  - Determine the volume of a solid by integrating a cross-section with a square or rectangle (5)
  - Determine the volume of a solid by integrating a cross-section with a triangle (5)

6.3 Solids of Revolution
- The Disk Method
  - Use the disk method to find the volume of a solid of revolution around the x-axis with polynomials or roots (40)
  - Use the disk method to find the volume of a solid of revolution around the x-axis with other functions (5)
  - Use the disk method to find the volume of a solid of revolution around the y-axis with a function defined as a function of y (5)
- The Washer Method
  - Use the washer method to find the volume of a solid of revolution around the x-axis (5)
  - Use the washer method to find the volume of a solid of revolution around the y-axis (5)
  - Use the washer method to find the volume of a shifted solid of revolution
- The Shell Method
  - Use the shell method to find the volume of a solid of revolution around the y-axis
  - Use the shell method to find the volume of a solid of revolution around the x-axis
  - Use the shell method to find the volume of a shifted solid of revolution
- Solving Solids of Revolution Problems
  - Choose an appropriate method to find the volume of a solid of revolution (5)
  - Use a calculator to find the volume of a solid of revolution (5)

6.4 Arc Length and Surface Area
- Calculating Arc Length
  - Calculate the arc length of a function of x
  - Calculate the arc length of a function of y
  - Use a calculator to determine the arc length of a function (6)
- Area of a Surface of Revolution
  - Calculate the surface area of a surface of revolution around the x-axis
  - Calculate the surface area of a surface of revolution around the y-axis

6.5 Physical Applications
- Mass and Density
  - Calculate the mass of one-dimensional objects given the linear density (5)
  - Calculate the mass of a circular object given the radial density
- Work and Force for Springs and Cables
  - Understand the relationship between work and force (5)
  - Calculate the amount of work done to compress a spring (5)
  - Calculate the amount of work done to lift an object and cable (5)
- Work and Pumping Water
  - Solve a pumping problem with a cylindrical tank (5)
- Solve a pumping problem with a non-cylindrical tank (5)

- Hydrostatic Force and Pressure
  - Find the hydrostatic force on a trough triangular in shape (5)
  - Find the hydrostatic force on a trough in shapes other than triangles (5)

6.6 Centers of Mass
- Centers of Mass on a Line or Plane
  - Find the center of mass of objects in a line (6)
  - Find the center of mass of objects in a plane (6)

- Centroids of Regions on a Plane
  - Find the centroid of a region bounded by a function and an axis (5)
  - Find the centroid of a region bounded by two functions (5)
  - Use the Theorem of Pappus to find volume (5)

6.7 Hyperbolic Functions
- Introduction to Hyperbolic Functions
  - Evaluate or recognize graphs of hyperbolic functions (5)
  - Use identities of hyperbolic functions (5)
  - Evaluate or determine the domain of an inverse hyperbolic function (5)

- Differentiating Hyperbolic Functions
  - Differentiate a hyperbolic function involving sinh or cosh (5)
  - Differentiate other hyperbolic functions (5)
  - Differentiate inverse hyperbolic functions (5)

- Integrating Hyperbolic Functions
  - Integrate a hyperbolic function involving sinh or cosh (5)
  - Integrate other hyperbolic functions
  - Integrate inverse hyperbolic functions (6)
  - Solve hyperbolic function application problems

Chapter 7: Techniques of Integration
7.1 Integration by Parts
- Basic Integration by Parts with Indefinite Integrals
  - Use integration by parts when u and v are given (40)
  - Use integration by parts for indefinite integrals (5)

- Advanced Integration by Parts with Indefinite Integrals
  - Apply integration by parts more than once for indefinite integrals (5)
  - Use more advanced patterns for integration by parts problems

- Integration by Parts with Definite Integrals
  - Use integration by parts to find the area of a region (5)
  - Use integration by parts to find the volume of a revolution (5)

7.2 Integrating Powers and Products of Trigonometric Functions
- Integrate Powers and Products of Sine and Cosine
  - Integrate products and powers of sine and cosine where at least one exponent is odd
  - Integrate products and powers of sine and cosine where both exponents are even
  - Integrate a product of sine and cosine with different angles
- Integrate Powers and Products of Tangent and Secant
● Integrate products and powers of tangent and secant where tangent has an odd exponent or secant has an even exponent
● Integrate products and powers of tangent and secant where secant has an odd exponent and tangent has an even exponent

7.3 Trigonometric Substitution
● Integrating with Trigonometric Substitution
  ● Integrate a square root of a difference of squares of the form $a^2 - x^2$ using trigonometric substitution
  ● Integrate a square root of a sum of squares using trigonometric substitution
  ● Use trigonometric substitution to find an arc length
  ● Integrate a square root of a difference of squares of the form $x^2 - a^2$ using trigonometric substitution

