# Chapter 2 Curriculum Framework

This curriculum is adapted from the *Syllabuses for Secondary Schools – Additional Mathematics (Secondary 4-5) 1992* (referred as *Syllabus 1992*). Some topics have been deleted or trimmed from the *Syllabus 1992*. The relevant changes and the comparison between this curriculum and the *Syllabus 1992* can be found in Appendices 1 & 2 respectively. The rationale of the revision is to create curriculum space for consolidating concepts and adjusting teaching strategies (to cater for students' individual differences), etc. so as to improve the learning of Additional Mathematics. The total teaching time for this curriculum should be unchanged when compared with the *Syllabus 1992* to serve the said rationale (see Chapter 3 for the suggested time allocation of the curriculum).

Instead of dividing the contents of the curriculum into dimensions as in the secondary mathematics curriculum, they are divided into 9 units. For each unit, specific learning objectives are given to provide a sharper focus. The subject matter of each unit is broken into sub-units to facilitate learning/teaching and achievement of the specific learning objectives.

It should be noted that some of the contents in the curriculum are topics from the "Number and Algebra Dimension" and "Measures, Shape and Space Dimension" of the secondary mathematics curriculum but they are treated with further depths.

## Content and Specific Learning Objectives

| Unit | Content | Specific Learning Objective |
|---|---|---|
| 1 | **Principle of Mathematical Induction**<br>1.1 Concept of Mathematical Induction<br>1.2 Steps in the Method of Mathematical Induction<br>1.3 Applications of Mathematical Induction | 1. To understand the concept of mathematical induction<br>2. To be familiar with the steps in the method of mathematical induction<br>3. To apply the principle of mathematical induction to various fields |
| 2 | **Binomial Theorem for Positive Integral Indices**<br>2.1 The n! and $C_r^n$ Notations<br>2.2 The Pascal Triangle | 1. To recognize the notations n! and $C_r^n$<br>2. To learn to expand a binomial with positive integral index by the binomial theorem |

| Unit | Content | Specific Learning Objective |
|---|---|---|
| | 2.3 Expanding Binomials using the Pascal Triangle<br>2.4 Binomial Theorem for Positive Integral Indices | |
| 3 | **Quadratic Equations and Quadratic Functions**<br>3.1 Solution of Quadratic Equations<br>3.2 Nature of Roots<br>3.3 Quadratic Functions<br>3.4 Absolute Values | 1. To acquire skills in solving quadratic equations by the method of completing the square and by formula<br>2. To determine the nature of roots of quadratic equations<br>3. To find the maximum and minimum values of quadratic functions |
| 4 | **Trigonometry**<br>4.1 Radian Measure<br>4.2 The Six Trigonometric Functions of Angles of Any Magnitude and their Graphs<br>4.3 Compound Angles (Excluding Triple Angle Formulae and Half Angle Formulae)<br>4.4 The Subsidiary Angle Form<br>4.5 General Solution of Simple Trigonometric Equations<br>4.6 Solution of Triangles<br>4.7 Problems in Two and Three Dimensions | 1. To understand the six trigonometric functions of the general angle and their graphs<br>2. To understand and apply the compound angle formulae and sum and product formulae<br>3. To find the general solution of trigonometric equations<br>4. To acquire skills in solving harder problems in two and three dimensions |
| 5 | **Limits and Differentiation**<br>5.1 Limits<br>5.2 Derivatives<br>5.3 Differentiation<br>5.3.1 Simple Algebraic Functions and Rules of Differentiation | 1. To learn the concept of limits<br>2. To evaluate the limits of functions<br>3. To find the derivatives of functions<br>4. To apply the technique of differentiation to problem solving |

