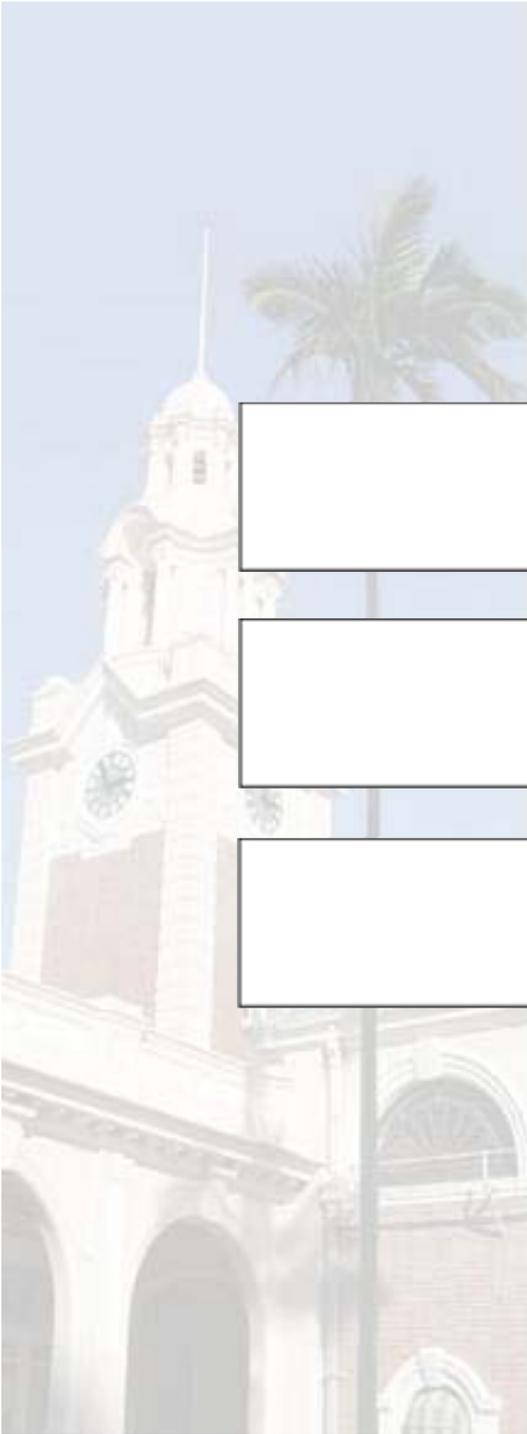




*Major and Minor  
in  
Mathematics*

*Chan Jor Ting*



# BSc Curriculum

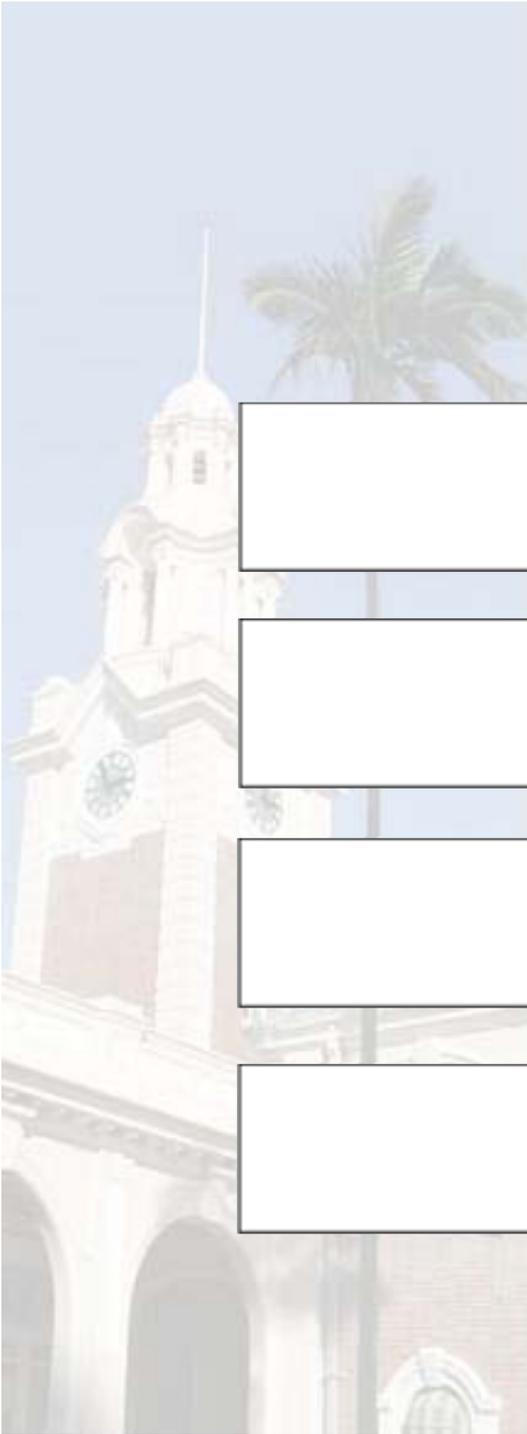
**Primary Science Major:** 96 credits  
2 Science Foundation courses (SCNC1111 & SCNC1112),  
13 Disciplinary courses  
and 1 Capstone course

