**Curriculum**

**IB Math HL Y2**

**Course Overview**

This is a two-year course designed to prepare students with a strong background and keen interest in mathematics for the International Baccalaureate Diploma Program, a rigorous pre-university course of studies. Many of the topics for the Higher Level course are similar to the topics covered in the Standard Level course but will be examined at a much deeper level than the Standard Level. A TI-83+ or TI-84+ is required for this course. In the second year, students will study the remaining three topics. The topics to be covered include Statistics and Probability, Calculus, and the Optional Topic. We will choose the optional topic from the following: Statistics and Probability, Sets, Relations and Groups, Series and Differential Equations, and Discrete Mathematics. The optional topic to be studied will be chosen by the instructor. Students will also complete portfolio pieces. As in the first year, the portfolio assignments will be of varying difficulty and will cover different areas of the curriculum. The purpose of the portfolio is to give students the opportunity to study a particular topic in greater detail. They also provide the students with the opportunity to communicate effectively with sound mathematical writing.

**Department Standards**

Students will be able to comprehend mathematical concepts.

Students will apply mathematical procedures accurately, efficiently, and appropriately.

Students will be able to formulate, represent, and solve mathematical problems.

Students will develop logical mathematical thought and precise mathematical communication.

**Benchmarks**:

Students will be able to:

understand and interpret the results obtained in Descriptive Statistics, Probability and Modelling Data

understand Complex Numbers including DeMoivre’s Theorem

understand and apply the concepts and techniques of Differential and Integral Calculus

demonstrate a thorough knowledge of the Optional Topic

prepare for the IB End of Course Exam

**Performance Indicators**

First Quarter

Students will be able to:

use theorems of divisibility and methods of proof to construct divisibility proofs;

use algorithms to find divisors and remainders;

use the Euclidean algorithm for determining the gcd of two integers;

use the gcd of two integers to find the lcm;

use algorithms to determine if a number is prime; use the gcd to determine if two numbers are relatively prime;

state and apply the fundamental theorem of arithmetic;

convert a base 10 number into bases such as 2, 3, 4 and 8;

convert numbers from other bases into base 10;

convert numbers between two non-10 bases;

find the general solution of a linear Diophantine equation; find solutions to Diophantine equations subject to constraints such as all solutions must be positive;

perform modular addition, subtraction and multiplication;

solve equations in modular form;

determine if two numbers are congruent mod n;

state and use the Chinese remainder theorem and FermatÆs little theorem;

identify probability trials, outcomes and events;

find the samples space of an event;

find the probability of an event by dividing the successful outcomes by the sample space;

recognize that all probabilities are fractions between 0 and 1 inclusive;

describe an event with a probability of 0 or 1; use Venn diagrams, tree diagrams and tables of outcomes to solve problems;

recognize that the sum of the probabilities of an event and its complement is 1;

find the probability of a combined event using the operators ôANDö and ôORö;

recognize that the intersection of mutually exclusive events is 0;

find the probability of mutually exclusive events by adding the individual probabilities;

use the definition of conditional probability to find the probability of an event A given event B has occurred;

recognize that the term ôindependentö is equivalent toôstatistically independentö; utilize the formula for the intersection of independent events to find probabilities;

apply BayesÆ theorem to two event probability;

find the derivative of exponential equations in base e and a;

find the derivative of logarithmic equations in base e and a;

find the derivative of.sin x , cos x , tan x;

find the derivative of reciprocal trigonometric functions sec x , csc x , cot x;

find the derivative of inverse trigonometric functions arcsin x , arccos x , arctan x;

find the local maxima and minima of trigonometric functions;

use the derivative interpreted as a gradient function and as rate of change.functions; and

use the chain rule in related rates.

Second Quarter

Students will be able to:

interpret indefinite integration as anti-differentiation or as a family of curves;

find the indefinite integral of polynomial, trigonometric, logarithmic and exponential expressions;

find the integral of composites of basic functions using substitution;

use partial fractions to integrate rational expressions;

use integration to find the area between a curve and the x-axis or y-axis in a given interval;

find the area between curves;

use anti-differentiation to find the general form of a curve;

use anti-differentiation with a boundary condition to determine the constant term;

solve problems involving displacement, s,

velocity, v, and acceleration;

understand that a velocityûtime graph represents distance; and

find the volume of revolution of a solid about the x-axis or the y-axis.

