Semester – III
Paper – VI (A) Functional Analysis - I

Unit – I
Normed linear spaces. Banach spaces and examples, quotient spaces of a normal linear space and its completeness, equivalent norms. (15 lectures)

Unit – II
Bounded linear transformations, Normed linear spaces of bounded linear transformations, Halm-Banach theorem. Conjugate spaces with examples, natural embedding of a normed linear space in its second dual, reflexive spaces (15 lectures)

Unit – III
Open mapping theorem, closed graph theorem, uniform boundedness theorem and its consequences. Inner product spaces, examples. (15 lectures)

Unit – IV
Hilbert spaces and its properties. Orthogonal complements, orthonormal sets, Bessel's inequality, complete orthonormal sets and parseval's identity, conjugate space of a Hilbert space, reflexivity of a Hilbert space. (15 lectures)

Unit – V
Self adjoint operators, positive, projection, normal and unitary operators and their properties Eigen values and eigen space of an operator on a Hilbert space, spectrum of an operator on a finite dimensional Hilbert space Finite dimensional spectral theorem. (15 lectures)

Text Book:

1. G. F. Simmons :Introduction to topology and Modern Analysis, McGraw Hill (1963) Chapter 9,10,11 (excluding section 63)

Reference Books:

1) Johan Horvath, Topological Vector spaces and Distributions, Addison-Wesley Publishing Company, 1966.
2) J.L. Kelley and Isaac Namioka, Linear Topological Spaces, D. Van Nostrand Company, Inc, 1963.

Semester – III
Paper – VII (A) Partial Differential Equations

Unit – I
Examples of Partial Differential Equations Classification of second order Partial Differential Equations. Transport equation – Initial value problem Non-homogeneous equations.
Laplace's equation- Fundamental solution, Poisson's equation, Mean value formulas, Properties of Harmonic functions, (15 lectures)

Unit – II
Laplace,s Equation,Strong maximum principle, Strong minimum principle, uniqueness, Regularity, Local estimates for harmonic functions Green's function, Derivation of Green's function, Green's function for half space, Green's function for a ball, Energy methods, uniqueness. (15 lectures)

Unit – III
Heat Equation-fundamental solution, Initial value problem, Non-homogenous problem,
Mean value formula, Properties of solutions, Strong maximum principle, uniqueness, Energy methods, uniqueness, Backwards uniqueness, Wave Equation – solution by spherical means, (15 lectures)
Unit – IV
Non-homogeneous equations, Energy methods. Nonlinear first Order PDE-Complete Integrals, envelopes, new solutions from envelopes characteristics, Representation of solutions-separation of variables, Similarity Solutions, Plane and Traveling waves, solutions, similarity under scaling, (15 lectures)

Unit – V
Transformation Methods Fourier and Lap lace Transform, Applications Converting Nonlinear into linear Partial Differential Equation cole-Hopf transformation, A parabolic Partial Differential Equation with quadratic no linearity Burger's equation with viscosity, Hodograph and Legendro Transforms, Potential function. (15 lectures)

Text Books:

1. Lawrence C. Evans: Partial Differential Equations, Graduate studies in Mathematics Vol. 19 AMS, 1998.
2. Ion N. Sneddon: Elements of Partial Differential Equations McGraw Hill, 1957.

Reference Books:

1) F. John: Partial differential Equation, Springer Verlag, (4^{th} edition), 1995
2) P. Prasad & R. Ravindran: Partial differential Equations,

Semester – III
Paper – VIII – (A) Programming in C (with ANSI Features) Theory and Practical - I

Unit – I Introduction:
Introduction to computers, Characteristics of Computers, Application area's of computer, Classification of computers, Overview of programming, types of programming languages (classification), Introduction to c, Features of C, Program structure, characteristics of programs, concept of header file.
(15 lectures)

Unit – II C Fundamental
Preprocessor, Character Set, Identifiers, reserved words, constants and variables, Data types, type modifiers, types of statements, Declaration and Initialization, comments, (15 lectures)

