Malaysia Chinese Independent Secondary Schools

Curriculum Standard for Advanced Mathematics (Senior)

Unified Curriculum Committee of Malaysian Independent Chinese Secondary School (MICSS) Working Committee

Contents

Curriculum Standard for Advanced Mathematics (Senior)

I. Learning Objectives

1. To help students acquire the basic knowledge and skills in order to pursue their tertiary studies and participate in social activities;
2. To cultivate students' abilities of computing, logical thinking and space imagination skills to gradually form the abilities to analyse and solve practical problems using knowledge in Mathematics;
3. To cultivate students' expressive abilities in numbers, quantities and shapes;
4. To serve as prerequisite knowledge when learning other subjects;
5. To equip students with research mentality and the thought of seeking truth from facts; and
6. To help students realise the depth of Mathematics and its scope of applications in order to arouse their interest towards Mathematics

II. Time Allocation

Each level will have thirty-two academic weeks on a yearly basis with eight periods per week and one period consists of forty minutes.

III. Contents

Senior Middle One Volume 1

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
Chapter 1 Functions	1.1 Functions The concepts of correspondence and mapping, concepts of images and preimages, criteria of mappings, definition of function, concepts of independent and dependent variables, representations of functions – analytical method, Venn diagram method, graphical method, tabulation method 1.2 Domains and ranges of functions Domains and ranges of functions and methods to find them, concept and representations of intervals 1.3 Functions and their graphs	1.1 Master the definition and representations of functions 1.2 Master the ways to find domains and ranges of functions 1.3 Recognise the graphs of simple functions 1.4 Master the concept and operations of composite functions 1.5 Understand one-to-one, onto and one-to-one onto functions.

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	Definition of the graph of function, graphs of simple functions – graphs of linear functions in one variable, quadratic functions, reciprocal functions and absolute value functions 1.4 Composite functions Definition and methods to find composite functions 1.5 One-to-one onto functions Definitions and criteria of one-to-one functions, onto functions and one-to-one onto functions 1.6 Inverse functions Definition of inverse function, criteria of the existence of inverse functions, methods to find inverse functions, graphs of functions	1.6 Master the concept of inverse function and ways to find them
Chapter 2 Quadratic Equations in One Variable and Quadratic Functions	2.1 Solutions of quadratic equations in one variable Solutions of quadratic equations in one variable – factorisation, completing the square, formula 2.2 Determinants of roots of quadratic equations in one variable Definition of determinant of roots of quadratic equations, criteria of properties of roots and perfect square expressions 2.3 Relationships between roots and coefficients of quadratic equations in one variable Relationships between roots and coefficients of quadratic equations in one variable 2.4 Graphs and properties of quadratic functions Graphs and properties of quadratic functions	2.1 Master the solutions of quadratic equations in one variable 2.2 Master the determinants of roots of quadratic equations in one variable 2.3 Master the relationships between roots and coefficients of quadratic equations in one variable 2.4 Master the graphs and properties of quadratic functions 2.5 Master the ways to find local extreme values of quadratic functions

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	2.5 Local extreme values of quadratic functions Use completing the square to find the local extreme values of quadratic functions	
Chapter 3 Polynomials	3.1 Polynomials Concepts related to polynomials 3.2 Algorithm of polynomials Addition, subtraction, multiplication and division of polynomials, concepts of factors and multiples, method of detached coefficients 3.3 Synthetic division Synthetic division 3.4 Remainder theorem Remainder theorem and its applications 3.5 Factor theorem Factor theorem and its applications 3.6 Factorisations of polynomials in one variable Factorisations of polynomials in one variable over the field of rational numbers 3.7 Solve higher degree equations in one variable Solve general higher degree equations in one variable, biquadratic equations, higher degree equations and reciprocal equations that can be transformed into quadratic equations in one variable Appendix Factorisations of cyclic polynomials Factorization methods of cyclic polynomials	3.1 Master the operations of polynomials 3.2 Master remainder theorem and factor theorem 3.3 Master the factorisations of polynomials in one variable 3.4 Master the solutions of higher degree equations in one variable, biquadratic equations and reciprocal equations
Chapter 4 Partial Fractions	4.1 Fractions	4.1 Master the algorithm of fractions

