CAL POLY

September 2009

MATH 344 Linear Analysis II

1. Catalog Description

MATH 344 Linear Analysis II (4) GE B6

Linear methods applied to the solution of differential equations. Laplace transforms. Series solutions to ordinary differential equations. Orthogonality in *n*-space, Gram-Schmidt orthogonalization and least squares methods. Orthogonal bases in function spaces, Sturm-Liouville theory. Fourier series and transforms. Special functions of applied mathematics. 4 lectures. Prerequisite: MATH 206 and MATH 242, or MATH 241 and MATH 244, or consent of instructor.

2. Required Background or Experience

Math 206 and Math 242, or Math 241 and Math 244 or their equivalent.

3. Learning Objectives

The student should:

a. Develop an understanding of the theory of Laplace transforms and its application to ordinary differential equations and linear systems.
b. Be familiar with orthogonality in a linear space, its application to approximation theory, and its use in the solution of ordinary and partial differential equations.
c. Be able to show how boundary value problems generate many of the special functions of applied mathematics and become familiar with some of the orthogonal families of these functions that arise as solutions to Sturm Liouville problems.

4. Text and References

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

Hartig, Donald, Least Squares Approximations , An Introduction, El Corral.

5. Minimum Student Materials

Paper, pencils, calculator and notebook.

6. Minimum University Facilities

Classroom with ample chalkboard space and computer lab.

7. Content and Method

Topic		Days
Edwards/Penney/Greenberg, Differential Equations and Linear Algebra – Custom Edition for Cal Poly SLO		
Chapter 7.	**Laplace Transform Methods**	9
7.1	Laplace transforms and inverse transforms	
7.2	Transformation of initial value problems	
7.3	Translation and partial fractions	
7.4	Derivatives, integrals, and products of transforms	
7.5	Periodic and piecewise continuous input functions	
7.6	Impulse and delta functions	

Chapter 8.	**Power Series Methods**	9
8.1	Introduction and review of power series	
8.2	Series solutions near ordinary points	
8.3	Regular singular points	
8.4	Method of Frobenius; The exceptional cases	
8.5	Bessel's equation	

Hartig, Donald, Least Squares Approximations , An Introduction 6

1. Introduction, projections in $\mathbf{R}^2$
2. Projections in $\mathbf{R}^3$
3. Projections in $\mathbf{R}^n$, the normal equation
4. Least squares in function spaces

Edwards/Penney/Greenberg, Differential Equations and Linear Algebra – Custom Edition for Cal Poly SLO

Chapter 9.	**Fourier Series Methods**	6
9.1	Periodic functions and trigonometric series	
9.2	General Fourier series and convergence	
9.3	Fourier sine and cosine series	
9.4	Applications of Fourier series	
9.5	Heat conduction and separation of variables	

(From Greenberg's Advanced Engineering Mathematics)

Chapter 17.	**Fourier Series, Fourier Integral, Fourier Transform**	4
17.9	Fourier integral	
17.10	Fourier transform	
	Total	34

Optional topics (only if time permits)

8.6	Applications of Bessel functions
17.11	Fourier cosine and sine transforms

Method

Lecture/discussion and regular homework assignments.

8. Methods of Assessment

The primary methods of assessment are, in decreasing order of importance: essay examinations, quizzes and homework. Typically, there will be two or three hour-long examinations during the quarter, and a comprehensive final examination. Students are required to show their work, and are graded not only on the correctness of their answers, but also on their understanding of the concepts and techniques. Quizzes are typically given once or twice a week to provide a spot check of student learning. Homework is required daily.