

## Syllabus

Instructor: Prof. Abdelkader Boucherif

**Course No.:** Math.611

**Course Title:** Hilbert space methods in applied mathematics

**Textbook:** I. Stakgold, Green's functions and boundary value problems,  
John Wiley & Sons, New York, 1979

**Course Description:** Review of normed and inner product spaces. Theory of distributions, weak solution.

Complete orthonormal sets and generalized Fourier expansions. Green's functions and boundary-value problems, modified Green's functions.

Operator theory, invertibility, adjoint operators, solvability conditions. Fredholm alternative. Spectrum of an operator.

Extremal principles for eigenvalues and perturbation of eigenvalue problems. Applications.

**Objectives:** This course is designed to expose the students to methods applicable to problems arising in the applied sciences.

Metric and Hilbert spaces shall be discussed in order to introduce the basic ideas of operator theory, spectral theory and some applications.

The theory of distributions will be presented in an elementary way.

The method of Green's functions is introduced through intuitive ideas and simple examples,

and then applied to the systematic study of two-point boundary value problems for second and higher order differential equations.

Sturm Liouville theory, eigenfunctions expansion are introduced to complement the Green's function approach.

Week	Section #	Topic
1-2	Chapter 4	Metric and Hilbert Spaces
3-5	Chapter 5	Operator Theory, Spectral Theory and Applications
6-8	Chapter 2	Theory of distributions and related topics
9-12	Chapter 1	Green's functions: examples, properties
13-14	Chapter 3	One dimensional boundary value problems
15	Reviews	Applications

**Grading Policy:** One Midterm Exam: **35 %**; Final Exam: **45 %**; Assignments: **20 %**.