+

**Common Core Courses:** 36 credits  
6 courses in 4 Areas of Inquiry  
(at least 1 and not more than 2 courses from each Aol)

+

**Language Courses:** 18 credits  
English: 12 credits [6 credits in Core University English (CAES1000) and  
6 credits in English in the Discipline (CAES9820)]  
Chinese: 6 credits (CSCI9001)



# BSc Curriculum

## Option A

**Primary Science Major:** 96 credits  
2 Science Foundation courses (SCNC1111 & SCNC1112),  
13 Disciplinary courses  
and 1 Capstone course

+

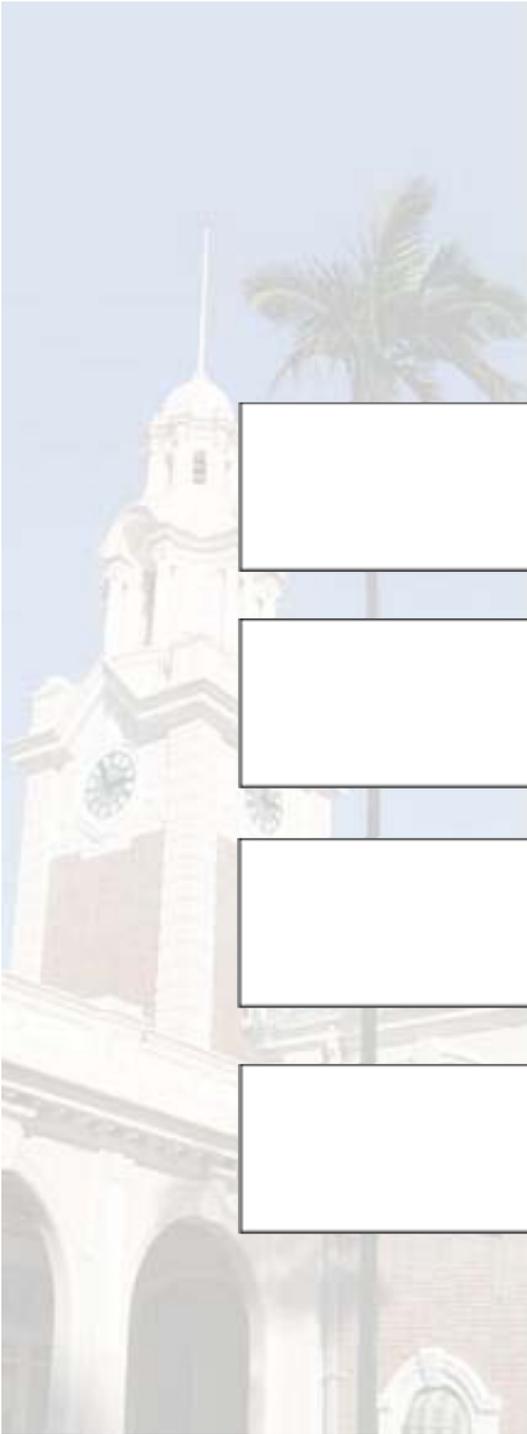
**Common Core Courses:** 36 credits  
6 courses in 4 Areas of Inquiry  
(at least 1 and not more than 2 courses from each Aoi)

+

**Language Courses:** 18 credits  
English: 12 credits [6 credits in Core University English (CAES1000) and  
6 credits in English in the Discipline (CAES9820)]  
Chinese: 6 credits (CSCI9001)

+

**Electives:** 90 credits  
To make up the 240 total credits



# BSc Curriculum

## Option B

**Primary Science Major:** 96 credits  
2 Science Foundation courses (SCNC1111 & SCNC1112),  
13 Disciplinary courses  
and 1 Capstone course

+

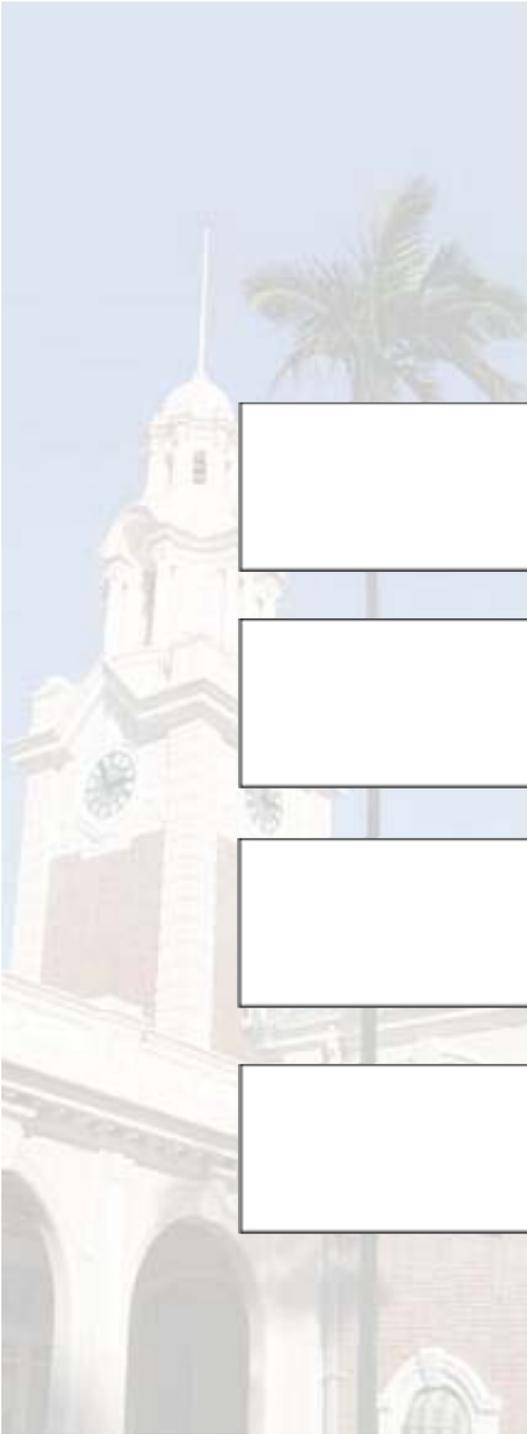
**Common Core Courses:** 36 credits  
6 courses in 4 Areas of Inquiry  
(at least 1 and not more than 2 courses from each Aoi)

