T-104
2022

Course Specification

Course Specification

Course Title:	**Functional Analysis**
Course Code:	**477Math-3**
Program:	**B.Sc. of Mathematics**
Department:	**Mathematics**
College:	**Art and Science**
Institution:	**Najran University**
Version:	1
Last Revision Date:	**07-05-2023**

Table of Contents:

A. General information about the course:

Course Identification					
1. Credit hours:	3				
2. Course type					
a.	University ☐	College ☐	Department ☒	Track☐	Others☐
b.	Required ☐	Elective☐			
3. Level/year at which this course is offered:		8 / 4			

4. Course general Description
The course gives an introduction to functional analysis, which is a branch of analysis in which one develops analysis in infinite dimensional vector spaces. The central concepts, which are studied, are metric, Banach and Hilbert spaces. Operators' theory is studied in details.

5. Pre-requirements for this course (if any): **Real Analysis (1) (372Math-3)**

6. Co- requirements for this course (if any): **None**

7. Course Main Objective(s)
The main objective of the course is the study of principles of metric, Banach, Hilbert spaces and bounded linear operators.

1. Teaching mode (mark all that apply)

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

2. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	45
2.	Laboratory/Studio	---
3.	Field	---
4.	Tutorial	---
5.	Others (specify)	---
	Total	45

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	Describe the basic concepts of functional analysis	K1	Discussion and exercises during lecture time	Quiz Written Exam
2.0	Skills			
2.1	Construct different examples in metric, Banach and Hilbert spaces	S3	Discussion and exercises during lecture time	Quiz Written Exam Homework
2.2	Solve various problems in functional analysis			
2.3	Prove elementary theorems in functional analysis	S2		Written Exam Homework
3.0	Values, autonomy, and responsibility			
3.1	Work independently and in a group	V1	Assigning each group of students to collect and write topic in functional analysis and explain it to their classmates.	Oral Exam Rubrics

C. Course Content

No	List of Topics	Contact Hours
1.	Metric spaces: Distance function, Hölder and Minkowski inequalities, some famous metric spaces ($\mathbb{R}^n$, $C[a,b]$,$L_p[a,b]$,ℓ_p ,$C^{(k)}[a,b]$), convergence and Cauchy sequences, separable metric spaces, completeness, completion of metric spaces.	18
2.	Normed spaces: linear spaces, normed function, normed spaces, some famous normed spaces, finite dimensional normed spaces, Banach spaces.	12
3	Introduction to operator theory: Linear operators, bounded and continuous linear operators, compact operators, linear functionals	6

4	Inner product spaces: Inner product function, Inner product spaces, some famous inner spaces, Hilbert spaces, Schwartz inequality, triangle inequality, orthogonal sets, orthonarmal basis.	9
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam (1)	6-8	20
2.	Assignments	During the term	10
3.	Midterm Exam (2)	11-13	20
4.	Final Exam	16-18	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	E. Kreyszig, Introductory functional analysis with applications, John Wiley, New York, 1978
Supportive References	None
Electronic Materials	Lectures on the Department of Mathematics YouTube Channel.
Other Learning Materials	None

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classroom with suitable seats
Technology equipment (projector, smart board, software)	• Data show • Smart Board • Wi Fi

Items	Resources
Other equipment (depending on the nature of the specialty)	• None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire (Indirect)
Effectiveness of students assessment	Peer Reviewer	Rubrics (Indirect)
Quality of learning resources	Peer Reviewer	Rubrics (Indirect)
The extent to which CLOs have been achieved	-	-
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data

COUNCIL /COMMITTEE	Council of Mathematics Department
REFERENCE NO.	14441017-0208-00014
DATE	17-10-1444H