



# COMP2300

## Applied Cryptography

Session 2, In person-scheduled-weekday, North Ryde 2023

*School of Computing*

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#### Disclaimer

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## General Information

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Credit points

10

Prerequisites

(COMP1010 or COMP125) and (DMTH137 or MATH1007 or DMTH237)

Corequisites

Co-badged status

COMP6300

Unit description

This unit provides an introduction to modern applied cryptography. It deals with the concepts and techniques behind cryptographic primitives, such as hash functions, symmetric-key ciphers, public-key cryptography and digital signatures. It then explains the concept of cryptanalysis before addressing important cryptographic protocols. The unit concludes with a review of existing applications including blockchain and cryptocurrencies, electronic voting schemes, executable code signing, full disk encryption, etc.

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

## Learning Outcomes

On successful completion of this unit, you will be able to:

**ULO1:** Explain the concepts and principles on which modern cryptography relies upon.

**ULO2:** Employ adapted cryptographic tools and techniques to encrypt, decrypt and sign messages.

**ULO3:** Decipher simple encrypted messages using a range of cryptanalysis methods.

**ULO4:** Apply cryptographic technologies and protocols to increase data security and protect privacy.

## General Assessment Information

### Late Assessment Submission Penalty

From 1 July 2022, Students enrolled in Session based units with written assessments will have the following university standard late penalty applied. Please see <https://students.mq.edu.au/study/assessment-exams/assessments> for more information.

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark) will be applied each day a written assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. Submission time for all written assessments is set at 11:55 pm. A 1-hour grace period is provided to students who experience a technical concern.

For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, students need to submit an application for Special Consideration.

Assessments where Late Submissions will be accepted

In this unit, late submissions will accepted as follows:

Assignments 1 and 2 – YES, Standard Late Penalty applies

Module Exams 1, 2 and 3 - NO, unless Special Consideration is Granted

### Hurdle Assessment

The weekly tasks, i.e., weekly quizzes, are the only hurdle assessment for this unit. There will be 10 weekly quizzes. You are required to **attempt** at least 6 of the 10 to pass the hurdle. Note that the hurdle is the attempt, not the marks obtained. For example, you may secure less than 50% marks in the quizzes, but you will still pass the hurdle if you have attempted 6 or more of them. This activity is a hurdle to ensure that you are regularly attending and keeping up with the lectures and workshops preceding the quizzes. There is no opportunity to resit the hurdle, as it only requires you to attempt the quizzes. In the rare occasion that you missed a couple of quizzes resulting in you failing the hurdle, please email the unit convenor and apply for special consideration.

### Special Consideration

The [Special Consideration Policy](#) aims to support students who have been impacted by short-term circumstances or events that are serious, unavoidable and significantly disruptive, and which may affect their performance in assessment. If you experience circumstances or events that affect your ability to complete the assessments in this unit on time, please inform the convenor and submit a Special Consideration request through [ask.mq.edu.au](https://ask.mq.edu.au).

### Requirements to Pass this Unit

To pass this unit, you must:

- Achieve a total mark equal to or greater than 50%
- Attempt at least 6 out of the 10 weekly quizzes (hurdle requirement)

You will maximise your chances of passing this unit if:

- You attempt all assessments
- Attend all lectures and practicals

## Assessment Tasks

Name	Weighting	Hurdle	Due
<a href="#">Weekly Tasks</a>	10%	Yes	Every Week
<a href="#">Module Exam #1</a>	20%	No	Week 5
<a href="#">Assignment 1</a>	15%	No	Week 7
<a href="#">Module Exam #2</a>	20%	No	Week 9
<a href="#">Assignment 2</a>	15%	No	Week 12
<a href="#">Module Exam #3</a>	20%	No	Week 13

## Weekly Tasks

Assessment Type <sup>1</sup>: Problem set

Indicative Time on Task <sup>2</sup>: 5 hours

Due: **Every Week**

Weighting: **10%**

**This is a hurdle assessment task (see [assessment policy](#) for more information on hurdle assessment tasks)**

Each week, a set of exercises will be available online. Some require written submissions, while some are multiple choice. Your solutions should be submitted electronically via iLearn before the deadline specified in the text.