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	Definition and four operations of fractions, solutions and applications of fractional equations 4.2 Method of undetermined coefficients The concept of identity, use method of undetermined coefficients to determine values of undetermined coefficients – substitution method and comparing coefficients method 4.3 Partial fractions Decompose fractions with denominators being product of linear factors, power of linear factors, product of quadratic factors and power of quadratic factors into partial fractions	4.2 Master the solutions and applications of fractional equations 4.3 Master the methods to decompose fractions with denominators being product of linear factors, power of linear factors, product of quadratic factors and power of quadratic factors into partial fractions
Chapter 5 Irrational Expressions	5.1 Radicals, irrational expressions Concepts of radicals and irrational expressions 5.2 Basic properties of radicals Basic properties of radicals, express radicals with different indices into radicals with same indices 5.3 Properties of fractional indices and radicals Definition and laws of operations of fractional indices 5.4 Simplification of radicals Movements of factors under and outside the radical signs, remove the radical signs from the denominators, simplify radicals in simplified forms 5.5 Addition and subtraction of radicals Addition and subtraction of radicals 5.6 Multiplication and division of radicals Multiplication and division of radicals, use fractional indices to perform multiplication and division of indices	5.1 Master the algorithm of irrational expressions 5.2 Master the methods to rationalise denominators 5.3 Master the solutions of irrational equations 5.4 Able to find square roots of quadratic surds

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	5.7 Rationalising factors and rationalising denominators Rationalizing factors and rationalising denominators 5.8 Irrational equations Solve irrational equations 5.9 Square roots of quadratic surds Find the square roots of quadratic surds	
Chapter 6 Formations of Angles and Their Units	6.1 Angles Definition and units of angles, conversions between radians and degrees 6.2 Arc lengths and areas of sectors Formulas of arc lengths and areas of sectors	6.1 Able to perform conversions between radians and degrees 6.2 Master the formulas of arc lengths and areas of sectors
Chapter 7 Trigonometric Functions	7.1 Trigonometric functions of arbitrary angles Generalisation of the concept of angles, quadrant angles, definition of trigonometric functions of arbitrary angles, values of trigonometric functions of arbitrary angles 7.2 Values of trigonometric functions of special angles Values of trigonometric functions of $0°, 30°, 45°, 60°, 90°, 180°, 270°$ and related angles 7.3 Induction formulas of trigonometric functions Induction formulas of trigonometric functions – relationships between values of trigonometric functions of $90° \pm \alpha, 180° \pm \alpha, 270° \pm \alpha$ and that of α 7.4 Find angles with given values of trigonometric functions Find angles with given values of trigonometric functions	7.1 Understand the definitions of trigonometric functions 7.2 Able to use values of trigonometric functions of special angles ($0°, 30°, 45°, 60°, 90°$) 7.3 Able to determine the signs of the values of trigonometric functions 7.4 Master the ways to find the values of trigonometric functions 7.5 Understand the graphs of trigonometric functions and their variations

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	7.5 Graphs of trigonometric functions Graphs of sine functions, cosine functions and tangent functions and their properties – domains, ranges and periods	
Chapter 8 Solutions of Arbitrary Triangles	8.1 Sine rule Sine rule and its applications – solve triangles with given two angles and a side and with given two sides and a non-included angle 8.2 Cosine rule Cosine rule and its applications – solve triangles with given three sides and with given two sides and an included angle 8.3 Measurement problems of plane trigonometry Measurement problems of plane trigonometry, angles of elevation, angles of depression, bearings 8.4 Areas of triangles Find the areas of triangles with given two sides and an included angle and with given three sides 8.5 Radii of circumcircles and inscribed circles of triangles Formulas of radii of circumcircles and inscribed circles of triangles and their applications	8.1 Master the applications of sine rule and cosine rule 8.2 Able to solve measurement problems 8.3 Master the formulas of areas of triangles 8.4 Master the methods to find the radii of circumcircles and inscribed circles of triangles
Chapter 9 Trigonometric Identities	9.1 Basic relationships of the same angle trigonometric functions Reciprocal relation, division relation and square relation 9.2 Trigonometric functions of the sums and differences of two angles Cosine of the sums and differences of two angles, sine of the sums and differences of two angles, tangent of the sums and differences of two angles	9.1 Master the basic relationships of the trigonometric functions of the same angle 9.2 Master the formulas of trigonometric functions of the sums and differences of two angles

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	9.3 Trigonometric functions of double and half angles Sine, cosine and tangent of double angles, sine, cosine and tangent of half angles 9.4 Product-to-sum of trigonometric functions Formulas of product-to-sum of trigonometric functions and their applications 9.5 Sum-to-product of trigonometric functions Formulas of sum-to-product of trigonometric functions and their applications	9.3 Master the formulas of trigonometric functions of double and half angles 9.4 Master the formulas of product-to-sum of trigonometric functions 9.5 Master the formulas of sum-to-product of trigonometric functions
Chapter 10 Trigonometric Equations	10.1 Conditional solutions of simple trigonometric equations Conditional solutions of simple trigonometric equations 10.2 General solutions of simple trigonometric equations General solutions of simple trigonometric equations 10.3 Solve trigonometric equations Solve trigonometric equations that can be transformed into the same angles and that can be factorised, solve homogeneous equations in $\sin x$ and $\cos x$ and of the forms of $a\sin x + b\cos x = c$ 10.4 Graphs of trigonometric functions Graphs of $y = rf(x)$, $y = f(kx)$ and $y = f(x + \alpha)$ 10.5 Graphical methods of solving trigonometric equations Use graphical methods to solve trigonometric equations	10.1 Master the methods to find the conditional solutions and general solutions of trigonometric equations 10.2 Master the graphical methods of solving trigonometric equations

