

Statement of Syllabus Topics

Mathematics Preliminary Course

Basic Arithmetic and Algebra

- 1.1 Review of arithmetical operations on rational numbers and quadratic surds.
- 1.2 Inequalities and absolute values.
- 1.3 Review of manipulation of and substitution in algebraic expressions, factorisation, and operations on simple algebraic fractions.
- 1.4 Linear equations and inequalities. Quadratic equations. Simultaneous equations.

Plane Geometry

- 2.1 Preliminaries on diagrams, notation, symbols and conventions.
- 2.2 Definitions of special plane figures.
- 2.3 Properties of angles at a point and of angles formed by transversals to parallel lines.
Tests for parallel lines.
Angle sums of triangles, quadrilaterals and general polygons.
Exterior angle properties.
Congruence of triangles. Tests for congruence.
Properties of special triangles and quadrilaterals. Tests for special quadrilaterals.
Properties of transversals to parallel lines.
Similarity of triangles. Tests for similarity.
Pythagoras' theorem and its converse.
Area formulae.
- 2.4 Application of above properties to the solution of numerical exercises requiring one or more steps of reasoning.

Real Functions

- 4.1 Dependent and independent variables. Functional notation. Range and domain.
- 4.2 The graph of a function. Simple examples.
- 4.3 Algebraic representation of geometrical relationships.
Locus problems.
- 4.4 Region and inequality. Simple examples.

Trigonometric Ratios

- 5.1 Review of the trigonometric ratios, using the unit circle.
- 5.2 Trigonometric ratios of: $-\theta$, $90^\circ - \theta$, $180^\circ \pm \theta$, $360^\circ \pm \theta$.
- 5.3 The exact ratios.
- 5.4 Bearings and angles of elevation.
- 5.5 Sine and cosine rules for a triangle. Area of a triangle, given two sides and the included angle.

Linear Functions

- 6.1 The linear function $y = mx + b$ and its graph.
- 6.2 The straight line: equation of a line passing through a given point with given slope; equation of a line passing through two given points; the general equation $ax + by + c = 0$; parallel lines; perpendicular lines.
- 6.3 Intersection of lines: intersection of two lines and the solution of two linear equations in two unknowns; the equation of a line passing through the point of intersection of two given lines.
- 6.4 Regions determined by lines: linear inequalities.
- 6.5 Distance between two points and the (perpendicular) distance of a point from a line.
- 6.7 The mid-point of an interval.

Tangent to a Curve and the Derivative of a Function

- 8.1 Informal discussion of continuity.
- 8.2 The notion of the limit of a function and the definition of continuity in terms of this notion. Continuity of $f + g$, $f - g$, fg in terms of continuity of f and g .
- 8.3 Gradient of a secant to the curve $y = f(x)$.
- 8.4 Tangent as the limiting position of a secant. The gradient of the tangent. Equations of tangent and normal at a given point of the curve $y = f(x)$.
- 8.5 Formal definition of the gradient of $y = f(x)$ at the point where $x = c$.
Notations $f'(c)$, $\frac{dy}{dx}$ at $x = c$.
- 8.6 The gradient or derivative as a function.
Notations $f'(x)$, $\frac{dy}{dx}$, $\frac{d}{dx}(f(x))$, y'
- 8.7 Differentiation of x^n for positive integral n .
The tangent to $y = x^n$.
- 8.8 Differentiation of $x^{\frac{1}{2}}$ and x^{-1} from first principles. For the two functions u and v , differentiation of Cu (C constant), $u + v$, $u - v$, uv . The composite function rule.
Differentiation of $\frac{u}{v}$.
- 8.9 Differentiation of: general polynomial, x^n for n rational, and functions of the form $\{f(x)\}^n$ or $f(x)/g(x)$, where $f(x)$, $g(x)$ are polynomials.

The Quadratic Polynomial and the Parabola

- 9.1 The quadratic polynomial $ax^2 + bx + c$. Graph of a quadratic function. Roots of a quadratic equation. Quadratic inequalities.
- 9.2 General theory of quadratic equations, relation between roots and coefficients. The discriminant.
- 9.3 Classification of quadratic expressions; identity of two quadratic expressions.
- 9.4 Equations reducible to quadratics.
- 9.5 The parabola defined as a locus. The equation $x^2 = 4Ay$. Use of change of origin when vertex is not at $(0, 0)$.