

Advanced Engineering Mathematics-II

Course Content

Unit 0: Motivation

Why study this course- Relevance and Significance?

Unit I: Numerical Methods and Optimization

Bisection and Newton-Raphson methods, Gauss Elimination and Gauss-Seidel methods, Finite difference operators, Interpolation with equal and unequal intervals, Numerical differentiation, and integration, Numerical solution of ODEs: Picard's method, Euler's method, Runge-Kutta fourth order method.

Introduction to optimization, The Simplex method, Duality, Lagrange multipliers, Convex sets and functions, Elements of Gradient search algorithms: Steepest descent, Newton and Jacobi algorithms, Least Squares method, Application: The Markowitz Model, and Overview of constrained optimization, Hill climbing, Single variable search. Recap of Unit I.

Unit II: Infinite Series and Introduction to Complex Analysis

Sequence and series, Convergence tests: p-series, Comparison, Ratio and root test, Alternating series.

Complex number system, Euler's formula, Functions of a complex variable, Hyperbolic functions, Limit and Continuity, Derivative and Analytic functions, Holomorphic functions, Cauchy-Riemann equations, Harmonic functions, Line integral and independence of path, Cauchy's theorem, Cauchy's integral formula, Zeros and singularities of a function, Power series: Taylor's and Laurent's series. Some applications. Recap of Unit II.

Unit III: Introduction to Special Functions

Introduction to Power series method, Legendre's equation and Legendre polynomials, Bessel's equation and Bessel functions. Application of Bessel functions: CV Raman's model of Indian drums. Recap of Unit III.

Unit IV: Integral Transforms

Laplace Transform and its properties, Shifting Theorems, Laplace Transform of derivatives, integrals, and periodic functions, Heaviside and Dirac Delta Functions. Inverse Laplace transforms, Convolution, Solutions of differential equations using Laplace transforms. Fourier series and applications, Dirichlet's condition, Fourier Transforms, Fourier sine and cosine transforms, Properties of Fourier Transforms, Fast Fourier Transform, Inverse Fourier transforms. Recap of Unit IV.

Unit V: Introduction to PDEs and Applications

Introduction to Partial differential equations (PDE) and real-world applications, Classification of PDEs: Elliptic, Hyperbolic, Parabolic, Solution of homogeneous and non-homogeneous linear PDEs, Method of separation of variables using Fourier series, Solution of Heat conduction or Diffusion equation, Connection between diffusion and randomness, Wave Equation, Laplace Equation, and Poisson Equation. Some applications: Air pollution, Traffic model. Recap of Unit V.