Course Description

HL IB Mathematics

Syllabus 2016-2017

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About This Course

This course is designed for students with a good background in mathematics who are competent in a range of analytical and technical skills. The majority of these students will include mathematics as a major component of their university studies, either as a subject in its own right or within courses such as physics, engineering and technology. Others may take this subject because they have a strong interest in mathematics and enjoy meeting its challenges and engaging with its problems.

In this course you will engage in a wide array of mathematics topics: Algebra, Functions and Equations, Circular Functions and Trigonometry, Matrices, Vectors, Statistics and Probability, Calculus, and Discrete Mathematics. You will have to be able to demonstrate your understanding using graphical representations and algebraic representations. You must be able to discuss and write mathematics in a coherent manner using appropriate vocabulary and symbolic representation.

Course Details

This course focuses on developing important mathematical concepts in a comprehensible, coherent, and rigorous way. This is achieved by means of a carefully balanced approach. You are encouraged to apply your mathematical knowledge to solve problems set in a variety of meaningful contexts. Development of each topic should feature justification and proof of results. As you embark on this course you should expect to develop insight into mathematical form and structure, and should be intellectually equipped to appreciate the links between concepts in different topic areas. You should be equipped with the skills needed to continue your mathematical growth in other learning environments.

This course is a demanding one, requiring students to study a broad range of mathematical topics through a number of different approaches and to varying degrees of depth. Students wishing to study mathematics in a less rigorous environment should therefore opt for one of the standard level courses.

Your Role as a Student

In this course you will be expected to guide your own learning. It is your responsibility to seek help and support when necessary. You must come to every class prepared, on time, and ready to actively engage in mathematics. You must always maintain respect for your fellow students, the classroom, and the learning environment. Organization is key in this course (and any IB course), you must be organized, prepared and conscientious of all deadlines. Finally, you must be willing to discuss mathematical ideas openly and honestly.

My Role as a Teacher

As a teacher it is my responsibility to guide your learning, help you focus and hone your study skills. It is my duty to be available for extra help, when needed. I must maintain a safe and open classroom environment. I must encourage participation and discussion. I must be open to suggestions, comments and critiques. It is my duty to generate enthusiasm about the topics, present topics in multiple formats, and assist in the learning

process as much as possible. Finally, I must provide meaningful and appropriate feedback on your progress in the course.

Prior Learning

Mathematics is a linear subject, and it is expected that most students embarking on a Diploma Programme (DP) mathematics course will have studied mathematics for at least 10 years. There will be a great variety of topics studied, and differing approaches to teaching and learning. Thus students will have a wide variety of skills and knowledge when they start the mathematics HL course. Most will have some background in arithmetic, algebra, geometry, trigonometry, probability and statistics.

Mathematics and Theory of Knowledge

The Theory of knowledge guide (March 2006) identifies four ways of knowing, and it could be claimed that these all have some role in the acquisition of mathematical knowledge. While perhaps initially inspired by data from sense perception, mathematics is dominated by reason, and some mathematicians argue that their subject is a language, that it is, in some sense, universal. However, there is also no doubt that mathematicians perceive beauty in mathematics, and that emotion can be a strong driver in the search for mathematical knowledge.

As an area of knowledge, mathematics seems to supply a certainty perhaps missing in other disciplines. This may be related to the “purity” of the subject that makes it sometimes seem divorced from reality. However, mathematics has also provided important knowledge about the world, and the use of mathematics in science and technology has been one of the driving forces for scientific advances.

Despite all its undoubted power for understanding and change, mathematics is in the end a puzzling phenomenon. A fundamental question for all knowers is whether mathematical knowledge really exists independently of our thinking about it. Is it there “waiting to be discovered” or is it a human creation?

Mathematics and the International Dimension

Mathematics is in a sense an international language, and, apart from slightly differing notation, mathematicians from around the world can communicate within their field. Mathematics transcends politics, religion and nationality, yet throughout history great civilizations owe their success in part to their mathematicians being able to create and maintain complex social and architectural structures.

Despite recent advances in the development of information and communication technologies, the global exchange of mathematical information and ideas is not a new phenomenon and has been essential to the progress of mathematics. Indeed, many of the foundations of modern mathematics were laid many centuries ago by Arabic, Greek, Indian and Chinese civilizations, among others.

The importance of science and technology in the everyday world is clear, but the vital role of mathematics is not so well recognized. It is the language of science, and underpins most developments in science and technology. A good example of this is the digital revolution, which is transforming the world, as it is all based on the binary number system in mathematics.