+

**Language Courses:** 18 credits  
English: 12 credits [6 credits in Core University English (CAES1000) and  
6 credits in English in the Discipline (CAES9820)]  
Chinese: 6 credits (CSCI9001)

+

**Minor:** 36 – 48 credits  
+  
**Electives:** 42 – 54 credits  
To make up the 240 total credits



# BSc Curriculum

## Option C

**Primary Science Major:** 96 credits  
2 Science Foundation courses (SCNC1111 & SCNC1112),  
13 Disciplinary courses  
and 1 Capstone course

+

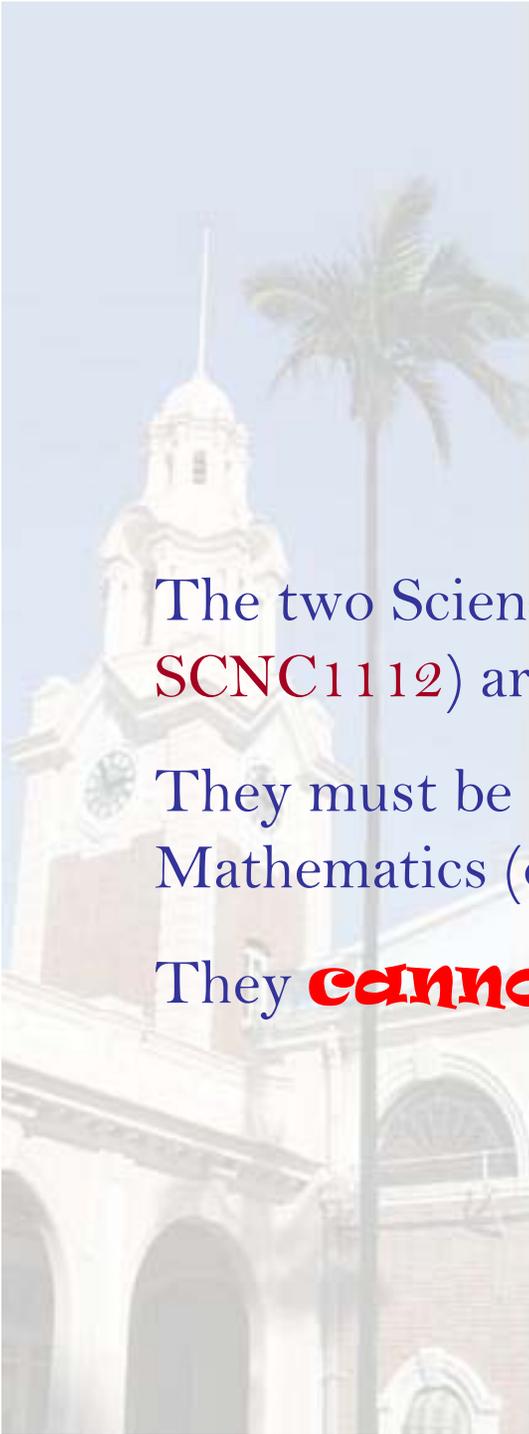
**Common Core Courses:** 36 credits  
6 courses in 4 Areas of Inquiry  
(at least 1 and not more than 2 courses from each Aoi)

+

**Language Courses:** 18 credits  
English: 12 credits [6 credits in Core University English (CAES1000) and  
6 credits in English in the Discipline (CAES9820)]  
Chinese: 6 credits (CSCI9001)

+

**2<sup>nd</sup> Major:** 72 – 96 credits



## Note

The two Science Foundation Courses (**SCNC1111** and **SCNC1112**) are required courses for all Science majors.

They must be taken by **non-BSc students** majoring in Mathematics (or any Science major).

They **cannot** be replaced by disciplinary courses.