Senior Middle One Volume 2

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
Chapter 11 Cartesian Coordinate System	11.1 Cartesian coordinate system Cartesian coordinate system, distance formula, midpoint formula 11.2 Gradients/Slopes Angles of inclination and gradients, use gradients to show three points are collinear 11.3 Areas of triangles Formulas of areas of triangles and their applications 11.4 Areas of polygons Formulas of areas of polygons and their applications 11.5 Formula of the division of line segments Directed line segments, points dividing line segments in given ratios of line segments, ratios of division of line segments, formula of division of line segments	11.1 Master the distance formula between two points 11.2 Master the formulas of the areas of triangles and polygons using coordinates 11.3 Master the formula of the division of line segments
Chapter 12 Equations of Straight Lines	12.1 Linear equations in two variables and straight lines Linear equations in two variables and straight lines 12.2 Equations of straight lines Equations of straight lines – point-slope form, two-point form, gradient-intercept form, slope-intercept form, general form 12.3 Parallelism and perpendicularity of two straight lines Parallelism and perpendicularity of two straight lines 12.4 Angles of intersections of two straight lines	12.1 Understand the definition of gradient 12.2 Master the methods to find equations of straight lines 12.3 Able to determine the gradients and intercepts of straight lines from their equations 12.4 Master the conditions of two straight lines being parallel and perpendicular 12.5 Able to find the angle of intersections between two straight lines 12.6 Able to find the intersection point of two straight lines

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	Angles of intersections of two straight lines 12.5 Intersection point of two straight lines Intersection point of two straight lines 12.6 Distance from a point to a line Distance from a point to a line, distance between two parallel lines	12.7 Master the formulas of distance from a point to a line and distance between two parallel lines
Chapter 13 Simultaneous Equations	13.1 Simultaneous linear equations in three variables Solutions of simultaneous linear equations in three variables and simultaneous equations that can be transformed into simultaneous linear equations in three variables 13.2 Simultaneous linear equations in two variables Solving method of simultaneous equations consisting a linear equation in two variables and a quadratic equation in two variables, solving method of simultaneous equations consisting two quadratic equations in two variables – elimination method, an equation can be factorised into product of two linear equations, two equations where all terms containing the variables are homogenous	13.1 Able to solve simultaneous linear equations in three variables 13.2 Able to solve simultaneous quadratic equations in two variables 13.3 Able to construct simultaneous equations to solve application problems
Chapter 14 Inequality	14.1 Inequality Concepts of inequality 14.2 Properties of inequality Properties of inequality 14.3 Proofs of inequality Proofs of inequality – comparing method, mixed	14.1 Master the properties of inequality 14.2 Master the proofs of inequality 14.3 Master the solutions of linear inequality in one variable, quadratic inequality in one variable,

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	method, AM-GM of two and three positive numbers 14.4 Quadratic inequality in one variable Solutions of linear inequality in one variable and simultaneous linear inequality in one variable, quadratic inequality in one variable, simultaneous quadratic inequality in one variable 14.5 Higher degree inequality in one variable Solutions of higher degree inequality in one variable 14.6 Fractional inequality Solutions of fractional inequality 14.7 Irrational inequality Solutions of irrational inequality 14.8 Inequality that contains absolute values Solutions of inequality containing absolute values (expressions under the absolute signs are linear or quadratic expressions) 14.9 Maximum and minimum values of algebraic expressions Maximum and minimum values of quadratic expressions in one variable, maximum and minimum values of algebraic expressions with both denominators and numerators being quadratic expression in one variable	simultaneous linear inequality in one variable, simultaneous quadratic inequality in one variable 14.4 Master the solutions of higher degree inequality in one variable and fractional inequality 14.5 Master the solutions of irrational inequality 14.6 Master the solutions of inequality containing absolute values 14.7 Able to find the maximum and minimum values of algebraic expressions
Chapter 15 Linear Inequalities in Two	15.1 Linear inequalities in two variables Graphs of linear inequalities in two variables	15.1 Master the solutions of linear inequalities in two variables and simultaneous