On successful completion you will be able to:

- Explain the concepts and principles on which modern cryptography relies upon.
- Employ adapted cryptographic tools and techniques to encrypt, decrypt and sign messages.

- Decipher simple encrypted messages using a range of cryptanalysis methods.
- Apply cryptographic technologies and protocols to increase data security and protect privacy.

## Module Exam #1

Assessment Type <sup>1</sup>: Examination

Indicative Time on Task <sup>2</sup>: 10 hours

Due: **Week 5**

Weighting: **20%**

A 50 minutes long written examination worth 20% that will be held in week 5 during practical class. This will test your understanding of material covered in weeks 1 to 4.

On successful completion you will be able to:

- Explain the concepts and principles on which modern cryptography relies upon.
- Employ adapted cryptographic tools and techniques to encrypt, decrypt and sign messages.
- Decipher simple encrypted messages using a range of cryptanalysis methods.

## Assignment 1

Assessment Type <sup>1</sup>: Project

Indicative Time on Task <sup>2</sup>: 7 hours

Due: **Week 7**

Weighting: **15%**

This assignment deals with symmetric-key cryptography and is due on week 7. The assignment is to be submitted via iLearn.

On successful completion you will be able to:

- Explain the concepts and principles on which modern cryptography relies upon.
- Employ adapted cryptographic tools and techniques to encrypt, decrypt and sign messages.
- Decipher simple encrypted messages using a range of cryptanalysis methods.

## Module Exam #2

Assessment Type <sup>1</sup>: Examination

Indicative Time on Task <sup>2</sup>: 10 hours

Due: **Week 9**

Weighting: **20%**

A 50 minutes long written examination worth 20% that will be held in week 9 during practical class. This will test your understanding of material covered in weeks 5 to 8.

On successful completion you will be able to:

- Explain the concepts and principles on which modern cryptography relies upon.
- Apply cryptographic technologies and protocols to increase data security and protect privacy.

## Assignment 2

Assessment Type <sup>1</sup>: Project

Indicative Time on Task <sup>2</sup>: 8 hours

Due: **Week 12**

Weighting: **15%**

This assignment deals with public-key cryptography and is due on week 12. The assignment is to be submitted via iLearn.

On successful completion you will be able to:

- Apply cryptographic technologies and protocols to increase data security and protect privacy.

## Module Exam #3

Assessment Type <sup>1</sup>: Examination

Indicative Time on Task <sup>2</sup>: 10 hours

Due: **Week 13**

Weighting: **20%**

A 50 minutes long written examination worth 20% that will be held in week 13 during practical class. This will test your understanding of material covered in weeks 9 to 12.

On successful completion you will be able to:

- Explain the concepts and principles on which modern cryptography relies upon.
- Apply cryptographic technologies and protocols to increase data security and protect privacy.

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<sup>1</sup> If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the [Writing Centre](#) for academic skills support.

<sup>2</sup> Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

## Delivery and Resources

### COMPUTING FACILITIES

**Important!** Please note that this is a BYOD (Bring Your Own Device) unit. You will be expected to bring your own laptop computer (Windows, Mac or Linux) to the workshop, install and configure the required software, and incorporate secure practices into your daily work (and play!) routines.

### CLASSES

Each week you should complete any assigned readings and review the lecture slides in order to prepare for the lecture. There are three hours of lectures and a one-hour workshop every week. There uses hands-on exercises to reinforce concepts introduced during the lectures; you should have chosen a practical on enrollment. You will find it helpful to read the workshop instructions before attending - that way, you can get to work quickly!

For details of days, times and rooms consult the [timetables webpage](#).

Note that **Workshops commence in week 1**.

You should have selected a practical at enrollment.

Please note that you will be **required** to submit work every week. Failure to do so may result in you failing the unit or being excluded from the exam.

### NON-LECTURE ACTIVITIES IN WEEK 1

Please note that apart from the lectures we will have workshops also commencing from week 1. Please refer to your timetable for up-to-date information about the time and location of your workshop.

## METHODS OF COMMUNICATION

We will communicate with you via your university email or through announcements on iLearn.

Queries to convenors can either be placed on the iLearn discussion board or sent to the [unit convenor](#) from your university email address.

