هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Functional Analysis**
Course Code:	**418 Math**
Program:	**B. Sc. in Mathematics**
Department:	**Mathematics**
College:	**Science**
Institution:	**Jazan University**

Table of Contents

A. Course Identification

1. Credit hours:
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: Level 8/Year 4
4. Pre-requisites for this course (if any)**: 417 Math**
5. Co-requisites for this course (if any)**:**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	30	100%
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**30**
2	**Laboratory/Studio**	
3	**Tutorial**	
4	**Others** (specify)	
	Total	**30**

B. Course Objectives and Learning Outcomes

1. Course 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.

2. Course Main Objective

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

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	Distinguish mathematical concepts relevant to Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	K1
1.2	Identify background science, features and structure of Mathematics problems in Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	K2
1.3	Explain notations and concepts required Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	K3
2	**Skills :**	
2.1	Apply theoretical, computational or practical aspect relevant to Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	S1
2.2	Compute numerical quantities for various parameters to approximate the solution in Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	S2
2.3	Apply various mathematical rules, techniques and theorems in Application in Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	S3
2.4	Solve mathematical problem using critical thinking in Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	S4
3	**Values:**	
3.1	Cultivate a mathematical attitude and nurture the interest.	V1
3.2	Realize the importance of responsibilities through different modes of practice, competition and related activities.	V2
3.3	Inculcating values and ethics in thought, expression and deed.	V3

C. Course Content

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

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	Distinguish mathematical concepts relevant to Metric Spaces, Normed Spaces, Hilbert Spaces, and Operators.	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.	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.	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 Spaces, Normed Spaces, Hilbert Spaces, and Operators.	Lectures, problem solving, web based work, Classroom discussions.	Written exam (Problem solve, MCQ, true/false, Proof, 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.	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.	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.	Lectures, problem solving, web based work, Classroom discussions.	Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments
3.0	**Values**		
3.1	Cultivate a mathematical attitude and nurture the interest.	Group work, problem solving, web based work	Assignments
3.2	Realize the importance of responsibilities through different modes of practice, competition and related activities.	Group work, problem solving, web based work	Assignments
3.3	Inculcating values and ethics in thought, expression and deed.	Group work, problem solving, web based work	Assignments

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Homework	3	5%
2	First exam.	6	20%
3	Second exam.	12	20%
4	Homework	14	5%
5	Final exam.	16	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 :

Each group of students assigned to a member of staff who will be available for help and academic guidance office hours at specific hours on daily basis. At least be available 8 hours per week.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	- Introduction to Functional Analysis with applications, E. kreyzsig, John Wiley And sons, New York (1978)
Essential References Materials	- 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	
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Classroom, Computer lab.
Technology Resources (AV, data show, Smart Board, software, etc.)	Data show; Smart Board, Mathematics software.
Other Resources	

Item	Resources
(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (Course Evaluation Survey)- Indirect peer evaluation
Assessment	Students, Program assessment committee	Direct/ Indirect
Extent of achievement of course learning outcomes	Instructor	Direct/Indirect
Quality of learning resources	Students, Faculty members	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	**Board Of Mathematics Department**
Reference No.	**12th Meeting Of The Board Of Mathematics Department 1441-1442**
Date	**14/6/1442 A. H.; 27/1/2021 A. D.**