



## UNSW Course Outline

# MATH3431 Number Theory - 2024

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## General Course Information

Course Code : MATH3431

Year : 2024

Term : Term 1

Teaching Period : T1

Is a multi-term course? : No

Faculty : Faculty of Science

Academic Unit : School of Mathematics & Statistics

Delivery Mode : In Person

Delivery Format : Standard

Delivery Location : Kensington

Campus : Sydney

Study Level : Undergraduate

Units of Credit : 6

### Useful Links

[Handbook](#) [Class Timetable](#)

## Course Details & Outcomes

### Course Description

The course will cover some basic notions and techniques of number theory. The focus will be on such topics as divisibility, prime numbers, the arithmetic of residues rings, additive properties of integers and their powers and Diophantine approximations. Some applications of number theory to cryptography will be discussed as well. Students taking this course will develop an

appreciation of the basic problems of number theory and will learn the interplay between number-theoretic problems and other areas of mathematics.

The ability to provide logical and coherent proofs of number-theoretic results, and the ability to solve concrete number-theoretic problems will be paramount. It is planned that it will be suitable for students in both ordinary and advanced programs.

It is recommended to take it together with MATH3711, which will provide students with very useful complementing knowledge and skills.

## Relationship to Other Courses

It is recommended to take it together with MATH3711, which will provide students with very useful complementing knowledge and skills.

## Course Learning Outcomes

Course Learning Outcomes
CL01 : State and explain fundamental mathematical principles behind the main number theoretic techniques.
CL02 : Apply standard number theoretic techniques to a broad range of number theoretic problems.
CL03 : Demonstrate broad and advanced disciplinary knowledge and skills in number theory.
CL04 : Communicate effectively in a written form.

Course Learning Outcomes	Assessment Item
CL01 : State and explain fundamental mathematical principles behind the main number theoretic techniques.	<ul style="list-style-type: none"><li>• Test 1</li><li>• Test 2</li><li>• Final Exam</li></ul>
CL02 : Apply standard number theoretic techniques to a broad range of number theoretic problems.	<ul style="list-style-type: none"><li>• Quiz</li><li>• Test 1</li><li>• Test 2</li><li>• Final Exam</li></ul>
CL03 : Demonstrate broad and advanced disciplinary knowledge and skills in number theory.	<ul style="list-style-type: none"><li>• Final Exam</li></ul>
CL04 : Communicate effectively in a written form.	<ul style="list-style-type: none"><li>• Test 1</li><li>• Test 2</li><li>• Final Exam</li></ul>

# Learning and Teaching Technologies

Moodle - Learning Management System

## Learning and Teaching in this course

See summary of the course.

## Additional Course Information

N/A

## Assessments

### Assessment Structure

Assessment Item	Weight	Relevant Dates
Quiz Assessment Format: Individual	5%	Start Date: 12/02/2024 08:00 AM Due Date: 03/03/2024 11:59 PM
Test 1 Assessment Format: Individual	20%	
Test 2 Assessment Format: Individual	20%	
Final Exam Assessment Format: Individual	55%	

## Assessment Details

### Quiz

#### Assessment Overview

A short on-line quizz to test the knowledge of the necessary prerequisites, during weeks 1-2, with instant feedback.

#### Course Learning Outcomes

- CL02 : Apply standard number theoretic techniques to a broad range of number theoretic problems.

#### Detailed Assessment Description

The quiz will be open from week 1 until the end of week 3.

### Assessment Length

3 weeks

## Test 1

### Assessment Overview

Test during week 4, feedback at the end of week 5 via Moodle.

### Course Learning Outcomes

- CL01 : State and explain fundamental mathematical principles behind the main number theoretic techniques.
- CL02 : Apply standard number theoretic techniques to a broad range of number theoretic problems.
- CL04 : Communicate effectively in a written form.

### Detailed Assessment Description

More information will be provided in Moodle.

### Assessment Length

45min

## Test 2

### Assessment Overview

Test during week 9, feedback at the end of week 10 via Moodle.

