CAL POLY

September 2009

MATH 244 Linear Analysis I

1. Catalog Description

MATH 244 Linear Analysis I (4) (Also listed as HNRS 244)

Separable and linear ordinary differential equations with selected applications; numerical and analytical solutions. Linear algebra: vectors in *n*-space, matrices, linear transformations, eigenvalues, eigenvectors, diagonalization; applications to the study of systems of linear differential equations. 4 lectures. Prerequisite: MATH 143 or consent of instructor.

2. Required Background or Experience

Math 143 or equivalent.

3. Learning Objectives

The student should:

a. Develop an understanding of the elementary theory of ordinary differential equations and their solutions in the context of separable and first order linear ordinary differential equations and recognize situations where these equations arise in selected mathematical models.
b. Become familiar with the terminology and methods of solution of higher order linear differential equations, especially methods for constant coefficient homogeneous and forced equations, and understand how these solution methods apply to selected second order linear models.
c. Develop an understanding of linear algebra in Euclidean *n*-space and how vectors and matrices are used to solve systems of equations, both algebraic and differential.

4. Text and References

Edwards/Penney/Greenberg, Differential Equations and Linear Algebra – Custom Edition for Cal Poly SLO, Pearson/Prentice-Hall, 2006.

5. Minimum Student Materials

Paper, pencils, calculator and notebook.

6. Minimum University Facilities

Classroom with ample chalkboard space and computer laboratory.

7. Content and Method

Topic	Days
Chapter 1. First Order Differential Equations	5
1.1 Differential equations and mathematical modeling	
1.2 Integrals as general and particular solutions	
1.3 Slope fields and solution curves	
1.4 Separable equations and applications	
1.5 Linear first-order equations	

Chapter 2. Mathematical Models and Numerical Methods	1
2.4 Numerical approximations: Euler's method	
Chapter 3. Linear Systems and Matrices	6
3.1 Introduction to linear systems	
3.2 Matrices and Gaussian elimination	
3.3 Reduced row-echelon matrices	
3.4 Matrix operations	
3.5 Inverses of matrices	
3.6 Determinants	
Chapter 4. Vector Spaces	7
4.1 The vector space $\mathbf{R}^3_n$	
4.2 The vector space $\mathbf{R}^n$ and subspaces	
4.3 Linear combinations and independence of vectors	
4.4 Bases and dimension for vector spaces	
4.5 Row and column spaces	
4.7 General vector spaces (May be omitted if time is short)	
Chapter 5. Linear Equations of Higher Order	7
5.1 Introduction: Second-order linear equations	
5.2 General solutions of linear equations	
5.3 Homogeneous equations with constant coefficients	
5.4 Mechanical vibrations	
5.5 Nonhomogeneous equations and undetermined coefficients	
5.6 Forced oscillations and resonance	
Chapter 6. Eigenvalues and Eigenvectors	3
6.1 Introduction to eigenvalues	
6.2 Diagonalization of matrices	
Chapter 7. Linear Systems of Differential Equations	4
7.1 First-order systems and applications	
7.2 Matrices and linear systems	
7.3 The eigenvalue method for linear systems	
Total	33

The principal emphasis in Chapter 5 should be on second-order equations.

Optional topics (only if time permits)

6.3 Applications involving powers of matrices
7.4 Second-order systems and mechanical applications
7.5 Multiple eigenvalue solutions
7.6 Numerical methods for systems

Method

Lecture/discussion and regular homework assignments.

8. Methods of Assessment

Homework assignments, tests, classroom participation and a comprehensive final examination.