

Mathematics (Senior Secondary)

1. Introduction

The Department of Mathematics at HKUGAC strives to develop students' mathematical skills, their ability to communicate mathematics, their ability to reflect and evaluate, and their ability to develop and apply mathematical and technical knowledge. We aim to foster in our students a positive attitude, an appreciation of mathematics and their significance to everyday life. The programme will incorporate elements to increase intercultural awareness and cross-subject links.

The curriculums are designed based on the following.

S4 – S6	The guiding principles of curriculum design and assessment of mathematics education, which stipulated in Mathematics Curriculum and Assessment Guide (Secondary 4 – 6) (2017)
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1.2 Teaching methods

Given students' diverse learning styles, we employ various teaching and assessment strategies to ensure that all of our students have an opportunity to learn and demonstrate their understanding.

The teacher will act as a resource for the student to learn to use. This will require them to take an active part in their own learning. Thus, they are encouraged to ask questions when there is a conflict between their understanding and the feedback that they obtain.

Local and international cultures, as well as the history of mathematics, are incorporated into the syllabus wherever possible. Throughout the six years of study, students will be assigned problem solving tasks, various projects and modelling assignments that will require them to apply their mathematical knowledge to applications involving problems from the real world.

The use of e-resources and technology is incorporated into the curriculum in order to facilitate mathematical learning and assessment. Technology, whenever appropriate, is used in lessons for students to explore mathematical concepts, to be assessed and to perform mathematical experiments. Learning materials are also provided online.

We will provide various levels of study groups to ensure that all students are given the academic opportunity and challenge to reach their full potential. This is essential in developing students' abilities to express ideas clearly and to think critically, in order for them to become contributing members to society.

For the higher ability students, we provide extra training for them to take part in the International Mathematical Olympiad.

1.3 Assessment

Assessment will take various forms that will incorporate skills acquisition, class participation, oral discussion, note-taking, worksheets, assignments, projects and written tests.

2. Aims & Objectives of Mathematics Education

The aims for mathematics are to enable students to:

- develop a positive attitude toward the continued learning of mathematics
- appreciate the usefulness, power and beauty of mathematics, and recognize its relationship with other disciplines with everyday life
- gain knowledge and develop understanding of mathematical concepts
- develop mathematics skills and apply them in daily life
- develop the ability to communicate mathematics with appropriate symbols and language
- develop ability to reflect upon and evaluate the significance of their work and the work of others
- share ideas and experience and work cooperatively with others in accomplishing mathematical tasks/activities and solving mathematical problems
- develop patience and persistence when solving mathematical problems
- develop and apply information and communication technology skills in the study of mathematics
- appreciate the international dimensions of mathematics and its varied cultural and historical perspectives

At the end of the course students should be able to:

- know and understand concepts, and demonstrate skills, from the branches of mathematics
- understand and use a variety of mathematical forms and have the ability to move confidently between them
- select and use appropriate mathematical knowledge, skills and techniques when investigating problems and justify their relationship
- recognize patterns and structures and describe them as relationships or general rules when investigating problems
- draw conclusions consistent with findings
- communicate mathematical facts, ideas, methods, results and conclusions using appropriate language and symbols
- reflect on their methods and processes and be able to consider possible alternative approaches
- evaluate the significance and reliability of their findings and findings of others

3. Curriculum

3.1 Mathematics Curriculum Framework

9 Refined Generic Skills [#]		
Basic Skills: Communication Skills, Mathematical Skills, IT Skills		
Thinking Skills: Critical Thinking Skills, Creativity, Problem Solving Skills		
Personal and Social Skills: Self-management Skills, Self-learning Skills, Collaboration Skills		
Level	Dimensions	Units
S4	Number and Algebra	Number Systems
		Quadratic Equations in One Unknown
		Basic Knowledge of Functions
		Quadratic Functions
		More about Polynomials
		Exponential Functions
		Logarithmic Functions
	Rational Functions	
	Measure, Shape and Space	Equations of Straight Lines
		Basic Trigonometry
Basic Properties of Circles		
More about Basic Properties of Circles		
Data Handling	Nil	
Module 1	Binomial Expansion	
	Exponential Functions and Logarithmic Functions	
	Limits and Derivatives	
	Differentiation	