Many international bodies now exist to promote mathematics. Students are encouraged to access the extensive websites of international mathematical organizations to enhance their appreciation of the international dimension and to engage in the global issues surrounding the subject.

Group 5 Aims

The aims of all mathematics courses in group 5 are to enable students to:

1. Enjoy mathematics, and develop an appreciation of the elegance and power of mathematics
2. Develop an understanding of the principles and nature of mathematics
3. Communicate clearly and confidently in a variety of contexts
4. Develop logical, critical and creative thinking, and patience and persistence in problem-solving
5. Employ and refine their powers of abstraction and generalization
6. Apply and transfer skills to alternative situations, to other areas of knowledge and to future developments
7. Appreciate how developments in technology and mathematics have influenced each other
8. Appreciate the moral, social and ethical implications arising from the work of mathematicians and the applications of mathematics
9. Appreciate the international dimension in mathematics through an awareness of the universality of mathematics and its multicultural and historical perspectives
10. Appreciate the contribution of mathematics to other disciplines, and as a particular “area of knowledge” in the TOK course.

Assessment Objectives

Problem-solving is central to learning mathematics and involves the acquisition of mathematical skills and concepts in a wide range of situations, including non-routine, open-ended and real-world problems. Having followed a DP mathematics HL course, students will be expected to demonstrate the following:

1. Knowledge and understanding: recall, select and use their knowledge of mathematical facts, concepts and techniques in a variety of familiar and unfamiliar contexts.
2. Problem-solving: recall, select and use their knowledge of mathematical skills, results and models in both real and abstract contexts to solve problems.
3. Communication and interpretation: transform common realistic contexts into mathematics; comment on the context; sketch or draw mathematical diagrams, graphs or constructions both on paper and using technology; record methods, solutions and conclusions using standardized notation.
4. Technology: use technology, accurately, appropriately and efficiently both to explore new ideas and to solve problems.
5. Reasoning: construct mathematical arguments through use of precise statements, logical deduction and inference, and by the manipulation of mathematical expressions.
6. Inquiry approaches: investigate unfamiliar situations, both abstract and real-world, involving organizing and analysing information, making conjectures, drawing conclusions and testing their validity.

Purpose of internal assessment

Internal assessment is an integral part of the course and is compulsory for all students. It enables students to demonstrate the application of their skills and knowledge, and to pursue their personal interests, without the time limitations and other constraints that are associated with written examinations. Internal assessment in mathematics HL is an individual exploration. This is a piece of written work that involves investigating an area of mathematics. It is marked according to five assessment criteria.

Learning Styles

- Inquirers: by providing students with in-depth mathematical investigations, this course will allow inquirers to ask and answer mathematical questions.
- Knowledgeable: by covering a wide range of challenging mathematical topics, this course will allow knowledgeable students to gather new information and facts.
- Thinkers: by encouraging critical thinking and problem solving this course will allow thinkers to

solve mathematical problems using an intuitive and logical approach.

- Communicators: by providing multiple in class opportunities to collaborate, this class will allow communications to engage topics in mathematics with other students. In addition, students will be expected to communicate their ideas and understandings algebraically and descriptively in various assessments.
- Principled: this course will provide students with a collaborative classroom style, allowing principled learners to establish respectful and productive relationships with fellow class members and assessments will uphold the ethical principles associated with academic integrity.
- Open-Minded: an open-ended and investigative approach to learning mathematics in this course will develop open-minded learners and encourage creative thinking.
- Caring: by teaching the applications of mathematics in a wide variety of scenarios, caring students will be able to study mathematics that could help others globally (mathematically optimizing efficiency of food distribution, water supplies, etc..).
- Risk-takers: by providing challenging, thought-provoking problems, risk takers will be able to explore innovative and efficient methods of solving problems outside of the typical approaches.
- Balanced: by establishing study skills, encouraging participating, and requiring efficiency this course will help balanced learners find time to attend to all their academic, social, and physical pursuits.
- Reflective: by allowing students to engage in self-evaluation, this course will allow reflective learners to accurately assess their progress, and reflect on their process of learning information.