Unit – III I/O operation
Types of I/O statements: formatted and Unformatted, getchar(), putchar(), printf() scanf(), escape sequences and format specifiers(%d, %f, %c,….)
(15 lectures)

Unit- IV Operator and expressions
Types of operators (unary binary and ternary) Classification of operators: assignment, arithmetic, relational, logical, comma operator, sizeof operator, operator, Hierarchy and associatively Type conversion (explicit and implicit), library functions. (15 lectures)

Unit- V Control statements:
Conditional statements, (if, if else, switch case), Looping Statement (for, while, do while), Nested Loops Infinite Looping, break and continue. (15 lectures)

Text Books:

1) Balaguruswamy: Programming in ANSI C
2) Yeshwant Kanetkar: Let US C.

Reference Books:

1) Gottlried: Programming in C Schism's Series
2) Brian W. Kernighan, Dennis Ritchie, and Dennis M. Ritchie: The C. Programming Language (2^{nd} edition)
3) Peter Darnell & P. E. Marglis: C- Asogtware Engineering approach, Narosa Publication New Delhi 1993.

Semester – III
Paper – IX (A) Fluid Mechanics - I

Unit – I
Review of vector Analysis, Kinematics: Lagrangian and Eulerian methods (Rathy) Real and ideal fluids, velocity at a point, streamlines, path lines, streak lines, velocity potential, irrotational and rotational motions (Rathy), vorticity and circulation, Local and particle rates of change, The equation of continuity.
(15 Lectures)

Unit – II
Acceleration of a Fluid. Conditions at rigid boundary, General analysis of fluid motion. Pressure at a point in a fluid at rest and moving fluid, conditions at a boundary of two inviscid immiscible fluids, Euler's equation of motion, Bernoulli's equation. (15 Lectures)

Unit – III
Steady motion under conservative body forces, Potential Theorems, Axial symmetric flows, some two dimensional flows, Impulsive motion, some aspects of vortex motion, sources, sinks, doublets and their images. (15 Lectures)

Unit – IV
Some two dimensional flows: Meaning of two dimensional flow, use of cylindrical polar coordinates, The stream function, The complex potential for two dimensional irrotational, incompressible flow, complex velocity potentials for standard two dimensional flows. (15 Lectures)

Unit – V
Examples, two dimensional image systems, Milne-Thomson circle theorem, applications and extension of circle theorem, the theorem of Blasius, conformal Transformation. (15 Lectures)

Text Books:

1. R. K. Rathy, An Introduction to Fluid Dynamics, IBH, New Delhi, 1976
   Chapter – III: Article 3.1,3.5,3.6
2. F. Chorlton, Text Book of Fluid Dynamics, C.B.S. Publishers and distributors, Delhi, 1985.
   Chapter – 2: Article 2.1 to 2.10, Chapter – 3 Article 3.1 to 3.12
   Chapter – 4: Article 4.1 to 4.3, Chapter – 5: Article 5.1 to 5.10

Reference Books:

1. S. W. Yuan Foundations of Fluid Mechanics, Prentic Hall of India Pvt. Ltd, New Deli, 1976.
2. W. H. Besaint and A. S. Ramsey, A Treatise on Hydromechanics, Part- II CBS Publishers, Delhi, 1988.
3. J. Chorin and A. Marsden, A Mathematical Introduction to Fluid Dynamics, Springer-verlag, New York, 1993.

