**Algebra Syllabus**

**Unit 1:**

* **Complex Numbers:**
  + Polar representation.
  + nth roots of unity and De Moivre’s theorem.
* **Theory of Equations:**
  + Relationship between roots and coefficients.
  + Transformation of equations.
  + Location of roots: Descartes rule of signs, Sturm’s theorem, cubic and biquadratic equations, Cardon’s, Ferrai’s, and Euler’s methods.
* **Inequality:**
  + Inequalities involving AM ≥ GM > HM and Cauchy-Schwartz inequality.

**Unit 2:**

* **Relations and Order:**
  + Equivalence relations, partial order relations, and poset.
* **Properties of Integers:**
  + Well-ordering property, division algorithm, divisibility, Euclidean algorithm.
  + Prime numbers and their properties.
  + Euclid’s theorem, congruence relation, principles of mathematical induction.
  + Statement of the Fundamental Theorem of Arithmetic.

**Unit 3:**

* **Linear Algebra:**
  + Systems of linear equations, row reduction, and echelon forms.
  + Vector equations and the matrix equation Ax = b.
  + Solutions to linear systems and applications, including linear independence.

**Unit 4:**

* **Linear Transformations:**
  + Introduction to linear transformations and the matrix of a linear transformation.
  + Inverse of a matrix and properties of invertible matrices.
* **Subspaces:**
  + Characterization of subspaces in ℝⁿ, dimension of subspaces.
  + Geometric significance and rank of a matrix.
* **Eigenvalues and Eigenvectors:**
  + Characteristic equation, Cayley-Hamilton theorem, and methods for finding the inverse of a matrix.