Edron Maths Department
Higher Maths Core Syllabus

(for further details please refer to individual IB syllabi)

	Number and Algebra
	Number systems natural numbers, integers, rationals, irrationals, real numbers.
	Complex numbers, *i*, real and imaginary parts, conjugate, modulus, argument, Cartesian and mod'arg forms (include Eulers), argand representation. Sums products and quotients of complex numbers. De Moivres theorem, roots and powers of complex numbers, change of base.
	Conjugate roots of real polynomials (extend to include general theory of polynomials)
	Arithmetic sequences and series, geometric sequences and series, sum of arithmetic series, sum of finite and infinite geometric series. Applications of series
	Exponentials and logarithms, laws of exponentials, laws of logarithms. Applications of logs and exponentials
	The binomial theorem (Pascal's triangle and calculator method) expansion of $(ax+b)^n$
	Proof by mathematical induction

	Functions and equations
	Note simultaneous equations, mapping and function, absolute value functions are not needed as such but will need to be covered due to exam questions
	Concept of function: $f:x \ f(x)$: domain, range, image(value). Composite functions $fog(x)$, identity function, inverse function f^{-1} Domain restrictions. The graph of a function, its equation y =f(x).
	Function graphing skills; use of a graphical calculator to graph a variety of functions. Appropriate use of window, use of zoom, and trace) or equivalent= to locate points to a given accuracy, use of connected and dot (or equivalent) modes as appropriate. Solution of f(x)=0 to a given accuracy..
	Transformations of graphs, translations, stretches, reflections in the axes. The graph of f as a reflection in the line y=x of the graph of *f, reciprocal and absolute functions.*
	The function f(x)=ax+b, its graph, gradient and intercept (alternate forms of finding y=ax+b)
	The reciprocal function y =1/x, x = 0, its graph and self inverse nature.
	The quadratic function $y=ax^2+bx+c$, its graph. The form $y=a(x-h)^2+kx+c$, $a\neq0$, vertex (h,k) y intercept (0,c) The form y=a(x-p)(x-q) , x intercepts (0,p) (0,q)
	The solution of ax2+bx+c, a≠0. The quadratic formula. Solution of f(x)=g(x), f and g linear or quadratic. Inequalities in one variable, solution of f(x) >=g(x), f and g linear or quadratic
	The exponential function $y=a^x$, a>0, its domain and range. The inverse function $y= \log_a x$. Graphs of $y=a^x$ and $y=\log_a x$. Solution of $a^x=b$
	The functions $y=e^x$ and y=lnx. Applications to the solutions of equations based on problems of growth and decay.
	Polynomial functions (factor and remainder theorems, solution of equations)

	Circular functions and Trigonometry
	The circle. Radian measure of angles, length of an arc, area of a sector.
	Definition of (cos(x), sin(x)) in terms of the unit circle. The identity $\cos^2 x + \sin^2 x = 1$ and it's companion sets. Definition of tan(x) as sin(x)/cos(x) Double angle formulae, $\sin 2x = 2\sin x \cos x$, $\cos 2x = \cos^2 x - \sin^2 x$ Proof of double angle formulae. Addition and half angle formulae (with proof) Compound angle transformation (with proof)
	The circular functions y=sinx, y=cosx, and y=tan x, their domains and ranges, their periodic nature, and their graphs. The inverse functions y=arcsin x, y=arccos x and y=arctan x, domains and ranges. The reciprocal circular equations, y=cosecx, y=secx and y=cotx. Composite functions of the form y=asinb(x+c) solutions of f(x)=k in a given finite region. Solutions of equations leading to quadratic or linear equations in sinx etc. Graphical representation of the above.
	Solutions of triangles. The cosine rule $c^2 = a^2 + b^2 - 2ab\cos C$ The Sine rule, including ambiguous case. Area of a triangle as $\frac{1}{2}ab\sin C$

