هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	**Functional Analysis**
Course Code:	**2024115-3**
Program:	**Bachelor in Mathematics.**
Department:	**Mathematics and Statistics Department**
College:	**Faculty of sciences**
Institution:	**Taif university**

Table of Contents

A. Course Identification

1. Credit hours: 3	
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☐ Elective ☑
3. Level/year at which this course is offered:	10th level / 4th year
4. Pre-requisites for this course (if any)**:**	Real Analysis (2) (2023202-4)
5. Co-requisites for this course (if any)**:**	None

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	**5Hr /Week**	100
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	50
2	**Laboratory/Studio**	
3	**Tutorial**	
4	**Others** (specify)	
	Total	50

B. Course Objectives and Learning Outcomes

1. Course Description

This course will cover the principles and methods of Functional analysis and its applications in metric spaces with example, Complete metric spaces , Separable metric space , Compact sets, Normed & Banach spaces , Convergence , Bounded linear functional and operators , Dual spaces , Reflexive spaces, Ad joint operator, Inner product space and Hilbert spaces with example, Projection theorem , Orthonormal sets and sequences ,Total orthonormal sets , Riesz representation theorem, Self-ad joint, Unitary and Normal operators, Hilbert -Adjoint operator, The Hahn Banach Extension theorem, Uniform boundedness theorem (The Banach Steinhaus theorem), Open mapping theorem and Closed graph theorem .

2. Course Main Objective

In this course, the student should be taught as follows:

1. Stating and defining metric and normed spaces.
2. Identifying and know linear operators and transformation, Reproducing Hahn

Banach theorem and Hilbert spaces applications, Studying the fixed-point theorem. and applying the spectral theory in finite and infinite dimensional

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and understanding:**	
1.1	State the definition of (metric spaces and Complete Spaces -normed space and Banach spaces – Hilbert space)	K2
1.2	Describe the (Convergence, Completeness) in a different space	K2
2	**Skills:**	
2.1	Use Analytical techniques in solving many Applications in other disciplines.	S1
2.2	Explain the dual and reflexive spaces.	S1
2.3	Summarize open and closed mapping.	S1
3	**Values:**	
3.1	Show the responsibility for their own learning and continuing personal and professional development.	V2

C. Course Content

No	List of Topics	Contact Hours
1	Linear spaces, Metric spaces **and** Inequalities.	5
2	Convergence, Complete metric **spaces with examples.**	5
3	Normed spaces**, Banach spaces.**	5
4	Inner product spaces and Hilbert spaces.	5
5	Properties of Hilbert spaces and **Riesz Representation Theorem.**	5
6	**Midterm exam,** Bounded linear operators and bounded linear functionals.	5
7	Dual spaces, Reflexive spaces.	5
8	Hahn- **Banach Theorem.**	5
9	Open mapping theory and closed mapping theory.	5
10	Fixed point Theorem, Spectral theory.	5
Total		50

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**		
1.1	State the definition of (metric spaces and Complete Spaces -normed space and Banach spaces – Hilbert space)	• Lectures • Group discussions	• Quizzes Assignments
1.2	Describe the (Convergence, Completeness) in a different space	• Lectures • Group discussions	• Exams • Assignments
2.0	**Skills**		
2.1	Use Analytical techniques in solving many Applications in other disciplines.	• Interactive classes Group discussions	• Quizzes Assignments
2.2	Explain the dual and reflexive spaces.	• Lectures • Group discussions	• Exams • Quizzes
2.3	Summarize open and closed mapping.	• Lectures Self-learning through the website	• Exams • Quizzes Assignments
3.0	**Values**		
3.1	Show the responsibility for their own learning and continuing personal and professional development.	Projects.	Through the oral presentation of the projects.

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes + Home works**	**Continues**	**10 %**
2	**Midterm exam**	**5th-6th**	**30 %**
3	**Class Work (Homework- report- class test….)**	**8th**	**10 %**
4	**Final exam**	**11th**	**50 %**

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:

6 hours per week (as defined in the teaching schedule of the faculty member) for academic advice and consultations.
Teaching staff is also available using Blackboard web site and Taif University "Edugate" System.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	**Zeidler, E. Applied Functional Analysis: Applications to Mathematical Physics. New York: Springer-Verlag, 1995.**
Essential References Materials	**K. Yosida, Functional analysis, Sixth Edition. Springer-Verlag. Berlin Heidelberg, 1980**
Electronic Materials	**Publisher's website at http://mathworld.wolfram.com/FunctionalAnalysis.htm**
Other Learning Materials	**Journal of functional analysis**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Lecture halls, containing white boards, and electronic monitors - The seats fit the number of students - Laboratories equipped with suitable numbers of computers**
Technology Resources (AV, data show, Smart Board, software, etc.)	**none**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**Wi-Fi internet connections**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment	Students	Indirect
Quality of learning resources	Peer Reviewer Students	Direct Indirect
Extent of achieving the course learning outcomes	Peer Reviewer Students	Direct Indirect

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	Department of Mathematics and Statistics
Reference No.	11
Date	12-7-1443 H

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