

MATH 3121 Abstract Algebra

Course Outline - Fall 2023

1. Instructor

Professor *Huai Liang Chang*

Contact Details: *mahlchang@ust.hk*, Office 3490

Office hour: Friday 10:30-11:30pm

2. Teaching Assistant

SUN, Haofang

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ZHANG Huaigong T1b

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3. Meeting Time and Venue

Lectures

Date/Time: Tue/Thu 10:30 - 11:50 am,

Venue: 6591

Tutorials

Date/Time, Venue: T1a, Wed 19:00 - 19:50 LSK1027

T1b, Wed 14:30 -15:20 rm 1104

4. Course Description

Duration: one semester. Credits: 4 units.

Pre-requisite: Math2121

Exclusion: Math2131

This course covers the following basic topics in algebra:

Sets and relations. Groups, group actions, symmetric groups, symmetry. Rings and Fields, applications to number theory. Jordan canonical form of square matrices. Students will investigate the fundamentals of these topics and become able to apply them to solve basic problems in science.

5. Intended Learning Outcomes

Upon successful completion of this course, students should be able to:

1. Recognize and use appropriately important concepts and definitions in algebra.
2. Know the applications of algebra such as symmetry.
3. Understand how the mathematical knowledge students learnt before can be better organized and generalized.
4. Know how to solve problems in algebra.
5. Know how to construct rigorous proofs.

6. Assessment Scheme

- a. Examination duration: 2 hours
- b. Percentage of course work, examination

Assessment: Assessing Course ILOs

Coursework: 25% 1, 2, 3, 4,
Examination: 75% 1, 3, 4

Letter Grades: Students should aim at getting a course total of 85% or above for A-/A/A+, and about 60% or above for B-/B/B+.

Grade Descriptors:

Grade s	Short Description A	Elaboration on subject grading description
A	Excellent Performance	The student has mastered almost all concepts and techniques of abstract algebra taught in the course, has excellent understanding of the deepest content of the subject, and acquired workable knowledge for further studies of graduate level algebra and related fields.
B	Good Performance	The student has mastered most computational techniques of groups operations and algebra structural operations taught in the course, yet the understanding of some challenging concepts may not be deep enough for further studies on related advanced subjects.
C	Satisfactory Performance	The student meets the minimum expectation of the instructor, has acquired some basic computational techniques of the subject, yet some concepts were not clearly understood.
D	Marginal Pass	The student is only able to recall some fragments of topics and is able to complete some of the easiest computations.
F	Fail	The student does not have sufficient understanding of even some fragments of topics, and is not even able to complete some of the easiest computations.

Course AI Policy

Students are allowed to consult any person (including the instructor, TA, classmates, friends outside HKUST) in any homework for ideas and hints, but are required to write up the solutions by themselves. You are required to **list the persons and references** you have consulted in every homework.

The use of ChatGPT or other generative AI is allowed, and they are regarded as “persons” you have consulted, and therefore must be **listed** in your homework.

However, please be warned that at the current stage of development of AI, the response to problems in advanced courses – especially those in pure mathematics – is not quite reliable. Students should be critical of the response generated by AI and do not blindly copy the generated responses to your homework.

7. Student Learning Resources

Lecture Notes:

Lecture Notes can be downloaded at the course home page in Canvas.

Textbooks:

J.B. Fraleigh, "A First Course in Abstract Algebra", 7th edition, Addison-Wesley.

8. Teaching and Learning Activities

Scheduled activities: 3 hrs (lecture)

9. Course Schedule

Week	Content	Remarks
1	Section 0. Basic set theory. Mappings. Section 1. Complex numbers and roots of unity.	
2	Section 2. Binary operations. Section 4. Groups.	
3	Section 5. Subgroups. Section 6. Cyclic groups.	
4	Section 7. Generating sets and Cayley digraphs. Section 8. Groups of permutations.	
5	Section 9. Orbits, cycles, and the alternating groups, orbits	
6	Section 10. Lagrange Theorem.	
7	Section 11. Direct products and finitely generated abelian groups	Midterm Review
8	Section 12. Symmetry. Section 13. Homomorphisms	.
9	Section 14. Factor groups Section 15. Group actions.	
10	Section 15. Group actions (continued) Section 18. Rings	
11	Section 19. Integral domains.	
12	Section 20. Fermat's and Euler's theorems.	
13	Section 21. The field of quotients of an integral domain. Section 26. Homomorphisms and factor rings	
14	Jordan canonical form of square matrices (lecture notes). Review for Final.	