# Science Foundation Courses

## **SCNC1111 Scientific method and reasoning (6 credits)**

Course Contents	<ul style="list-style-type: none"><li>- The nature and methodology of science</li><li>- Quantitative Reasoning</li><li>Mathematics and Statistics</li></ul>
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## **SCNC1112 Fundamentals of modern science (6 credits)**

Course Contents	<ul style="list-style-type: none"><li>- Universal principles and unifying concepts of science</li><li>- Fundamental structure of matter</li><li>- Atoms and molecules</li><li>- DNA/Genetic</li><li>- Cells and systems</li><li>- Organism and environment</li><li>- Earth and Beyond</li></ul>
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# Major in Mathematics

## Required courses (96 credits)

### 1. Introductory level courses (48 credits)

#### Science Foundation Courses (12 credits)

SCNC1111      Scientific method and reasoning (6)

SCNC1112      Fundamentals of modern science (6)

#### Disciplinary Courses (36 credits)

MATH1013      University mathematics II (6)

MATH2012      Fundamental concepts of mathematics (6)

MATH2101      Linear algebra I (6)

MATH2102      Linear algebra II (6)

MATH2211      Multivariable calculus (6)

MATH2241      Introduction to mathematical analysis (6)

# Major in Mathematics

## Required courses (96 credits)

### 2. Advanced level courses (42 credits)

MATH3301	Algebra I (6)
MATH3401	Analysis I (6)
MATH3403	Functions of a complex variable (6)

Plus at least 24 credits advanced level Mathematics courses (MATH3XXX or MATH4XXX or MATH7XXX level), at least 12 credits of which should be from MATH4XXX or MATH7XXX level, excluding MATH4966 Mathematics internship, subject to pre-requisite requirements.

### 3. Capstone requirement (6 credits)

At least 6 credits selected from the following courses:

MATH3999	Directed studies in mathematics (6)
MATH4910	Senior mathematics seminar (6)
MATH4911	Mathematics capstone project (6)
MATH4966	Mathematics internship (6)
MATH4999	Mathematics project (12)

# Major in Mathematics

## Required courses (96 credits)

### 2. Advanced level courses (42 credits)

MATH3401          Analysis I (6)

*And 2 courses from*

MATH3301          Algebra I (6)

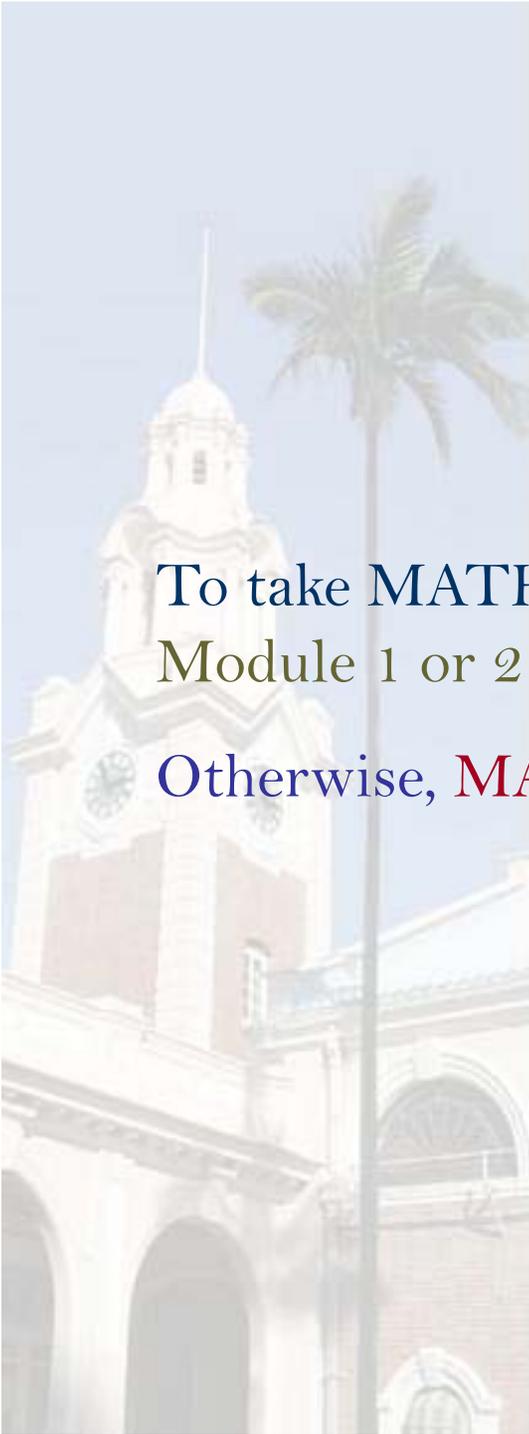
MATH3403          Functions of a complex variable (6)

MATH3601          Numerical analysis (6)

MATH3603          Probability theory (6)

MATH3904          Introduction to optimization (6)

Plus at least 24 credits advanced level Mathematics courses (MATH3XXX or MATH4XXX or MATH7XXX level), at least 12 credits of which should be from MATH4XXX or MATH7XXX level, excluding MATH4966 Mathematics internship, subject to pre-requisite requirements.



## Note

To take MATH1013, Level 2 or above in HKDSE Extended Module 1 or 2 of Mathematics is required.

Otherwise, **MATH1011** should be taken first.

