1. **Introduction to Differential Equations**
   1.1 Preliminaries
   1.2 Differential Equations; Basic Terminology
   1.3 \( n \)-Parameter Family of Solutions; General Solution
   1.4 Initial-Value Conditions; Initial-Value Problems

2. **First Order Differential Equations and Applications**
   2.1 Preliminaries
   2.2 Linear Differential Equations
   2.3 Separable Differential Equations
   2.4 Change of Variable: Extensions to Other First Order Equations
   2.5 Some Applications of First Order Differential Equations
   2.6 Direction Fields; Existence and Uniqueness
   2.7* Some Numerical Methods

3. **Second Order Linear Differential Equations**
   3.1 Introduction; Basic Terminology and Results
   3.2 Second order Linear Homogeneous Equations
   3.3 Homogeneous Equations with Constant Coefficients
   
   **Exam 1**
   
   3.4 Second Order Linear Nonhomogeneous Equations
   3.5 Nonhomogeneous Equations with Constant Coefficients; Undetermined Coefficients
   3.6 Vibrating Mechanical Systems
   3.7 Higher-Order Linear Differential Equations

4. **The Laplace Transform**
   4.1 Preliminaries
   4.2 Laplace Transform Introduction
   4.3 Basic Properties of the Laplace Transform
   4.4 Inverse Laplace Transforms and Initial-Value Problems
   4.5 Piecewise Continuous Functions, Part I: Laplace Transforms
   4.6 Piecewise Continuous Functions, Part II: Inverse Laplace Transforms
   4.7 Initial-Value Problems with Piecewise Continuous Nonhomogeneous Terms

   **Exam 2**

5. **Linear Algebra**
   5.1 Introduction
   5.2 Systems of Linear Equations; Some Geometry
   5.3 Solving Systems of Linear Equations, Part I
5.4 Solving Systems of Linear Equations, Part II
5.5 Matrices and Vectors
5.6 Square Matrices; Inverse of a Matrix, Determinants
5.7 Vector Spaces and Subspaces
5.8 Linear Dependence and Linear Independence of Vectors
5.9 Eigenvalues and Eigenvectors
5.10 *Diagonalization

6. Systems of Linear Differential Equations
6.1 Systems of Linear Differential Equations
6.2 Homogeneous Systems
6.3 Homogeneous Systems with Constant Coefficients, Part I
6.4 Homogeneous Systems with Constant Coefficients, Part II

Exam 3

6.5 *Nonhomogeneous Systems
6.6 *Direction Fields and Phase Planes

* Optional Section