IB Mathematics Higher Level

Course description:

IB Mathematics HL is a demanding and rigorous course that will prepare International Baccalaureate students for future studies in areas such as applied or pure science, engineering or similar fields. The topics explored in this course will progress from function analysis to multi-variable calculus and differential equations.

In addition to an in-class assessment, students are required to complete external assessments based on IB curriculum and standards.

Topics:

1. Algebra (30 hrs – Fall 2014)
    - Arithmetic and geometric sequences and series; sigma notation
    - Exponents and logarithms; laws of logarithms; change of base
    - Binomial Theorem; counting principles, including permutations and combinations
    - Proof by mathematical induction; forming conjectures to be proved by mathematical induction
    - Complex numbers; conjugate, modules and argument; Cartesian form
    - Sums, products and quotients of complex numbers
    - De Moivre's theorem; powers and roots of a complex number
    - Conjugate roots of polynomial equations with real coefficients

2. Functions and Equations (22 hrs - Fall 2014)
    - Concept of function, domain and range, image, composite functions, inverse function
    - Graph of a function, use of GDC to investigate properties of graphs and their solutions
    - Transformations of graphs: translations, stretches; reflections in the axes inverse functions—reflection across y = x; graph of the reciprocal of a function; absolute value graphs
    - Reciprocal function, its graph; its self-inverse nature
    - Quadratic function, graph, axis of symmetry, vertex form, factored form and x-intercepts
    - Solutions to quadratic functions, quadratic formula, use of its discriminant
    - Exponential and logarithmic functions
    - The exponential function of e raised to the x power and its inverse $\ln x, x > 0$
    - Inequalities in one variable, using their graphical representation
    - Polynomial functions; the factor and remainder theorems, with application to the solution of polynomial equations and inequalities

3. Circular Functions and Trigonometry (22 hrs - Winter 2015)
    - Circles, radian measure, arc length, sector area
    - Definition of $\sin\theta, \cos\theta, \tan\theta, \csc\theta, \sec\theta$ and $\cot\theta$ in terms of unit circle
    - Pythagorean identities
    - Compound angle identities and double angle identities
    - Periodic nature of trig functions, their domains, ranges and graphs
    - Solutions to trig equations over finite interval; Use of trig identities and factorisation to transform equations
    - Solution of triangles, cosine rule, sine rule, area of triangle

4. Vectors (24 hrs – Winter 2015)
    - Vectors as displacements in 2 and 3 dimensions
    - Scalar product of two vectors – Algebraic properties of the scalar product; perpendicular vectors, parallel vectors, and the angle between vectors
    - Line as $r = a + \lambda b$, the angle between two lines
    - Distinguishing between coincident, parallel intersecting and skew lines, points of intersection
    - Vector product of two vectors, $v \times w$; determinant representation; geometric interpretation of $|v \times w|$
    - Vector equation of a plane $r = a + \lambda b + \mu c$; use of normal vector to obtain the form $r \bullet n = a \bullet n$; Cartesian equation of a plane $ax + by + cz = d$
    - Intersections of: a line with a plane; two planes; three planes. Angle between: a line and a plane; two planes

5. Statistics and Probability (36 hrs – Fall 2015)
    - Concept of population, sample, random sample and frequency distribution of discrete and continuous data
    - Presentation of data: frequency tables and diagrams, box and whisker plots
    - Measures of central tendency: mean, median, ode; quartiles, percentiles; range; interquartile range; variance; standard deviation
    - Cumulative frequency; cumulative frequency graphs; use to find median, quartiles, percentiles.
    - Concepts of trial, outcome, equally likely outcomes, sample space (U) and event; probability of an event, complementary events
    - Combined events
    - Conditional probability; independent events; use of Bayes' theorem for two events
    - Venn diagrams, tree diagrams and tables of outcomes to solve problems
    - Concept of discrete and continuous random variables and their probability distributions; definition and use of probability density functions; expected value (mean), mode, median variance and standard deviation
    - Binomial distribution; its mean and variance. Poisson distribution; its mean and variance
    - Normal distribution; its properties; standardization of normal variables

6. Calculus (48 hrs – Winter 2015 and Fall 2015)
    - Limits and convergence
    - Differentiation of a sum and a real multiple of the functions in VII. A, chain rule, application of the chain rule to related rates of change; product rule, quotient rule, second derivative; awareness of higher derivatives
    - Local maxima & minima points, first & second derivatives in optimization problems
    - Indefinite integration as anti-differentiation; indefinite integrals of exponential, and trig functions, the composite of any of these with the linear function ax + b
    - Anti-differentiation with a boundary condition to determine the constant term; definite integrals; areas under curves; areas between curses; volumes of revolution
    - Kinematic problems involving displacement, s, velocity, v, and acceleration, a
    - Graphical behaviour of functions; tangents and normals, behaviour for large $|x|$, asymptotes; significance of the second derivative; distinction between maximum and minimum points; points of in flexion with zero and non-zero gradients.
    - Implicit differentiation
    - Further integration: integration by substitution; integration by parts
    - Solution of first order differential equations by separation of variables

Optional Topic

7. Calculus (48 hrs – Winter 2016)

Assessment for Year 2014/2015:

Students will be given several assignments and tests throughout the year.

Assessment for Year 2015/2016:

Students will be assessed both internally and externally.

Internal assessment (20%) is based on the student's math project. The project will be an individual exploration in an area of mathematics. The topic can be unrelated to or related to topics covered in class. The project is internally assessed by the teacher and externally moderated by the IBO.

External assessment (80%) consists of three written papers to be given in May 2016.

Paper one (30%) 2 hours – no calculator
This paper will consist of twenty compulsory short-response questions based on the compulsory core of the syllabus.

Paper two (30%) 2 hours – calculator required
This paper will consist of five compulsory extended-response questions based on the compulsory core of the syllabus.

Paper three (20%) 1 hour – calculator required
This paper will be extended-response questions based on the Calculus Option.

In addition to the internal and external assessments, students will take tests and quizzes throughout the year to provide students, parents and the teacher frequent feedback on how well course objectives are being met.

Resources:

Mathematics HL Core by P Urban, D Martin, R Haese, S Haese, M Haese & M Humphries 2nd Edition

Standards:
http://www.ibo.org