# Bridging Course

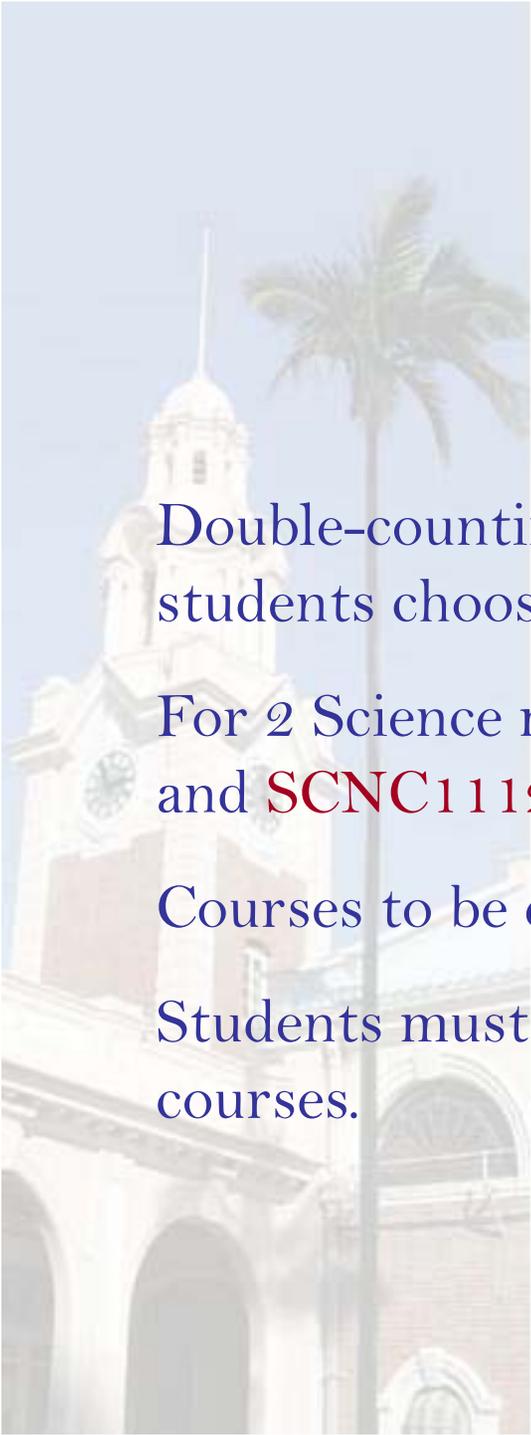
## MATH1011 University mathematics I (6 credits)

### Course Contents

- Sets, Venn diagram, set operations
- Permutations, combinations and elementary probabilities
- Mathematical induction
- Exponential and logarithmic functions
- Trigonometric functions, trigonometric formulae
- Limits of algebraic, exponential and logarithmic functions
- Derivatives of algebraic, exponential and logarithmic functions
- Differentiation rules: addition, product, quotient and chain rule
- Maxima and minima
- Indefinite and definite integrals
- Area
- Integration by substitution
- Trapezoidal rule with error estimation

# Equivalent Qualifications

HKDSE	Grade	IB	GCE	AP	Gao Kao (高考)
Mathematics + (M1 or M2)	2 or above	Mathematics (HL)/Mathematical Studies (HL)	Pure Mathematics (AL) Further Mathematics (AL)	Calculus AB or BC	Equivalent to fulfillment of all HKDSE requirements



# Double Counting

Double-counting of courses **up to 24 credits** is allowed for students choosing two majors

For 2 Science majors, the courses must include **SCNC1111** and **SCNC1112**.

Courses to be double-counted must be **disciplinary core**.

Students must make up the 240 credits by taking other courses.



## Note

For non-Science students, if MATH1013 has already been taken, it must be replaced by either **MATH2241** or any 6-credit level 2 or above **Mathematics Disciplinary Elective**.

# Required Courses

## **MATH1013 University mathematics II (6 credits)**

### Course Contents

- Functions; graphs; inverse functions
- Limits, continuity and differentiability
- Mean value theorem; implicit differentiation; L'Hopital's rule
- Higher order derivatives, maxima and minima, graph sketching
- Radian, calculus of trigonometric functions
- Improper integrals, partial fractions, integration by parts
- Complex numbers, polar form, de Moivre's formula
- Basic matrix and vector (of order 2 and 3) operations, determinants
- First order ordinary differential equations

# Required Courses

## **MATH2012 Fundamental concepts of mathematics (6 credits)**

- |                 |   |
|-----------------|---|
| Course Contents | <ul style="list-style-type: none"><li>- elementary set theory</li><li>- statement calculus</li><li>- mathematical proofs</li><li>- relations and functions</li><li>- finite and infinite sets</li><li>- natural numbers and mathematical induction</li><li>- axiomatic systems in mathematics</li><li>- real numbers and the limit of a sequence</li><li>- examples of groups</li></ul> |
|-----------------|---|

# Required Courses

## MATH2101 Linear algebra I (6 credits)

### Course Contents

- Vector Geometry in  $\mathbb{R}^2$  and  $\mathbb{R}^3$ : Revision of addition and scalar multiplication of vectors, dot product, lines and planes; and applications to geometry
- Matrix Algebra: Matrix addition and multiplication, determinant and inverse of square matrices, system of linear equations as a matrix equation
- Systems of Linear Equations: Gauss-Jordan elimination, elementary row operations, row echelon form, elementary matrices, matrix inversion
- Vector Spaces: Coordinate system in  $\mathbb{R}^n$ , the Euclidean spaces as vector spaces, its subspaces, span of vectors, linear independence, basis, dimension, change of basis (computational examples), applications
- Linear Transformations: Definition and examples of linear transformations in  $\mathbb{R}^2$  and  $\mathbb{R}^3$ , standard matrices of linear transformations, kernel and image, isomorphism
- Eigenvalue Problem: Eigenvalues and eigenvectors, diagonalization of matrices (with distinct eigenvalues), applications
- Inner Product: Gram-Schmidt process, least square problems

