Final Exam Material and Expectations

For the final exam, you should be able to do the following things:

Chapter 2.

- Identify whether a first-order ODE is separable, linear, exact, or homogeneous (in the non-linear sense)
- Solve separable first-order ODEs
- Solve linear first-order ODEs
- Solve exact first-order ODEs
- Solve homogeneous first-order ODEs

Chapter 3.

- Solve word problems involving growth/decay
- Solve word problems involving Newton's Law of heating/cooling
- Solve word problems involving mixtures of solutions of salt water

Chapter 4.

- Compute the Wronskian of two functions to verify linear independence
- Use the reduction of order formula to generate a second linearly independent solution
- Solve second-order linear-homogeneous equations with constant coefficients
- Use the method of undetermined coefficients from Section 4.4 to solve second-order linear-inhomogeneous equations with constant coefficients
- Use variation of parameters to solve other second-order linear-inhomogeneous equations
- Solve second-order Cauchy-Euler equations

Chapter 5.

- Form the differential equation describing motion of a spring-mass system given the mass, spring constant, damping constant, and forcing term
- Solve the equation and determine whether the system is undamped, underdamped, critically damped, or overdamped

Chapter 6.

- Given a power series, shift indices and rewrite
- Find derivatives of a power series and multiples by powers of x
- Determine whether 0 is an ordinary point, regular singular point, or irregular singular point of a differential equation
- Find two power series solutions centered at 0 to an equation when 0 is an ordinary point
- Find the indicial roots of an equation when 0 is a regular singular point
- Determine number of series solutions based on the indicial roots
- Find power series solution(s) centered at 0 when 0 is a regular singular point

Chapter 7.

- Write the integral definition of a Laplace transform
- Use the provided list of Laplace transforms to compute transforms of polynomials, exponentials, sin/cos, integrals, unit step functions, etc.
- Use the provided list of Laplace transforms to compute inverse transforms of rational functions, or rational functions multiplied by e^{as}
- Translate a piecewise-defined function into unit step functions
- Use Laplace transforms to solve initial value problems and integral equations

Chapter 11.

- Use the integral inner product to determine whether functions are orthogonal on a given interval
- Compute the Fourier series of functions defined on an interval $(-p, p)$
- For even/odd functions on $(-p, p)$, find the Fourier cosine or sine series, respectively
- Use half-range expansions to compute Fourier cosine and sine series of functions defined on an interval $(0, L)$.
- Find Fourier series solutions to differential equations

Chapter 12.

- Use the method of separation of variables to attempt to find product solutions to partial differential equations