Introduction to Ordinary Differential Equations
Outline for Exam 3

Test Date: 01/18/2023

NO BOOKS OR NOTES WILL BE PERMITTED! NO ELECTRONIC DEVICES ARE PERMITTED!

I. Higher Order Linear ODEs

A. Linear Homogeneous DEs with Constant Coefficients

1. Be able to find the general solution by finding roots of the associated characteristic polynomial.
2. Be able to solve initial value problems.

B. Wronskians and Fundamental Sets of Solutions

1. Be able to compute the Wronskian of two given functions.
2. Know what it means when the Wronskian of solutions to a DE is non-zero.

C. Method of Undetermined Coefficients for Inhomogeneous Problems

1. Be able to find the general solution to linear inhomogeneous DEs with Constant Coefficients by Undetermined Coefficients.
2. Be able to solve initial value problems.

D. Variation of Parameters

1. Know how to use variation of parameters to solve inhomogeneous 2nd order differential equations with constant coefficients.
2. The formulas for v_1 and v_2 will be given!

E. Cauchy–Euler Equations

1. Know how to find general solutions to homogeneous Cauchy–Euler Equations by finding the roots of the associated characteristic polynomial.
2. Know how to solve inhomogeneous Cauchy–Euler Equations with undetermined coefficients.

F. Oscillators (i.e. Spring-Mass Systems and RLC Circuits)

1. Be able to solve undamped oscillator problems (both free and forced).
2. Know the classification of damped oscillators (over-damped, critically damped, under-damped).
3. Be able to solve damped oscillator problems (both free and forced). Understand what is meant by transient and steady–state parts of the solution.
4. Know what resonance is.

II. Eigenvalues and Eigenvectors

A. Know the basic definitions of eigenvectors and eigenvalues. Understand what the definition means geometrically.

B. Be able to determine the eigenvalues of a square matrix (real and complex).

C. Be able to find the family of eigenvectors for a given eigenvalue (real and complex).

III. Diagonalization

A. Know when a square matrix M is diagonalizable.

B. Be able to compute the invertible matrix B and diagonal matrix D so that

$$M = BDB^{-1}.$$

C. Know how to compute functions of a diagonalizable matrix: especially powers and the matrix exponential.