Course Specification
(Postgraduate Programs)

Course Title:	**Harmonic Analysis**
Course Code:	**MAT 7219**
Program:	**Doctor of Philosophy in Mathematics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**2024 – V1**
Last Revision Date:	**None**

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: 4((4 Lectures, 0 Lab, 0 Tutorial))

2. Course type

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

3. Level/year at which this course is offered: (Level 3 / Year 2)

4. Course General Description:

The course describes the most important ideas in the analysis of compact (and locally compact) groups as well as group representation of groups. In this respect, fundamental theorems are provided.

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

None.

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

None.

7. Course Main Objective(s):

The objective of this course is to give a thorough introduction to Harmonic analysis in abstract setting. More precisely the course intends to generalize the classical Fourier series from standard topological groups (the unit circle, the integers, and the real line) to locally compact Abelian groups.

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning	0	0%
3	Hybrid • Traditional classroom • E-learning	0	0%
4	Distance learning	0	0%

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	60
2.	**Laboratory/Studio**	0

3.	Field	0
4.	Tutorial	0
5.	Others (specify)……	0
	Total	**60**

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

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Identify Harmonic analysis techniques as well as classical and modern methods.	K1, K2	4 lecture hours\week	Direct: Regular Exams
1.2	Describe the important theorems in connection with representation and compact group theories.	K1, K2	• 4 lecture hours\week • Self-study	Direct: Short Quizzes
2.0	**Skills**			
2.1	Use techniques of proof in algebra and spectral theories.	S1, S2	Self-study	Direct: • Participations Short Quizzes
2.2	Develop oral communication and technical writing skills through representation theory.	S4	Real-life problems	Direct: Homework and Mini projects
2.3	Analyze Internet in searching for locally compact groups.	S3	Real-life problems	Direct: Short Quizzes
2.4	Choose out deep proofs of most important theorems	S1, S2	Self-study	Direct: Participations
3.0	**Values, autonomy, and responsibility**			
3.1	Work with independence and responsibility.	V1, V2	Personal questions	Direct: Participation
3.2	Lead team works.	V1, V3	Teamwork and class discussions.	Direct: Homework and Mini projects

C. Course Content:

No	List of Topics	Contact Hours
1.	Banach Algebra: Basic Concepts, Gelfand Theory, Spectral Theory, Maximal Ideals, Basics of C* - algebra Theory.	10
2.	Locally Compact Groups: Topological Groups, Haar Measure, The Modular Function, Convolutions, The Topology of Locally Compact Groups.	15
3.	Representation Theory: Unitary Representations, Group Algebra, Representations of Groups, Functions of Positive Types.	10

4.	**Analysis on Locally Compact Groups: The Dual Group, The Character Group, Fourier Transform, Pontryagin Duality Theorem, The Bochner & The Plancherel Theorems, The Bohr Compactification.**	**15**
5.	**Analysis on Compact Groups: Group algebra of Compact groups, Representations of Compact Groups, The Peter – Weyl Theorem. Tannaka-Krein duality.**	**10**
Total		**60**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**HomeWorks, Quizzes, Mini projects**	**During the semester**	**30%**
2.	**Midterm**	**Week 6-7**	**30%**
3.	**Final Exam**	**Week 13**	**40%**

*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	• **Y. Katznelson,** *An Introduction to Harmonic Analysis, Cambridge Library, 3rd edition, 2004.* • **H. Reiter and J.D.** *Stegeman, Classical Harmonic Analysis and Locally Compact Groups (London Mathematical Society Monographs), 2nd edition, Oxford University, 2001* • **E. Hewitt and K.A. Ross,** *Abstract Harmonic Analysis, Volume I: Structure of topological groups, Integration theory, Group representation, Springer, 2nd edition, 1979.* • **L.H. Loomis,** *An Introduction to Abstract Harmonic Analysis, Dover Publ, 2011.*
Supportive References	**None**
Electronic Materials	**None**
Other Learning Materials	**None**

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	▪ **Each class room should be equipped with a whiteboard and a projector.** ▪ **Laboratories should be equipped with computers and an internet connection.**
Technology equipment (Projector, smart board, software)	**The rooms should be equipped with data show and Smart Board.**

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**	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of students' assessment	**Program Leaders**	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Quality of learning resources	**Students**	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory- GCC)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio.
	Course Responsible	**Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
The extent to which CLOs have been achieved	**Course Responsible**	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Other	**None**	

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

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	**MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL**
REFERENCE NO.	**8/1446**
DATE	**05/04/1446 (08/10/2024)**