

XE Engineering Sciences

XE0: Engineering Mathematics (Compulsory for all XE candidates)

Section XE0.1: 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); Eigenvalues and eigen vectors of matrices; Properties of eigenvalues and eigen vectors of symmetric matrices, diagonalization of matrices; Cayley-Hamilton Theorem.

Section XE0.2: 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 (Cauchy Condensation Test, Ratio, Root and integral tests); Power series; Taylor's series.

Section XE0.3: Vector Calculus

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

Section XE0.4: Complex variables

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

Section XE0.5: 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 XE0.6: Partial Differential Equations

Classification of second order linear partial differential equations, One dimensional heat and wave equations, two dimensional Laplace equation, Method of separation of variables, Fourier series method.

Section XE0.7: Probability and Statistics

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

Section XE0.8:	Numerical Methods
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Solution of systems of linear equations using LU decomposition, Gauss elimination method; Lagrange and Newton's interpolations; Solution of polynomial and transcendental equations by Bisection method and Newton-Raphson method; Numerical integration by trapezoidal rule and Simpson's $1/3^{\text{rd}}$ and $3/8^{\text{th}}$ rules; Numerical solutions of first order differential equations by Euler's method.