1 First Order ODEs

- Direction fields and solution curves, existence and uniqueness of solutions to first order ODEs (1.3)
- Methods for solving first order ODEs - separable, linear, exact, and substitution tricks (1.4, 1.5, 1.6)
- Equilibria, phase and bifurcation diagrams for autonomous equations (2.2)
- Euler's approximation method (2.4)

2 Higher Order ODEs

- Existence and uniqueness of solutions, form of solutions... $y = y_c + y_p$ (3.2)
- Solving homogeneous equations with constant coefficients - via roots of the characteristic polynomial (3.3)
- Solving nonhomogeneous equations - guessing a particular solution/undetermined coefficients (3.5)
- Application of 2nd order ODEs to oscillations - under/overdamped, natural frequencies, resonance (3.4, 3.6)

3 Systems of ODEs

- Rewriting higher order systems as first order systems - in matrix-vector notation (4.1, 5.1)
- Solving constant coefficient homogeneous systems - eigenvalues/vectors and fundamental matrix (5.2, 5.4)
- Solving constant coefficient homogeneous systems - matrix exponentials (5.5)
- Nonhomogeneous systems with constant coefficients (5.6)
- Classification of critical points of 2D systems (6.2)
- Application of second order systems to oscillations - natural modes and frequencies (5.3)

4 Boundary Value Problems and Fourier Series

- Finding eigenvalues and eigenfunctions of $x'' + \lambda x = 0$ with various boundary conditions (3.8)
- Dirichlet, Neumann and Fourier boundary value problem - eigenvalues and eigenfunctions (see handout)
- Computing Fourier, sine and cosine series of functions (9.2, 9.3)
- Relation of Fourier, sine and cosine series to boundary value problems (see handout)
- Application of Fourier series to forced oscillations (9.4)

5 PDEs

- General outline of separation of variables method (which all the examples we've seen follow)
- One dimensional heat and wave equations (9.5, 9.6)
- Laplace's equation in two dimensions and harmonic functions (9.7)
- More examples: transverse vibrations of bars (10.2 p. 672-674), forced string vibrations (10.3, p. 678-679)