# Required Courses

## **MATH2101 Linear algebra II (6 credits)**

### Course Contents

- Vector Spaces: Definition and examples, subspaces, kernel and image, row and column spaces and rank of a matrix, linear independence, basis, dimension
- Determinant and its properties
- Linear Transformations: matrix representation, change of basis
- Eigenvalue Problem: Characteristic polynomial, Cayley theorem, eigen-subspaces
- Inner Product Spaces: Inner product, Gram-Schmidt orthogonalization, orthonormal basis, self-adjoint operators
- Diagonalization of Matrices

# Required Courses

## MATH2211 Multivariable calculus (6 credits)

### Course Contents

- Vectors: vectors in 2-, 3-, and n-dimensions; dot product and cross product; lines and planes; polar, cylindrical, and spherical coordinates
- Differentiation in several variables: limits and derivatives; the chain rule; directional derivatives and gradients
- Vector-valued functions: parametrized curves; arc-length; vector fields; gradient, divergence, curl, and the del operator
- Maxima and minima: differentials and Taylor's Theorem of several variables; extrema of functions; Lagrange multipliers; applications of extrema
- Multiple integration: double and triple integrals; change of variables; applications
- Line integrals: scalar and vector line integrals; Green's Theorem; conservative vector fields
- Surface integrals and vector analysis: parametrized surfaces; surface integrals; Stoke's and Gauss's Theorems

# Required Courses

## MATH2241 Introduction to mathematical analysis (6 credits)

### Course Contents

- The real number system: the real numbers as an ordered field, supremum and infimum, the completeness axiom, denseness of the rational numbers
- Sequences and series of real numbers: limits of sequences, properties of convergent sequences, monotone sequences and Cauchy sequences, subsequences, series, tests of convergence for series
- Continuity of real-valued functions: properties of continuous functions, the extreme value theorem, the intermediate value theorem, uniform continuity, limits of functions
- Differentiation: properties of differentiable functions, the mean value theorem, Taylor's theorem and its applications
- Integration: construction of the Riemann integral using Darboux sums and Riemann sums, the fundamental theorem of calculus

# Minor in Mathematics

## Required courses (36 credits)

### 1. Introductory level courses (18 credits)

MATH1013          University mathematics II (6)

MATH2101          Linear algebra I (6)

MATH2211          Multivariable calculus (6)

### 2. Advanced level courses (18 credits)

At least 18 credits of advanced level Mathematics courses (MATH3XXX or MATH4XXX or MATH7XXX level), subject to pre-requisite requirements.

# Minor in Mathematics

## Required courses (36 credits)

### 1. Introductory level courses (18 credits)

MATH1013	University mathematics II (6)
MATH2012	Fundamental concepts of mathematics (6)
MATH2014	Multivariable calculus and linear algebra (6)

### 2. Advanced level courses (18 credits)

At least 18 credits of advanced level Mathematics courses (MATH3XXX or MATH4XXX or MATH7XXX level), subject to pre-requisite requirements.

# Required Courses

## **MATH1013 University mathematics II (6 credits)**

### Course Contents

- Functions; graphs; inverse functions
- Limits, continuity and differentiability
- Mean value theorem; implicit differentiation; L'Hopital's rule
- Higher order derivatives, maxima and minima, graph sketching
- Radian, calculus of trigonometric functions
- Improper integrals, partial fractions, integration by parts
- Complex numbers, polar form, de Moivre's formula
- Basic matrix and vector (of order 2 and 3) operations, determinants
- First order ordinary differential equations

# Required Courses

## MATH2101 Linear algebra I (6 credits)

### Course Contents

- Vector Geometry in  $\mathbb{R}^2$  and  $\mathbb{R}^3$ : Revision of addition and scalar multiplication of vectors, dot product, lines and planes; and applications to geometry
- Matrix Algebra: Matrix addition and multiplication, determinant and inverse of square matrices, system of linear equations as a matrix equation
- Systems of Linear Equations: Gauss-Jordan elimination, elementary row operations, row echelon form, elementary matrices, matrix inversion
- Vector Spaces: Coordinate system in  $\mathbb{R}^n$ , the Euclidean spaces as vector spaces, its subspaces, span of vectors, linear independence, basis, dimension, change of basis (computational examples), applications
- Linear Transformations: Definition and examples of linear transformations in  $\mathbb{R}^2$  and  $\mathbb{R}^3$ , standard matrices of linear transformations, kernel and image, isomorphism
- Eigenvalue Problem: Eigenvalues and eigenvectors, diagonalization of matrices (with distinct eigenvalues), applications
- Inner Product: Gram-Schmidt process, least square problems

