

**THE CHINESE UNIVERSITY OF HONG KONG**  
**Department of Mathematics**  
**MATH 3030 (Fall 2023)**  
**Abstract Algebra**  
**Course Outline**

## Outline

In this course, we will discuss more advanced topics in group theory and ring theory which include:

- normal subgroups; quotient groups
- isomorphism theorems; subgroup series
- group action; Cayley's theorem
- Sylow theorems and their applications
- prime and maximal ideals
- factorization in rings; PIDs and UFDs

We assume as prerequisite a solid understanding of the basic theory of groups and rings, as covered in MATH 2070/2078.

## Class Information

- Instructor: CHAN Kwok Wai (Office: LSB 212; Email: [kwchan@math.cuhk.edu.hk](mailto:kwchan@math.cuhk.edu.hk))
- Teaching Assistant:
  - LAM Chin Hang Eddie (Office: LSB 222B; Email: [echlam@math.cuhk.edu.hk](mailto:echlam@math.cuhk.edu.hk))
  - SHEN Jianhao (Office: AB1 505; Email: [jhshen@math.cuhk.edu.hk](mailto:jhshen@math.cuhk.edu.hk))
- Lectures: Wed 10:30am - 12:15pm at YIA LT4; Thu 2:30pm - 3:15pm at LSB LT3
- Tutorials: Thu 3:30pm - 4:15pm at LSB LT3
- Webpage: <https://www.math.cuhk.edu.hk/course/2324/math3030>

## Textbook

- D. Dummit and R. Foote, *Abstract Algebra*, 3rd edition, John Wiley and Sons.

## Reference

- P. Aluffi, *Algebra: Chapter 0*, Graduate Studies in Mathematics Vol. 104, American Mathematical Society.
- M. Artin, *Algebra*, 2nd edition, Prentice Hall.
- J. Fraleigh, *A First Course in Abstract Algebra*, Addison-Wesley, 7th edition

## **Lectures, Tutorials and Homeworks**

*Lectures:* Students are expected to attend ALL the lectures. The lectures will focus mainly on the theoretical concepts and proofs, supplemented with a lot of examples. Below you can find a tentative schedule of this course. As the lectures would only cover the most essential materials (at a rather fast pace), it would be very helpful if you have read (or at least skimmed through) the relevant sections in the textbook and reference books beforehand.

*Tutorials:* Students are expected to attend ALL the tutorials. The tutorials will cover more examples and computational aspects of the materials. There will be also times during the tutorials for discussions and working out some exercises together. All the materials (unless otherwise stated) covered in lectures and tutorials will be tested in the midterm test and final exam.

*Homeworks:* There will be around 10 problem sets. The full mark for each homework is 1 point. Most of the problem sets consist of two parts – the compulsory part and the optional part. You only need to hand in your solutions of the compulsory part. But you are highly recommended to work out the optional part at home as well. Keep in mind that the best way to learn mathematics is to work out exercises and get the feeling by yourself.

## **Assessment**

- 10%: Homework
- 30%: Midterm (1st Nov 2023, Wednesday, 10:30am)
- 60%: Final

## Tentative Schedule

- Week 1–3:
  - group theory in a categorial language
  - free groups
  - normal subgroups
  - quotient groups
  - presentations of groups
  - computation of quotient groups
- Week 4–5:
  - isomorphism theorems
  - subgroup series
  - solvable groups
- Week 6–8:
  - group action; Cayley's theorem
  - class equation and its applications
  - Cauchy's theorem
  - Sylow theorems
- Week 9–13:
  - prime and maximal ideals
  - polynomial rings
  - factorization in rings
  - more on PIDs and UFDs