

King Fahd University of Petroleum & Minerals  
Department of Mathematics and Statistics

MATH 535 (071)

**Course Syllabus**

**Course Instructor:** Dr. Mohamed A. El-Gebeily

**Recommended Text:** Erdogan Suhubi, "Functional Analysis", Kluwer Academic Publishers, (2003)

**Main Topics to be Covered:** Normed linear spaces, Banach spaces, Hilbert spaces, Banach algebras (definitions, examples and geometric properties) bounded linear operators, convex sets, linear functionals, duality, reflexive spaces, weak topology and weak convergence, Banach fixed point theorem, Hahn-Banach theorem, uniform boundedness principle, open mapping theorem, closed graph theorem, representation of functionals on Hilbert spaces (Riesz Representation Theorem).

**Prerequisite: Math 411.**

**Course Objectives:** This course is designed to introduce the students to the structures of infinite dimensional vector spaces and transformations, which are frequently called operators, between such spaces. Properties of such spaces that come from the algebraic structures will be discriminated from those which come from topology and ultimately, metrics and norms.

**Students Learning Outcome:** After completion of the course, the students should be able to

- gain familiarity with spaces of infinite dimension
- understand bounded linear operators on these spaces
- understand the interplay between linear algebra and topology
- see some applications in other fields of mathematics

**Course Evaluation Policy:**

Exam I 25% Exam II 25% Final Exam 25% Homework 25%

**Policy about Unexcused Absences:** KFUPM policy on unexcused absences will be followed.

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**Office Hours:** SMW: 11:00-12:00 or by appointment

### Weekly Coverage of Course Material

Week	Date	Section	Topic
1	Sep 8-12	2.2 2.3 2.4	Linear Vector Spaces Subspaces Linear independence and dependence
2	Sep 15-19	2.5 2.7 2.10	Basis and Dimension Linear Transformations Linear functionals. Algebraic dual
3	Sep 22-26	4.2 4.3	Topological Structure Bases and Subbases
4	Sep 29-Oct 3	4.4 4.6	Some Topological concepts Topological vector spaces
5	Oct 20-25	5.2 5.3 5.4	The metric and the metric topology Various metric spaces Topological properties of metric spaces
6	Oct 27-31	5.5 5.6 5.7	Completeness of metric spaces Contraction mappings Compact metric spaces
7	Nov 03-07	6.2 6.3 6.4	Normed Spaces Semi-Norms Series of Vectors
8	Nov 10-14	6.5 6.6 6.7	Bounded Linear operators Equivalent Normed Spaces Bounded below operators
9	Nov 17-21	6.8 6.9 6.10	Continuous linear functionals Topological dual Strong and weak topologies
10	Nov 24-28	6.11 6.12 6.13	Compact operators Closed operators Conjugate operators
11	Dec 01-05	6.14 7.2 7.3	Classification of continuous linear operators Inner product spaces Orthogonal subspaces
12	Dec.08-12	7.4 7.5 7.6	Orthonormal sets and Fourier series Duals of Hilbert spaces Linear operators in Hilbert spaces
13	Dec29-Jan02	7.7 8.2 8.3	Forms and variational equations The resolvent set and the spectrum The resolvent operator
14	Jan 05-09	8.4 8.5 8.6	The spectrum of a bounded operator The spectrum of a compact operator Functions of operators
15	Jan.12-16		Banach Algebras

- September 23 is a national holiday.
- Oct. 04 -19: Eid al-Fitr Vacation
- October 25 is a normal Saturday classes.
- Dec 13-28: Id al-Adha Vacation