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
Variables and Linear Programming	15.2 Simultaneous linear inequalities in two variables Graphs of simultaneous linear inequalities in two variables 15.3 Linear programming Operation research, use simultaneous linear inequalities in two variables to solve linear programming problems	linear inequalities in two variables 15.2 Able to use graphical method to solve linear programming problems
Chapter 16 Sequences and Series	16.1 Sequences and series Concepts of sequences and series, find general terms, representation using the symbol Σ 16.2 Arithmetic sequences Definition of arithmetic sequence, first terms, common differences, general terms, arithmetic means, summation formulas 16.3 Geometric sequences Definition of geometric sequence, first terms, common ratios, general terms, geometric means, summation formulas 16.4 Infinite series Concept of infinite series, sum of infinite geometric series 16.5 Sums of simple special sequences Sums of natural numbers, squares of natural numbers, cubes of natural numbers and arithmetico-geometric sequences, method of differences Appendix: Harmonic sequence Definition of harmonic sequence, harmonic means	16.1 Master the formulas of general terms of arithmetic sequences and summation formulas of arithmetic series and their applications 16.2 Master the formulas of general terms of geometric sequences and summation formulas of geometric series and their applications 16.3 Master the summation formula of infinite geometric series 16.4 Able to find the sums of simple special sequences 16.5 Able to use method of differences to find the sum of sequences

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
Chapter 17 Exponential Functions and Logarithmic Functions	17.1 Exponents Definition and laws of operations of exponents 17.2 Logarithms Definition and laws of operations of logarithms 17.3 Formula of change of bases of logarithms Formula of change of bases of logarithms 17.4 Exponential equations Solutions of exponential equations 17.5 Logarithmic equations Solutions of logarithmic equations 17.6 Exponential functions and its graphs Definition of exponential function, graphs of exponential functions and its properties 17.7 Logarithmic functions and its graphs Definition of logarithmic function, graphs of logarithmic functions and its properties	17.1 Master the properties and laws of operations of exponential and logarithmic functions 17.2 Master logarithm change base formula 17.3 Master the solutions of exponential and logarithmic equations 17.4 Recognise the graphs of exponential and logarithmic functions and their properties

Senior Middle Two Volume 1

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
Chapter 1 Determinants	1.1 Determinants Definition of determinant, expansions of 2x2 and 3x3 determinants, Sarrus method 1.2 Properties of determinants Seven properties of determinants 1.3 Expanding determinants along rows (or columns) Expansions of 3x3 determinants, minors, cofactors, two theorems about cofactors, expansions of 4x4 determinants 1.4 Cramer's rule Use Cramer's rule to solve simultaneous linear equations	1.1 Able to calculate the values of determinants 1.2 Master the properties of determinants 1.3 Use Cramer's rule to solve simultaneous linear equations
Chapter 2 Matrices	2.1 Matrices Definition of matrix, concept of equal matrices, definitions of zero matrices 2.2 Addition and subtraction of matrices Addition and subtraction operations of matrices 2.3 Scalar product of matrices Multiplication of matrices by scalars 2.4 Multiplication of matrices Multiplication between matrices, definition of unit matrix 2.5 Transpose matrices Definition of transpose matrix 2.6 Inverse matrices Methods to find the inverse matrices of 2x2 matrices, use cofactors and Gaussian	2.1 Understand the concept of matrix 2.2 Able to perform addition and subtraction, scalar product and the multiplication of matrices 2.3 Master the methods to find the inverse matrices 2.4 Able to use inverse matrices or Gaussian elimination method to solve simultaneous linear equations

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	elimination method to find the inverse matrices of 3x3 matrices 2.7 Use matrices to solve simultaneous linear equations Use inverse matrices and Gaussian elimination method to solve simultaneous linear equations	
Chapter 3 Basic Solid Geometry	3.1 Angles between straight lines and planes Find the angles between straight lines and planes 3.2 Angles between two planes Find the angles between two planes 3.3 Basic application problems of solids Solve basic application problems of solids 3.4 Plans, front elevations, side elevations Orthogonal projections, plans, front elevations, side elevations	3.1 Able to find angles between straight lines and plane, and angles between two planes 3.2 Able to solve application problems of solids
Chapter 4 Longitudes and Latitudes	4.1 Planes and cross sections of spheres Cross sections of planes and spheres, great circles, small circles 4.2 Meridians and parallels of latitude, longitudes and latitudes Meridians and longitudes, parallels and latitudes, radii of parallels of latitude, definition of a nautical mile 4.3 Times and longitudes Local time, standard time 4.4 Distances between two points measured along the common meridians	4.1 Understand the concepts of longitudes and latitudes 4.2 Able to calculate the distances between two points measured along the common meridians or common parallels of latitude

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	Find the distances between two points measured along the common meridians and solve related application problems 4.5 Distances between two points measured along the common parallels of latitude Find the distances between two points measured along the common parallels of latitude and solve related application problems 4.6 The shortest distance between two points measured along the common parallel of latitude Find the shortest distance between two points measured along the common parallel of latitude and solve related application problems	
Chapter 5 Circles	5.1 Equations of loci Find the equations of loci where the loci are straight lines or circles 5.2 Standard equations of circles Definition of circle, standard equations of circles 5.3 General equations of circles General equations of circles 5.4 Tangents to circles Concept of tangents to circles, tangents to circles, lengths of tangents, tangents to circles with given gradients 5.5 Touches and orthogonality of circles Conditions for two circles to touch externally and internally, condition for two circles to be orthogonal	5.1 Master the concept of and methods to find loci 5.2 Master the methods to find equations of circles 5.3 Able to find the centres and radii of circles from equations of circles 5.4 Able to solve problems related to circles (circles and tangents touch, lengths of tangents, longest or shortest distances from points to circles) 5.5 Able to find equations of tangents to circles 5.6 Master the conditions of touches and orthogonality of two circles