	Module 2	Pre-requisite Knowledge Mathematical Induction Binomial Theorem More about Trigonometric Functions Limits and the Number e
S5	Number and Algebra	More about Equations Inequalities in One Unknown More about Graphs of Functions Variations
	Measure, Shape and Space	Equations of Circles Locus Applications of Trigonometry in 2-dimensional Problems Applications of Trigonometry in 3-dimensional Problems
	Data Handling	Permutation and Combination More about Probability Measures of Dispersion
	Module 1	Applications of Differentiation Indefinite Integration and its Applications Definite Integration Applications of Definite Integration Further Probability Probability Distribution, Expectation and Variance Discrete Probability Distributions

	Module 2	Differentiation Applications of Differentiation Indefinite Integration Definite Integration Applications of Definite Integration Matrices and Determinants
S6	Number and Algebra	Arithmetic Sequences Geometric Sequences Linear Inequalities in Two Unknowns and Linear Programming
	Measure, Shape and Space	Nil
	Data Handling	Uses and Abuses of Statistics
	Module 1	The Normal Distribution and its Applications Sampling Distribution and Point Estimation Interval Estimation
	Module 2	Systems of Linear Equations Introduction to Vectors Scalar Products and Vector Products

3.2 Delivery Schedule

S4

Time Frames	Compulsory Part	Module 1	Module 2
September	Equations of Straight Lines, Number Systems	Nil	Nil
October	Quadratic Equations in One Unknown,		
November	Basic Knowledge of Functions Quadratic Functions		
December	More about Polynomials	Nil	Nil
January/February	First Term Exam		
February	Exponential Functions, Logarithmic Functions,	Binomial Expansion , Exponential Functions and Logarithmic Functions	Pre-requisite Knowledge, Mathematical Induction
March	Rational Functions, Basic Trigonometry,	Limits and Derivatives	Binomial Theorem
April	Basic Properties of Circles, More about Basic Properties of Circles	Differentiation	More about Trigonometric Functions
May	Revision of Mensuration, Law of Indices, Change of Subject, Factorization		Limits and the Number e
June	Final Exam	Final Exam	Final Exam
July	Summer Holidays	Summer Holidays	Summer Holidays

Time Frames	Compulsory Part	Module 1	Module 2
September	More about Equations, Inequalities in One Unknown	Applications of Differentiation	Differentiation
October	More about Graphs of Functions, Variations	Indefinite Integration and its Applications	Applications of Differentiation
November	Permutation and Combination	Definite Integration	
December	More about Probability	Applications of Definite Integration	Indefinite Integration
January/ February	First Term Exam	First Term Exam	First Term Exam
February	Application of Trigonometry in 2-dimensional Problems, Application of Trigonometry in 3-dimensional Problems	Further Probability	Definite Integration
March	Measures of Dispersion	Probability Distribution, Expectation and Variances	Applications of Definite Integration
April	More about Dispersion, Equations of Circles	Discrete Probability Distributions	Matrices and Determinants
May	Locus		
June	Final Exam	Final Exam	Final Exam
July	Summer Holidays	Summer Holidays	Summer Holidays

Time Frames	Compulsory Part	Module 1	Module 2
September	Arithmetic Sequences Geometric Sequences	The Normal Distribution and its Applications	Systems of Linear Equations
October	Linear Inequalities in Two Unknowns and Linear Programming Uses and Abuses of Statistics	Sampling Distribution and Point Estimation Interval Estimation	Introduction to Vectors Scalar Products and Vector Products
November - December	Assessment week		
	Revision		
January	Mock Exam		
February	Post-Exam Revision Programme		
March - April	Study Leave		
April	HKDSE		

4. Assessing students

4.1 Formative and Summative Assessment

Formative assessment is an integral part of the learning experience that is designed to measure what students know and what they are learning as they go along; the objectives addressed by specific assessment tasks are shared with students, with feedback taking place. Formative assessment is carried out in various ways, including project work, oral presentation, class discussions, homework assignments, and written tests in class or at home. Summative assessment is the judgment made by the teacher of the standard of achievement reached by each student at a particular point in time and at the end of the year.

4.2 Assessment Criteria

Compulsory Part

The students are assessed on three assessment criteria:

“Numerical and Algebraic Skills” (NAS); “Spatial and Geometric Skills” (SGS);

“Data Handling Skills” (DHS)

“Application of Mathematical Concepts and Skills” (AM).

