Candidates will be required to answer at least one question from each of the three Sections.

Section ‘A’, ‘B’, and ‘C’.

SECTION A

Linear Algebra:
Vector space, Linear dependance and independence, Sub-spaces, Bases, Dimension, Finite Dimensional vector spaces.

Matrices, Cayley-Hamilton theorem, Eigenvalues and Eigenvectors, Matrix of linear transformation, Row and column reduction, Echelon from Equivalence, Congruence and Similarity, Reduction to Canonical from Rank, Orthogonal, Symmetrical, Skew Symmetrical, Unitary, Hermitian Skew-Hermitian forms- their eigenvalues. Orthogonal and Unitary reduction of quadratic and Hermitian forms, positive definite quadratic form, Simultaneous reduction, Sylvester’s law of inertia.

Calculus:
Real numbers, Limits, Continuity Differentiability, Mean-value Theorems, Taylor’s theorem with remainders, Indeterminate forms, Maxima an Minima, Asymptotes, Functions of several variables, Continuity. Differentiability, partial derivatives, Maxima and Minima, Lagrange’s method of Multipliers, Jacobian, Riemann’s definition of Definite integrals; Indefinite integrals, infinite and improper integral, Double and triple integrals (Techniques only). Repeated integral, Beta and Gamma Functions. Areas, Surface and Volumes, Centre of Gravity.

SECTION B

Geometry:
Cartesian and polar coordinates in two and three dimension; Second degree equations two and three dimensions, reduction to Canonical forms; Straight lines, plane Sphere, Cone Cylinder, Paraboloid, Ellipsoid, Hyperboloid of one and two sheets and their properties. Shortest distance between two skew lines; Curves in space, Curvature and torsion Serret-Frenet’s formulae.

Ordinary Differential Equations:

Second orderlinear equations with variable coefficients. Determination of complete solution when one solution when one solution is known. Method of variation of Parameters.

Vector Analysis:
Scalar and vector fields, triple products, Differentiation of vector function of a scalar variable, Gradient, Divergence and Curl in Cartesian, Cylindrical and Spherical coordinates and their physical interpretation. Higher order derivatives. Vector Identities and vector Equation Application to Geometry, Gauss and Stroke’s Theorems, Green’s identities.

Tensor Analysis:

Statics:
Equilibrium of a system of particles, work and potential energy, Friction, Common Catenary, Principle of Virtual work, Stability of Equilibrium, Equilibrium of forces in three Dimensions.
Dynamics:
Degree of freedom and constraints, Rectilinear motion, Simple Harmonic motion, Motion in a plane, Projectiles, Constrained Motion, Work and energy, Conservation of energy, Motion under Impulsive forces, Kepler’s laws, Orbits under central forces, Motion of varying mass, Motion under resistance.

Hydrostatics:
Pressure of heavy fluids, Equilibrium of fluids under given system of forces, Centre of Pressure, Thrust on curved surfaces, Equilibrium of floating bodies, Stability of Equilibrium, Metacentre, Pressure of gases, problems relating to atmosphere.

Special Theory of Relativity:

PAPER-II
Candidates will be required to answer at least one question from each of the three Sections-Section ‘A’, ‘B’ and ‘C’.

SECTION-I

Algebra:
Group, Subgroup, Normal subgroups, Homomorphism of groups, Quotient Groups, Basic Isomorphism Theorems, Sylow’s Group, Permutation Groups, Cayley-Hamilton Theorem, Rings and Ideals, Principles Ideal Domains, Unique Factorization Domains and Euclidean Domains, Field Extensions, Finite Fields.

Real Analysis:
Real number system, Ordered sets, Bounds, Ordered field, Real Number system as an Ordered Field with least Upper Bound, Cauchy Sequence, Completeness, Completion, Continuous Functions, Uniform Continuity, Properties of continuous functions on compact sets, Riemann Integral, Improper integrals, Differentiation of functions of several variables, change in the order of Partial derivatives, Implicit function theorem, Maxima and Minima, Absolute and Conditional Convergence of series of real and complex terms. Rearrangement of series Uniform convergence, Infinite products, Continuity, differentiability and integrability for series, multiple integrals.

Complex Analysis:
Analysis function, Cauchy-Riemann Equations, Cauchy's Theorem, Cauchy's integral formula, power series, Taylor’s series, Laurent’s series singularities, Cauchy’s Residue Theorem Contour integration. Conformal mapping, Bilinear Transformations.

SECTION-B

Partial differential equation:
Curves and surfaces in the three dimensions; Formations of partial Differential Equations; Solutions of Equation of type dx/p=dy/Q=dz/R; Orthogonal Trajectories, Pfaffian Differential Equations; Partial Differential Equations of the first order; Solution by Cauchy’s method of Characteristics; Charpit’s method of solution; Linear partial Differential Equations of the second order with constant coefficients; Equations of vibrating string; Heat equation; Laplace equation.

Mechanics:
Generalised Coordinates, Constraints, Holonomic and Non-Holonomic, systems, D’Alembert’s Principles and Lagrange’s equations, Hamilton equations, Moment of Inertia Motion of rigid bodies in two dimension.
Hydrodynamics:

Equation of continuity, Euler’s equation of motion for Inviscid Flow, Stream -lines, Path of a particle, potential flow , two dimensional and axisymmetric motion, sources and Sink Vortex motion flow past a Cylinder and a Sphere, Method of Images, Naiver Strokes Equation for a viscous, fluid and its limitations.

Numerical Analysis and Computer Programming

Numerical methods: Solution of algebraic and transcendental equations of one variable by bisection, Regula-falsi and Newton Raphson methods, Solution of system of linear equations by Gaussian elimination and Gauss-Jordan (direct) methods. Gauss Seidel (Iterative) method.

Interpolation: Newton’s (Forward and backward) and Lagrange’s method.

Numerical integration: Simpson’s one third rule Trapezoidal rule, Gaussian quadrature formula.


Computer Programming: Storage of number in Computer: Bits, Bytes and Words, Binary System, Arithmetic and logic operations on numbers, Bitwise operations, AND, OR, XOP, NOT and shift/rotate operators Octal and Hexadecimal Systems. Conversion to and from decimal Systems.

Representation of unsigned Integers, Signed Integers and Reals. Double Precision reals and Long integers.

Algorithms and Flow charts for solving numerical analysis problems.

Developing Simple programs in BASIC for problems involving techniques covered in the numerical analysis.

SECTION-C

Probability and Statistics:


Statistics:


Operations research:

Linear programming problems, Basic, Basic Feasible and Optimal solution, Graphical method and Simplex method of Solution, Duality.

Transportation and assignment problems, Traveling salesman problems.

Game Theory:

Rectangular games, pure strategy and mixed strategy. Saddle point value of the game and optimal strategy, principles of dominance, Algebraic, method relations between, game and LPP.