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
Chapter 6 Permutations and Combinations	6.1 Multiplication principle Multiplication principle and its applications 6.2 Permutations and numbers of permutations Concept of permutation, formula of the number of permutations and its applications 6.3 Addition principle Addition principle and its applications 6.4 Circular permutations Numbers of circular permutations and their applications 6.5 Permutations of all n objects when all objects are not distinct Permutations of all n objects when all objects are not distinct 6.6 Permutations of different objects with repetitions allowed Permutations of different objects with repetitions allowed 6.7 Combinations and formula of the number of combinations Concept of combination, formula of the number of combinations and its applications 6.8 Properties of the numbers of combinations Properties of the numbers of combinations 6.9 Miscellaneous examples Problems in permutations and combinations	6.1 Master multiplication and addition principles 6.2 Master the formula of the number of permutations and solve problems in linear arrangements 6.3 Able to solve problems in circular permutations 6.4 Able to solve problems in the permutations of all n objects when all objects are not distinct 6.5 Able to solve problems in the permutations of different objects with repetitions allowed 6.6 Master the formula of the number of combinations and able to solve problems in combinations
Chapter 7 Binomial Theorem	7.1 Binomial theorem with natural number exponents Binomial theorem with natural number exponents and its applications	7.1 Able to expand binomials with natural number exponents

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	7.2 General terms of binomial expansions General terms of binomial expansions 7.3 Binomial theorem with rational number exponents Binomial theorem with rational number exponents and its applications 7.4 Applications of binomial theorem in approximate calculations Applications of binomial theorem in approximate calculations	7.2 Master the general terms of the binomial expansions 7.3 Able to expand binomials with rational number exponents 7.4 Master the applications of binomial theorem in approximate calculations
Chapter 8 Statistics	8.1 Sorting out of data Grouping of data, frequency distribution tables, histograms, frequency polygons, cumulative frequency tables, cumulative frequency polygons 8.2 Central tendency Methods to find means of ungrouped and grouped data, method to find weighted means, find medians of ungrouped data, find medians from cumulative frequency polygons or by formula, find modes of ungrouped data, find modes of grouped data from histograms 8.3 Measures of dispersion Find ranges of data, find quartile deviations of ungrouped data, find quartile deviations of grouped data from cumulative frequency polygons, find mean deviations, standard deviations and variances 8.4 Indices Concept of and methods to find indices, composite indices	8.1 Able to construct cumulative frequency tables, frequency polygons and cumulative frequency polygons 8.2 Master the measurements of central tendency 8.3 Master the measurements of dispersion 8.4 Master the concept and calculations of composite indices 8.5 Master the concept of and method to find moving averages

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	8.5 Moving averages Concept of and method to find moving averages	
Chapter 9 Probabilities	9.1 Probabilities Concept of random phenomena, concepts of and methods to find sample spaces and events, statistics and classical definitions of probabilities 9.2 Mutually exclusive events and addition principle Concepts of mutually and non-mutually exclusive events, addition principle and applications of mutually and non-mutually exclusive events, calculations of probabilities of complementary events 9.3 Independent events and multiplicative principle Concept of independent event, multiplication principle of independent events, concept of dependent event, definition and calculations of conditional probabilities 9.4 Mathematical expectations Concept and calculations of mathematical expectations 9.5 Binomial distributions Concept and applications of binomial distributions 9.6 Normal distributions Concept and applications of normal distributions Appendix: Table of standard normal distribution	9.1 Understand the concepts of sample spaces, events and probabilities 9.2 Understand the concept of mutually exclusive event and master addition principle 9.3 Understand the concept of independent event and master multiplication principle 9.4 Understand the concept of dependent event and master method to find probabilities of dependent events 9.5 Master the concept and calculations of mathematical expectations 9.6 Master the applications of binomial distributions 9.7 Master the applications of normal distributions

Senior Middle Two Volume 2

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
Chapter 10 Plane Vectors	10.1 Vectors Concept of vectors, differences between scalars and vectors, concept of equal vectors 10.2 Addition and subtraction of vectors Triangle law of vector addition, parallelogram law of vector addition, properties of vector addition, definitions of zero vector and inverse vectors, subtraction of vectors 10.3 Scalar multiplication of vectors Definition, calculations and properties of scalar multiplication of vectors 10.4 Position vectors Definition of position vector, representations using coordinates and unit vectors, applications of position vectors 10.5 Magnitudes of vectors Lengths of vectors 10.6 Vector geometry Midpoint rule, ratio rule, applications of vectors in plane geometry 10.7 Scalar product of vectors Definition, calculations and properties of scalar products, special cases of scalar product – perpendicular and parallel, formula of scalar product of vectors represented by vector components, applications of scalar product of vectors	10.1 Master the concept of plane vectors 10.2 Master addition, subtraction, and scalar multiplication of vectors 10.3 Master the concept of position vectors and its applications 10.4 Able to find unit vectors 10.5 Master the applications of vectors in plane geometry 10.6 Master the scalar product of vectors and its applications

