MATH 344 Linear Analysis II

1. Catalog Description

MATH 344 Linear Analysis II **4 units**
GE Area B6

Prerequisite: MATH 206 and MATH 242, or MATH 241 and MATH 244.

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. Fulfills GE B6.

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

Note: No single text suffices – each text needs a supplement.
The text is to be chosen by the instructor. Suggested texts include:

- Nagle, Saff, and Snider, Fundamentals of Differential Equations
- Zill and Cullen, Differential Equations with Boundary-Value Problems
- Polking, Boggess, and Arnold, Differential Equations with Boundary Value Problems
- Goode and Annin, Differential Equations and Linear Algebra
- Boyce and Prima, Elementary Differential Equations and Value Boundary Problems

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

a. **Laplace Transform Methods**
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

b. **Power Series Methods**
Introduction and review of power series
Series solutions near ordinary points
Regular singular points
Method of Frobenius; The exceptional cases
Legendre's equation
Bessel's equation

c. **Fourier Series Methods**
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

d. **Extensions of Fourier Series**
Fourier integral
Fourier transform
Fourier sine and cosine transform (time permitting)

e. **Orthogonality**
Orthogonality *n*-space
Gram-Schmidt orthogonalization and least square methods
Orthogonal bases in function spaces
Sturm-Liouville theory

8. Methods of Assessment

The primary methods of assessment are: essay examinations, quizzes and homework. Typically, there will be one or more hour-long examinations during the quarter, and a required 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.