राष्ट्रीय प्रौद्योगिकी संस्थान, कुरूक्षेत्र

NATIONAL INSTITUTE OF TECHNOLOGY

(Under the Ministry of Education, Govt. of India)

KURUKSHETRA-136119

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SYLLABUS FOR SCREENING TEST

Name of the Post: Assistant Professor Grade – II (Level – 10)
Name of the Department: Mathematics

Calculus: Functions of two or more variables, continuity, directional derivatives, partial derivatives, total derivative, maxima and minima, saddle point, method of Lagrange's multipliers; Double and Triple integrals and their applications to area, volume, and surface area; Vector Calculus: gradient, divergence and curl, Line integrals and Surface integrals, Green's theorem, Stokes' theorem, and Gauss divergence theorem.

Linear Algebra: Finite dimensional vector spaces, Linear transformations and their matrix representations, rank, systems of linear equations, eigen values and eigen vectors, minimal polynomial, Cayley-Hamilton Theorem. diagonalization, Hermitian. Skew-Hermitian and Unitary matrices. Linear Functional, Hyperspaces, Jordan canonical form; bilinear and quadratic forms. Finite dimensional inner product spaces.

Complex Analysis: Functions of a complex variable: continuity, differentiability, analytic functions, harmonic functions; complex integration. Cauchy's integral theorem and formula, Liouville's theorem; maximum modulus principle, Taylor and Laurent's series, residue theorem and applications for evaluating real integrals, transcendental functions like trigonometric, exponential, and Hyperbolic; Rouche's theorem, Argument principle, Schwarz lemma; Conformal mappings, Mobius transformations.

Real Analysis: Sequences and series of functions. Uniform convergence. power series. Fourier series. Functions of several variables, maxima, minima. Rieman' integrations. Multiple integrals. Line, surface, and volume integrals, Green's, Stokes, and Gauss theorem, metric spaces, completeness, and Weirstrass approximation theorem. Compactness, Lebesgue measure. Measurable functions, Lebesgue integral, and Fatou's lemma dominated convergence theorem. Limit, Continuity, Derivative, Partial Derivative.

Ordinary Differential Equations: First-order ordinary differential equations, existences and uniqueness theorems, system of linear first-order ordinary differential equations, linear ordinary differential equations of higher order with constant coefficients. Linear second-order ordinary differential equations with variable coefficients. The method of Laplace transforms for solving ordinary differential equations and series solutions, Legendre polynomial and Bessel functions with their properties.

Algebra: Normal subgroups and homomorphism theorems, automorphisms, Group actions. Sylow's theorems and their applications, Euclidean domains, Principle ideal domains and unique factorization domains, Prime ideals, and maximal ideals in commutative rings. Fields, finite fields.

Topology: Basic concepts of topology, bases, subbases, subspace topology, order topology, product topology, quotient topology, metric topology, connectedness, compactness, countability and separation axioms, Urysohn’s Lemma.

Functional Analysis: Banach spaces, Hahn-Banach extension theorem, open mapping and closed graph theorems, principle of uniform boundedness, Hilbert spaces, orthonormal bases. Riesz representation theorem, bounded linear operators.

Numerical Analysis: Numerical solutions of algebraic and transcendental equations: bisection. Secant method. Newton-Raphson method, fixed point iteration, interpolation, error of polynomial interpolations. Lagrange. Newton interpolations, numerical differentiation. Numerical integration. Trapezoidal and Simpson rules. Gauss Legendre quadrature, method of undetermined parameters, least square polynomial approximation, numerical solutions of systems of linear equations, direct methods (Gauss eliminations. LU decomposition), iterative methods (Jacobi and Gauss-Seidel), matrix eigenvalue problems, power method, numerical solution of ordinary differential equations, initial value problems. Taylor series methods. Euler's method. Runge-Kutta methods.

Partial Differential Equations: Linear and quasilinear first-order partial differential equations. Method of characteristics, second-order linear equations in two variables and their classifications, Cauchy, Dirichlet, and Neumann problems, solutions of Laplace. Wave and diffusion equations in two variables. Fourier transform, Laplace transform.

Mechanics: Generalized coordinates. Lagrange's equations, Hamiltonian canonical equations. Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, Theory of small oscillations, Virtual work, and moment of inertia.

Probability and Statistics: Probability space. Conditional probability, Baye's theorem, independence, Random variables, joint and conditional distributions. Standard probability distributions and their properties, expectation, and conditional expectation. Moments. Weak and Strong law of large numbers. Central limit theorem. Sampling distributions. Testing of hypotheses, standard parametric tests based on normal. Chi-square, t. F-distributions. Linear regression, interval estimation.

Linear programming: Linear programming problem and its formulation, convex sets, and their properties. graphical method. Basic feasible solution, simplex method. Big-M and two-phase methods, infeasible and Unbounded Linear Programming Models, and alternate optima. Dual problem and duality theorems. dual simplex method and its application in post-optimality analysis, Balanced and unbalanced transportation problems. different methods for solving transportation problems. assignment problems. Sensitivity Analysis.