Semester – III
Paper – X (A) Integral Equations

Unit – I
Definitions of integral equations regularity conditions Special kinds of kernels. Eigen values and Eigen functions. Convolution integral. The inner of scalar product of two functions. Reduction to a system of algebraic equations. Examples. An approximate method (15 lectures)

Unit – II
Iterative scheme for Fredholm integral equations of second kind. Examples. Iterative scheme for holterra integral equations of second kind Examples. Some results about the Resolvent kernel. Classical Fredholm theory. Fredholm Theorems (without proofs) (15 lectures)

Unit – III
Symmetric kernels. Complex Hilbert space Orthonormal system of functions. Fundamental Properties of eigen values and eaten functions for symmetric kernels. Expansion in eigen function and bilinear form. Hilbert Schmidt theorem and some immediate consequences. Solution of a symmetric integral equation, examples. (15 lectures)

Unit IV.
The Abel integral Equatins Examples. Inversion formula for singular integral equation with kernel of the type $[h(s)-h(t)\ ],0\angle\infty\angle)$, Cauchy's principal value for integrals. Solution of the couchy type singular integral equation. Examples. The Hilbert kernel. (15 lectures)

Unit- V
Solution of the Hilbert type singular integral equation. Examples. Integral transforms method. Fourier transform, Laplace transform Applications to volterra integral equations with convolution type kernels Examples. (15 lectures)

Text Book:
1. R. P. Kanwal, Linear Integral Equations theory and Technique. Academic press, New York, 1971

Articles: 1.1- 1.6, 2.1-2.2, 2.5,3.1-3.5, 4.1-4.5, 7.1-7.6, 8.1-8.8, 9.1-9,5.

Reference books:
1. S. G. Mikhlin, Linear Integral equations. (Translated from Russian), Hindustan Book Agency 1960.
2. B. L. Moiseiwitsch, Integral Equations, Longman, London and New York.
3. M. Krasnov, A. Kiselev, G. Makaregko, Problems and Exercises in integral equations (Translated from the Russian by George Yankovsky) MIR publishers, Moscow 1971.

Semester – III
Paper- XI (A) Numerical Analysis - I

Unit – I
Solution of algebraic and transcendental equations: Introduction; Bisection method; Iteration methods; first degree equations iteration methods Newton Raphson method; Secant and Regular falsi methods, Rate of convergence for secant method and Newton Raphson method; General iteration methods.
(15 lectures)

Unit – II
System of Linear Algebraic equations: Introduction; Linear system of Equations: Direct methods; Gauss Elimination method; Iteration methods; Jacobi iteration method; Gauss seidal iteration method; successive over Relaxation (SOR) method. (15 lectures)

Unit – III
Interpolation and approximation: Introduction; Interpolation; Langrange and Newton Interpolation Finite difference operators; Interpolating polynomial using finite difference; Hermite interpolation; piecewise and spleen interpolation.
(15 lectures)

Unit – IV
Numerical differentiation and integration: Introduction; Numerical differentiation and integration based on interpolation; Gauss Lagendre interpolation method; Gauss Hermite integration method, Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule. (15 lectures)

Unit – V
Numerical solution of ordinary differential equations: introduction; solutin by Taylor series, picards method of successive approximations, Euler method, Modified Euller method, Range – kutta methods. (15 lectures)

Prescribed Book:

1. Jain, Iyenger and Jain: Numerical methods for scientific and engineering computation. (4^{th} edition) New Age Pub. New Delhi.

Reference Books:

1. S. S. Sastry: Introductiry methods of Numerical Analysis (4^{TH} edition) Prentice Hall)
2. J. I. buchaman and P. R. Turner: Numerical method & Analysis (PHI)

Semester – III
Paper – XII (A) Lattice Theory - I

Unit – I
Partially ordered sets, two definitions of Lattices, lattice as a poset, lattice as algebra, Hasse diagrams, planer and optimal Diagrams, meet and join tables, Homomorphism. (15 lectures)

Unit – II
Isotone maps, sub lattices, ideals and their characterizations congruence relations, congruence lattices, the homomorphism theorem, product lattices, ideal Lattice, complete lattice and their properties. (15 lectures)

Unit –III
Distributive and modular inequalities and identities, complements and pseudo complements Demorgan's identities, Boolean lattice of pseudo complements, meet and join-irreducible elements, characterization theorems and representation theorems Dedikinds modularity criterion, Birkhoff's distributivity criterion (proofs without using free lattices) (15 lectures)

