香 港 資 優 教 育 學 苑
The Hong Kong Academy for Gifted Education

FROM NUMBER THEORY TO NETWORK COMMUNICATION SERIES:

INTRODUCTION TO ABSTRACT ALGEBRA (MATS3270)

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 second programme in the series, Introduction to Abstract Algebra.

From the end of the 19th and the beginning of the 20th century, there was a tremendous shift of methodology of studying algebra. Instead of investigating individual mathematical systems (such as integers, real numbers, complex numbers, matrices and vectors), mathematicians concentrated more on the general algebraic structures. The abstraction of concepts and building algebraic systems with structural axioms constituted the study of abstract algebra (occasionally called modern algebra), one of the main branch of pure mathematics.

This course will discuss basic knowledge in abstract algebra including groups, rings, fields and linear algebra. From the perspective of abstract algebra, some important results in number theory will be revisited and handled in a more general and elegant approach.

Programme Type / Level

Algebra Course (Level 4) (Token-required)

Instructor(s)

Dr Liu Chun Lung Kelvin

Pre-requisites

Student should have basic knowledge basic number theory, including Euclidean Algorithm, modular arithmetic, Chinese remainder theorem, Fermat's little theorem and primitive roots.

Target Participants

- S1 to S6 HKAGE student members
- Class size: 25

All applicants **MUST submit the Screening Test answers no later than 18 Nov 2019 (Mon) at 12 noon** except those who have passed the programme "Basic Number Theory (MATS2440)".

Priority will be given to student members who have passed MATS2440 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:

- Attending **AT LEAST 3 sessions** AND
- Satisfactory performance in all assignments and assessments

Intended Learning Outcomes

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

1. apply basic knowledge and concepts of abstract algebra in problem solving;
2. provide rigorous proofs for simple mathematical statements with knowledge in abstract algebra;
3. understand and appreciate the connection and transition between the study of concrete and abstract algebraic systems.

Application Deadline

11 Nov 2019
12:00 n.n.

Application Result Release Date

~~**22 Nov 2019**~~
29 Nov 2019

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

Schedule

Session	Date	Time	Venue (HKAGE)	Content
	~~16 Nov~~ [Cancelled]	~~2:30 p.m. – 3:30 p.m.~~	Room G01	Screening Test
Submission Deadline of Screening Test Answers	18 Nov	12:00 n.n.		
1	7 Dec	2:00 p.m. – 5:00 p.m.		Groups, Subgroups and Lagrange's Theorem Rings and Ideals
2	14 Dec			Fields, Finite Fields Number Theory Revisited
3	21 Dec			Matrices
4	28 Dec			System of Linear Equations Gaussian Elimination

Remarks:

1. Screening Test paper will be sent to students concerned through email duly. Please return your answers through email no later than 18 Nov 2019 (Mon) at 12 noon. Late submission will not be considered.

2. For any assessment to be held in the programme, no make-up will be

	arranged, including Screening Test.
Sample Examples for the Programme	1) Show that a Rubik's cube is a group where each element of the group is a permutation and hence a Rubik's cube puzzle can always be solved. 2) Show that the set of all polynomials with usual addition and multiplication is a ring. 3) Prove that if a system of linear equations has more than one solution, then it has infinitely many solutions.
Enquiries	For enquiries, please contact us at 3940 0101 after language selection, press "1".