	Vector Geometry
	Vectors as displacements in a a 2-d and 3-dplane. Components of a vector, column representation. The sum of two vectors, the zero vector, the inverse vector ($-\boldsymbol{v}$). Multiplication by a scalar. Magnitude of a vector $\lvert\boldsymbol{v}\rvert$. Position vector **OA**=**a**
	The scalar product of 2 vectors $\boldsymbol{u.v = u_1v_1 + u_2v_2}$ Properties of the scalar product $\boldsymbol{v.w = w.v}$, $\boldsymbol{u.(v.w) = u.v + u.w}$, $\boldsymbol{(kv).w = k(v.w)}$ where k is a scalar. $\boldsymbol{v.v = \lvert v\rvert^2}$ Perpendicular and parallel vectors.
	Representation of a line in the plane as $\boldsymbol{r = p + td}$ Elimination of $\boldsymbol{t}$ to obtain the Cartesian equation of a line as ax + by = g where a,b and g are scalars. Common point of two lines. Parallel lines, coincident lines, skew lines, distinguishing between these cases.
	The expression $\boldsymbol{v.w = \lvert v\rvert\lvert w\rvert\cos x}$; the angle between two vectors. The projection of a vector $\boldsymbol{v}$ in the direction of $\boldsymbol{w}$; simple application e.g. finding the distance of a point from a line.
	Vector product, area of a triangle or parallelogram. Determinant representation
	Vector equation of line $\boldsymbol{r = a + kb}$, of plane $\boldsymbol{r = a + kb + lc}$ and $\boldsymbol{r.n = a.n}$ Cartesian equations of a line and plane
	Intersections of 2 lines, a line and a plane, 2 planes, 3 planes. Angle between two lines, line and a plane, 2 planes.

Matrices and Transformations (n.b max 3x3 Matrix)
Definition of a matrix: the terms element, row, column and dimension.
Algebra of matrices: equality; addition; subtraction; multiplication by a scalar; multiplication of two matrices. The identity matrix
Determinants of matrices; the conditions for singularity of a matrix.
The inverse of a square matrix. Inverse of a composite, $\mathbf{(PQ)^{-1} = P^{-1}Q^{-1}}$ **N.b. 2x2 may be asked for by hand – 3x3 is only by GDC**
Solution of linear equations(a maximum of three equations in three unknowns). Conditions for the existence of a unique solution, no solution and an infinity of solutions.

	Statistics and Probability
	Concepts of population and sample. Discrete data and continuous data. Frequency tables.
	Presentation of data. Grouped data. Mid-term values. Interval width, upper and lower interval boundaries. Frequency histograms.
	Measures of central tendency. Sample mean, median
	Cumulative frequency, cumulative frequency graphs, quartiles, percentiles, box and whisker plots, calculator usage.
	Measures of dispersion; range; interquartile range; standard sample deviation s_n. Unbiased sample estimate of population deviation s_{n-1}
	Sample space, *U;* the event A. The probability of an event A as P(A)=n(A)/n(U) The complementary events A and A´(not A); the relation P(A) +P(A¨)=1
	Combined events A∩B and A∪B. The relation P(A∪B)=P(A)+P(B)-P(A∩B) Mutually exclusive events; the relation P(A∩B)=0
	Conditional probability; the relation p(A| B)=P(A∩B)/P(B) Independent events; the events P(A| B)=P(A)=P(A| B´)
	Use of Venn diagrams, tree diagrams and tables of outcomes to solve problems. Applications.
	Discrete and continuous probability distributions. E(X) and Var(X)
	Normal distribution
	Binomial distribution and Poisson distribution
	Bayes theorem

	Calculus
	Informal ideas of limit and convergence Differentiation from first principles Derivation of $x \Rightarrow x^n$, $n \in Q$, $x \Rightarrow \sin x$, $x \Rightarrow \cos x$, $x \Rightarrow e^x$, $x \Rightarrow \ln x$ Rational powers of x, sin x, cos x, tan x e^x, ln x, a^x, $\log_a x$ Differentiation of a sum and a real multiple of the above functions. Chain rule for composite functions. Finding equations of tangents and normals. Identifying increasing and decreasing functions.
	Applications of the first derivative to tangents, maximum and minimum problems, kinematical problems involving displacement, s velocity, ds=v, and acceleration dv=a Second derivative, including points of inflexion. Awareness of higher derivatives. Applications to kinematical problems.
	Product and quotient rules.
	Graphical behaviour; tangents, normals, singularities, behaviour for large mod x
	Implicit differentiation Derivatives of inverse trig functions
	Indefinite integration
	Boundary conditions; constant of integration. Application to definite integrals (including calc method) and areas. Volume of rotation
	Integration by substitution
	Integration by parts (incl. definite integrals)
	Solution of first order differential equations by separation of variables.