

FOUNDATIONS OF CODING THEORY

(MATS3430)

Introduction

- How do QR codes work? Why are damaged QR codes still decodable?
- How does Bitcoin work? How to protect your Bitcoins against hackers?
- What is the theory behind e-signature? How to verify its authenticity? How to prevent the receiver from reusing it without the sender's authorisation?

With the rapid development of computers and the internet, there is a great demand on security and accuracy in electronic transmission of information, which has stimulated the great development of coding theory and cryptography over the past few decades. At heart, these theories rely heavily on number theory and abstract algebra, which are two important, classical branches of pure mathematics. In this series of courses, we will appreciate the interaction of pure and applied mathematics and explore some of their real-world applications.

The "From Number Theory to Network Communication Series" programmes offered by the **Department of Mathematics, The Chinese University of Hong Kong**, are designated for students to learn Cryptography progressively.

From Number Theory to Network Communication Series consists of the following programmes:

Programme	Code	Application	Programme held
Basic Number Theory	MATS2440	Jul-19	Oct 2019
Introduction to Abstract Algebra	MATS3270	Oct-19	Dec 2019
Foundations of Coding Theory	MATS3430	Jan-20	Mar 2020
Introduction to Cryptography	MATS3440	Apr-20	Jun - Jul 2020

Here comes the third programme in the series, Foundations of Coding Theory.

From storage of information in a DVD, satellite broadcasting of high definition television, to sending pictures back to the Earth from spacecrafts, it is unavoidably influenced by noise or corruption. Improving the reliability of these procedures relies on the techniques for error detection and corrections, which is one of the main purposes of studying coding theory.

This course will discuss basic knowledge related to error control in coding theory including basic properties of general codes, Hamming codes, Golay codes, BCH codes and Reed-Solomon codes.

Programme Type / Level

Numbers and Arithmetic Course (Level 5) ([Token-required](#))

Instructor(s)

Dr Chan Kai Leung

Pre-requisites

Student should have basic knowledge in:

1. Vectors
2. Matrix Operations

3. Groups, Rings and Fields in Abstract Algebra

Target Participants



- S1 – S6 HKAGE student members
- Class size: 20

All applicants **MUST submit the Screening Test answers no later than 17 Feb 2020 (Mon) at 12 noon** except those who have passed the programme “Introduction to Abstract Algebra (MATS3270)”

Priority will be given to student members who have passed MATS3270 and they could have direct admission to this programme when apply.

Medium of Instruction



Cantonese with English handouts

Certificate



E-Certificate will be awarded to participants who have:

- ❖ Attended **at least 3 sessions** **AND**
- ❖ Had Satisfactory performance in all assignments and assessments

Intended Learning Outcomes



Upon completion of the programme, participants should be able to:

1. understand the characteristics of different codes introduced in the course;
2. perform encoding and decoding procedures;
3. understand and appreciate the applications of mathematical theories via coding theory.

Application Deadline

10 Feb 2020
12:00 n.n.

Application Result Release Date

21 Feb 2020

If student members withdraw from the programme after the Application Deadline, the token will be deducted.

MATHEMATICS

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Schedule



Session	Date	Time	Venue	Content
	15 Feb 2020 [Cancelled]	2:30 p.m. – 3:30 p.m.	WMY 505	
Submission Deadline of Screening Test	17 Feb	12:00 n.n.	---	Screening Test
1	7 Mar	2:00 p.m. – 5:00 p.m.	WMY 403 Online Teaching	Basic Ideas of Coding Theory Error Control Basic Properties of General Codes
2	14 Mar			Brief Review of Linear Algebra Linear Codes Hamming Codes and Golay Codes
3	21 Mar			Finite Fields Cyclic Codes
4	28 Mar			BCH Codes Reed-Solomon Codes
Submission Deadline of Take-Home Exam	30 Mar	12:00 n.n.	---	Take-Home Exam
5	4 Apr	1:00 p.m. – 5:00 p.m.		Oral Exam

Remarks:

- Screening Test paper will be sent to students concerned through email duly. Please return your answers through email no later than 17 Feb 2020 (Mon) at 12 noon. Late submission will not be considered.**
- After submission of your Take-Home Exam, you will be arranged a 15-min time slot for the Oral Exam between 1 p.m. and 5 p.m., 4 Apr (Sat). Please reserve your time. The details will be announced in due course.**
- For any assessment to be held in the programme, no make-up will be arranged, including Screening Test.

Sample Examples for the Programme

- Is the number Z672413(3) a valid Hong Kong identity card number?
- Suppose that a code word is sent using the Hamming [7,4] code and 0101010 is received. Assume the received message contains at most one error, find the decoded message.
- Let C be the binary code of length 7 generated by the polynomial $g(X)=1+X^2+X^3+X^4$. Find the minimum distance of the code C.

Enquiries



For enquiries, please contact us at 3940 0101 after language selection, press "1".