Course Specification

(Postgraduate Programs)

Course Title:	Group Representations
Course Code:	MAT 7228
Program:	Doctor of Philosophy in Mathematics
Department:	Mathematics and Statistics
College:	Science
Institution:	Imam Mohammad Ibn Saud Islamic University
Version:	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 consists mainly of two parts. First, some abstract ring theory and other basic concepts regarding group representation theory are presented. Secondly, the character theory of finite groups, or equivalently, representation theory of finite groups over a field of characteristic zero is described with applications: Burnside's p^aq^b theorem, the character theory in subgroup structure, the representation theory in molecular vibration.					
5. Pre-requirements for this course (if any):					
None					
6. Pre-requirements for this course (if any):					
None					
7. Course Main Objective(s):					
The main purpose of this course is to acquire knowledge and skills in group representation theory and related areas of algebra. The course explains some fundamental applications of linear algebra to the study of finite groups. And the main results in representation theory of finite groups such as Maschke and Schur Theorems are presented together with some applications, as in group theory and computation of character tables of finite groups of various types.					

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	To list new tools which give answers to deep questions in finite group theory.	K1, K2	4 lecture hours\week	Direct: Regular Exams
1.2	To outline complex problems that require making decisions in situations regarding the type of groups or fields studied.	K1, K2	4 lecture hours\week Self-study	Direct: Short Quizzes
...				
2.0	Skills			
2.1	To develop techniques of proof in Groups and fields	S1, S2	Self-study	Direct: • Participations Short Quizzes
2.2	To develop oral communication and technical writing skills through writing and oral presentation.	S3	Real-life problems	Direct: Homework and Mini projects

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.3	To use Internet in searching for p-Groups	S4	Real-life problems	Direct: Short Quizzes
2.4	To carry out deep and not short proofs in Fields and Field extension	S1, S2	Self-study	Direct: Participations
3.0	Values, autonomy, and responsibility			
3.1	To execute works independently	V1, V3	Personal questions	Direct: Participation
3.2	To cooperate with team work	V1, V2	Teamwork and class discussions.	Direct: Homework and Mini projects

C. Course Content:

No	List of Topics	Contact Hours
1.	Definitions and Examples, Equivalent Representations, Regular Representation, Permutation Representation.	10
2.	Group Algebras, Group Algebras Modules and Submodules, Irreducible Modules and Completely Reducible Modules, Module homomorphisms, Isomorphic Modules.	10
3.	Mschke's theorem, Schur's Lemma and Applications. The Conjugacy Class Equation, Center of Group Algebra, Characters, Irreducible.	10
4.	Regular and Faithful Characters. Inner Products of Characters, The Number of Irreducible Characters, Character Tables, Row and Column Orthogonality Relations of Characters.	10
5.	Computing Character Tables of Small Orders Groups. Lifted Characters, Finding Linear Characters by Lifting. Tensor Product of Representations and their Characters.	10
6.	Characters of Finite Direct Product of Groups. Application in the Burnside's theorem and in the investigations of molecular vibration.	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	30%

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
		semester	
2.	Midterm	Week 8-9	30%
3.	Final Exam	Week 15	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	G. James and M. Liebeck, Representations and Characters of Groups; 2nd ed., Cambridge 2001. (Main Reference)
Supportive References	M. Burrow, Representation Theory of Finite Groups; Dover Pub. 2011.
Electronic Materials	L. Dornhoff, Group Representation Theory - Part A; Marcel Dekker 1971.
Other Learning Materials	The GAP Group, GAP -- Groups, Algorithms, and Programming, Version 4.8.6; 2016. (http://www.gap-system.org)

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 are equipped with data show and Smart Board.
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'	Program Leaders	**Direct:** Course e-Portfolio.

Assessment Areas/Issues	Assessor	Assessment Methods
assessment		**Indirect:** Course report.
Quality of learning resources	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
The extent to which CLOs have been achieved	• Students • Faculty (Academic Advisory- GCC) • Program Leaders • Course Responsible	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review. **Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Other		

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)