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
Chapter 11 Logical Reasoning	11.1 Logic Introduction to logic 11.2 Statements Definitions and determination of statements 11.3 Compound statements Concept of compound statement, negations and its truth tables, conjunctions and its truth tables, disjunctions and its truth tables 11.4 Truth tables and logical equivalence Construction of truth tables, concept and determination of logical equivalence, De Morgan's law, law of double negation 11.5 Implications Concept of implication and its truth tables, four forms of implications 11.6 Arguments Logical reasoning, validity of argument, law of sylogism	11.1 Understand the compound statements and its truth values 11.2 Able to use truth tables to prove logical equivalence 11.3 Understand the concept of implications 11.4 Able to determine validity of arguments
Chapter 12 Limits	12.1 Concept of limits Concept of limits 12.2 Limits of sequences Concept, properties and calculations of limits of sequences 12.3 Limits of functions Concept of limits of functions, left, right limits, examples when limits do not exist, limits when $x \to \infty$ 12.4 Properties of the limits of functions	12.1 Understand the concept of limits and master its properties 12.2 Master the calculations of limits of sequences 12.3 Master the calculations of limits of functions 12.4 Able to determine continuity of functions

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	Properties of the limits of functions and the applications in calculations 12.5 Continuous functions Concept and determination of continuous functions	
Chapter 13 Differentiation (I)	13.1 Gradients of tangents, instantaneous velocities Gradients of tangents and limits, instantaneous velocities and limits 13.2 Derivatives Definition of the derivatives, use first principle of differentiation to find derivatives 13.3 Continuity of the functions Relationship between differentiability and continuity 13.4 Rules of the differentiation Derivatives of power functions, rules of differentiation of sums and differences, products and divisions of functions 13.5 Chain rule – rule of differentiation of composite functions Use chain rule to find derivatives of composite functions 13.6 Higher order derivatives Higher order derivatives and its applications 13.7 Rules of the differentiation of trigonometric functions Value of $\lim_{x\to 0}\frac{\sin x}{x}$, formula of derivatives of trigonometric functions	13.1 Master the concept of derivatives 13.2 Master the relationship between differentiability and continuity of functions 13.3 Master the rules of differentiation 13.4 Able to use chain rule to find derivatives of composite functions 13.5 Able to find higher order derivatives 13.6 Master the rules of differentiation of trigonometric functions

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
Chapter 14 Applications of Differentiation (I)	14.1 Tangents and normals Find tangents and normals to curves 14.2 Increasing and decreasing of functions Concept of monotone functions, criteria of increasing and decreasing of functions 14.3 Local maximum and minimum values of functions Local extreme values of functions and stationary points, derivative tests of local extreme values – first derivative test, second derivative test 14.4 Global maximum and minimum values of functions Find global maximum and minimum values of functions, application problems of global maximum and minimum values of 14.5 Velocities and accelerations Instantaneous velocities and accelerations in motions along straight lines 14.6 The related rates of change Concept and calculations of related rates of change 14.7 Approximate calculations Applications of differentiation in approximate calculations	14.1 Able to find tangents and normals to points on curves 14.2 Able to determine increasing and decreasing of functions 14.3 Able to find local maximum and minimum values of functions 14.4 Able to find global maximum and minimum values of functions and solve related application problems 14.5 Able to find the instantaneous velocities and accelerations in motions along straight lines 14.6 Master the concept of rates of change and its applications 14.7 Master the applications of differentiation in approximate calculations
Chapter 15 Indefinite Integrals (I)	15.1 Indefinite integrals – reverse process of differentiation Definition of antiderivatives, concept of indefinite integrals 15.2 Rules of integration Integration formulas of power functions and trigonometric functions, rules of integration –	15.1 Understand the concept of indefinite integrals 15.2 Master the integration formulas of the basic functions 15.3 Master the rules of integration

