XE-A (Compulsory for all XE candidates)	Engineering Mathematics

Section 1: Linear Algebra

Algebra of matrices; Inverse and rank of a matrix; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalisation of matrices; Cayley-Hamilton Theorem.

Section 2: Calculus

Functions of single variable: Limit, continuity and differentiability; Mean value theorems; Indeterminate forms and L'Hospital's rule; Maxima and minima; Taylor's theorem; Fundamental theorem and mean value-theorems of integral calculus; Evaluation of definite and improper integrals; Applications of definite integrals to evaluate areas and volumes.

Functions of two variables: Limit, continuity and partial derivatives; Directional derivative; Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Double and triple integrals, and their applications.

Sequence and series: Convergence of sequence and series; Tests for convergence; Power series; Taylor's series; Fourier Series; Half range sine and cosine series.

Section 3: Vector Calculus

Gradient, divergence and curl; Line and surface integrals; Green's theorem, Stokes theorem and Gauss divergence theorem (without proofs).

Section 3: Complex variables

Analytic functions; Cauchy-Riemann equations; Line integral, Cauchy's integral theorem and integral formula (without proof); Taylor's series and Laurent series; Residue theorem (without proof) and its applications.

Section 4: Ordinary Differential Equations

First order equations (linear and nonlinear); Higher order linear differential equations with constant coefficients; Second order linear differential equations with variable coefficients; Method of variation of parameters; Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Section 5: Partial Differential Equations

Classification of second order linear partial differential equations; Method of separation of variables; Laplace equation; Solutions of one dimensional heat and wave equations.

Section 6: Probability and Statistics

Axioms of probability; Conditional probability; Bayes' Theorem; Discrete and continuous random variables: Binomial, Poisson and normal distributions; Correlation and linear regression.

Section 7: Numerical Methods

Solution of systems of linear equations using LU decomposition, Gauss elimination and Gauss-Seidel methods; Lagrange and Newton's interpolations, Solution of polynomial and transcendental equations by Newton-Raphson method; Numerical integration by trapezoidal rule, Simpson's rule and Gaussian quadrature rule; Numerical solutions of first order differential equations by Euler's method and 4th order Runge-Kutta method.

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