

PH. D. ENTRANCE

MATHEMATICS

Unit 1: Algebra

Finite dimensional vector space; linear transformations and their matrix representations, rank; system of linear equations, eigen values and eigen vectors, minimal polynomial, Cayley-Hamilton Theorem, diagonalisation, Hermitian, Skew-Hermitian and unitary matrices.

Subgroups, rings and fields.

Books:

- (i). I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1975.
- (ii). P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press; Indian Edition, 1997.
- (iii). Gilbert Strang, Linear Algebra and its applications, Thomson's books, 2006.

Unit 2: Mathematical Analysis

Analytic functions, conformal mappings, bilinear transformations; complex integration, Cauchy's integral theorem and formula, Liouville's theorem, Taylor and Laurent's series, residue theorem.

Sequences and series of functions, uniform convergence, power series, functions of several variables, maxima, minima, multiple integrals, line, surface and volume integrals, theorems of Green, Stokes and Gauss.

Banach spaces, principle of uniform boundedness, Hilbert spaces, orthonormal bases, bounded linear operator.

Books:

- (i). Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar, Inc. New York, 1975.
- (ii). A.J. White, Real Analysis; an introduction. Addison-Wesley Publishing Co., Inc., 1968.
- (iii). Churchill, R.V. and Brown, J.W., Complex Variables and Applications McGraw Hill Publishing Company, 1990.
- (iv). E. Kreyszig: Introductory Functional Analysis with Applications, John Wiley and Sons, New York, 1978.

Unit 3: Differential Equation

First order ordinary differential equations, existence and uniqueness theorems, system of linear first order ordinary differential equations, linearly differential equations of higher order with constant coefficients, linear second order differential equations with variable coefficients, methods of Laplace transforms for solving ordinary differential equations.

Linear and quasilinear first order partial differential equations, method of characteristic, second order linear equations in two variables and their classification, solutions of Laplace, wave and diffusion equations in two variables.

Books:

- (i) G.F. Simmons, Differential Equations, Tata McGraw-Hill , 1993.
- (ii) Zafar Ahsan, Differential Equations and their applications, PHI Learning Private Ltd, 2010.
- (iii) I.N. Snedden, F. John, P. Prasad etc. Partial Differential Equations, Graduate studies.

Unit 4: Numerical Methods

Numerical solution of algebraic and transcendental equations, bisection, secant method, Newton-Raphson method, fixed point iteration, interpolation, error of polynomial interpolation, Lagrange Newton interpolations, numerical differentiation, numerical integration, Trapezoidal and Simpson's rules, Gauss-Legendre quadrature, method of undetermined parameters, least square polynomial approximation, numerical solution of system of linear equations: direct methods(Gauss elimination, approximation, L U decomposition), iterative methods(Jacobi and Gauss-Siedel), matrix- eigen value problems, powermethod, numerical solution of ordinary differential equations, initial value problems, Taylor series methods, Euler's method, Runge-Kutta methods.

Books:

- (i). Introductory Method of Numerical Analysis : Sastry, PHI
- (ii). Numerical Method : Balaguruswamy, TMH
- (iii). Numerical Methods for Scientific & Engineering Computations: Jain, Iyengar, Jain, New Age International.

Unit 5: Differential Geometry and fluid Mechanics

Basic concept of tensor algebra; Christoffel symbols and covariant differentiation, space curves, Tangent normal, binomial, curvature and torsion of space curves, serret-frenet formulae; surface, curvilinear equations of curve on the surface, Tangent and normal, family of surfaces.

Viscous and non viscous fluid, equation of motion, equations of continuity, conservation of energy, Reynold number, Richardson's number, parallel flows, shear flows.

Books:

- (i) Gupta, Pandey, Malik, Tensors and Differential Geometry, Pragati Prakashan.
- (ii) Louis N. Hand and Janet D. Finch, Analytical Mechanics, Cambridge University Press, 1998.
- (iii) Luther Pfahler Eisehart, An Introduction to Differential Geometry, Maugham Press, 2008.