Third Quarter

Students will be able to:

define population and sample;

understand a random sample and sampling techniques;

determine if data is discrete or continuous;

create and utilize frequency tables, diagrams and box and whisker plots;

compare data using box and whisker plots;

find mid-interval values, interval width, upper and lower interval boundaries of grouped data;

create and interpret a frequency histogram using equal intervals;

find the mean, median, mode and quartiles of data with one variable;

use the calculator to find the 5 number summary of one variable data;

recognize that the population mean, , is

generally unknown, and that the sample mean, x , serves as an unbiased estimate of this quantity;

find the range and interquartile range of data;

understand of the concept of dispersion and the significance of the numerical value of the standard deviation;

obtain the standard deviation (and indirectly the variance) from a GDC and by other methods;

recognize that the population variance is

generally unknown, and how to find an unbiased estimate of this value;

create and interpret cumulative frequency tables and graphs;

use such graphs to find median, quartiles,

percentiles of data;

define and use probability density

functions;

know and use the formulae for E(X ) and Var(X );

recognize applications of expectations, for example, games of chance;

find the mean and variance of binomial and Poisson distributions; recognize the conditions under which random variables have these distributions;

appreciate that the standardized value (z)

gives the number of standard deviations from the mean;

use calculator (or tables) to find normal

probabilities; the reverse process;

use standard substitutions to find the integral of a function by substitution;

find the integral of an expression using integration by parts one or more times; and

solve a first order differential equation by

separation of variables.

**Assessments**

First Quarter

Unit Tests on Core Topics

Mathematical Investigation Portfolio Piece

Second Quarter

Unit Tests on Core Topics

Mathematical Modeling Portfolio Piece

Semester Exam

Third Quarter

Unit Tests on Core Topics

Mathematical Investigation Portfolio Piece

Mathematical Modeling Portfolio Piece

Mock IB Exam

Fourth Quarter

IB Exams

**Core Topics**

First Quarter

Number Theory

Probability

Further Differentiation

Second Quarter

Integration

Applications of Integration

Third Quarter

Descriptive Statistics

Statistical Distributions of Discrete and Continuous Random Variables

Further Integration and Differential Equations

Fourth Quarter

Review and Preparation for IB Exam

**Specific Content**

First Quarter:

NUMBER THEORY

Divisibility

Division and Euclidean algorithms.

The greatest common divisor (gcd) and

the least common multiple (lcm) of

integers a and b.

Relatively prime numbers; prime numbers and the fundamental theorem of arithmetic.

Representation of integers in different bases

Linear diophantine equations ax+by=c

Modular arithmetic

Linear congruences.

Chinese remainder theorem and FermatÆs little theorem

PROBABILITY

Trial, outcome, equally likely outcomes, sample space (U) and event.

The probability of an event.

The complementary events A and A (not A);

Combined events

Mutually exclusive events

Conditional probability

Independent events

Bayes Theorem

Second Quarter:

FURTHER DIFFERENTIATION

Derivatives of exponential and logarithmic functions.

Derivatives of circular functions

Maxima/minima with trigonometry

Related Rates

INTEGRATION

The meaning of the integral.

Finding the integral of an expression.

Integration by substitution and using partial fractions.

APPLICATIONS OF INTEGRATION

Definite integrals as areas between lines and curves.

Use of the integral in finding equations from the derivative.

Applications in kinematics.

Volumes of revolution of a solid.

Third Quarter:

DESCRIPTIVE STATISTICS

Population, sample, random sample

and frequency distribution of discrete and

continuous data.

Presentation of data: frequency tables and

diagrams, box and whisker plots.

Grouped data.

Frequency histograms.

Mean, median, mode; quartiles, percentiles.

Range; interquartile range; variance, standard

deviation.

Cumulative frequency; cumulative frequency

Graphs.

STATISTICAL DISTRIBUTIONS

Discrete and continuous random

variables and their probability distributions.

Expected value (mean), mode, median, variance and standard deviation.

Binomial and Poisson distributions.

Normal distribution and standardization of normal variables.

FURTHER INTEGRATION

Standard integrals and integration by parts

Differential equations

**Resources**

TI 84+ Graphic calculator

Mathematics for the International Student: Mathematics HL Core

Haese & Harris Publications 2nd edition

Mathematics for the International Student: Mathematics HL Options

Haese & Harris Publications 2nd edition

SMARTBoard Software