Unit – IV
Hereditary subsets, ring of sets, Stone theorems, Nachbin theorem Distributive join-semi lattices and characterization, Distributive lattices with pseudocomplementation. (15 lectures)

Unit – V
Join infinite distributive identify, algebraic lattices stone algebra and its characterizations. Distributive standard and neutral elements. (15 lectures)

Text Book:

George Gratzer, General lattice Theory Birkhauser (1998)

Chapter - 1: (section 1,2,3, Section 4 from lemma I onwards)
Chapter - 2: (sections 1,5 (lemmas 1 & 2), 6 (up to lemma 3)
Chapter - 3: (section 2 (up to theorems 5)

Reference Books:
1. G. Birkhoff : Lattice theory. Amer. Math. Soc. 3rd Edition (1973)
2. P. Crawley and R. P. Dilworth: Theory of algebraic lattice, Prentice Hall (1973)

Semester III
PAPER XIII (A): ADVANCED FUNCTIONAL ANALYSIS – I

Definition and examples of topological Vector Spaces. Convex, balanced and absorbing sets and their properties. Minkowski's functional, subspace, product space and quotient space of a topological Vector space.

Locally conves topological Vector spaces. Normable and metrizable topological vector spaces. Complete; topological vector spaces and Fechet space.

Linear transformations and linear functionals and their continuity. Finite-dimensional topological vector spaces.

Reference Books:

1) Johan Horvath, Topological Vector spaces and Distributions, Addison-Wesley Publishing Company, 1966.
2) J.L. Kelley and Isaac Namioka, Linear Topological Spaces, D. Van Nostrand Company, Inc, 1963.

Semester III
PAPER XIV (A): ADVANCED THEORY OF PARTIAL DIFFERENTIAL EQUATION - I

Distribution- Test Functions and Distributions, Examples, Operations on Distributions, Supports and Singular Supports, Convolution, Fundamental Solutions, Fourier Transform, Schwartz Space, Tempered Distributions.

Sobolev Spaces-Basic Properties, Approximation by Smooth Functions, Extension Theorems, Compactness Theorems, Dual Spaces, fractional Order Spaces, Trace Spaces, Trace Theory. Inclusion Theorem.

Weak solutions of Elliptic Boundary Value Problems-Variational Problems, Weak Formulation of Elliptic PDE, Regularity, Galerkin Method, Maximum Principles, Eigenvalue Problems, Introduction to the Finite Element Method.

Evolution Equations – Unbounded Linear Operators, C – Semigroups, Hille-Yosida Theorem, Contraction Semigroups on Hilbert Spaces, Heat Equation, Wave Equation, Schrodinger Equation, Inhomogeneous Equations.

Reference Books:

1. S. Kesavan, Topics in Functional Analysis and Applications, Wiley-Eastern, New Age International, 1989.
2. L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Volume 19, AMS, 1998.

Semester III
PAPER XV (A): THEORY OF ORDINARY DIFFERENTIAL EQUATIONS - I

Existence theorems for differential equations-Introdiction. Auziliary results. Existence theorems of Cauchy-Peano type. Extreme solutions of real Scallar Differential Equations. Uniqueness theorem. Existence theorems by the method of iterations. Applications of the contraction mapping theorem to existence theorems. Differential equations of higher order. Linear vector differential equations. Differentiability of solutions of real differential systems.

Linear differential systems-Introduction. Adjoint vector differential equations. Adjoint n-th order differential equations. Homogenceous differential systems involving two-point boundary conditions. Nonhomogeneous differential systems involving two-point boundary conditions. Adjoint differential systems. Green's matrix. Differential systems involving a single n-th order linear differential equations.

Differential systems involving an n-th order linear vector differential equation.

Recommended Text.

