Chapter Review Sheets for
Elementary Differential Equations and Boundary Value Problems, 8e

Chapter 7: Systems of First Order Linear Equations

Definitions:

- Systems of ODE's
- Linear vs. Nonlinear Systems
- Solution
- Prey-predator system
- Homogenous and Nonhomogeneous Systems Matrix,
- Transpose, Conjugate, Adjoint, Determinant Scalar
- (Inner) Product, Orthogonal
- Nonsingular (Invertible) and Singular (Noninvertible)
- Row Reduction (Gaussian Elimination)
- Linear Systems, Homogeneous, Nonhomogeneous
- Augmented Matrix
- Linear Dependence and Independence
- Eigenvalues, Eigenvectors, Generalized Eigenvectors
- The matrix exp(At)
- Normalization
- Multiplicity m, Simple Multiplicity (m = 1)
- Self Adjoint (Hermitian)
- General Solution, Fundamental Set of Solutions
- Phase Plane, Phase Portrait
- Generalized eigenvector
- Node, Saddle Point, Spiral Point, Improper Node
- Fundamental Matrix
- Similarity Transformation, Diagonalizable

Theorems:

- Theorem 7.1. l: Existence and uniqueness of solutions for general systems of First Order IVP's s
- Theorem 7.1.2. Existence and uniqueness of solutions for linear systems
- Theorem 7.4.1: Superposition of solutions
- Theorem 7.4.2: Theorem Superposition of solutions – general case
- Theorem 7.4.3: Nonvanishing of Wronskian for linearly independent solutions
- Theorem 7.4.4: Existence of fundamental set of solutions

Important Skills:

- Representation of solutions and vectors
- Find the inverse of a matrix. (Example 2, p.370)
- Find the solution to a set of linear algebraic equations. (Example 1, p.375)
- Determine if a set of vectors are linearly independent. (Example 3, p.378)
- Find the eigenvalues and eigenvectors of a matrix. (Example 5, p.381)
- Sketch a direction field for a 2 x 2 system of linear ODE's. (Example 2, p.394)
- Find the general solution of a system of linear ODE's.
- Distinct Eigenvalues (Example 3, p.394)
- Complex Eigenvalues (Example 1, p.402)
- Repeated Eigenvalues (Example 2, p.423)
- Find the fundamental matrix for a system of linear ODE's. (Example 3, p.418)

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- Find the similarity transformation to diagonalize a matrix. (Example 3, p.418)
- Use the method of undetermined coefficients to find the particular solution to a nonhornogeneous linear system of QDE's. (Example 2, p.434)
- Use the method of variation of parameters to find the particular solution to a nonhomogeneous linear system of QDE's. (Example 3, p.436)

Relevant Applications:

- Multiple Spring Mass Problems, Multiple Tank Mixture Problems