# Required Courses

## MATH2211 Multivariable calculus (6 credits)

### Course Contents

- Vectors: vectors in 2-, 3-, and n-dimensions; dot product and cross product; lines and planes; polar, cylindrical, and spherical coordinates
- Differentiation in several variables: limits and derivatives; the chain rule; directional derivatives and gradients
- Vector-valued functions: parametrized curves; arc-length; vector fields; gradient, divergence, curl, and the del operator
- Maxima and minima: differentials and Taylor's Theorem of several variables; extrema of functions; Lagrange multipliers; applications of extrema
- Multiple integration: double and triple integrals; change of variables; applications
- Line integrals: scalar and vector line integrals; Green's Theorem; conservative vector fields
- Surface integrals and vector analysis: parametrized surfaces; surface integrals; Stoke's and Gauss's Theorems

# Required Courses

## **MATH2012 Fundamental concepts of mathematics (6 credits)**

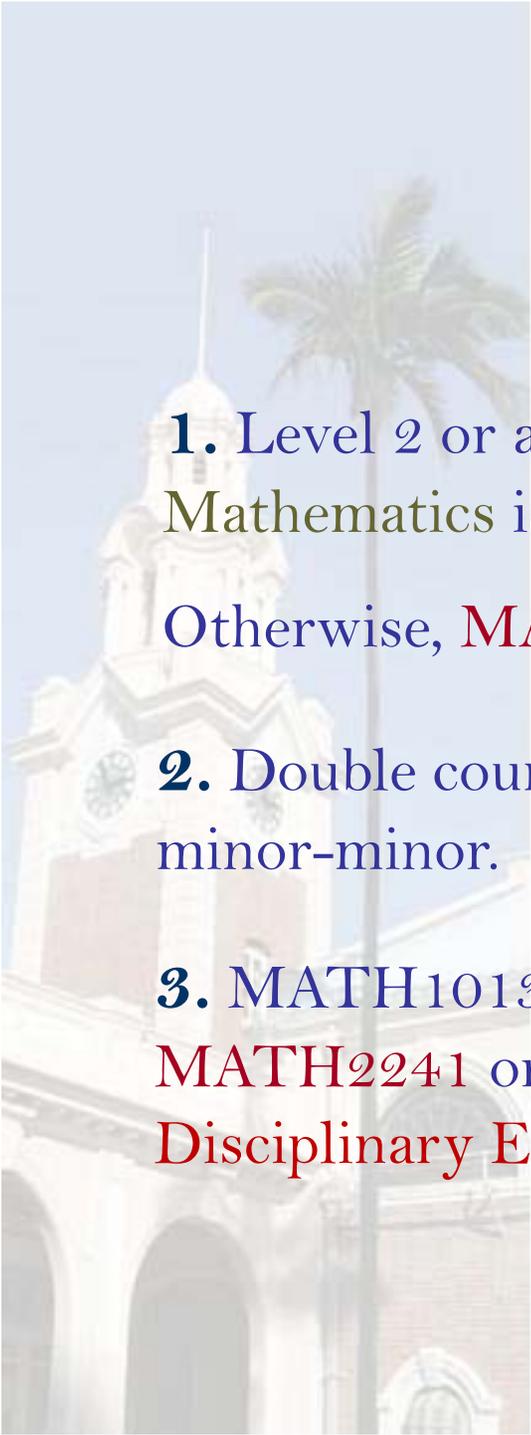
- |                 |   |
|-----------------|---|
| Course Contents | <ul style="list-style-type: none"><li>- elementary set theory</li><li>- statement calculus</li><li>- mathematical proofs</li><li>- relations and functions</li><li>- finite and infinite sets</li><li>- natural numbers and mathematical induction</li><li>- axiomatic systems in mathematics</li><li>- real numbers and the limit of a sequence</li><li>- examples of groups</li></ul> |
|-----------------|---|

# Required Courses

## **MATH2014 Multivariable calculus and linear algebra (6 credits)**

### Course Contents

- Vectors and Matrices: Vectors in space, dot product and cross product, determinants.
- Partial Derivatives: Functions of several variables, partial derivatives, extreme values and Lagrange multipliers, Taylor's formula
- Multiple Integrals: Double and triple integrals, substitution in multiple integrals
- Matrix Algebra: Matrix addition and multiplication, system of linear equations as a matrix equation
- Vector Spaces: The Euclidean spaces as vector spaces, its subspaces, span of vectors, linear independence, basis and dimension
- Eigenvalues and Eigenvectors: Diagonalization and computing powers
- Numerical Methods: Bisection method and Newton's method for finding roots of equations, Simpson's rule and Trapezoidal rule for numerical integration



## Note

1. Level 2 or above in HKDSE Extended Module 1 or 2 of Mathematics is required.

Otherwise, **MATH1011** should be taken first.

