

12. Pre-requisites or Other Academic Requirements	II (Ma104b) (MA209-16) Linear Algebra II (Ma104b) Elementary Number Theory (MA209-16)
	13. Courses for which this course is a pre-requisite Main subsequent courses: Group representation theory, Algebra (Graduate), Topology
	14. Cross-listing Dept.

SYLLABUS

15. **Course Objectives**

The course assumes basic knowledge of number theory as prerequisites, begins with fundamental concepts of abstract algebra and covers most important topics in the core of group theory and ring theory. The objectives include familiarizing students with fundamental contents of abstract algebra, having concrete examples and applications well understood, and introducing students to get used to methods of thinking and analyzing in abstract algebra. The course will provide necessary background knowledge of algebra and adequate training of abstract thinking for the study of subsequent courses.

16. **Learning Outcomes**

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An adequate training through this course should help the students to understand fundamental concepts of abstract algebra and connect concrete examples and applications to theory, thus leading to a good comprehension of the most important theorems in group theory and ring theory. Students are expected to well understand at least the following material: basics of group theory, structure theorem of finitely generated abelian groups, symmetric groups and dihedral groups as most important examples of non-commutative groups, fundamental theorems of group homomorphisms, group actions, as well as other useful tools and methods in the analysis of structure of finite groups; ring theoretic facts like the Chinese remainder theorem, polynomial rings, divisibility theory in various interesting domains, and applications with special regard to finite fields and number fields.

17.

Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

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$\frac{1}{2}1$ _____

1.1

1.2

1.3

$\frac{1}{2}2$ _____

2.1

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2.3

2.4

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$\frac{1}{2}1$ _____

1.1

1.2 Lagrange

1.3

1.4

$\frac{1}{2}2$ _____

2.1

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$\frac{1}{2}3$ _____

3.1

3.2

3.3

1/2 4

1.1

1.2

1/2 5

2.1

2.2

1/2 6 Sylow

3.1

3.2 p-

3.3 Sylow

(16)

1/2 1

1.1

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1/2 2

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1/2 3

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1/2 4

4.1

4.2 UFD PID

4.3

4.4 UFD

4.5

(4)

1/2 1

1.1

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1/2 2

2.1

2.2

Chapter 0: First glimpse (4h)

1/2 1 When Algebra comes stately

1.1 What is Abstract Algebra

1.2 Sets and maps

1.3 Binary operations and algebraic structures

1/2 2 Where do groups come from

2.1 Integers and their congruence classes

2.2 Matrices and permutations

2.3 Symmetries

2.4 More surprising examples

Chapter 1: Introduction to groups (24h)

1/2 1 Basic definitions in group theory

1.1 Subgroups and homomorphisms

1.2 Cosets and Lagrange's theorem

1.3 Normal subgroups

1.4 Direct products and direct sums

1/2 2 Cyclic groups and finitely generated abelian groups

2.1 Orders of elements, generators

2.2 Subgroups of cyclic groups

2.3 Finitely generated abelian groups

1/2 3 Permutations and symmetric groups

3.1 Symmetric groups and cycles

3.2 Cycle decomposition

3.3 Alternating groups

1/2 4 Symmetries and dihedral groups

4.1 Isometries of the plane

4.2 Dihedral groups and symmetry of plane figures

1/2 5 Fundamental theorems of group homomorphisms

5.1 Equivalence relations and quotient groups

5.2 Isomorphism theorems for group homomorphisms

1/2 6 Group actions and Sylow's theorems

6.1 Basic notions of group actions

6.2 Applications to p-groups

6.3 Sylow's theorems

Chapter 2: Basics of ring theory (16h)

1/2 1 Basic definitions and properties

1.1 Definition and examples of rings

1.2 Domains and fields

1.3 Fraction field of a domain

1/2 2 Ideals and homomorphisms

2.1 Ideals and quotient rings

2.2 Ring homomorphisms

2.3 Chinese remainder theorem

2.4 Maximal ideals and prime ideals

1/2 3 Polynomial rings

3.1 Definitions and basic properties

3.2 Euclidean division for polynomials

3.3 Polynomials over a field

1/2 4 Divisibility in integral domains

4.1 Prime elements and irreducible elements

4.2 UFD and PID

4.3 Euclidean domains

4.4 Polynomials over a UFD

4.5 Irreducibility criteria

Chapter 3: Fields and their extensions (4h)

1/2 1 Basic theory of field extensions

1.1 Simple extensions and algebraic extensions

1.2 Ruler and compass constructions

1/2 2 Finite fields and cyclotomic fields

2.1 Finite fields

2.2 Cyclotomic fields

<p>Textbook:</p> <p>David S. Dummit and Richard M. Foote, Abstract Algebra (Third Edition), John Wiley & Sons, Inc, 2004. ISBN: 978-0-471-43334-7</p> <p>Supplementary readings</p> <p>Joseph Rotman, A First course in abstract algebra, (Third edition), Pearson; 2005. ISBN-13: 978-0-131-86267-8</p> <p style="text-align: center;">, 2000.</p> <p style="text-align: center;">3 , , 2009.</p>
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ASSESSMENT

19.

Type of Assessment	Time	% of final score	Penalty	Notes
Attendance				
		10		
Class Performance				
Quiz				
Projects				
		20		
Assignments				
		35		
Mid-Term Test				
		35		
Final Exam				
Final Presentation				
Others (The above may be modified as necessary)				

20.

GRADING SYSTEM

A.	Letter Grading
B.	/ Pass/Fail Grading

REVIEW AND APPROVAL

21.

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This Course has been approved by the following person or committee of authority

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