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	taking out common factors, term-by-term integration 15.3 Integration by substitution Use integration by substitution to find indefinite integrals	15.4 Master the integration by substitution
Chapter 16 Definite Integrals and Its Applications (I)	16.1 Concept of the definite integrals Method to find areas of trapeziums with curved edges, method to find displacements of linear motions with speeds varied, definition of definite integrals 16.2 Calculations of the definite integrals Relationship between definite and indefinite integrals – Fundamental Theorem of Calculus, properties and calculations of definite integrals, use integration by substitution to find definite integrals 16.3 Calculations of areas Find areas bounded by two curves 16.4 Volumes of solids of revolution Find the volumes of solids generated when the regions are revolved about the coordinate axes 16.5 Linear motions Velocities and displacements in linear motions	16.1 Understand the concepts of definite integrals 16.2 Master the relationship between definite and indefinite integrals 16.3 Able to use definite integrals to find areas 16.4 Able to use definite integrals to find volumes of solid of revolution 16.5 Able to use definite integrals to solve problems in linear motions

Senior Middle Three Volume 1

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
Chapter 1 Mathematical Induction	1.1 Mathematical induction Principles of mathematical induction	1.1 Master the applications of mathematical induction

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	1.2 Applications of mathematical induction Applications of mathematical induction	
Chapter 2 Inverse Trigonometric Functions	2.1 Definitions and graphs of the inverse trigonometric functions Definitions and graphs of the inverse sine functions, inverse cosine functions, inverse tangent functions and inverse cotangent functions 2.2 Operations of the inverse trigonometric functions Operations of inverse trigonometric functions 2.3 Identities of the inverse trigonometric functions Identities of inverse trigonometric functions 2.4 Equations of the inverse trigonometric functions Solve equations of inverse trigonometric functions	2.1 Understand the definitions and graphs of inverse trigonometric functions 2.2 Perform the operations of inverse trigonometric functions 2.3 Master the proofs of identities of inverse trigonometric functions 2.4 Solve the equations of inverse trigonometric functions
Chapter 3 Differentiation (II)	3.1 Implicit differentiation Differentiation of the implicit functions 3.2 Derivatives of the inverse trigonometric functions Derivatives of inverse functions, derivatives of inverse trigonometric functions 3.3 Derivatives of the logarithmic functions Value of $\lim_{x\to 0}(1+x)^{\frac{1}{x}}$, formula of derivative of natural logarithm 3.4 Derivatives of the exponential functions	3.1 Master the differentiation of implicit functions 3.2 Master the differentiation of inverse trigonometric functions, logarithmic functions and exponential functions 3.3 Master the logarithmic differentiation 3.4 Able to apply L' Hospital's rule to find the limits of functions

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	Derivative of $f(x)=e^x$, derivatives of $f(x)=a^x$ 3.5 Logarithmic differentiation Find derivatives by taking logarithms on both sides 3.6 L' Hospital's rule Apply L' Hospital's rule to find limits – indeterminate forms $\frac{0}{0}$ and $\frac{\infty}{\infty}$	
Chapter 4 Transformations of Axes	4.1 Translation of axes Formulas of the translation of coordinates 4.2 Simplify quadratic equations in two variables by using the translation of axes Simplify quadratic equations in two variables by using the translation of axes 4.3 Rotation of axes Formulas of rotation of coordinates Appendix I: Simplify quadratic equations in two variables by using the rotation of axes Appendix II: Simplification of general quadratic equations in two variables	4.1 Master the formulas of translation and rotation of axes 4.2 Simplify quadratic equations in two variables by using the translation of axes
Chapter 5 Conic Sections	5.1 Conic sections Definition and classifications of conic sections – circles, ellipses, parabolas and hyperbolas, definitions of foci, directrices and eccentricities 5.2 Parabolas	5.1 Master the standard equations of parabolas, ellipses and hyperbolas and their geometrical properties

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	Standard equations and geometrical properties of parabolas 5.3 Ellipses Standard equations and geometrical properties of ellipses 5.4 Hyperbolas Standard equations, geometrical properties and asymptotes of hyperbolas, rectangular hyperbolas	
Chapter 6 Tangents to Conic Sections	6.1 Tangents to points on conic sections Find tangents to points on conic sections 6.2 Equations of tangents with given gradients Find the equations of tangents with given gradients 6.3 Equations of tangents to conic sections passing through points lying outside the conic sections Find the equations of tangents to conic sections passing through points lying outside the conic sections	6.1 Able to find the equations of tangents and normals to conic sections
Chapter 7 Parametric Equations	7.1 Parametric equations Concept of parametric equations 7.2 Conversions between parametric equations and Cartesian equations Conversions between parametric equations and Cartesian equations 7.3 Parametric equations and loci Use parametric equations to solve problems of loci in plane geometry 7.4 Differentiation of parametric functions	7.1 Able to perform conversions between parametric equations and Cartesian equations 7.2 Able to use parametric equations to solve problems in loci 7.3 Master the differentiation of parametric functions 7.4 Master the parametric equations of conic sections and their applications