## COVID INFORMATION

For the latest information on the University's response to COVID-19, please refer to the Coronavirus infection page on the Macquarie website: <https://www.mq.edu.au/about/coronavirus-faqs>. Remember to check this page regularly in case the information and requirements change during semester. If there are any changes to this unit in relation to COVID, these will be communicated via iLearn.

## REQUIRED AND RECOMMENDED TEXTS AND/OR MATERIALS

Required readings for this unit:

- N. Smart, **Cryptography Made Simple**, Springer. The PDF version of the book is available online at <https://www.springer.com/us/book/9783319219356> and also through MQ Library.
- Easttom, Chuck. **Modern Cryptography: Applied Mathematics for Encryption and Information Security**. 1 edition. New York: McGraw-Hill Education, 2015. The book is available in online format through the Library; there will be allocated readings each week.

Recommended readings for this unit:

- R. Anderson, **Security Engineering (SE)** Wiley Publishing, Inc. 2008. The complete second edition is now available online at <http://www.cl.cam.ac.uk/~rja14/book.html>
- A. J. Menezes, P. C. van Oorschot and S. A. Vanstone, **Handbook of applied cryptography (HAC)**, CRC Press, Boca Raton, FL, 1996. All required chapters are available online at <http://cacr.uwaterloo.ca/hac/>
- **NIST SP 800** documents available from <http://csrc.nist.gov/publications/PubsSPs.html>
- **IETF RFC's** available from <http://www.rfc-editor.org>
- Bauer, Craig P., **Secret History: The Story of Cryptology**, CRC Press (2013)
- **Cryptography Engineering: Design Principles and Practical Applications**, Ferguson, Neils, Tadayoshi Kohno and Bruce Schneier, 1st ed., Wiley

## TECHNOLOGY USED AND REQUIRED

### iLearn

[iLearn](#) is a Learning Management System that gives you access to lecture slides, lecture recordings, forums, assessment tasks, instructions for practicals, discussion forums and other



resources.

### Echo 360 (formerly known as iLecture)

Digital recordings of lectures are available. Read these [instructions](#) for details.

### Technology Used

Python programming language and GP/PARI, GnuPG, VeraCrypt, Thunderbird, Gnu Privacy Guard, Enigmail, OpenSSH, PuTTY, Ophcrack.

## Unit Schedule

Week	Topic
1	Introduction to Cryptography and Elementary Number Theory
2	Symmetric Cryptography
3	Hashes, Digests and Passwords
4	Encrypting Files and Filesystems
5	Introduction to Public Key Cryptography and Advanced Number Theory
6	Digital Signatures and Authentication Protocols
7	Network and Telecommunications Security
8	ElGamal Cryptosystem and Elliptic Curve Cryptography
9	Blockchain and Cryptocurrencies I
10	Blockchain and Cryptocurrencies II
11	Quantum Computing and Post-Quantum Cryptography
12	Advanced Topics in Cryptography
13	Revision and Exam Preparation

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](https://policies.mq.edu.au) (<https://policies.mq.edu.au>). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- [Academic Appeals Policy](#)
- [Academic Integrity Policy](#)
- [Academic Progression Policy](#)
- [Assessment Policy](#)
- [Fitness to Practice Procedure](#)
- [Assessment Procedure](#)

- [Complaints Resolution Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#)

Students seeking more policy resources can visit [Student Policies](https://students.mq.edu.au/support/study/policies) (<https://students.mq.edu.au/support/study/policies>). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit [Policy Central](https://policies.mq.edu.au) (<https://policies.mq.edu.au>) and use the [search tool](#).

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: <https://students.mq.edu.au/admin/other-resources/student-conduct>

## Results

Results published on platform other than [eStudent](#), (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in [eStudent](#). For more information visit [ask.mq.edu.au](http://ask.mq.edu.au) or if you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@mq.edu.au)

## Academic Integrity

At Macquarie, we believe [academic integrity](#) – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free [online writing and maths support](#), [academic skills development](#) and [wellbeing consultations](#).

## Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

## The Writing Centre

[The Writing Centre](#) provides resources to develop your English language proficiency, academic writing, and communication skills.