S4

Assessment Criteria	Topics involved	
	S4 Term 1	S4 Term 2
NAS	• Number Systems • Quadratic Equations in One Unknown • Basic Knowledge of Functions • Quadratic Functions • More about Polynomials	• Exponential Functions • Logarithmic Functions • Rational Functions
SGS	• Equations of Straight Lines	• Basic Trigonometry • Basic Properties of Circles • More about Basic Properties of Circles
DHS	Not assessed	Not assessed

S5

Assessment Criteria	Topics involved	
	S5 Term 1	S5 Term 2
NAS	• More about Equations • Inequalities in One Unknown • More about Graphs of Functions • Variations	Not assessed
SGS	Not assessed	• Application of Trigonometry in 2-dimensional Problems • Application of Trigonometry in 3-dimensional Problems • Locus • Equations of Circles
DHS	• Permutation and Combination • More about Probability	• Measures of Dispersion

S6

Assessment Criteria	Topics involved
	S6 Term 1
NAS	• Arithmetic Sequences • Geometric Sequences
SGS	• Linear Inequalities in Two Unknowns and Linear Programming
DHS	• Uses and Abuses of Statistics
AM	• Cross-topic assessment

Extended Part – Module 1

S4 Term 2

1. Manipulation of Binomial Expansions; Exponential and Logarithmic Functions
2. Computation of Limits and Derivatives of Different Functions

S5 Term 1

1. Application of Differentiation and Indefinite Integration Techniques to Solve Real-Life Problems
2. Computation and Application of Definite Integrals to Solve Real-Life Problems

S5 Term 2

1. Solving Problems about Conditional Probability and Random Variables
2. Modelling Real-Life Scenarios by Discrete Distributions

S6 Term 1

1. Modelling Real-Life Scenarios by the Normal Distribution
2. Estimation of Parameters from Samples and Construction of Confidence Intervals

Extended Part – Module 2

S4 Term 2

1. Manipulation of Mathematical Induction
2. Manipulation of Binomial Theorem
3. Manipulation of More about Trigonometric Functions
4. Computation of Limit and the number e

S5 Term 1

1. Computation of Differentiation
2. Computation of Application of Differentiation
3. Computation of Indefinite Integration

S5 Term 2

1. Computation of Definite Integration
2. Techniques and Application of Definite Integration
3. Manipulation of Matrices and Determinants

S6 Term 1

1. Exploration of System of Linear Equations by Matrices
2. Introduction to Vectors
3. Computation of Scalar Products and Vector Products

4.3 Weighting of Component Parts

	S4 – S5	S6
Continuous Assessment [#]	40%	40%
First Term Exam	30%	-
Final Exam	30%	-
Mock Exam	-	60%
Total	100%	100%

[#] Continuous Assessment includes homework, quizzes and unit tests.

4.4 Reference Level Descriptors and Boundaries

Levels	Boundaries of Levels		
	Compulsory Part	Module 1	Module 2
5**	90% or above	90% or above	85% or above
5*	85% to 89%	80% to 89%	75% to 84%
5	75% to 84%	70% to 79%	65% to 74%
4	65% to 74%	60% to 69%	55% to 64%
3	50% to 64%	50% to 59%	45% to 54%
2	35% to 49%	35% to 49%	35% to 44%
1	34% or below	34% or below	0% to 34%

The marks are rounded off to the nearest %.

The actual boundaries will vary depending on the performance of students.

4.5 Requirement of taking the extended module in S4 to S6

Based on our analysis of our graduates' past performance in the HKDSE examination, it has been observed that students who do not achieve a satisfactory standard in school examinations consistently struggle with both the Compulsory Part and the Extended Module in Mathematics.

To ensure students are able to focus on the Compulsory Part and thus improve their prospects of achieving a better grade in the HKDSE, we have established the following benchmarks. Students must meet these criteria to be eligible to continue with either M1 or M2:

	Eligibility Criteria	
	Compulsory Part	Extended Part (M1 or M2)
S4 First Term Exam	50% or above	-
S4 Final Exam	60% or above	40% or above
S5 First Term Exam		
S5 Final Exam		

In order to achieve a satisfactory result in the HKDSE, students are strongly advised to meet the following internal examination benchmarks. These results indicate a strong foundation and the readiness required for the advanced content in M1 and M2.

