# COURSE OUTLINE: MH3220

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|---|---|---|---|
| Course Title | **Algebra II** | | |
| Course Code | **MH3220** | | |
| Offered | Study Year 3, Semester 1 | | |
| Course Coordinators | Tong Ping | tongping@ntu.edu.sg | 65137457 |
| | Johan Chrisnata | johan.chrisnata@ntu.edu.sg | 65137442 |
| Pre-requisites | MH1201 and MH2220 | | |
| Mutually exclusive | MH3200 | | |
| AU | 4 | | |
| Contact hours | Lectures: 39, Tutorials: 12 | | |
| for delivery from | AY 2023/24 semester 1 | | |
| Last revised | 28 June 2023 | | |

## Course Aims

This MAS course aims to introduce ring theory that is essential for more advanced algebra courses and applications. The axiomatic concepts serve as a language to study concrete examples in broader sense and helps in developing logical thinking.

## Intended Learning Outcomes

Upon successfully completing this course, you should be able to:

1. State basic definitions related to rings and explain them to a layman.
2. Give examples and counter-examples involving rings.
3. Categorize rings based on their properties.
4. Compute quotient rings.
5. Distinguish ideals from subrings.
6. Apply ring isomorphism theorems to prove that two rings are isomorphic.
7. Prove or disprove statements involving rings.

## Course Content

Basic definitions from ring theory

Examples of rings including polynomial rings, matrix rings

Ideals and ring homomorphisms

Maximal and prime ideals

Quotient rings and isomorphism theorems

Ring of fractions

Euclidean domains, Principal ideal domains, Unique factorization domains

## Assessment

| Component | Course ILOs tested | Weighting | Team / Individual | Assessment Rubrics |
|---|---|---|---|---|
| **Continuous Assessment** | | | | |
| **Tutorials** | | | | |
| Assignment | 3,4,5,6,7 | 15 | Individual | See Appendix for rubric |
| Class Participation | 1,2,3,4,5,6,7 | 10 | Individual | See Appendix for rubric |
| **Mid-term Test** | | | | |
| Short Answer Questions | 1,2,3,5,7 | 25 | individual | See Appendix for rubric |
| **Examination (2 hours)** | | | | |
| Short Answer Questions | 1, 2, 3, 4, 5, 6, 7 | 50 | individual | See Appendix for rubric |
| | **Total** | **100%** | | |

## Formative Feedback

You will receive formative feedback for your CA. It is done by commenting on the mistakes and misunderstanding that appeared in your CA. This is possible because this course has a small number of students (typically less than 20). General feedback for your performance as part of the end of course review is done based on the final exam: the most common mistakes, as well as the questions that were best answered, are discussed in the report provided to all students.

## Learning and Teaching Approach

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| **Lectures** (39 hours) | Interactive Lecture:<br>The suggested learning and teaching approach consists of breaking the flow of the lectures by introducing exercises to be solved by the students in small groups during the lectures themselves. A typical pattern would be: the lecturer introduces a new concept, or a new proof, and then asks you to answer a question or solve a small exercise involving the new concept/proof. The lecturer then discusses the answer with you. If the newly introduced concept is understood well enough, the lecturer can then continue to build upon it, otherwise, further explanation is given. This also ensures that you have improved your knowledge in each of the classes that they are attending. This also encourages you to attend the classes, by being more active. |
| **Tutorials** (12 hours) | Problem solving:<br>Develop competence in logical thinking and problem solving especially in abstract algebra. |

## Reading and References

D.S. Dummit, R.M. Foote, Abstract Algebra, third edition, John Wiley & Sons, Inc., Hoboken, NJ, 2004.
ISBN-10 : 0471433349

## Course Policies and Student Responsibilities

You are expected to attend all classes punctually and take all scheduled assignments and tests by due dates. You are expected to take responsibility to follow up with course notes, assignments and course related announcements. You are expected to participate in all discussions and activities.

You are expected to attend the midterm test. A student who is absent from midterm test without valid Leave of Absence will be given zero mark. No make-up midterm test will be arranged. In case of valid reason for absence, the total course marks would subsequently be rescaled to a base of 100%.

## Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the Academic Integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

## Course Instructors

| Instructor | Office Location | Phone | Email |
|---|---|---|---|
| Tong Ping | SPMS MAS 04-17 | 65137457 | tongping@ntu.edu.sg |
| Johan Chrisnata | SPMS MAS 04-05 | 65137442 | Johan.Chrisnata@ntu.edu.sg |

## Planned Weekly Schedule

| Week | Topic | Course ILO | Readings/ Activities |
|---|---|---|---|
| 1 | Basic definitions from ring theory | 1 | Textbook: 7.1 |
| 2 | Examples of rings including polynomial rings, matrix rings | 1, 2 | Textbook: 7.2 |
| 3 | Ideals | 1, 2, 3, 5, 7 | Textbook: 7.4 |
| 4 | Properties of ideals | 1, 2, 3, 5, 7 | Textbook: 7.4 |
| 5 | Maximal and prime ideals | 1, 2, 3, 5, 7 | Textbook: 7.4 |
| 6 | Ring homomorphisms | 3, 7 | Textbook: 7.3 |
| 7 | Quotient rings | 3, 4, 7 | Textbook: 7.3 |
| 8 | Isomorphism theorems | 1, 2, 3, 4, 5, 6, 7 | Textbook: 7.3<br>Mid-term test |
| 9 | Isomorphism theorems | 1, 2, 3, 4, 5, 6, 7 | Textbook: 7.3 |
| 10 | Ring of fractions | 1, 2 | Textbook: 7.5 |
| 11 | Polynomial Ring | 1, 2 | Textbook: 9.1, 9.2 |
| 12 | Euclidean domains, Principal ideal domains, Unique factorization domains | 1, 2, 3, 5, 6, 7 | Textbook: 8.1, 8.2, 8.3 |
| 13 | Euclidean domains, Principal ideal domains, Unique factorization domains | 1, 2, 3, 5, 6, 7 | Textbook: 8.1, 8.2, 8.3 |

**Rubric for Tutorial: Assignment (15%)**
*Point-based marking*

**Rubric for Tutorial: Class participation (10%)**
*Presentation of solutions to at least 5 tutorial questions during tutorial.*

**Rubric for Mid-term Test: Short Answer Questions (25%)**
Point-based marking

**Rubric for Examination: Short Answer Questions (50%)**
Point-based marking