HEMCHAND YADAV VISHWAVIDYALAYA, DURG (C.G.)

M.A. /M.Sc. (MATHEMATICS) (Semester-III)

M.Sc./M.A. Course (Third Semester)

PAPER -I

Integration Theory and Functional Analysis (I)

Max. Marks 80

Integration Theory:

Unit-I Signed measure. Hahn decomposition theorem, mutually singular measures. Radon-Nikodym theorem. Labesgue decomposition. Riesz representation theorem. Extension theorem (Caratheodory).

Unit-II Lebesgue-Stieltjes integral, product measures, Fubini's theorem. Differentiation and Integration. Decomposition into absolutely continuous and singular parts.

Unit-III Baire sets. Baire measure, continuous functions with compact support. Regularity of measures on locally compact spaces. Integration of continuous functions with compact support, Riesz-Markoff theorem.

Functional Analysis:

Unit-IV Normed linear spaces. Banach spaces and examples. Quotient space of normed linear spaces and its completeness, equivalent norms. Riesz Lemma, basic properties of finite dimensional normed linear spaces and compactness.

Unit-V Weak convergence and bounded linear transformations, normed linear spaces of bounded linear transformations, dual spaces with examples.

M.Sc. /M.A. Course (Third Semester)
PAPER -II
Partial Differential Equations

Max. Marks 80

Partial Differential Equations

Unit-I Examples of PDE. Classification. Transport Equation-Initial value Problem. Non-homogeneous Equation, Laplace's Equation-Fundamental Solution, Mean Value Formulas, Properties of Harmonic Functions, Green's Function, Energy Methods.

Unit-II Heat Equation-Fundamental Solution, Mean Value Formula, Properties of Solutions, Energy Methods. Wave Equation-Solution by Spherical Means, Non-homogeneous Equations, Energy Methods.

Unit-III Non-linear First Order PDE-Complete Integrals, Envelopes, Characteristics, Hamilton Jacobi Equations (Calculus of Variations, Hamilton's ODE, Legendre Transform, Hopf-Lax Formula, Weak Solutions, Uniqueness), Conservation Laws (Shocks, Entropy Condition, Lax Oleinik formula, Weak Solutions, Uniqueness, Riemann's Problem, Long Time Behaviour)

Unit-IV Representation of Solutions-Separation of Variables, Similarity Solutions (Plane and Travelling Waves, Solitons, Similarity under Scaling), Fourier and Laplace Transform, Hopf-Cole Transform, Hodograph and Legendre Transforms, Potential Functions.

Unit-IV Hamilton's Principle. Principle of least action. Poincare Cartan Integral invariant. Whittaker's equations. Jacobi's equations. Lee Hwa Chung's theorem, canonical transformations and properties of generating functions.

Unit- V Asymptotic (Singular Perturbations, Laplace's Method, Geometric Optics, Stationary Phase, Homogenization), Power Series (Non-characteristic Surfaces, Real Analytic Functions, Cauchy-Kovalevskaya Theorem).

M.Sc. /M.A. Course (Third Semester)

PAPER-III (A)

Fundamentals of Computer Science-Theory and Practical
(Object Oriented Programming and Data Structure)

Max. Marks. 100 (Theory-70
+Practical-30)

Unit-I Object Oriented Programming-Classes and Scope, nested classes, pointer class members; Class initialization, assignment and destruction.

Unit-II Overloaded functions and operators; Templates including class templates; class inheritance and virtual functions.

Unit-III Data Structures-Analysis of algorithms, q, W, 0, o, w notations; Sequential and linked representations, Lists, Stacks, and queues;

Unit-IV Trees: Binary tree- search tree implementation, B-tree (concept only);

Unit-V Sorting: Insertion sort, shell sort, quick-sort, heap sort and their analysis; Hashing-open and closed.

Books Recommended:

1. S. B. Lipman, J. Lajoi: C++ Primer, Addison Wesley.
2. B. Stroustrup; The C++ Programming Language, Addison Wesley.
3. C. J. Date : Introduction to Database Systems, Addison Wesley.
4. C. Ritehie: Operating Systems-Incorporating UNIX and Windows, BPB Publications.
5. M. A. Weiss, Data Structures and Algorithm Analysis in C++, Addison Wesley.

M.Sc. /M.A. Course (Third Semester)
PAPER-III (B)
General Relativity & Cosmology (I)

Max Marks – 80

Unit-I General Relativity-Transformation of coordinates. Tensors. Algebra of Tensors. Symmetric and skew symmetric Tensors. Contraction of tensors and quotient law. Reimannian metric. Parallel transport. Christoffel Symbols. Covarient derivatives, intrinsic derivatives and geodesies.

