KINGDOOM OF SAUDI ARABIA
Ministry of Education
Al-Imam Mohammad Ibn Saud Islamic University
College of Sciences
Department of Mathematics & Statistics

المملكة العربية السعودية
وزارة التعـلـيـم
جامعة الإمام محمد بن سعود الإسلامية
كلية العلوم
قسم الرياضيات والإحصاء

SYLLABUS

Course Code	Course Num.	Course Name	Credit Hours	Lec.	Lab.	Tut.	Private study	Pre-requisites	Course Level	Teaching Language
MAT	**613**	**Introduction to Functional Analysis**	**4**	**3**	**0**	**1**	**8**	**MAT 611**	**1**	**English**

A. Course Description

This course describes the most important ideas, theoretical results, and applications in Functional Analysis. The course includes the theories of normed, Banach, and Hilbert spaces and their impact on fundamental theorems of Functional Analysis. It also introduces the notions of weak and weak* topologies.

It covers the concept of linear, adjoint, unitary and normal operators. The emphasis is on theoretical results and their applications.

B. Course Outcomes

At the end of this course the student will be able to:

1. Learn about characterizations and properties of Banach and Hilbert spaces.
2. Be familiar with linear operators and functionals.
3. Learn the basic concepts and fundamental theorems in Functional Analysis.
4. Be familiar with weak and weak* topologies.

C. References:

Required Textbook

E. Kreyszig, *Introductory Functional Analysis, 1st Ed. Wiley, 1989.*

Other references

1. *Real Analysis,* H.L. Royden, P.M. Fitzpatrick, 4th Edition, Prentice Hall, 2010.
2. *Applied Functional Analysis,* J.P. Aubin, Wiley-Interscience, 2000.
3. *Applied Functional Analysis,* J. Oden, L. Demkowicz, Chapman & Hall, 2nd Ed. 2009.

Course Website: Google Classroom Webpage: http://www.imamm.org/

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D. Topics Outline

1. **Normed and Banach Spaces:** Review of Metric Spaces, Normed Spaces, Cauchy Sequences and Banach Spaces, Equivalence of Norms in Finite Dimensional Normed Spaces, The Euclidian Space R^n and The Unitary Space C^n, The Spaces L^1 and L^∞.

2. **Inner Product And Hilbert Spaces:** Schwarz and Triangle Inequalities, Subspaces of Hilbert Spaces, Orthogonal Complements and Direct Sums, The Null Space Lemma, Orthonormal Sets and Sequences, Bessel Inequality, Total Sets and Total Orthonormal Sets, Separable Hilbert Spaces, Isomorphic Property of The Dimension.

3. **Continuous Linear Operators between Normed Spaces:** The Normed Space of Linear Operators, Hilbert's Adjoint Operator and its Properties, Self-Adjoint, Unitary, and Normal Operators, The Uniform Boundedness Theorem, The Open Mapping and The Closed Graph Theorem.

4. **Duality of Normed Spaces:** Hahn-Banach Theorem, Weak Convergence, Weak* Convergence, and Weak Sequential Convergence.

E. Office Hours

Office hours give students the opportunity to ask in-depth questions and to explore points of confusion or interest that cannot be fully addressed in class.

F. Exams & Grading System

The semi-official dates of the exams for this course are:

– **Midterm:** 8th or 9th week.

– **Quizzes & Homework:** During the semester.

– **Final Exam:** 16th week.

Your course grade will be based on your semester work as follows:

Midterm : 30 %	Final Exam: 40 %
4 Quizzes + 4 Homeworks, Attendance & Participation: 30 %	

The grading distribution:

A^+	A	B^+	B	C^+	C	F
[95, 100]	[90, 95)	[85, 90)	[80, 85)	[75, 80)	[70, 75)	[0, 70)

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G. Student Workload:

#	Teaching/learning activities	Contact Hours	Frequency	Total Contact hours	Self-study hours	Total self-study hours	Student Learning Time
1	Lecture	3	15	45	1.5	22.5	67.5
2	Tutorial	1	15	15	3	45	60
3	Lab\Practical	0	0	0	0	0	0
4	Homework	0	4	0	1.5	22.5	22.5
5	Quiz	0.25	4	1	1	4	5
6	Test (Midterm)	2	1	2	12	12	14
7	Final Exam	2	1	2	12	12	14
Total				65		118	183

Independent self-study = 118/15 $\cong$ 8 hrs per week

H. Student Attendance/Absence

Only three situations will be considered as possible excused absences:

- Occurrence of a birth or death in the immediate family will be excused. ("Immediate family" is defined by the University as spouse, grandparents, parents, brother, or sister).
- Severe illness in which a student is under the care of a doctor and physically unable to attend class will be excused. Students are not excused for a doctor's appointment. Do not make appointments that conflict with rehearsals. Notes from the University Health Center will be accepted.

Executive Rules for Study Regulations and Examsgoo.gl/ykm7t3