



Department of Mathematics

College of Science

Salahaddin University -Erbil

Subject: Group Theory

Course Book – (PhD)

Lecturer's name Abdullah M. PhD

Academic Year: 2023/2024

Units: 3 (First Semester)

Course Book

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| 1. Course name | Group Theory |
| 2. Lecturer in charge | Professor Dr. Abdullah M. Abdul-Jabbar |
| 3. Department/ College | Mathematics / Science |
| 4. Contact | e-mail:abdullah.abduljabbar@su.edu.krd e-mail:m1abdullah.math71@gmail.com |
| 5. Time (in hours) per week | Theory: 3 Practical: 0 Tutorial: |
| 6. Office hours | Availability of the lecturer to the student during the week |
| 7. Course code | |
| 8. Teacher's academic profile | <ul style="list-style-type: none"> i. BSc. (1992-1993) ii. M. Sc. (Topology) (2000) iii. Assistant Lecture (2000) iv. Lecture (2004) v. PhD. (Algebra) (2007) vi. Assistant Professor (2009) vii. Head of Mathematics in (Basic Education College) (2009-2010) viii. (46) Published paper about Algebra and General Topology. ix. Reviews at Mathematical Reviews in American Mathematical Society (USA) and Members of Editorial Board in (16) Journals outside Iraq. x. Professor (2019) |
| 9. Keywords | Group, subgroup, normal subgroup, quotient group |
| 10. Course overview: | <p>In abstract algebra, group theory studies the algebraic structures known as groups. The concept of a group is central to abstract algebra: other well-known algebraic structures, such as rings, fields, and vector spaces, can all be seen as groups endowed with additional operations and axioms. Groups recur throughout mathematics, and the methods of group theory have influenced many parts of algebra. Linear algebraic groups and Lie groups are two branches of group theory that have experienced advances and have become subject areas in their own right.</p> |
| 11. Course objective: | <p>1. Decide whether a given group is cyclic, and given a finite cyclic group, find a generator</p> |

for a subgroup of a given order

2. Study some properties and characterizations of subgroups.
3. Study some properties and characterizations of normal subgroup.
4. describe inner automorphisms and their properties.
5. Extend group structure to finite permutation groups (Cayley's Theorem).
6. Study some properties and characterizations of quotient group.
7. Generate groups with given specific conditions.
8. investigate symmetry using group theory.
9. Other objectives.

12. Student's obligation

In this course, every lecture we review all topics with students which we gave in the previous lecture and when we teach, we try to contribute all students.

13. Forms of teaching

We use data-show with white board and give a copy of my lecture about On group theory with applications for all students step by step.

14. Assessment scheme

Your course grade will be determined as follows:

Midterm examination: 20%

Seminar: 5% (A part of seminar contains applications on group theory)

Quiz: 10%

Homework: 5%

Final Exam: 60%

15. Student learning outcome:

In first year in our Department of Mathematics, students studies Foundation of Mathematics, which included set theory. In this course we discuss on group theory with applications which is applications of set theory step by step to understand them.

16. Course Reading List and References:

- [1] McCoy N. H. and Berger T. R., Algebra: Groups, Rings and Other Topics, Allyn and Bacon, Inc. Boston London Sydney Toronto, 1977.
- [2] Fraleigh J. B., A first Course in Abstract Algebra, ADDISON-WESLEY PUBLISHING COMPANY, 1982.
- [3] Herstei I. N., Topics in Algebra, JOHN WILEY & SONS New York Chichester Brisbane Toronto Singapore, 1975.
- [4] Allenby R B J T, Rings, Fields and Groups, Edward Arnold, 1983.
- Dummit D. S. and Foote R. M., Abstrat Algebra, John Wiley & Sons, Inc., 2003.
- [5] Singh S. and Zameeruddin Q., Modern Algebra, VIKAS PUBLISHING HOUSE PVT LTD, 1972.
- [6] Durbin J. R., Modern Algebra, JOHN WILEY & SONS New York Chichester Brisbane Toronto Singapore, 1985.
- [7] Gallian J. A., Contemporary Abstract Algebra, HOUGHTON MIFFLIN COMPANY, 1998.

| 17. The Topics: | Lecturer's name |
|---|---|
| <p>Group Theory</p> <p>0. Basics</p> <p>0.1 Some Concepts of Set Theory</p> <p>0.2 The Division Algorithm, Greasts Common Divisors</p> <p>0.3 Introduction to Groups (Basic Axioms and Examples)</p> <ul style="list-style-type: none"> • Binary operation (Definition, Properties) • Mathematical system (Definition, Examples) • Semi-group (Definition, Examples) <p>1. Groups</p> <p>1.1 Group (Definition, Properties, Examples)</p> | <p>Non-Commutative Algebra (3 hours per week)</p> |

1.2 Group of integers modulo n

1.2.1 Congruent modulo n (Definition, Properties)

1.3 Cyclic group (Definition, Properties)

1.4 Finite group (Definition, Examples)

1.5 Permutation mapping (Definition, Examples)

2. Subgroups

2.1 Subgroup (Definition, Properties, Examples)

2.2 Center of a group (Definition, Properties)

2.3 Order of an element of a group

2.4 Groups of cosets (Definition, Properties)

2.5 Index of a subgroup

2.6 Lagrange Theorem

2.7 Non-trivial subgroup

3. Normal Subgroups and Quotient Groups

3.1 Normal subgroup (Definition, Properties)

3.2 Quotient Groups (Definition, Properties)

3.3 Normalizer subgroup (Definition, Properties)

3.4 Commutator subgroup (Definition, Properties)

3.5 Simple groups

4. Homomorphism and Isomorphism of a Group

4.1 Homomorphism group (Definition, Properties, Examples)

4.2 Kernel of a group (Definition, Properties)

4.3 Epimorphism and monomorphism of a group

4.4 Isomorphism group (Definition, Properties, Examples)

4.5 Automorphism group (Definition, Properties, Examples)

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| 4.6 First Isomorphism Group Theorem Second Isomorphism Group Theorem Third Isomorphism Group Theorem 4.7 Direct product of two groups 5. P-Groups and Sylow's Theorems (Elective) | |
| 18. Practical Topics (If there is any) | |
| 19. Examinations: Q;/ Define normal subgroup and state and prove an equivalent statement of normal subgroup. Q:/ State and prove cayley theorem. Q:/ State and prove Fundamental Theorem of Isomorphism. 2. True or false type of exams: <i>We use this type in exam.</i> 3. Multiple choices: <i>We cannot use this type of exams.</i> | |
| 20. Extra notes: We apply seminar instead of assignments. | |
| 21. Peer review | |