Unit-II Riemann Christoffel curvature tensor and its symmetry properties. Bianchi identities and Einstein tensor. Review of the special theory of relativity and the Newtonian Theory of gravitation.

Unit-III Principle of equivalence and general covariance, geodesic principle, Newtonian approximation of relativistic equations of motion. Einstein's field equations and its Newtonian approximation.

Unit-IV Schwarzschild external solution and its isotropic form. Planetary orbits and anologues of Kepler's Laws in general relativity. Advance of perihelion of a planet. Bending of light rays in a gravitational field, vitational redshift of spectral lines. Radar echo delay.

Unit-V Energy-momentum tensor of a perfect fluid. Schwarzschild internal solution. Boundary conditions. Energy momentum tensor of an electromagnetic field. Einstein-Maxwell equations. Reissner-Nordstrfim solution.

M.Sc. /M.A. Course (Third Semester)

PAPER-III (C)

Fuzzy Set Theory and Its Applications (I)

Max Marks – 80

UNIT-I Fuzzy sets-Basic definitions, α-level sets. Convex fuzzy sets. Basic operations on fuzzy sets. Types of fuzzy sets. Cartesian products, Algebraic products. Bounded sum and difference, t-norms and t-conorms.

UNIT-II The Extension Principle- The Zadeh's extension principle. Image and inverse image of fuzzy sets. Fuzzy numbers. Elements of fuzzy arithmetic.

UNIT-III Fuzzy Relations on Fuzzy sets, Composition of Fuzzy relations. Min-Max composition and its properties.

UNIT-IV Fuzzy equivalence relations. Fuzzy compatibility relations. Fuzzy relation equations. Fuzzy graphs, Similarity relation.

UNIT-V Possibility Theory-Fuzzy measures. Evidence theory. Necessity measure. Possibility measure. Possibility distribution. Possibility theory and fuzzy sets. Possibility theory versus probability theory.

M.Sc./M.A. Course (Third Semester)
PAPER-III (D)
Mathematical Biology (I)

Max. Marks - 80

UNIT-I

Population Dynamics

Malthusian growth model, Logistic equation, model of species competition, Linear and Nonlinear First Order Discrete Time Models, Biology of Insect Population Dynamics, Model for Insect Population Dynamics with Competition, Differential Equation Models.

UNIT-II

Age Structured Population Dynamics

Evolutionary Aspects, Harvesting and Fisheries, Metapopulations, Delay Effects, Fibonacci's Rabbits, golden ratio, Age-structured Population's in Discrete Time, continuous age-structured populations, Euler-Lotka Equations.

UNIT-III

Population Dynamics of Interacting Species

Host-parasitoid Interactions, Lotka-Volterra Prey-predator Equations, Modelling the Predator Functional Response, Ecosystems Modelling, Interacting Metapopulations, Competition, Predation, Predator-mediated Coexistence of Competitors, Effects of Habitat Destruction.

UNIT-IV

Population Genetics and Evolution

Mendelian Genetics in Populations with Non-overlapping Generations, Haploid genetics, Spread of a favored allele, Mutation-selection balance, Diploid genetics, Sexual reproduction, Spread of a favored allele, Mutation-selection balance, Heterosis, Frequency-dependent selection, Linkage equilibrium, Random genetic drift, Evolution of the Genetic System.

UNIT-V

Infectious Disease

Simple Epidemic and SIS Diseases, SIR Epidemics, SIR epidemic disease model, SIR Endemics, SIR endemic disease model, No Disease-related Death, Including Disease- related Death, Vaccination, Evolution of virulence, Vector -borne Diseases, Basic Model for Macroparasitic Diseases.

M.Sc./M.A. Course (Third Semester)
PAPER –IV (A)
Operations Research (I)

Max. Marks 80

Unit-I Operations Research and its Scope. Necessity of Operations Research in Industry. Linear Programming-Simplex Method. Theory of the Simplex Method. Duality and Sensitivity Analysis.

Unit-II Other Algorithms for Linear Programmrng-Dual Simplex Method.

Unit-III Parametric Linear Programming. Upper Bound Technique. Interior Point Algorithm. Linear Goal Programming.

Unit-IV Transportation and Assignment Problems.

Unit-V Network Analysis-Shortest Path Problem. Minimum Spanning Tree Probiem. Maximum Flow I Problem. Minimum Cost Flow Problem. Network Simplex Method. Project Planning and Control I with PERT-CPM.