	Recommended benchmark	
	Compulsory Part	Extended Part (M1 or M2)
S4 First Term Exam	65% or above	-
S4 Final Exam	65% or above	50% or above
S5 First Term Exam		
S5 Final Exam		

5. Parents' role and homework and assignments

5.1 Parents' role

Parents are encouraged to talk to their children about their work in class, what they are currently learning and check the aims and objectives of the unit being studied. They should also discuss the results obtained by their children and to regularly check their diaries.

Homework is a valuable aid to help students make the most of their school experience. Homework consolidates, reinforces and strengthens concepts learnt in class, encourages students to develop responsibility, time management skills, good study habits and helps teachers assess the performance of students. Teachers will assign homework at a suitable level of difficulty and related appropriately to specific objectives. A homework load of around 30 minutes will be assigned on the day of each mathematics lesson.

5.2 Homework Policy

As a measure to train students to be responsible for completing homework in a timely manner, late submission will result in zero marks given. Students who hand in homework late will be required to complete the unfinished work after school and the homework will receive their teachers' feedback as usual.

6. Guideline on AI-assisted Learning

Artificial intelligence (AI), including Generative AI, could serve as an effective tool for learning mathematics. This section provides examples of using AI to assist learning in mathematics and general reminders.

6.1 Areas Where AI Can Enhance Learning in Mathematics

Personalized Practice and Tutoring

AI-driven platforms can provide customized exercises based on a student's performance, helping to address individual knowledge gaps and reinforcing areas of weakness. These tools can adapt to the learner's pace, offering more challenging problems as they improve or revisiting foundational concepts as needed.

Instant Feedback on Problems

AI-based math solvers can offer immediate feedback on mathematical problems, helping students identify mistakes in real time. By receiving step-by-step solutions, students can learn how to approach problems methodically.

Conceptual Understanding and Visualization

AI can generate graphs, charts, and visual aids that help students understand complex mathematical concepts like functions, geometry, and calculus. These visualizations make abstract concepts more tangible and easier to comprehend.

Exploration of Multiple Problem-Solving Methods

AI tools can present different approaches to solving the same problem, exposing students to a variety of mathematical methods or techniques, which can enhance their problem-solving flexibility.

Supplementary Learning Resources

AI can recommend additional learning resources such as video tutorials, articles, or practice exercises based on a student's current level of understanding. This helps students explore topics in greater depth or revisit areas where they need more practice.

6.2 Important Considerations When Using AI in Mathematics

Verify the Information Generated

AI tools are not infallible and can sometimes provide incorrect or incomplete information. Always cross-check the solutions generated by AI with your textbook, classroom notes, or by consulting your teacher. Don't rely solely on AI-generated answers without understanding the underlying concepts.

Understand the Process, Not Just the Answer

AI can provide answers quickly, but the goal of learning mathematics is to understand the process. Use AI to guide and help you work through problems, but avoid using it as a shortcut to merely obtain the final solution. Make sure you can explain the steps involved in reaching the solution on your own.

Practice Without AI

While AI is a useful tool, it's essential to practice solving problems independently. Over-reliance on AI can hinder your ability to develop critical problem-solving skills. Balance AI-assisted learning with traditional methods, such as working through problems by hand and discussing solutions with peers or teachers.

6.3 Ethical Use of AI in Mathematics Learning

Do Not Use AI to Cheat

It can be tempting to use AI to quickly solve homework problems or complete assignments. However, this defeats the purpose of learning. AI should be used as a learning aid, not as a replacement for your own efforts. Using AI to generate answers without engaging with the problem is academically dishonest and can result in disciplinary consequences.

Acknowledge AI Assistance Where Required

If you've used AI to help understand a problem or generate part of a solution, make sure to acknowledge that assistance where appropriate, especially in formal assessments or reports. This ensures transparency and academic integrity.

Respect Data Privacy

When using AI platforms, be mindful of the personal data you share. Ensure that the tools you are using are from trusted sources and comply with data privacy regulations. Avoid sharing sensitive personal information with AI tools unnecessarily.

Avoid Plagiarism

If you use AI-generated content in your work, ensure you paraphrase, modify, and adequately cite the ideas, where applicable. Copying and pasting AI-generated solutions or explanations without understanding and reworking them into your own words can be considered plagiarism.