

XE-A

Engineering Mathematics (Compulsory for all XE candidates)

**Section 1: Linear Algebra**

Algebra of real matrices: Determinant, inverse and rank of a matrix; System of linear equations (conditions for unique solution, no solution and infinite number of solutions); Eigen values and eigen vectors of matrices; Properties of eigen values and eigen vectors of symmetric matrices, diagonalization of matrices; Cayley-Hamilton Theorem.

**Section 2: Calculus**

**Functions of Single Variable:** Limit, indeterminate forms and L'Hospital's rule; Continuity and differentiability; Mean value theorems; Maxima and minima; Taylor's theorem; Fundamental theorem and mean value theorem of integral calculus; Evaluation of definite and improper integrals; Applications of definite integrals to evaluate areas and volumes (rotation of a curve about an axis).

**Functions of Two Variables:** Limit, continuity and partial derivatives; Directional derivative; Total derivative; Maxima, minima and saddle points; Method of Lagrange multipliers; Double integrals and their applications.

**Sequences and Series:** Convergence of sequences and series; Tests of convergence of series with non-negative terms (ratio, root and integral tests); Power series; Taylor's series; Fourier Series of functions of period  $2\pi$ .

**Section 3: Vector Calculus**

Gradient, divergence and curl; Line integrals and Green's theorem.

**Section 4: Complex variables**

Complex numbers, Argand plane and polar representation of complex numbers; De Moivre's theorem; Analytic functions; Cauchy-Riemann equations.

**Section 5: Ordinary Differential Equations**

First order equations (linear and nonlinear); Second order linear differential equations with constant coefficients; Cauchy-Euler equation; Second order linear differential equations with variable coefficients; Wronskian; Method of variation of parameters; Eigen value problem for second order equations with constant coefficients; Power series solutions for ordinary points.

**Section 6: Partial Differential Equations**

Classification of second order linear partial differential equations; Method of separation of variables: One-dimensional heat equation and two-dimensional Laplace equation.

**Section 7: Probability and Statistics**

Axioms of probability; Conditional probability; Bayes' Theorem; Mean, variance and standard deviation of random variables; Binomial, Poisson and Normal distributions; Correlation and linear regression.

**Section 8: Numerical Methods**

Solution of systems of linear equations using LU decomposition, Gauss elimination method; Lagrange and Newton's interpolations; Solution of polynomial and transcendental equations by Newton-Raphson method; Numerical integration by trapezoidal rule and Simpson's rule; Numerical solutions of first order differential equations by explicit Euler's method.