### Course Learning Outcomes

- CL01 : State and explain fundamental mathematical principles behind the main number theoretic techniques.
- CL02 : Apply standard number theoretic techniques to a broad range of number theoretic problems.
- CL04 : Communicate effectively in a written form.

### Detailed Assessment Description

More information will be provided in Moodle.

### Assessment Length

45min

# Final Exam

## Assessment Overview

Final examination during the exam period, feedback upon request.

## Course Learning Outcomes

- CLO1 : State and explain fundamental mathematical principles behind the main number theoretic techniques.
- CLO2 : Apply standard number theoretic techniques to a broad range of number theoretic problems.
- CLO3 : Demonstrate broad and advanced disciplinary knowledge and skills in number theory.
- CLO4 : Communicate effectively in a written form.

## Assessment Length

2 hours

# General Assessment Information

## Late Submission of Assessment Tasks

No late submissions will be accepted. (Where "late" in this context means after any extensions granted for Special Consideration or Equitable Learning Provisions.)

## Grading Basis

Standard

## Requirements to pass course

The assessment tasks include: a quiz (5%), two tests (20% each) and the final exam (55%). You need to secure at least 50% to pass the course.

# Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 12 February - 18 February	Lecture	The integers, rings and integral domains, divisibility, primes and greatest common divisors, the Euclidean algorithm and the Bezout identity, unique factorisation.
Week 2 : 19 February - 25 February	Lecture	Diophantine equations linear Diophantine equations, congruences, the arithmetic functions $d$ and $\sigma$ and their average values, perfect numbers, special prime numbers, the prime number theorem.
Week 3 : 26 February - 3 March	Lecture	Fields, units, groups, isomorphism. The groups $Z_m$ and $U_m$ ; Wilson's Theorem.
Week 4 : 4 March - 10 March	Lecture	Subgroups, the theorems of Lagrange, Fermat and Euler, cyclic groups, Chinese Remainder Theorem, applications to cryptography (RSA cryptosystem).
Week 5 : 11 March - 17 March	Lecture	Primitive roots, exponential congruences, applications to cryptography (Diffie-Hellman key exchange protocol).
Week 7 : 25 March - 31 March	Lecture	Quadratic residues, Euler's Criterion, Legendre symbol, Gauss' Lemma, the Law of Quadratic Reciprocity and its applications.
Week 8 : 1 April - 7 April	Lecture	Norms, units, primes, division, greatest common divisors, ideals and principal ideals in $Z[i]$ , unique factorisation, determination of Gaussian primes and the sum of two squares, sums of three and four squares, Waring's Problem.
Week 9 : 8 April - 14 April	Lecture	Polynomials over fields, degree, division, the Remainder Theorem, roots, prime and irreducible polynomials, Eisenstein's criterion.
Week 10 : 15 April - 21 April	Lecture	Algebraic extensions of fields, algebraic number, minimal polynomial, the dimension theorem, complex algebraic extension fields, Diophantine approximations.

## Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

## General Schedule Information

The course will include material taken from some of the following topics. This should only serve as a guide as it is not an extensive list of the material to be covered and the timings are approximate. The course content is ultimately defined by the material covered in lectures.

## Course Resources

### Prescribed Resources

Weekly lecture notes.

### Recommended Resources

Lecture notes and tutorial exercises.

## Additional Costs

N/A

## Course Evaluation and Development

Student feedback is very important to continual course improvement. This is demonstrated within the School of Mathematics and Statistics by the implementation of the UNSW online student survey *myExperience*, which allows students to evaluate their learning experiences in an anonymous way. *myExperience* survey reports are produced for each survey. They are released to staff after all student assessment results are finalised and released to students. Course convenor will use the feedback to make ongoing improvements to the course.

## Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Alina Ostafe		RC-5104	N/A	Consultation on request via email	No	Yes

## Other Useful Information

### Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University's conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University's reputation and good standing.

For more information, visit the [UNSW Student Code of Conduct Website](#).

### Academic Honesty and Plagiarism

**Referencing** is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.

Further information about referencing styles can be located at <https://student.unsw.edu.au/>

**Academic integrity** is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage. At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.