W.T. Reid, Ordinary Differential Equations. John Willey & Sons, NY (1964)

Reference Books:

1. Philip Hartman, Ordinary Differential Equatins, Wiley & Sons, N. Y. 1964.
2. E. A. Coddington and N. Levinsion. Theory of Ordinary Differential Equations, McGraw-Hill, N. Y. 1955.

Semester – III
Paper – XVI (A) Difference Equations - I

Unit – I
Introduction, Difference Calculus-The Difference Operator summation, Generating functions and approximate summation, (15 Lectures)

Unit- II
Linear difference Equations- first order equations, General results for linear equations. Equations with constant coefficients (15 Lectures)

Unit- III
Application, Equations with variable coefficients nonlinear equations, which can be linearized, The Z transform (15 Lectures)

Unit- IV
Stability Theory- Initial value problems for linear systems. Stability of linear systems Stability of nonlinear systems chaotic behaviors (15 Lectures)

Unit- V
Asymptotic Methods-Introduction Asymptotic analysis of sums. Linear equations nonlinear equations. (15 Lectures)

Text Book:

1. Walter G. Kelley and Allan C. Peterson: difference Equations – An Introduction with applications. Academic Press, Harcourt Brace Jouranovich Pub. 1991.

Reference book:

1. Calvin Ahlbrandt and Allan C. Peterson: Discrete Hamiltonian systems Difference equations, continued fractions and riccati Equations, Kulwer, Boston 1996.

Semester – III
Paper - XVII (A) Computational Fluid Dynamics - I

Unit- I

Prerequisites-Numerical Analysis. Computer Programming. Partial Differential Equations. Basic equations of Fluid Dynamics. (15 Lectures)

Unit – II
Analytic Aspects of PDE.Finite Volume and Finite Difference Methods on No uniform Grids. (15 Lectures)

Unit - III
Stationary Convection- Diffusion Equation (Finite Volume Discretization, Schemes of Positive Type, Upwind Discretization) (15 Lectures)

Unit – IV
No stationary Convection-Diffusion Equation: Stability. Discrete Maximum principle. (15 Lectures)

Unit - V
Incompressible Navier-Stokes (NS) Equations-Boundary Conditions. Spatial and Temporal Discretization on Collocated and on Staggered Grids. (15 Lectures)

Text Book:

P. Wesseling, Principles of Computational Fluid Dynamics, Springer-Verlag, 2000.

Reference Books:

1. J. E. Wendt, J. D. Anderson, G Degrez and E. Dick, Computational Fluid Dynamics: An Introduction, Springer-Verlag, 1996.
2. J. D. Anderson, Computational Fluid Dynamics : The Basics with Applications, McGraw-Hill, 1995.

Semester III
PAPER XVIII (A): ALGEBRAIC CODING THEORY -I

The Communication channel. The coding Problem, Types of Codes. Block Codes. Error-Detecting and Error-Correcting Codes. Linear Codes. The Hamming Metric. Description of Linear Block Codes by matrices. Dual Codes. Standard Array. Syndrome. Step-by-Step Decoding Modular representation. Error-Correction Capabilities of Linear Codes. Bounds on Minimum Distance for Block Codes. Plotkin Bound. Hamming Sphere packing bound. Varshamov-Gilbert-Sacks Bound Bounds for burst-Error Detecting and Correcting Codes. Important Linear Block Codes. Hamming Codes. Golay Codes. Perfect Codes. Quasi-perfect Codes. Reed-Muller Codes. Codes derived from Hadmard Matrices. Product codes. Concatenated Codes.

Reference Books:

1. Raymond Hill, A first Course in Coding Theory, Oxford, 1986.
2. Man Young Rhee, Error Correcting Coding Theory, McGraw Hill, 1989.
3. W.W. Peterson and E.J. Weldon, Jr. Error-Correcting Codes. Combridge Massachusetts. 1972.
4. E. R. Berlekamp, algebraic Coding Theory, McGraw Hill Inc., 1968.
5. F. J. Macwilliams and N.J.A. Sloane, Theory of Error Correcting Codes, North-Holand Publishing Company, 1977.