- [Workshops](#)
- [Chat with a WriteWISE peer writing leader](#)
- [Access StudyWISE](#)
- [Upload an assignment to Studiosity](#)
- [Complete the Academic Integrity Module](#)

The Library provides online and face to face support to help you find and use relevant information resources.

- [Subject and Research Guides](#)
- [Ask a Librarian](#)

## Student Services and Support

Macquarie University offers a range of [Student Support Services](#) including:

- [IT Support](#)
- [Accessibility and disability support](#) with study
- Mental health [support](#)
- [Safety support](#) to respond to bullying, harassment, sexual harassment and sexual assault
- [Social support including information about finances, tenancy and legal issues](#)
- [Student Advocacy](#) provides independent advice on MQ policies, procedures, and processes

## Student Enquiries

Got a question? Ask us via [AskMQ](#), or contact [Service Connect](#).

## IT Help

For help with University computer systems and technology, visit [http://www.mq.edu.au/about\\_us/offices\\_and\\_units/information\\_technology/help/](http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/).

When using the University's IT, you must adhere to the [Acceptable Use of IT Resources Policy](#). The policy applies to all who connect to the MQ network including students.

## Grading Standards

At the end of the semester, you will receive a grade that reflects your achievement in the unit

- **Fail (F)**: does not provide evidence of attainment of all learning outcomes. There is missing or partial or superficial or faulty understanding and application of the fundamental concepts in the field of study; and incomplete, confusing or lacking communication of ideas in ways that give little attention to the conventions of the discipline.
- **Pass (P)**: provides sufficient evidence of the achievement of learning outcomes. There is demonstration of understanding and application of fundamental concepts of the field of study; and communication of information and ideas adequately in terms of the conventions of the discipline. The learning attainment is considered satisfactory or adequate or competent or capable in relation to the specified outcomes.
- **Credit (Cr)**: provides evidence of learning that goes beyond replication of content knowledge or skills relevant to the learning outcomes. There is demonstration of

substantial understanding of fundamental concepts in the field of study and the ability to apply these concepts in a variety of contexts; plus communication of ideas fluently and clearly in terms of the conventions of the discipline.

- **Distinction (D)**: provides evidence of integration and evaluation of critical ideas, principles and theories, distinctive insight and ability in applying relevant skills and concepts in relation to learning outcomes. There is demonstration of frequent originality in defining and analysing issues or problems and providing solutions; and the use of means of communication appropriate to the discipline and the audience.
- **High Distinction (HD)**: provides consistent evidence of deep and critical understanding in relation to the learning outcomes. There is substantial originality and insight in identifying, generating and communicating competing arguments, perspectives or problem solving approaches; critical evaluation of problems, their solutions and their implications; creativity in application.

Your final grade depends on your performance in each assessment task and on your ability to perform well enough on the hurdle assessment tasks.

For each task, you receive a mark that reflects your standard of performance. Then the different component marks are added up to determine an aggregated mark out of 100. In order to pass the unit, this aggregated mark needs to be at least 50.

You also need to achieve a minimum standard of performance on the hurdle assessment tasks.

### Hurdle Assessment Task

- Submission of practical tasks in this unit is a hurdle requirement. You are required to make at least 6 out of 10 submissions in order to pass the unit.

Note that assignment submission in this unit is not a hurdle requirement. However, if you do not make a reasonable attempt at the two assignments, you will be unlikely to pass the unit.

Your final grade is then a direct reflection of the aggregated mark (provided that you satisfy the hurdle requirements) according to the following:

- 85-100 for **HD**
- 75-84 for **D**
- 65-74 for **CR**
- 50-64 for **P**

If you receive special consideration for the final exam, a supplementary exam will be scheduled in the interval between the regular exam period and the start of the next session. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with

the policy prior to submitting an application. You can check the supplementary exam information page on FSE101 in iLearn ([bit.ly/FSESupp](https://bit.ly/FSESupp)) for dates, and approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

If you are given a second opportunity to sit the final examination as a result of failing to meet the minimum mark required, you will be offered that chance during the same supplementary examination period and will be notified of the exact day and time after the publication of final results for the unit.

## Changes since First Published

Date	Description
05/10/2023	"tutorial" replaced by "practical"
11/07/2023	Joined the online offering into this unit guide

Unit information based on version 2023.02 of the [Handbook](#)