

Department of Mathematics
Johns Hopkins University

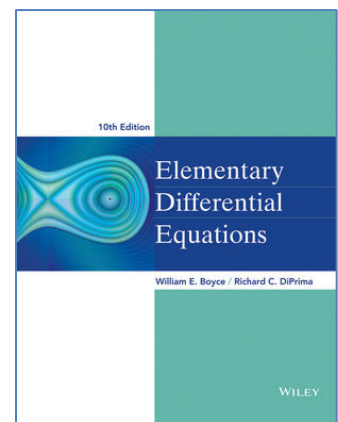
110.302 Differential Equations Course Syllabus

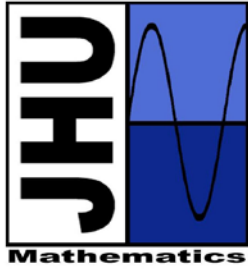
The following list of topics is considered the core content for the course 110.302 Differential Equations. The current text for the course is:

Text: [Elementary Differential Equations](#), 10th Edition, William E. Boyce and Richard C. DiPrima, ISBN: 978-0470458327.

Course Topics

- **Introduction (1- weeks)**
 - 1.1 Mathematical Models and Slope Fields
 - 1.2 Solutions to Some Differential Equations
 - 1.3 Classification of Differential Equations
- **First Order Differential Equations (3- weeks)**
 - 2.1 Linear Equations and Integrating Factors
 - 2.2 Separable Equations
 - 2.3 Modeling with First Order Equations
 - 2.4 Linear vs. Nonlinear Equations
 - 2.5 Autonomous Equations and Population Dynamics
 - 2.5 Exercises: Bifurcation Theory and Diagrams
 - 2.6 Exact Equations and Integrating Factors
 - 2.8 The Existence and Uniqueness Theorem (with proof)
- **Second Order Linear Equations (2 weeks)**
 - 3.1 Homogeneous equations with Constant Coefficients
 - 3.2 Solutions of Linear Homogeneous Equations: The Wronskian
 - 3.3 Complex Roots of Characteristic Equation
 - 3.4 Repeated Roots: Reduction of Order
 - 3.5 Nonhomogeneous Equations: Method of Undetermined Coefficients
 - 3.6 Variation of Parameters
 - 3.7 mechanical and Electrical Vibrations
- **Higher Order Linear Equations (1- weeks)**
 - 4.1 General Theory
 - 4.2 Homogeneous Equations with Constant Coefficients
 - 4.3 The Method of Undetermined Coefficients
- **Systems of First Order Linear Equations (2+ weeks)**
 - 7.1 Introduction
 - 7.2 Review of Matrices
 - 7.3 Linear Algebraic Equations: Independence, Eigensystems
 - 7.4 Basic Theory of First order Linear Systems
 - 7.5 Homogeneous Linear Systems with Constant Coefficients
 - 7.6 Complex Eigenvalues
 - 7.7 Fundamental Matrices
 - 7.8 Repeated Eigenvalues





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- **Nonlinear Differential Equations And Stability (2 weeks)**

- 9.1 The Phase Plane: Linear Systems
- 9.2 Autonomous Systems and Stability
- 9.3 Locally Linear Systems
- 9.4 Competing Species
- 9.5 Predator-Prey Equations
- 9.7 Periodic Solutions and Limit Cycles

- **Numerical methods (1- weeks)**

- 8.1 The Euler or Tangent Line Method
- 8.2 Improvements to the Euler Method
- (Optional) 8.3 The Runge-Kutta Method

Optional Topics (One of these will be covered at the Instructor's discretion.)

- **The Laplace Transform (1 week)**

- 6.1 Definition of the Laplace Transform
- 6.2 Solution of Initial value Problems
- 6.3. Step Functions
- 6.4 Discontinuous Forcing Functions

- **Series Solutions of Second Order Linear Equations (1 week)**

- 5.1 Review of Power Series
- 5.2 Series Solution near an Ordinary Point Part I
- 5.3 Series Solution near an Ordinary Point Part II
- 5.4 Euler Equations: Regular Singular Points
- 5.5 Series Solution near a Singular Point Part I