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	First order derivatives of parametric functions 7.5 Parametric equations of conic sections Parametric equations of parabolas, ellipses, hyperbolas and rectangular hyperbolas and their applications	
Chapter 8 Polar Coordinates	8.1 Polar coordinate system Concept of polar coordinate system 8.2 Polar equations of curves Polar equations of curves 8.3 Conversions between polar coordinates and rectangular coordinates Conversions between polar coordinates and rectangular coordinates 8.4 Discussions of polar equations and graph sketching Discussions of polar equations and graph sketching	8.1 Master the methods to find polar equations 8.2 Perform the conversions between polar coordinates and rectangular coordinates 8.3 Master the graphs of polar equations
Chapter 9 Complex Numbers	9.1 Extension of numbers Extension of numbers, introduce the concept of imaginary numbers 9.2 Complex numbers Concept of complex numbers, equality of complex numbers, conjugate complex numbers 9.3 Addition and subtraction of the complex numbers Addition and subtraction operations of complex numbers 9.4 Multiplication of the complex numbers Multiplication of two complex numbers, power of complex numbers	9.1 Master the concept of complex numbers and its operations 9.2 Master the graphs of complex numbers on complex plane 9.3 Able to perform conversions between algebraic form and trigonometric form of complex numbers 9.4 Master the multiplication and division of complex numbers in trigonometric form

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
	9.5 Division of the complex numbers Division of the complex numbers 9.6 Vector representation of complex numbers Complex numbers and rectangular coordinate system, complex plane, vector representation of complex numbers, moduli and arguments of complex numbers 9.7 Trigonometric form of complex numbers Trigonometric form of complex numbers 9.8 Multiplication and division of complex numbers in trigonometric form Perform multiplication and division of complex numbers in trigonometric form 9.9 Power of the complex numbers De Moivre's theorem and its applications 9.10 Extraction of complex numbers Find the *n*th roots of the complex numbers, solve binomial equations, cube roots of 1 9.11 Discussions on the roots of equations of degree *n* in one variable Properties of the oots, relationships between roots and coefficients Appendix: Proof of Theorem 3	9.5 Master De Moivre's theorem and its applications 9.6 Able to find *n*th roots of complex numbers and solve binomial equations 9.7 Master the relationships between the roots and coefficients of equations of degree *n* in one variable

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
Chapter 10 Applications of Differentiation (II)	10.1 Graph sketching of curves Concavities of curves and points of inflexions, graph sketching of curves, determination of symmetry of functions, asymptotes of curves 10.2 Approximate solutions of equations in one variable Use Newton's method to find approximate solutions of equations in one variable	10.1 Able to determine the concavities of functions and to find the points of inflexion 10.2 Able to find the asymptotes of curves 10.3 Master the graph sketching of functions 10.4 Able to use Newton's method to find approximate solutions in one variable
Chapter 11 Indefinite Integrals (II)	11.1 Basic integration formulas Basic integration formulas, use the integration by substitution to find indefinite integrals 11.2 Integration by partial fractions Use partial fractions to find the integrations of fractions 11.3 Integration of trigonometric functions Integration of even and odd powers of $\sin x$ and $\cos x$, integration of high powers of $\tan x$ and $\sec x$, find integrals by using product-to-sum formulas, integration of rational functions involving $\sin x$ and $\cos x$, integration of irrational functions involving $\sqrt{a^2 - x^2}$, $\sqrt{a^2 + x^2}$, $\sqrt{x^2 - a^2}$ 11.4 Integration by parts Use the integration by parts to integrate	11.1 Master the integration by partial fractions 11.2 Master the integration of trigonometric functions 11.3 Master the integration by parts
Chapter 12 Definite Integrals and Its	12.1 Calculations of definite integrals (II) Calculations of definite integrals	12.1 Able to use definite integrals to find the areas in polar coordinate

Chapters	Curriculum Contents	Learning Objectives: Students must be able to
Applications (II)	12.2 Calculations of the areas in polar coordinate system Calculations of the areas in polar coordinate system 12.3 Volumes of solids of revolution Find the volumes of solids generated when the regions are revolved about any straight lines that are parallel to the coordinate axes 12.4 Approximate calculations of definite integrals Use the trapezium rule and Simpson's rule to approximately calculate definite integrals	system (pictures are given) 12.2 Able to use definite integrals to find the volumes of solids of revolution 12.3 Able to use trapezium rule and Simpson's rule to calculate the approximate values of definite integrals
Chapter 13 Ordinary Differential Equations	13.1 Ordinary Differential Equations Introduce related concepts and examples of ordinary differential equations 13.2 Solutions of three types of first order differential equations Solve variable separable differential equations, solve first order homogeneous differential equations, solve first order linear differential equations – method of variation of parameters, method of integrating factors 13.3 Applications of first order differential equations Applications of first order differential equations 13.4 Second order linear differential equations with constant coefficients Solutions of second order linear differential equations with constant coefficients	13.1 Recognise the ordinary differential equations 13.2 Able to solve variable separable, first order homogeneous and first order linear differential equations 13.3 Able to solve the application problems of first order differential equations 13.4 Able to solve the application problems of second order differential equations