MATH340_Fall 2019 Review Guide for Exams

Exam I

- Separable equations (*Suggested problems: CH1.3: 9-14; CH2.2: 13-18*)
- First order linear equations (*Suggested problems: CH2.4: 1-12, 14-17, 36-41*)
- Exact equations (*Suggested problems: CH2.6: 9-21,22-25,26-28*)
- Existence and uniqueness for 1st order ODE IVPs (*Suggested problems: CH2.7: 27-32*)
- 1st order autonomous equations and stability (*Suggested problems: CH2.9: 15-22,23-26*)
- Electrical circuits and logistic equations (*Suggested problems: CH3.1: 16, 19; CH3.4: 15-18*)
- 2nd order differential equations (*Suggested problems: CH4.1:1-12; CH4.2: 4-6; CH4.3: 1-24; CH4.4: 11-13, 23*)
- Particular and general solutions of 2nd order constant coefficient ODEs and applications (*Suggested problems: CH4.5: 1-17, 24-29; CH4.7: 8-10, 44*)

Exam II

- Laplace transform: definition of transform and inverse transform; Transformation of derivatives, e^(ct) f(t), t^n f(t); partial fractions; definition and properties of Delta functions and Heaviside functions (Suggested problems: Ch5.1, 5, 25; CH5.2: 23, 41; CH5.4: 17,21; CH5.5: 4; CH5.6 5);
- Matrix algebra: matrix operations; singularity and determinant; row echelon form; consistence and solution of linear system; parametric form of solution; null space; basis vectors; dimension; linear combination and expansion (Suggested problems: Ch7,1: 7, 20, 30; CH7.2: 12, 22; CH7.3: 8; CH7.4: 4, 8, 20, 24, 28; CH 7.5: 12, 22, 31; CH7.6: 3, 15, 25, 34; CH7.7: 27, 38)
- Basis properties of linear ODE systems: nullclines; equilibrium points; phase portraits; reduction of high order ODE to first order ODE system (Suggested problems: CH8.2: 21, 22; CH8.3: 2, 8)

Final Exam

Final exam is accumulative. In addition to those covered in Exam I and II above, we will also cover

- Linear systems with constant coefficients: Eigenvalue and eigenvectors; representation of general solution using eigenvalue and eigenvectors (CH9.1: 8, 12, 23, 35; CH9.2: 6, 10, 14, 22, 52)
- Phase plan portraits: classifications of equilibrium points at the origin using eigenvalues; Direction of the solution curves (Suggested problems: CH9.3: 10, 14, 18, 22).
- Alternative determination of types of equilibrium points using trace-determinant plane (Suggested problems: CH9.4: 2, 6,19)
- High order linear ODE system: eigenvalues, eigenvectors, and fundamental solution set

(Suggested problems: CH9.4: 2, 8, 14).

- Exponential of Matrix: definition, fundamental set of solution, computation of e^{tA} for diagonalizable A, computation of e^{tA}v for special v (Suggested problems: 16, 18, 28)
- Stability of equilibrium points, and its relation to the type of equilibrium points (nodal sink etc), and phase portraits (Suggested problems: CH9.7: 5, 8)
- High order linear ODE: Characteristic polynomial, relation to reduced first-order ODE system; fundamental solution set (Suggested problems: CH9.8: 14, 24, 34, 38)
- Nonlinear systems: Nullclines, equilibrium points, linearization of nonlinear system at equilibrium points, stability of the linearized system (Suggested problems: CH10.1: 2.6)
- Numerical method for ODE: Euler method (CH6.1: 14, 18)