7.4 Integrating with Partial Fractions
● Integrating with Partial Fractions with Nonrepeated Linear Factors
  ● Integrate a rational function using long division of polynomials (5)
  ● Integrate a rational function using partial fractions with nonrepeated linear factors
  ● Integrate a rational function using long division and partial fractions
  ● Integrate a function by applying partial fractions after a substitution
● Integrating Partial Fractions with Repeated Linear Factors or Irreducible Quadratic Factors
  ● Integrate a rational function using partial fractions with repeated linear factors
  ● Integrate a rational function using partial fractions with an irreducible quadratic factor

7.5 Integrating with References
● Integration Tables and Computer Algebra Systems
  ● Use a formula from an integration table to evaluate an integral
  ● Use a computer algebra system to evaluate an integral

7.6 Numerical Integration
● Finding the Error in Midpoint and Trapezoid Approximations
  ● Calculate the absolute and relative error using the midpoint rule (5)
  ● Calculate the absolute and relative error using the trapezoidal rules (5)
  ● Determine error bounds for Simpson’s rule (5)

7.7 Improper Integrals
● Improper Integrals over Infinite Intervals
  ● Evaluate an improper integral over an infinite interval
  ● Evaluate an improper integral from negative infinity to positive infinity (5)
● Improper Integrals with Discontinuities
  ● Evaluate an integral with a discontinuity at one of the limits of integration (5)
  ● Evaluate an integral with a discontinuity within the limits of integration (5)
  ● Determine if an improper integral converges or diverges using the comparison theorem

Chapter 8: Introduction to Differential Equations
8.1 Differential Equations
● Basics of Differential Equations
  ● Verify a solution of a differential equation (40)
  ● Identify the order of a differential equation (5)
Linear Differential Equations
- Find a general solution to a linear differential equation (40)
- Find a particular solution to a linear differential equation (5)

Initial-Value Problems
- Verify a solution to a differential equation initial value problem (40)
- Solve a differential equation initial value problem (40)
- Solve applications of differential equation initial value problems (40)

8.2 Direction Fields
- Creating Direction Fields
  - Create a direction field for a first-order differential equation (5)
  - Sketch a solution curve given a direction field
- Identifying Solutions with Direction Fields
  - Identify equilibrium solutions to a different equation using a direction field (5)
  - Determine if an equilibrium solution is stable, unstable, or semi-stable (5)
  - Use Euler's method to approximate the solution to an initial value problem

8.3 Separable Equations
- Finding General Solutions using Separation of Variables
  - Find a general solution to a differential equation composed of two polynomials using separation of variables (40)
  - Find a general solution to a differential equation with a trigonometric function using separation of variables
  - Find a general solution to a differential equation with an exponential or logarithmic function using separation of variables
- Finding Specific Solutions using Separation of Variables
  - Find a specific solution to a differential equation composed of two polynomials using separation of variables
  - Find a specific solution to a differential equation with a trigonometric function using separation of variables
  - Find a specific solution to a differential equation with an exponential or logarithmic function using separation of variables
- Application Problems using Separation of Variables
  - Solve solution concentration problems using separation of variables
  - Solve Newton's law of cooling problems using separation of variables (40)

8.4 The Logistic Equation
- Solving Logistic Population Growth Problems
  - Understand logistic population growth and carrying capacity as a differential equation
  - Solve a logistic differential equation problem

8.5 First-order Linear Differential Equations
- Recognizing and Solving First-order Linear Differential Equations
  - Identify first-order linear differential equations (40)
  - Write first-order linear differential equations in standard form (40)
  - Solve a first-order linear differential equation using an integrating factor (40)
- Applications of First-order Linear Differential Equations
  - Solve first-order differential equation problems about free fall with air resistance
• Solve first-order differential equation problems about current in electrical circuits

Chapter 9: Sequences and Series

9.1 Sequences

• Determining the Explicit Formula for a Sequence
  • Find the explicit formula for the nth term of an infinite sequence (5)
  • Find the explicit formula for the nth term of a recursively defined sequence

• Determining the Convergence of a Sequence
  • Determine if a sequence converges and if so find its limit (5)
  • Determine if a continuous function defined on a convergent sequence converges and if so finds its limit (5)

• Finding the Limit of a Sequence
  • Use the Squeeze Theorem to find the limit of a sequence
  • Determine if a sequence is bounded (5)
  • Find the limit of a sequence using the Monotone Convergence Theorem

9.2 Infinite Series

• Convergent and Harmonic Series
  • Determine whether a series converges or diverges using the sequence of partial sums (5)
  • Evaluate a convergent series using algebraic properties (5)

• Geometric Series
  • Determine if a geometric series converges and if so find its sum
  • Express repeating decimals as fractions using geometric series (5)
  • Evaluate a telescoping series

9.3 Convergence Tests for Series

• The Divergence and Integral Tests
  • Determine if a series diverges using the divergence test (5)
  • Determine if a series converges or diverges using the integral test
  • Determine if a p-series converges or diverges (5)
  • Estimate the value of a convergent series (5)

