



September 2011

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

The text is to be chosen by the instructor. Possible texts include:

- a. Nagle, Saff, and Snider, Fundamentals of Differential Equations, 7th ed., Pearson/Addison-Wesley, 2008.
- b. Zill and Cullen, Differential Equations with Boundary-Value Problems, 7th ed., Brooks/Cole, 2009.
- c. Polking, Boggess, and Arnold, Differential Equations with Boundary Value Problems, 2nd ed., Pearson Prentice Hall, 2006.
- d. Goode and Annin, Differential Equations and Linear Algebra, 3rd ed., Pearson Prentice Hall, 2007, paired with Hartig, 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

<u>Topic</u>	<u>Days</u>
Laplace Transform Methods	10
Laplace transforms and inverse transforms	
Transformation of initial value problems	
Translation and partial fractions	
Derivatives, integrals, and products of transforms	
Periodic and piecewise continuous input functions	
Impulse and delta functions	
Power Series Methods	10
Introduction and review of power series	
Series solutions near ordinary points	
Regular singular points	
Method of Frobenius; The exceptional cases (see Note)	
Legendre's equation	
Bessel's equation	
Note: It is not necessary to develop the general recursion relation for the solution about a regular singular point. It suffices to find, in this case, only the first few nonzero terms in the series.	
Fourier Series Methods	10
Periodic functions and trigonometric series	
General Fourier series and convergence	
Fourier series as projection/least squares in function spaces	
Fourier sine and cosine series	
Applications of Fourier series	
Heat conduction and separation of variables (see Note)	
Note: Minimal time should be spent on the technique of separation of variables, which is a topic covered in detail in MATH 418.	
Extensions of Fourier Series	4
Fourier integral	
Fourier transform	
Fourier sine and cosine transform (time permitting)	
Total	<u>34</u>

Method

Lecture/discussion and regular homework assignments.

8. Methods of Assessment

The primary methods of assessment are 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 graded not only on the correctness of their answers, but also on their understanding of the concepts and techniques.