MA 366 Topics - Spring 2025

Chapter 1 - Introduction

1.1 - Basic Mathematical Models; Direction fields
1.2 - Solutions of Some Differential Equations
1.3 - Classification of Differential Equations

Chapter 2 - First Order Differential Equations

2.1 - First Order Linear Equations
2.2 - Separable Equations
2.3 - Modeling With First Order Equations
2.4 - Differences Between Linear and Nonlinear Equations
2.5 - Autonomous Equations
2.6 - Exact Equations & Integrating Factors
2.7 - Numerical Approximations; Euler (Tangent Line) Method

Chapter 3 - Second Order Linear Differential Equations

3.1 - Homogeneous Equations with Constant Coefficients
3.2 - Solutions of Linear Homogeneous Equations; Wronskians
3.3 - Complex Roots of the Characteristic Equation (and review of $\mathbb{C}$)
3.4 - Repeated Roots of the Characteristic Equation; Reduction of Order
3.5 - Nonhomogeneous Equations; Undetermined Coefficients
3.6 - Variation of Parameters
3.7 - Mechanical & Electrical Vibrations
3.8 - Forced Periodic Vibrations

Chapter 4 - Higher Order Linear Differential Equations

4.1 - n^{th} Order Linear Equations
4.2 - Homogeneous Equations with Constant Coefficients
4.3 - Undetermined Coefficients
4.4 - Variation of Parameters

Chapter 6 - The Laplace Transform

6.1 - Definition of the Laplace Transform
6.2 - Solution of Initial Value Problems
6.3 - Step Functions and Heaviside Function
6.4 - Differential equatiions with Discontinuous Forcing Functions
6.5 - Impulse Functions
6.6 - Convolutions

Chapter 7 - Systems of First Order Linear Equations

7.1 - Introduction
7.2 - Matrices
7.3 - Systems of Linear Algebraic Equations; Linear Independence, Eigenvalues, Eigenvectors
7.4 - Basic Theory of Systems of First-Order Linear Equations
7.5 - Homogeneous Linear Systems with Constant Coefficients
7.6 - Complex Eigenvalues (and review of $\mathbb{C}$)
7.7 - Fundamental Matrices
7.8 - Repeated Eigenvalues
7.9 - Nonhomogeneous Linear Systems

Chapter 9 - Nonlinear Differential Equations and Stability

9.1 - The Phase Plane
9.2 - Autonomous Systems and Stability
9.3 - Locally Linear Systems

If time permits, then also

9.4 - Competing Species
9.5 - Predator-Prey Equations