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 $\mathbb{R}^n$, 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.