9.4 Comparison Tests

• The Comparison Test
  • Determine if a series converges or diverges using the comparison test (10)
  • Determine if a series converges or diverges using the limit comparison test (10)

9.5 Alternating Series

• Alternating Series and the Alternating Series Test
  • Determine if an alternating series converges or diverges using the alternating series test (40)
  • Estimate the remainder of an alternating series (40)
  • Determine whether a series converges absolutely or conditionally (40)

9.6 Ratio and Root Tests

• Ratio and Root Tests
  • Determine if a series converges or diverges using the ratio test (5)
  • Determine if a series converges or diverges using the root test (5)
• When to Use Convergence Tests
  • Choose an appropriate convergence test for a series (5)
  • Determine if a series converges or diverges (5)

Chapter 10: Power Series
10.1 Power Series and Functions
• Convergent Power Series
  • Identify a power series (5)
  • Find the interval of convergence of a power series (5)
  • Represent a rational function with a power series (5)
  • Determine which convergence property a power series satisfies

10.2 Properties of Power Series
• Combining Power Series
  • Find the interval of convergence of the sum of two power series (5)
  • Find the interval of convergence of the product of a power series and a power (5)
  • Multiply two power series together

• Representing Functions with Power Series
  • Use a power series to solve application problems
  • Find the power series representation of a function using a known power series (5)
  • Find the function represented by a given power series

• Calculus of Power Series
  • Integrate a power series
  • Differentiate a power series (5)

• Differential Equations and Power Series
  • Solve a first order differential equation using a power series
  • Solve Airy’s equation using a power series (5)

10.3 Taylor and Maclaurin Series
• Taylor and Maclaurin Polynomials
  • Recognize a Taylor series (5)
  • Find the Taylor polynomials for a function at a value (40)

• Estimating Function Values with Taylor and Maclaurin Series
  • Find the Maclaurin polynomials for a function (40)
  • Determine the error of a estimated function value using Taylor’s theorem (5)
  • Estimate a function value using Taylor polynomials (40)
  • Estimate a trigonometric function value using Maclaurin polynomials (5)

• Representing Functions with Taylor and Maclaurin Series
  • Represent a function at a value with a Taylor series and determine the interval of convergence
  • Find the Maclaurin series for a function and show that the series converges

10.4 Working with Taylor Series
• Binomial Series
  • Find the binomial series for function (5)
  • Estimate a function value using a binomial series (5)
Finding the Maclaurin Series that Represents a Function
- Find the Maclaurin series for a trigonometric function (5)
- Find the Maclaurin series for a logarithmic or exponential function (5)
- Find a Maclaurin series by differentiating another series (5)

Applications of the Taylor and Maclaurin Series
- Evaluate a nonelementary definite integral using a Taylor series (5)
- Approximate a probability using a Maclaurin series (5)
- Approximate the period of a pendulum using a binomial series

Chapter 11: Parametric Equations and Polar Coordinates
11.1 Parametric Equations
- Write Parametric Equations
  - Parameterize a curve (5)
  - Find the parametric equations for a line segment given an orientation (5)
- Eliminate the Parameter
  - Eliminate the parameter in linear equations (5)
  - Eliminate the parameter in polynomial and radical equations (8)
  - Eliminate the parameter in exponential and logarithmic equations (8)
  - Eliminate the parameter in trigonometric parametric equations (5)
- Graph Parametric Equations
  - Graph parametric equations by plotting points (5)
  - Graph trigonometric parametric equations by plotting points (5)
  - Use parametric equations in applications
- Cycloids
  - Graph a cycloid defined by parametric equations (5)
  - Determine the number of cusps on a hypocycloid (5)

11.2 Calculus of Parametric Curves
- Derivatives of Parametric Equations
  - Find the derivative of a curve defined by polynomial parametric equations
  - Find the derivative of a curve defined by trigonometric parametric equations
  - Find the equation of a line tangent to a parametrically defined curve
  - Find the second derivative of curve defined by parametric equations (5)
- Integrating Parametric Curves
  - Find the area under a curve defined by parametric equations (5)
  - Find the arc length of a curve defined by trigonometric parametric equations (5)
  - Find the surface area of a volume of revolution generated by revolving a parametrically defined curve

11.3 Polar Coordinates
- Defining Polar Coordinates
  - Locate points in a plane by using polar coordinates
  - Convert coordinates from polar form to rectangular form
  - Convert coordinates from rectangular form to polar form
- Converting Equations Between Rectangular and Polar Forms
● Convert a cartesian equation to polar form
● Convert a polar equation to cartesian form
● Graphs Using Polar Coordinates
  ● Identify symmetry in polar equations and curves
  ● Graph polar equations by plotting points and find zeros and maximum values for a polar equation

11.4 Calculus in Polar Coordinates
● Area and Arc Length in Polar Coordinates
  ● Find the area of a region between two polar curves
  ● Find the arc length of a polar curve
  ● Find the area of a region bounded by a polar curve