Logistics

Required Materials

- Texas Instruments 84 graphing calculator.
- A notebook
- Pencils and Erasers.
- Ruler

What You Should Bring To Class EVERYDAY

- Your Calculator
- Pencil and Erasers
- Ruler
- Your Notebook

IB Practice Questions

Every warm-up will consist of old IB test questions. These questions will be on material we have covered prior to the class period, but will not be limited to the material we are currently studying (it may be questions from earlier in the course). These exercises will be timed (since IB exams are timed). These questions are designed to familiarize you with the IB testing format, challenge you, and help you self-assess your own level of understanding. After completing the quizzes we will then grade them together (to familiarize you with the IB grading schema).

Tests

Test will generally fall at the end of every chapter. We will spend the period prior to the test reviewing, practice test questions and solutions will be given.

Final Exams

Final Exams will be given at the end of every semester. Final exams will include material from the entire semester (they will be comprehensive)

Grading

- Letter Grade: You will receive a letter grade of A through F based on the following criteria:
    - Knowledge and understanding of subject (exams): 30%
    - Problem Solving 30%
    - Communication (Projects) - both oral and written: 20%
    - Inquiry approaches (exploration activities): 20%

- Your letter grade will be based on your average percentage:

Conversion of IB Grades, % Grades and GPA

Letter grade	Grade %	Grade points	Grade Descriptors
A	93-100	4.0	Excellent
A -	90-92.9	3.7	Very Good
B+	87-89.9	3.3	Good
B	83-86.9	3.0	Good
B -	80-82.9	2.7	Satisfactory
C+	77-79.9	2.3	Satisfactory
C	73-76.9	2.0	Satisfactory
C -	70-72.9	1.7	Satisfactory
D+	67-69.9	1.3	Mediocre
D	63-66.9	1.0	Mediocre
D -	60-62.9	0.7	Poor
F	<60	0.0	Poor

Feedback

You will receive feedback in a variety of ways. You will be receiving effort grades and letter grades. In addition, you will receive feedback on all assessments. During tests and finals, I will provide you with feedback on your knowledge and understanding of a subject, application of knowledge and skills, communication, and critical thinking skills. You will be grading your own weekly IB practice questions, providing yourself with feedback. Additionally, you will assess your performance on the five effort criteria (teamwork, personal organization, ability to meet deadlines, work habits, and effort) approximately every two weeks. Evaluations will be conducted through the exchange of a written paragraph discussing progress. If your performance is lower than expected or there is a major discrepancy between how you think you are doing and how I think you are doing, a meeting will be scheduled to discuss your progress.

Late Work

Late work can pile up quickly. The IB is fast-paced and missed assignments accumulate immediately. Please strive to turn in assignments on time! Late submissions will result in lowered effort grades.

Missed Class

Missed classes are inevitable but it is your responsibility to ensure you do not fall behind. If you know you are going to be gone it is your responsibility to hand in work BEFORE you leave; if you fail to do this, your work will be considered late. If you do not know ahead of time that you will be absent (i.e. illness or emergency) come speak with me and we will arrange new deadlines and due dates for your assignments.

Tardiness

It is very important that you show up prepared and on time. We have lot of material to cover and a lot of fun to have! Class time is valuable and tardiness will not be tolerated.

Academic Integrity

All the work you do and present in this class must be your own. Even when working together as a group, there will be components that must come from you and cannot be copied from other students, the Internet, or other sources. When other sources are allowed, they must always be given credit and be accompanied by your own thoughts, ideas, and opinions. Outside sources are used to set the stage, bring in information, or to establish facts and history. Unless otherwise instructed, you must provide original work, thoughts, observations, data, opinions, or analysis.

The following lists contain examples of violations of Academic Integrity:

- Plagiarism
    - Copying text or information from somewhere else (Internet, book, magazine, friend, etc.) and presenting it as your own without providing credit to the other source.
    - Presenting an idea from somewhere else without saying where that idea came from. Even if you put this idea into your own words, you still must say where you got it from.
    - Copying another student's work and presenting it as your own.
- Cheating
    - Planning in advance to cheat on a test or quiz – even if you don't get as far as actually cheating in class.
    - Looking at someone else's work during a test or quiz, including passing calculators. The answers you submit with your test or quiz must be your own.
    - Giving answers to someone else during a test.
    - Using any unapproved method to bring information or answers into a test environment.
    - Providing or accepting information about a test before all students have taken the test.
    - Copying someone else's homework, report, experiment, or project and presenting that work as your own.
    - Inventing data when doing an experiment or project.