Semester III

PAPER XIX (A): ALGEBRAIC TOPOLOGY - I

Fundamental group functor, homotopy of maps between topological spaces, homotopy equivalence,. Contractible and simply connected spaces, fundamental groups of S^1, and $S^1 \times S^1$ etc.

Calculation of fundamental group of S^n , $n > 1$ using Van Kampen's theorems, fundamental groups of a topological group, Brouwer;s fixed point

theorem, fundamental theorem of algebra. Vector fields on planer sets. Frobenius theory for 3x3 matrices.

Covering spaces. Unique path lifting theorem, covering homotopy theorems, group of covering transformations, criterion of lifting of maps in terms of fundamental groups universal covering, its existence, special cases of manifolds and topological groups.

Sigular homology, reduced homology, Eilenbberg Steenrod axioms of homology (no proof for homotopy invariance axiom,. Excision axiom and exact sequence axiom) and their application, relation between fundamental group and first homology.

Calculation of homology of S^n, Brouwer's fixed point theorem. Application spheres, vector fields, Mayer-Vietoris sequence (without proof) and its applications.

Reference Books:

1. James R. Munkres: Topology-A first Course, Prentice Hall, New Delhi.
2. Marwin J. Greenberg and J.R.Harper: Algebraic Topology - A first Course, Addison-Wesley Publishing Co. 1981.
3. W.S. Nassey: Algebraic Topology-An Introduction, Springer Verlag.,1977.

Semester – III
Paper - XX (A) Operation Research - I

Unit – I
Operations research and its scope, necessity of operations research in industry, Linear programming problems, convex sets, feasible solutions, formulation of L.P.P. method for solution of LPP. (15 lectures)

Unit – II
Graphical solution of L.P.P.Simplex method; theory and problems. Computational procedure, artificial variables inverse of a matrix using simplex method. (15 lectures)

Unit - III
Duality in L.P.P. Concept of duality, properties, dual simplex method, its algorithm. (15 lectures)

Unit – IV
Transportation and assignment problems, various methods. (15 lectures)

Unit - V
Game theory two person zero sum games, saddle point mixed strategies, graphical solution, by L.P.P., dominance. (15 lectures)

Text Books:

1. Kanti Swarup, P.K. Gupta and Man Mohan: Operations Research,
S. Chand; & Sons, New Delhi.
Chapter- 0 (Related concepts) Chapter 1, 2,3,4,6,7,9,
2. Mittal, K. V.: Optimization methods, Wiley, New Delhi.

Reference Books:

1. H. A.Taha: Operations Research- An introduction, Macmillan, New York,
2. N. S. Kambo, Mathematical-programming Techniques. Affiliated East-West Press, New Delhi.

Semester III

PAPER XXI (A): BANACH ALGEBRAS - I.

Definition of Banach algebra and examples. Singular and Non-Singular elements. The abstract index. The spectrum of an element. The spectral radius. Gelfand; formula. Multiplicative lilnear; functionals & the maximal ideal space,. Gleason-Kahane-Zelazko Theorem.

The Gelfand Transforms. The Spectral Mapping Theorem. Isometric Gelfand Transform. Maximal ideal spaces for Disc algebra and the algebra 1, (Z).

C*-algebras-Definition and ;examples. Self adjoint, unitary, normal positive and projection elements in C* algebras. Commutative C*-algebras.
C*- Homomorphisms. Representation of Commutative C*-algebra subalgebras and the ;spectrum. The spectral theorem. The continuous functional calculus. Positive linear functional and states in C*- algebras. The GNS construction.

