



**The University of Jordan**

**Accreditation & Quality Assurance Center**

**COURSE Syllabus**

Basics in Functional  
Analysis

1	Course title	Basics in Functional Analysis
2	Course number	(0331413)
3	Credit hours (theory, practical)	3
	Contact hours (theory, practical)	3
4	Prerequisites/corequisites	(0331212)
5	Program title	B.Sc.
6	Program code	
7	Awarding institution	The University of Jordan
8	Faculty	Science
9	Department	Mathematics
10	Level of course	Elective specialization requirement
11	Year of study and semester (s)	4 <sup>th</sup> year, 1 <sup>st</sup> and 2 <sup>nd</sup> semester
12	Final Qualification	B.Sc. in Mathematics
13	Other department (s) involved in teaching the course	None
14	Language of Instruction	English
15	Date of production/revision	12/11/2017

**16. Course Coordinator:**

*Office numbers, office hours, phone numbers, and email addresses should be listed.*

Dr. Abdalla Tallafha

**17. Other instructors:**

*Office numbers, office hours, phone numbers, and email addresses should be listed.*

**18. Course Description:**

*As stated in the approved study plan.*

Metric spaces, examples of metric spaces, open sets, closed sets, neighbourhoods, convergence, Cauchy sequences, completeness, examples of complete metric spaces, completion of metric spaces, vector spaces, infinite dimensional vector spaces and subspaces, linearly dependent and independent vectors, Hamel basis, normed spaces, Banach spaces, properties of normed spaces, compactness and finite dimensional spaces, linear functionals, dual spaces, inner product spaces, Hilbert spaces, orthonormal sets and sequences, linear operators, bounded and continuous linear operators.

**19. Course aims and outcomes:****A- Aims:**

- 1- To present the definition and basic properties of metric spaces.
- 2- To visualize the relation between metric space and topological space.
- 3- To introduce the idea convergent, Cauchy for sequences.
- 4- To present the idea completeness.
- 5- To introduce the definition and basic properties of vector spaces.
- 6- To present the definition and basic properties of inner product spaces.

**B- Intended Learning Outcomes (ILOs):** Upon successful completion of this course students will be able to

**A. Knowledge and Understanding Skills:** Student is expected to

- A1. Understand the definition of metric spaces.
- A2. Understand the definition of convergent, Cauchy for sequences.
- A3. Recall the relation between metric space and topological space
- A4. Explain the idea completeness
- A5. Recall the definition and basic properties of vector spaces.
- A6. Understand the definition of inner product spaces.
- A7. Summarize the basic properties of inner product spaces.

**B. Intellectual Analytical and Cognitive Skills:** Student is expected to

- B1. Classify different kinds of sequences, convergent, divergent, bounded, Cauchy.
- B2. Analyze different properties of metric spaces, vector spaces, and inner product spaces.

**C. Subject- Specific Skills:** Student is expected to

- C1. Apply different techniques for problem solving .
- C2. Construct examples of a metric space which is not induced by a norm.
- C3. Construct examples of a normed space which is not induced by an inner product.

**D. Creativity /Transferable Key Skills/Evaluation:** Student is expected to

- D1. Use tools of sequences of functions in many branches of applied math to find approximate solutions for problems in numerical analysis differential equations and optimization.
- D2. Use tools of functional analysis in differential equation.

**20. Topic Outline and Schedule:**

Topic	Week	Instructor	Achieved ILOs	Evaluation Methods	Reference
Metric spaces, examples of metric spaces.	1			Exam	
Open set, closed set, neighbourhood.	2			Exam	
Convergence, Cauchy sequence, completeness, examples of complete metric spaces.	3, 4			Exam	
Completion of metric spaces.	5			Exam	
Vector space, infinite dimensional vector space and subspaces.	6,7			Exam	
Linearly dependent and independent, Hamel basis.	8			Exam	
Normed space, Banach space, properties of normed space.	9,10			Exam	
Compactness and finite dimensional, Linear functional, , dual spaces.	11, 12			Exam	
Inner product space, Hilbert space, orthonormal sets	13			Exam	
Linear operators, bounded and continuous linear operators.	14			Exam	
Normed space of operators, dual space.	15			Exam	

**21. Teaching Methods and Assignments:**

Development of ILOs is promoted through the following teaching and learning methods:

In order to succeed in this course, each student needs to be an active participant in learning – both in class and out of class.

- The instructor will spend most of the class time on presenting the new material as well as on discussing homework problems.
- Group work in this class is encouraged.
- To actively participate in class, you need to prepare by reading the textbook and to do all assigned problems before class. (Problems will be assigned each class period, then to be discussed the following period).
- You should be prepared to discuss your homework at each class meeting.
- You are encouraged to work together with other students and to ask questions and seek help from your professor, both in and out of class.
- Students are also encouraged to use graphing calculators extensively and to use computer software supplements.

**22. Evaluation Methods and Course Requirements:**

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements:

ILO/s	Learning Methods	Evaluation Methods	Related ILO/s to the program
	Lectures	Exam	

**23. Course Policies:**

1. Attendance is absolutely essential to succeed in this course. You are expected to attend every class; please notify your instructor if you know you are going to be absent. All exams must be taken at the scheduled time.

- Exceptions will be made only in extreme circumstances, by prior arrangement with the instructor.
2. If a student is absent for more than 10% of lectures without an excuse of sickness or due to other insurmountable difficulty, then he/she shall be barred from the final examination also he/she will get a failing grade in this course.
  3. Medical certificates shall be given to the University Physician to be authorized by him. They should be presented to the Dean of the Faculty within two weeks of the student's ceasing to attend classes.
  4. Test papers shall be returned to students after correction. His/her mark is considered final after a lapse of one week following their return.
  5. Cheating is prohibited. The University of Jordan regulations on cheating will be applied to any student who cheats in exams or on homework.

#### 24. Required equipment:

#### 25. References:

A- Required book (s), assigned reading and audio-visuals:

1- Introductory Functional Analysis with Applications, Erwin Kreyszeg, John Wiley and sons, New York, 1989.

B- Recommended books, materials, and media:

1- Fundamentals of Functional Analysis, S. S. Kutateladze, Springer-Science+Business Media, B.V, 1995.

2 An Introduction to Functional Analysis, Laurent W. Marcoux, Department of Pure Mathematics University of Waterloo Waterloo, Ontario Canada N2L 3G1 May 24, 2013.

#### 26. Additional information:

Name of Course Coordinator: Dr. Abdalla Tallafha Signature: ----- Date: 12/11/2017

Head of curriculum committee/Department: Dr. Emad Abu Osba Signature: -----

Head of Department: Dr. Emad Abu Osba Signature: -----

Head of curriculum committee/Faculty: Dr. Salwa alBdour Signature: -----

Dean: Dr. Shaher Almomani Signature: -----

Copy to:

Head of Department

Assistant Dean for Quality Assurance

Course File