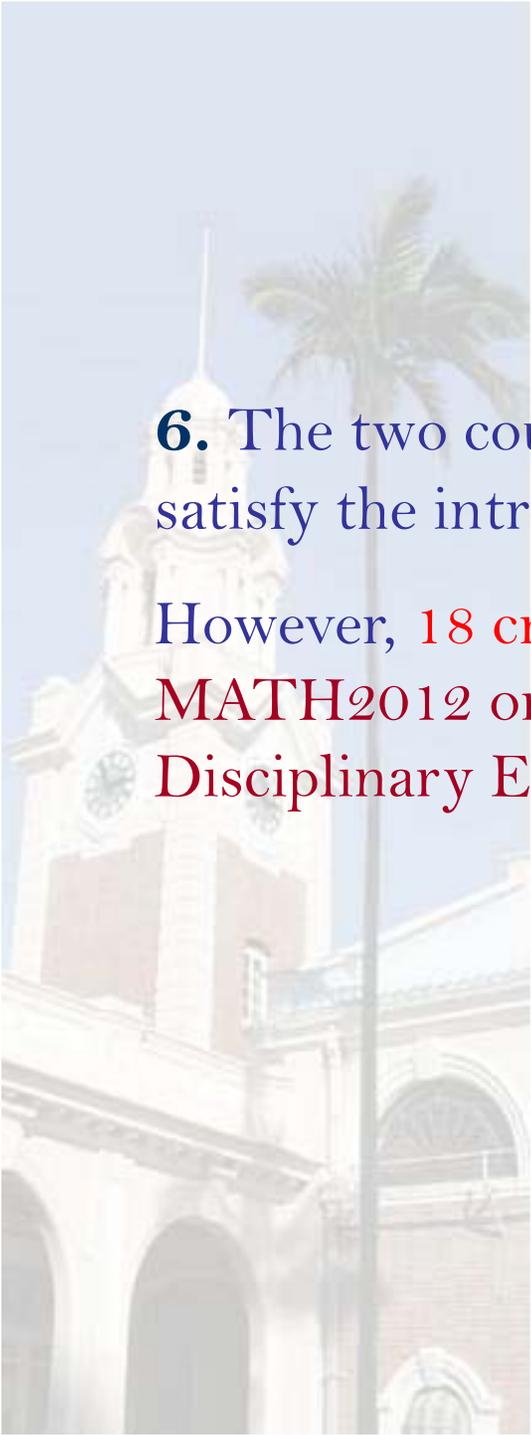
2. Double counting is **not** allowed for major-minor or minor-minor.

3. MATH1013, if already taken, can be replaced by **MATH2241** or any 6-credit level 2 or above **Mathematics Disciplinary Elective**.



## Note

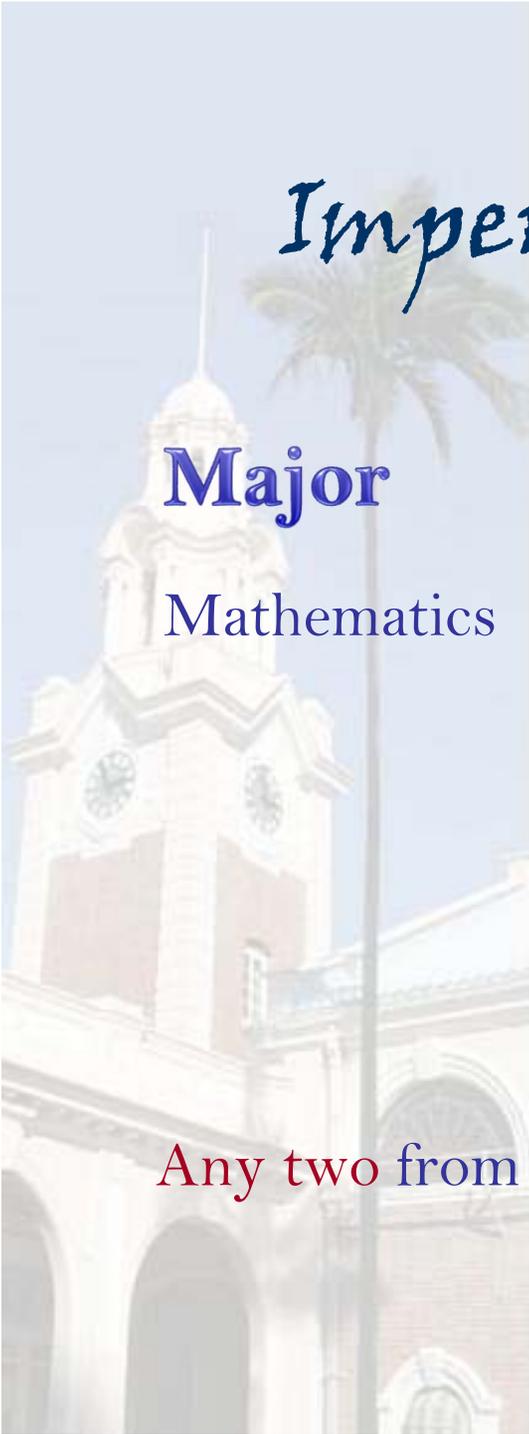
4. The two courses **MATH1851** and **MATH1853** together are equivalent to **MATH1013**.
5. The courses **MATH2014**, **MATH2011** and **MATH2211** can be replaced by **MATH2012** or **MATH2241** or advanced level **Mathematics Disciplinary Electives**.



## Note

6. The two courses **MATH1821** and **MATH2822** together satisfy the introductory level courses requirement.

However, **18 credits** of courses should be chosen from **MATH2012** or **MATH2241** or advanced level Mathematics **Disciplinary Electives** to replace these courses.



# Impermissible Combinations

## Major

Mathematics

## Minor

Mathematics

Computational & Financial  
Mathematics

Operations Research & Mathematical  
Programming

Any two from above are **not** allowed.



Thank You