Further information about academic integrity, plagiarism and the use of AI in assessments can be located at:

- The [Current Students site](#),
- The [ELISE training site](#), and
- The [Use of AI for assessments](#) site.

The Student Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: <https://student.unsw.edu.au/conduct>

## Submission of Assessment Tasks

### Penalty for Late Submissions

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessments where a penalty applies,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

***Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.***

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

### Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student



email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: <https://student.unsw.edu.au/special-consideration>

**Important note:** UNSW has a “fit to sit/submit” rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for Special Consideration. This is to ensure that if you feel unwell or are faced with significant circumstances beyond your control that affect your ability to study, you do not sit an examination or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

## Faculty-specific Information

### Additional support for students

- [The Current Students Gateway](#)
- [Student Support](#)
- [Academic Skills and Support](#)
- [Student Wellbeing, Health and Safety](#)
- [Equitable Learning Services](#)
- [UNSW IT Service Centre](#)
- Science EDI Student [Initiatives](#), [Offerings](#) and [Guidelines](#)

## School-specific Information

### School of Mathematics and Statistics and UNSW Policies

The School of Mathematics and Statistics has adopted a number of policies relating to enrolment, attendance, assessment, plagiarism, cheating, special consideration etc. These are in addition to the Policies of The University of New South Wales. Individual courses may also adopt other policies in addition to or replacing some of the School ones. These will be clearly notified in the Course Initial Handout and on the Course Home Pages on the Maths Stats web site. Students in courses run by the School of Mathematics and Statistics should be aware of the School and Course policies by reading the appropriate pages on the web site starting at: [The School of Mathematics and Statistics assessment policies](#)

The School of Mathematics and Statistics will assume that all its students have read and understood the School policies on the above pages and any individual course policies on the

Course Initial Handout and Course Home Page. Lack of knowledge about a policy will not be an excuse for failing to follow the procedure in it.

### **Special Consideration - Short Extension Policy**

The School of Mathematics and Statistics has carefully reviewed its range of assignments and projects to determine their suitability for automatic short extensions as set out by the UNSW Short Extension Policy. Upon comprehensive examination of our course offerings that incorporate these types of assessments, we have concluded that our current deadline structures already accommodate the possibility of unexpected circumstances that may lead students to require additional days for submission. Consequently, the School of Mathematics and Statistics has decided to universally opt out of the Short Extension provision for all its courses, having preemptively integrated flexibility into our assessment deadlines. The decision is subject to revision in response to the introduction of new course offerings. Students may still apply for Special Consideration via the usual procedures.

### **Computing Lab**

The main computing laboratory is room G012 of the Anita B. Lawrence Centre (formerly Red Centre). You can get to this lab by entering the building through the main entrance to the School of Mathematics (on the Mezzanine Level) and then going down the stairs to the Ground Level. A second smaller lab is Room M020, located on the mezzanine level through the glass door (and along the corridor) opposite the School's entrance.

For more information, including opening hours, see the [computing facilities webpage](#). Remember that there will always be unscheduled periods when the computers are not working because of equipment problems and that this is not a valid excuse for not completing assessments on time.

### **School Contact Information**

#### **School Contact Information**

Please visit the [School of Mathematics and Statistics website](#) for a range of information.

For information on Courses, please go to "Student life & resources" and either Undergraduate and/or Postgraduate and respective "Undergraduate courses" and "Postgraduate courses" for information on all course offerings.

All school policies, forms and help for students can be located by going to the "Student Services" within "Student life & resources" page. We also post notices in "Student noticeboard" for your information. Please familiarise yourself with the information found in these locations. If you cannot find the answer to your queries on the web you are welcome to contact the Student Services Office directly.

### **Undergraduate**

E: [ug.mathsstats@unsw.edu.au](mailto:ug.mathsstats@unsw.edu.au)

P: 9385 7011 or 9385 7053

### **Postgraduate**

E: [pg.mathsstats@unsw.edu.au](mailto:pg.mathsstats@unsw.edu.au)

P: 9385 7053

Should we need to contact you, we will use your official UNSW email address of in the first instance. **It is your responsibility to regularly check your university email account. Please use your UNSW student email and state your student number in all emails to us.**