Reference Books:

1. Kehe Zhu : An introduction to Operator Algebras - CRC Press . l993.
2. W. Arveson, Introduction to C*algebras, Springer-Verlag, 1976.
3. F.F. Bonsall and J. Duncan, Complete normed algebras, Springer-Verlag, 1973.
4. J. Dixmier, C* algebras, North Holland, Amsterdam, 1977.
5. R. V. Kadison and J. R. Ringrose, Fundamentals of Operator Theory, Vols. I and II Academic Press, (l983 and l986).
6. A. Naimark , Normed Algebras. Noordhoff, Grioningen. 1972.
7. T.W. Palmer, Banach Algebra Vol. I. Cambridge University Press l994.
8. C.E. Rickart, General Theory of Banach Algebras. Von Nostrand l960.
9. M. Takesaki: Theory of Operator Algebras I, Springer Verlag, New York, 1979.

Semester - III
PAPER XXII (A): WAVELETS - I

Preliminaries. Different ways of constructing wavelets- Orthonormal bases generated by a single function;
The Balian-Low theorem. Smooth projections on $L^2(R)$. Local sine and cosine bases and the construction of some wavelets. The unitary folding operators and the smooth projections.
Multiresolution analysis and construction of wavelets. Construction of compactly supported wavelets and estimates for its smoothness. Band limited wavelets. Orthonormality. Completeness. Characterization of Lemarie-Meyer wavelets and some other characterizations Franklin wavelets and Spline wavelets on the real line.
Orthonormal bases of piecewise linear continuous functions for $L^2(T)$.
Orthonormal bases of periodic splines. Periodization of wavelets defined on the real line.
Characterizations in the theory of wavelets- The basic equations and some of its applications. Characterizations of MRA wavelets, low-pass filters and scaling functions.

Recommended text.

Eugenio Hernandez and Guido Weiss, A First Course on Wavelets. CRC Press, New York, 1996.

Reference Books:

1. C.K. Chui, An Introduction to Wavelets, Academic Press, 1992.
2. I. Daubechies, Ten Lectures on Wavelets, CBS-NSF Regional Conferences in Applied Mathematics, 61, SIAM, 1992
3. Y. Meyer, Wavelets, algorithms and applications. SIAM, 1993.
4. M.V. Wickerhauser, Adapted wavelet analysis from theory to software, Wellesley, MA, A. K. Peters, 1994.

Semester III
PAPER XXIII(A): FUNDAMENTALS OF APPLIED FUNCTIONAL ANALYSIS - I

Review of basic properties of Hilbert spaces.

Convex Programming-support functional of a convex set. Minkowski functional. Separation theorem. Kuhn-Tucker theorem Minimax theorem. Farkas theorem.

Spectral theory of operators. Spectral theory of Compact Operators. Operators on a Separable hilbert space. Krein factorization theorem for continuous kernels. And its consequences. L2 Spaces over Hilbert Spaces. Multilinear forms. Analyticity theorem. Nonlinear Volterra Operators.

Recommended Text.
A. V. Balakrishnan, Applied Functional Analysis, Springer-Verlag, New York, Inc.

Reference Books:
1 N. Dunford and J.T. Schwartz, Linear Operators,Vls. I & II Interscience, 1958, 1968.
2. S. G. Krein, Linear Differential Equations in a Banach Space, American Mathematical Society, Translation, 1970.
3. K. Yosida, Functional Analysis, Springer-Verlag, 1974.

Semester III
PAPER XXIV (A): ALGEBRAIC NUMBER THEORY - I.

Algebraic number fields and their rings of integers calculuations for quadratic and cubic cases. Localization, Galois extension. Dedekind rings, discrete valuation rings, completion. Unramified and ramified extensions, different discriminant.

Reference Books:
1 S. Lang, Algebraic Number Theory, GTM Springer-Verlag, 1994.
2 J.P. Serre, Local Fields. GTM Vol. 67, S.pringer-verlag, 1979.
3 J. Esmonde, and M. Ram Murty, Problems in Algebraic Number Theory, GTM Vol. 190, Aspringer-Verlag-1999.