M.Sc./M.A. Course (Third Semester)
PAPER-IV (B)
Wavelets (I)

Max Marks – 80

Unit-I. Preliminaries-Different ways of constructing wavelets- Orthonormal bases generated by a single function: the Balian-Low theorem. Smooth projections on $L^2(R)$.

Unit-II. Local sine and cosine bases and the construction of some wavelets. The unitary folding operators and the smooth projections.

Unit-III. Multiresolution analysis and construction of wavelets. Construction of compactly supported wavelets and estimates for its smoothness. Band limited wavelets.

Unit-IV. Orthonormality. Completeness. Characterization of Lemarie-Meyer wavelets and some other characterizations. Franklin wavelets and Spline wavelets on the real line.

Unit-V. Orthonormal bases of piecewise linear continuous functions for L^2 (T). Orthonormal bases of periodic splines. Periodization of wavelets defined on the real line.

M.Sc. /M.A. Course (Third Semester)

PAPER –V (A)

Programming in C (with ANSI features) Theory and Practical (I)

Max. Marks. 100

(Theory-70 +Practical-30)

Unit-I An overview of programming. Programming language, Classification. C Essentials-Program Development. Functions. Anatomy of a C Function. Variables and Constants. Expressions. Assignment Statements. Formatting Source Files. Continuation Character. The Preprocessor.

Unit-II Scalar Data Types-Declarations, Different Types of Integers. Different kinds of Integer Constants. Floating-Point Types. Initialization. Mixing Types. Explicit Conversions-Casts. Enumeration Types. The Void Data Type. Typedefs. Finding the Address of an object. Pointers.

Unit-III Control Flow-Conditional Branching. The Switch Statement. Looping. Nested Loops. The break and continue Statements. The goto statement. Infinite Loops.

Unit-IV Operators and Expressions-Precedence and Associativity. Unary Plus and Minus operators. Binary Arithmetic Operators. Arithmetic Assignment Operators. Increment and Decrement Operators. Comma Operator. Relational Operators. Logical Operators. Bit - Manipulation Operators. Bitwise Assignment Operators. Cast Operator. Size of Operators. Conditional Operator. Memory Operators.

Unit-V Arrays -Declaring an Array. Arrays and Memory. Initializing Arrays. Encryption and Decryption.

M.Sc./M.A. Course (Third Semester)
PAPER-V (B)
Graph theory (I)

Max. Marks - 80

Unit-I: Operations on graphs, matrices and vector spaces: Topological operations, Homeomerphism, homomorphism, contractions, derived graphs, Binary operations.

Unit-II: Matrices and vector spaces: Matrices and vector spaces: The adjacency matrix, The determinant and the spectrum, Spectrum properties, The incidence matrix, cycle space and Bond space, Cycle bases and cycle graphs.

Unit-III: Colouring packing and covering: Vertex coverings, critical graphs, Girth and chromatic number, uniquely colourable graphs, edge-colourings, Face colourings and Beyond, The achromatic and the Adjoint Numbers.

Unit-IV: Combinational formulations: Setting up of combinational formulations, the classic pair of duals, Gallai, Norman-Rabin Theorems, Clique parameters, The Rosenfeld Numbers.

Unit-V: Perfect Graphs: Introduction to the "SPGC", Triangulated (Chordal) graphs, Comparability graphs, Interval graphs, permutation graphs, circular arc graphs, split graphs, weakly triangulated graphs.

M.Sc./M.A. Course (Third Semester)
PAPER-V (C)
Algebraic Number Theory (I)

Max Marks – 80

UNIT-I

Elementary Number Theory: Primes and factorization, Division Algorithm, Congruence, Congruence and Modular Arithmetic, Euler phi function, Primitive roots of Unity, Quadratic law of Reciprocity, Arithmetical functions, Mobius Inversion Formula, The Diophantine Equations, Farey Sequences.

UNIT-II

Algebraic Numbers: Algebraic Numbers, Conjugates and Discriminants, Algebraic Integers, Integral Bases, Rings of Integers.

UNIT-III

Special Fields: Calculations for Quadratic fields, cubic fields, biquadratic fields and sextic fields.

UNIT-IV

Localization: Localization, Integral closure, Prime ideals, Chinese remainder theorem, Galois extensions. **Rings:** Dedekind rings, discrete valuation rings, Explicit factorization of a prime.

UNIT-V

Completions: Definitions and completions, Polynomials in complete fields, Structure of complete discrete valuation ring, extension of complete fields.