هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title:	**Functional Analysis**
Course Code:	**418MATH-2**
Program:	**B. Sc. in Mathematics**
Department:	**Mathematics**
College:	**Science**
Institution:	**Jazan University**
Version:	**2024**
Last Revision Date:	**9/ 2024**

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours:	2

2. Course type

A.	University ☐ College ☐ Department ☒ Track☐ Others☐
B.	Required ☒ Elective☐

3. Level/year at which this course is offered:

Level 8 / Year 4

4. Course general Description

This course is designed to provide students with

- **Metric Space**: Metric space, examples, continuous functions and convergence in metric space, complete metric space, topology generated by metric
- **Normed Space**: Linear space, linear subspace, normed spaces, relationship between metric and normed spaces, Banach space, continuity and convergence in normed spaces, topology generated by normed.
- **Operators**: Linear operators, continuous linear operators, linear operators in normed spaces.
- **Functional:** Linear functional, continuous linear functional, dual space, generalized functions.

5. Pre-requirements for this course (if any): Math 417

6. Co- requirements for this course (if any):

7. Course Main Objective(s)

After finishing the course, the student is expected to be familiar with the following:

- Generalization of mathematical concepts in more general spaces
- Concepts of metric spaces and normed spaces to study convergence and divergence of sequences
- Linear operators and functions in different spaces
- Definition of Hilbert spaces

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1.	Traditional classroom	30	%100
2.	E-learning		
3.	Hybrid • Traditional classroom • E-learning		

No	Mode of Instruction	Contact Hours	Percentage
4.	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	30
2.	Laboratory/Studio	
3.	Field	
4.	Tutorial	
5.	Others (specify)	
	Total	30

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	Distinguish mathematical concepts relevant to Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	K1	Lectures, Web based work, Classroom discussions.	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
1.2	Identify background science, features and structure of Mathematics problems in Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	K2	Lectures, Web based work, Classroom discussions.	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
1.3	Explain notations and concepts required Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	K3	Lectures, Web based work, Classroom discussions.	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
2.0	Skills			
2.1	Apply theoretical, computational or practical aspect relevant to Metric	S1	Lectures, problem solving, web based work,	Written exam (Problem solve, MCQ, true/false, Proof,

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	Spaces, Normed Spaces, Hilbert Spaces, and Operators.		Classroom discussions.	Short answer), Quizzes, Assignments
2.2	Compute numerical quantities for various parameters to approximate the solution in Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	S2	Lectures, problem solving, web based work, Classroom discussions.	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
2.3	Apply various mathematical rules, techniques and theorems in Application in Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	S3	Lectures, problem solving, web based work, Classroom discussions.	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
2.4	Solve mathematical problem using critical thinking in Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	S4	Lectures, problem solving, web based work, Classroom discussions.	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
3.0	Values, autonomy, and responsibility			
3.1	Cultivate a mathematical attitude and nurture the interest.	V1	Group work, problem solving, web based work	Assignments and discussion
3.2	Realize the importance of responsibilities through different modes of practice, competition and related activities.	V2	Group work, problem solving, web based work	Assignments and discussion
3.3	Inculcating values and ethics in thought, expression and deed.	V3	Group work, problem solving, web based work	Assignments and discussion

C. Course Content

No	List of Topics	Contact Hours
1.	Metric Spaces	5
2.	Normed Spaces	4
3.	Inner product spaces	2
4.	Hilbert spaces	2
5.	Operators:	3
6.	Functionals	3
Total		30

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1	Homework and Quiz	3	5
2	First exam	6	20
3	Homework and Quiz	10	5
4	Second exam	12	20
5	Final exam	15	50

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Introduction to Functional Analysis with applications, E. kreyzsig, John Wiley And sons, New York (1978)
Supportive References	- A Course in Functional Analysis, J.B. Conway, 2nd ed., Springer, Berlin, (1990). - A First Course in Functional Analysis, C. Goffman and G. Pedrick. Prentice-Hall (1974). - Functional Analysis, B. V. Limaye, 2nd ed., New Age International, New Delhi (1996). - Introduction to Functional Analysis, A. Taylor and Delay, Wiley, New York, (1980). Principles & the Theory of Functions and Mathematical Analysis Dali, translated by Dr. Ibrahem Mahmoud Shousha, Dar Al-Mir, 1989.
Electronic Materials	Web sites dedicated to Graph Theory And Its Applications on the internet
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classroom, Computer lab.
Technology equipment (projector, smart board, software)	Data show; Smart Board, Mathematics software.
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (Course Evaluation Survey)- Indirect peer evaluation
Effectiveness of students assessment	Students, Program assessment committee	Direct/ Indirect
Quality of learning resources	Students, Faculty members	Indirect
The extent to which CLOs have been achieved	Instructor	Direct/Indirect
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

G. Specification Approval Data

COUNCIL /COMMITTEE	**Board Of Mathematics Department**
REFERENCE NO.	**2417**
DATE	**29/03/1446 A. H.; 2/10/2024 A. D.**