CSIR-NET Maths Important Chapters

Unit 1: Analysis and Linear Algebra

Analysis:

- Real number system as a completely ordered field
- Archimedean property, supremum, infimum
- Sequences and series, convergence
- Bolzano Weierstrass theorem
- Heine Borel theorem.
- Continuity & Differentiability

Linear Algebra:

- Algebra of matrices
- Cayley-Hamilton theorem
- Matrix representation of linear transformations
- Diagonal forms, triangular forms, Jordan forms. Quadratic forms, reduction, and classification of quadratic forms

Unit 2: Complex Analysis, Algebra, and Topology

Complex Analysis:

- Algebra of complex numbers
- Polynomials
- Analytic functions
- Cauchy-Riemann equations. Contour integral, Cauchy's theorem
- Cauchy's integral formula, Liouville's theorem,
- Taylor series, Laurent series, calculus of residues.

Algebra:

- Permutations & Combinations,
- Chinese Remainder Theorem
- Euler's Ø- function
- Cayley's theorem
- Sylow theorems.
- Fields, finite fields, field extensions, Galois Theory

Topology:

- Basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

Unit 3: ODEs, PDEs, and Classical Mechanics

Ordinary Differential Equations (ODEs):

- Existence and uniqueness of solutions of initial value problems for first-order ordinary differential equations, singular solutions of first-order ODEs, the system of first-order ODEs.

Partial Differential Equations (PDEs):

- Lagrange and Charpit methods for solving first-order PDEs
- Cauchy problem for first-order PDEs
- Classification of second-order PDEs, General solution of higher-order PDEs with constant coefficients
- Method of separation of variables for Laplace, Heat, and Wave equations

Classical Mechanics:

- Generalized coordinates, Lagrange's equations, Hamilton's canonical equations
- Hamilton's principle and the principle of least action
- The two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

Unit 4: Probability and statistics

Probability:

- Descriptive statistics, exploratory data analysis, Sample space, discrete probability, independent events, Bayes theorem
- Random variables and distribution functions (univariate and multivariate); expectation and moments.
- Independent random variables, marginal and conditional distributions.

Data Reduction Techniques:

- Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation.
- Simple random sampling, stratified sampling, and systematic sampling. Probability is proportional to size sampling.