Philadelphia University
Faculty of Science
Department of Basic Sciences and Mathematics
Second Semester 2007/2008

Course Syllabus

Course Title	Functional Analysis	**Course Code**	250412
Course Level	"4"	**Course Prerequisite**	250311 "Real Analysis I"
Lecture Time	Sun, Tue, Thu. 13:10–14:00	**Credit Hours**	"3"

Academic Staff Specific

Name	Hussien Albadawi	**Office Hours**	Sun.	09:00 – 10:00
Rank	Ass. Prof.		Mon	08:15 – 09:45
Office Number	"819"		Tue.	11:00 – 12:00
Location	Faculty of Science		Wed.	11:15 – 12:45
E – mail	hbadawi@philadelphia.edu.jo		Thu.	12:00 – 01:00

Course Description:

This course is intended to familiarize the students with the basic concepts, principles and methods of functional analysis and its applications.

The course covers many of important subjects. It starts with **Metric Spaces** and ends with **Fundamentals Theorems for Normed and Banach Spaces**. Between these two subjects, the student will deal with new concepts like **Normed Spaces, Banach Spaces, Inner Product Spaces, and Hilbert Spaces.** Also, the student will learn about **Bounded and Continuous Linear Operator.**

Course Objectives:

1. Define metric spaces and related concepts and illustrate them with typical examples.
2. Understand the theory of inner product spaces and prove their properties.
3. Understand the theory of normed spaces, Banach spaces, and the theory of linear operators.
4. Know examples of linear functionals, finite dimensional spaces, and dual space.
5. Derive and apply the basic properties of Hilbert spaces.
6. Prove the fundamental theorems for normed and Banach spaces.
7. Apply the fundamentals theorems to prove basic theorems.

Course components (Text Book):

Title	:	Introductory Functional Analysis with Applications
Author	:	Erwin Kreyszing
Publisher	:	John Wiley & Sons., Inc
Edition	:	1st
Year	:	1989
ISBN	:	0-471-03729-x

Teaching methods:

1. Understand properties of metric spaces and inner product spaces.
2. Use the properties of Banach spaces to prove some important theorems.
3. Use the properties of Hilbert spaces to prove some important theorems.

Learning outcomes:

- **Knowledge and understanding**
    1. To give the student the necessary information to deals with mathematical problems.
    2. To give the student the necessary mathematical tools for further study in applied and pure mathematics
    3. To demonstrate the ability of using Functional analysis in solving mathematical problems.
- **Cognitive skills (thinking and analysis).**
  To identify and solve problems. Work with given information and handle mathematical proofs based on mathematical theorems.
- **Communication skills (personal and academic).**
  Encourage the students to be self-starters (creativity, decisiveness, initiative) and to finish the mathematical problems properly (flexibility, adaptability). Also to improve general performance of students through the interaction with each other in solving different mathematical problems.
- **Practical and subject specific skills (Transferable Skills).**
  Gaining knowledge and experience of working with many pure mathematical problems.

Assessment instruments

Allocation of Marks	
Assessment Instruments	**Mark**
First Examination	20
Second Examination	20
Homeworks and Quizzes	10
Final Examination	50
Total	**100**

Module references:

Title	:	A Course in Functional Analysis
Author	:	John B. Conway
Publisher	:	Springer
Edition	:	4th printing edition
Year	:	1994
ISBN	:	0387972455

Expected workload:

On average students need to spend, at least, 6 hours of study and preparation per week for this course.

Attendance policy:

Absence from lectures shall not exceed 15%. Students who exceed the 15% limit without a medical or emergency excuse acceptable to and approved by the Dean of the relevant college/faculty shall not be allowed to take the final examination and shall receive a mark of zero for the course. If the excuse is approved by the Dean, the student shall be considered to have withdrawn from the course.

Course/module academic calendar

week	Basic and support material to be covered
(1)	**Metric Spaces:** 1. Metric Space. 2. Examples of Metric Spaces. 3. Convergence.
(2)	4. Cauchy Sequence and Completeness. 5. Completion of Metric Spaces. 6. Completeness Proofs.
(3)	**Normed Spaces and Banach Spaces:** 1. Vector Space. 2. Normed Space and Banach Space. 3. Properties.
(4)	4. Finite Dimensional Normed Spaces. 5. Subspaces. 6. Compactness.
(5)	7. Linear Operators. 8. Continuous Linear Operators. 9. Linear Functionals.
(6) **First examination**	10. Normed Spaces of Operators.
(7)	**Inner Product Spaces and Hilbert Spaces:** 1. Inner Product Space. 2. Hilbert Space. 3. Properties.
(8)	4. Orthonormal Sets and Sequences. 5. Hilbert Adjoint Operator.
(9)	6. Self Adjoint Operator. 7. Unitary Operators. 8. Normal Operators.
(10)	9. Bounded and Continuous Linear Operator. 10. Hilbert Space Operators. 11. Unitarily Invariant Norms.
(11) **Second examination**	12. Total Orthonormal Sets.
(12)	**Fundamentals Theorems for Normed and Banach Spaces:** 1. Zorn's Lemma. 2. Hahn – Banach Theorem.
(13)	3. Hahn – Banach Theorem for Complex Vector Spaces and Normed Spaces. 4. Applications to Bounded Linear Functionals on $C[a,b]$.
(14)	5. Adjoint Operator. 6. Reflexive Spaces.
(15)	7. Category Theorem and Uniform Boundedness Theorem. 8. Strong and Weak Convergence. 9. Convergence of Sequences Operators and Functionals.
(16) **Final Examination**	10. Open Mapping Theorem.

Website:

http://ecourse.philadelphia.edu.jo/login/index.php

Functional Analysis with Applications. Article (PDF Available) Â· August 2014 with 2,078 Reads. Source: arXiv.Â Over the decades, Functional Analysis has been enriched and inspired on account of demands from neighboring fields, within mathematics, harmonic analysis (wavelets and signal processing), numerical analysis (finite element methods, discretization), PDEs (diffusion equations, scattering theory), representation theory; iterated function systems (fractals, Julia sets, chaotic dynamical systems), ergodic theory, operator algebras, and many more. And neighboring areas, probability/statistics (for example stochastic processes, Ito and Malliavin calculus), physics (representation of Lie groups, quant