| Unit | Content | Specific Learning Objective |
|---|---|---|
| | 5.3.2 Differentiation of Composite Functions and Implicit Functions<br>5.3.3 Differentiation of Trigonometric Functions<br>5.3.4 Second Derivatives<br>5.4 Applications of Differentiation<br>5.4.1 Gradients, Tangents and Normals to a Curve<br>5.4.2 Maxima and Minima Sketching of Simple Curves<br>5.4.3 Rates of Change | |
| 6 | **Inequalities**<br>6.1 Basic Rules of Inequalities<br>6.2 Linear Inequalities in One Variable<br>6.3 Quadratic Inequalities in One Variable | 1. To understand the basic rules of inequalities<br>2. To solve linear inequalities in one variable<br>3. To solve quadratic inequalities in one variable |
| 7 | **Coordinate Geometry**<br>7.1 Plane Rectangular Coordinates and Distance between Two Points<br>7.2 Area of Rectilinear Figures<br>7.3 Inclination and Slopes of Straight Lines<br>7.4 Angle between Two Straight Lines<br>7.5 Equations of Straight Lines<br>7.6 The Normal Form<br>7.7 Family of Straight Lines<br>7.8 Concept of Locus<br>7.9 Equation of a Circle; Intersection of a Straight Line and a Circle<br>7.10 Equation of Tangents to a Circle<br>7.11 Family of Circles<br>7.12 Simple Parametric Equations and Locus Problems | 1. To find areas of plane rectilinear figures in the coordinate plane<br>2. To find the angle between two straight lines<br>3. To understand the normal form of a straight line equation and to apply the knowledge in finding distances<br>4. To find the equation of a circle and the points of intersection of a straight line and a circle<br>5. To find the equations of tangents to a circle<br>6. To find the equations of families of straight lines and circles<br>7. To acquire the concept of parametric equations and locus, and solve simple locus problem |

| Unit | Content | Specific Learning Objective |
|---|---|---|
| 8 | **Vectors in the Two-dimensional Space**<br>8.1 Scalar and Vector Quantities; Equalities of Vectors; Zero Vector and Unit Vector<br>8.2 Sum and Difference of Vectors; Multiplication of a Vector by a Scalar<br>8.3 Representation of Vectors in the Rectangular Coordinate System<br>8.4 Scalar Product of Two Vectors<br>8.5 Applications of Vectors, Division of a Line Segment, Parallelism and Perpendicularity | 1. To learn the concept and representation of vector quantities<br>2. To learn some properties of and operations on vectors in two-dimensional space<br>3. To understand the geometrical representation of vectors in two-dimensional space<br>4. To apply the vector method particularly to the solution of some geometric problems |
| 9 | **Integration**<br>9.1 Indefinite Integral<br>9.2 Integration of Simple Functions and Simple Applications<br>9.3 Simple Techniques of Integration<br>9.4 Definite Integral<br>9.5 Evaluation of Definite Integrals<br>9.6 Applications of Definite Integrals | 1. To recognize indefinite integration as a reverse process of differentiation<br>2. To understand the properties of indefinite integrals<br>3. To recognize some of the geometric and physical applications of indefinite integration<br>4. To recognize and use some standard formulae of indefinite integration<br>5. To understand the underlying principle of definite integral as the limit of a sum<br>6. To understand and apply the basic properties of definite integration<br>7. To apply definite integration to find plane areas and volumes of solids of revolution |

Units 3, 4, 6 and 7 have been designed as sequels to the relevant topics contained in the secondary mathematics curriculum. The elementary parts of Units 3, 4, 6 and 7 included in the secondary mathematics curriculum are also listed in this curriculum as sub-units for completeness. They form pre-requisites for more advanced parts of the units concerned.

The other five units, Units 1, 2, 5, 8 and 9, are completely new to the secondary mathematics curriculum. Although the topics in these units are found in the sixth form mathematics curriculum, their treatment in this course is restricted to an elementary level. Teachers should avoid treating the topics in these units at sixth form level.

**Generic Skills, Values and Attitudes**

As we live in a knowledge-based society, the mastering of generic skills[2] and the fostering of positive values and attitudes should also be stressed in the Additional Mathematics Curriculum. Generic skills are fundamental in helping students to learn to acquire knowledge, construct knowledge and apply knowledge to solve new problems, and hence help to realize the spirit of "learning to learn" in the classrooms. A priority focus will be placed on the development of three of these generic skills, namely communication skills, creativity and critical thinking skill (CDC, 2001, p.25), but it doesn't mean that the others are not essential.

The development of positive values and attitudes is also important in the learning of Additional Mathematics. Values are qualities that students should develop as principles underpinning conduct and decision-making, and positive attitudes are needed to perform a task well. These values and attitudes permeate the curriculum in different units. The following illustrate some essential ones:

- Be **open-minded** and **responsible** in doing work and willing to listen to others in the discussion of mathematical problems
- Show **interest** in pursuing more advanced mathematical knowledge
- Show **keenness** to participate in mathematical tasks
- Show **confidence** in applying mathematical knowledge in real-life and other disciplines
- Think **independently** in solving mathematical problems
- Be **persistent** in solving mathematical problems
- **Appreciate** the precise, aesthetic and cultural aspects of mathematics and the role of mathematics in human affairs

[2] The 9 generic skills recommended are collaboration skills, communication skills, creativity, critical thinking skills, information technology skills, numeracy skills, problem-solving skills, self-management skills and study skills.