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Scope and Sequence

Materials Covered

Chapter 1: Quadratics

This chapter explores quadratic functions, parabolas, problems solving with quadratics and quadratic optimization

Chapter 2: Functions

This chapter covers relations and functions, function notation, composite functions, rational functions and graphing functions.

Chapter 3: Exponentials

This chapter covers exponents, rational exponents, algebraic expressions, exponential equations, growth and decay and the natural exponential e^x.

Chapter 4: Logarithms

This chapter covers logarithms in base 10, logarithms in base a, laws of logarithms, natural logarithms, exponential equations using logarithms, the change of base rule, graphs of logarithmic functions and growth and decay.

Chapter 5: Transforming Functions

This chapter covers transformation of graphs, translation, stretches, reflections, miscellaneous transformations, simple rational functions, the reciprocal of a function and modulus functions.

Chapter 6: Complex Numbers and Polynomials

This chapter covers complex numbers, real polynomials, zeros, roots, factors, polynomial theorems and graphing real polynomials.

Chapter 7: Sequences and Series

This chapter covers number sequences, arithmetic sequences, geometric sequences, and series.

Chapter 8: Counting and the binomial expansion

This chapter covers the product principle, counting paths, factorial notation, permutations, combinations, binomial expansion and the binomial theorem.

Chapter 9: Mathematical Induction

This chapter covers the process of induction, the principle of mathematical induction.

Chapter 10: The Unit Circle and Radian Measure

This chapter covers radian measure, arc length and sector area, trigonometric ratios, applications of the unit circle and angle formulae.

Chapter 11: Non-Right Angled Triangle Trigonometry

This chapter covers areas of triangles, the cosine rule, the sine rule and applications of the sine and cosine rules.

Chapter 12: Trigonometric Functions:

This chapter covers periodic behavior, the sine function, modeling using the sine function,

the cosine function, the tangent function, general trigonometric functions, reciprocal functions and inverse trigonometric functions.

Chapter 13: Trigonometric Equations and Identities

This chapter covers trigonometric identities, using trigonometric models, trigonometric relationships, double angle formula, compound angle formula, trigonometric equations in quadratic form and trigonometric series and products.

Chapter 14: Vectors

This chapter covers vectors, scalars, geometric operations with vectors, vectors in the plane, the magnitude of a vector, operations with plane vectors, the vector between two points, vectors in space, parallelism, the scalar product of two vectors and the vector product of two vectors.

Chapter 15: Vector Applications

This chapter covers vector operations, area, lines in 2-D and 3-D, The angle between two lines, constant velocity problems, the shortest distance from a point to a line, intersecting lines, relationships between lines, planes, angles in space, intersecting planes.

Chapter 16: Complex Numbers

This chapter covers complex numbers as 2-D vectors, modulus, argument and polar form, Euler's form, De Moivre's theorem and roots of complex numbers.

Chapter 17: Introduction to Differential Calculus

This chapter covers limits, limits at infinity, trigonometric limits, rates of change, the derivative function, differentiation from first principles.

Chapter 18: Rules of Differentiation

This chapter covers the chain rule, the product rule, the quotient rule, implicit differentiation, derivatives of exponential functions, derivatives of logarithmic functions, derivatives of trigonometric functions, and higher derivatives.

Chapter 19: Properties of Curves

This chapter covers tangents and normal, increasing and decreasing functions, stationary points and inflections.

Chapter 20: Applications of Differential Calculus

This chapter covers kinematics, rates of change, optimization and related rates.

Chapter 21: Integration

This chapter covers the area under a curve, antidifferentiation, the fundamental theorem of calculus, integration, rules for integration, integration by substitution, integration by parts and definite integrals.

Chapter 22: Applications of Integration

This chapter covers the area under a curve, the area between two functions, kinematics, problem solving by integration and solids of revolution.

Chapter 23: Descriptive Statistics

This chapter covers key statistical concepts, measuring the centre of data, variance and standard deviation.

Chapter 24: Probability

This chapter covers experimental probability, sample space, tables of outcomes, compound events, tree diagrams, sampling with and without replacement, sets and venn diagrams, laws of probability, independent events, probabilities using permutations and combinations.

Chapter 25: Discrete and Random Variables

This chapter covers discrete random variables, discrete probability distributions, expectation, variance and standard deviation, the binomial distribution and the Poisson distribution.

Chapter 26: Continuous Random Variables

This chapter covers continuous random variables, the normal distribution, probabilities using calculator, the standard normal distribution and quantiles for k values.