Semester III
PAPER XXV (A): COMBINATORICS - I.

Introduction to enumeration, elementary counting principles, functions and the pigeonhole principle, subsets, binomial coefficients, mathematical induction, equivalence relations, distributions and multisets, partitions and Stirling numbers. Partitions of integers.

Algebraic counting techniques, the principle of inclusion and exclusion.

REFERENCE BOOKS:

1. I Anderson: A first course in combinatorial mathematics. Oxford University Press (1974)
2. K. P. Bogart: Introductory combinatorics. Harcourt publication Co. London, (2000)
3. M. Aigner : Combinatorial theory, Springer-Verlag, Berlin (1979)
4. V. Kirshnamurthy : Combinatorics . East-West Press, New Delh (1993)

Semester III
Paper No. XXVII- (A): REACTION DIFFUSION THEORY - I

Unit – I

Reaction Diffusion Equations. Derivation of Reaction Diffusion Equations. Boundary Conditions. Derivation of Some Specific Models. Linear Reaction diffusion Equations. Maximum Principles [2] Positivity Lemmas. (15 Lecturers)

Unit – II

Monotone Method for Time – Dependent Problems. Nonuniqueness of Time-Dependent Solutions. Monotone Method for Steady-State Problems. Applications to Specific Models. (15 Lecturers)

Unit – III

Parabolic Boundary – value Problems. A Review of the Linear Parabolic Problem. (Theorem 1.2, and Theorem 1.3, statements only) Lemma 1.1, 1.2, 1.3 and Theorem 1.1, 1.2, 1.3 only statements A Positivity Lemma. Upper and Lower Sequences. Positivity Lemma, Maximum Principles. [2] (15 Lecturers)

Unit - IV

Existence- Comparison Theorems. Elliptic Boundary-Value Problems.The Linear Boundary-Value Problem (Lemma 1.1, Lemma 1.2, Lemma 1.3, Theorem 1.3, Theorem 1.4, and Theorem 1.5, Statements only). The Method of Upper and Lower Solutions. (15 Lecturers)

Unit - V

The Uniqueness Problem. Positive Steady-State Solutions. Applications – (1) The Enzyme- Kinetics Model with Inhibition. (2) Chemical Reactor Model (3) The Thermal Ignition Problems (a) and (b). (15 Lecturers)

Text Books:

[1] C.V. Pao; Nonlinear Parabolic and Elliptic Equations; Plenum Press, New York and London, 1992.

[2]. M. H. Protter and H.F. Weinberger; Maximum Principles in Differential Equations. Springer-Verlag, New York, 1984.
Chapter 1, Article 1.1—Article 1.8.
Chapter 2, Article 2.1—Article 2.4.
Chapter 3, Article 3.1—Article 3.4 and Article 3.8

Reference Books:

[1] I. Stakgold ; Boundary Value Problems of Mathematical Physics, Vol. II, MacMillan, New York, 1968.

[2] O. A. Ladyzhenskaya, V. A. Solonikou and N.N. Uralceva ; Linear and Quasilinear Equations of Parabolic Type, Amer. Math. Soc. 1968.

[3] O. A. Ladyzhenskaya and N.N. Uralceva ; Linear and quasilinear Elliptic Equations, Academic Press, New York, 1968.

[4] R. Aris ; The Mathematical Theory of diffusion and Reaction in Permeable catalysts, Vol. I and II, Oxford University Press (Clarendon), London 1975.

[5] A Friedman; Partial Differential equations of Parabolic Type, Prentice Hall, Englewood cliffs, N. J. 1964.

[6] G. S. Ladde ; V. Lakshmikantham, and A. S. Vatsala, Monotone; Iterative Techniques for Nonlinear Differential Equations, Pittman, Boston 1985.

[7]. P. C. Fife, Mathematical Aspects of Reacting and Diffusion Systems, Lecture Notes in Biomathematics, 28, Springer-Verlag, new York, 1979.