Ganesh Dutt College
Department of Mathematics

Post Graduate:(Mathematics)

PSO: The students of PG after having two years of study in this programme enrich themselves in basics of mathematics (Applied and Pure) and related topics of concerned subject. They also develop their research acumen in related areas and new avenues for future research activities. Apart from these also become professionals, academicians and help the nation in contributing their expertise in planning and programmes.

Course Outcome: Semester-I

Course Core(CC- 01): Abstract Algebra:

The students are brainstorming ideas for Prerequisites: Introduction to Group. Elementary Properties of Group, Finite Group. and subgroup. Cyclic Group. Permutation Group, Properties of Permutations. rings, integral Domains. Characteristic of rings.

CO1: The students are coming up with ideas for Homomorphism: Group actions. Sylow theorems, Normal and subnormal series composition series of a group. Jordan- Holder Theorem. Solvable groups. commutator subgroup of a group. Nilpotent groups

CO2: The students are developing ideas for Ring homomorphism, isomorphism. quotient rings, ideals, Kernel of ring homomorphism. principal ideal ring and domain, prime and maximal ideal, Euclidean domain.

CO3: The learners are developing ideas for Extension fields, algebraic and transcendental extension, splitting field of Polynomial, separable and inseparable extension, normal extension, constructible real numbers:

CO4: The students will be concerned with the Cyclic Modules, simple Modules, semi-simple Modules, Schur's Lemma, Free Modules.

CO5: The students will be aware with the Solution of equations by radicals, insolvability of equations of degree 5 by radicals.

Course Core(CC- 02): Real Analysis:

CO1: The learners are developing ideas for Sequences and series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence. Weierstrass-M test, Abel's and Dirichlet's test for uniform convergence.

CO2: The students will be concerned with the Uniform convergence and differentiation, Weierstrass approximation theorem Power series, Uniqueness theorem for power series. Able's and Tauber's theorem.

CO3: The students will be aware with the Definition and examples of Riemann-Stieltje's integral Property of integral, Integration and differentiation, the fundamental theorem of Calculus, Integration Of vector valued function, rectifiable curves.

CO4: Improvements in the students' knowledge of Functions of several variables, linear transformation, Derivatives in an open subset of R" chain rule, partial derivatives, interchange of order of differentiation. derivative, of higher orders. Taylor's theorem.

CO5: Inverse function theorem. Implicit function theorem, Jacobians. Extremum Problems with constraints, Lagrange's multiplier methods, differentiation of Integrals, partition of unity, Differential forms, Stoke's theorem.

Course Core(CC- 03): Linear Algebra

CO1: The students will be familiarized with the Finite dimensional vector spaces: Linear transformations and their matrix representations, rank: systems of linear equations, eigenvalues and eigenvectors. minimal polynomial. Cayley-Hamilton Theorem, diagonalization.
CO2: The learners are developing ideas for Hermitian, SkewHermitian and unitary matrices; Finite dimensional inner product. spaces. Gram-Schmidt orthonormalization process, self-adjoint operators.
CO3:The students have begun generating ideas for Similarity of linear transformations. Invariant subspaces, reduction to triangular forms. Nilpotent transformations. Index of Nilpotency, invariants of a Nilpotent transformations, primary decomposition theorem, Joardan blocks and Jordan forms rational canonical form.
CO4: The students will be familiarized with the Bilinear form, algebra of bilinear form Matrix of bilinear forms, degenerate and Non-degenerate bilinear forms. Alternating bilinear forms Unit 5: Symmetric and Skew-symmetric bilinear forms. Quadratic form, law of Inertia, Sylvester's theorem. Hermitian forms definite forms.Discrete Mathematics:

Course Core(CC- 04): Discrete Mathematics

CO1: improvements in the students' knowledge of graphs, paths, circuits and subgraphs, induced subgraphs, degree of a vertex, connectivity, planar graphs and their properties. Trees and simple applications of graphs.
CO2: The students will be familiarized with the Lattices as partially ordered sets and their properties, lattices as algebraic system. Sub lattices, direct products and Homomorphisms of Lattices some special lattices eg Complete lattices, complemented lattices and distributive lattices.
CO3: Improvements in the students' knowledge of Boolean algebra as a complemented distributive lattice, Boolean rings. identification of Boolean algebra and Boolean rings, sub-algebra and generators
CO4: The students will be familiarized with the Boolean homomorphism and ring homomorphism ideals in a Boolean algebra and Dual ideals, Fundamental theorem of homomorphism and Stone's representation theorem for Boolean algebras and Boolean rings, simple application to eletrical network, solvability of Boolean equations and logical puzzles.
CO5: Improvements in the students' understanding of Permutation and combinations, partitions, pigeonhole principle, inclusion-exclusion principle, generating functions, recurrence relations.

Course Outcome: Semester-II

Course Core(CC- 05): General Advanced Mathematics

CO1: The students will be conversant with the Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field. Archimedean property, supremum, infimum.
CO2: The students have begun generating ideas for Fuzzy Sets Versus Crisp sets, Basic definitions, types, properties and representations of Fuzzy sets, Convex Fuzzy sets. Basics operation on Fuzzy

set, a- Cuts, Decompositions theorem, Complements, t-norm and t-conorms. Extension principles and Simple applications of Fuzzy sets.

CO3: Improvements in the students' understanding of Definition of graphs, paths, circuits and subgraphs, induced subgraphs, degree of a vertex. connectivity, planar graphs and their properties. Trees and simple applications of graphs.

CO4: The students will be conversant with the Divisiblity Theory In the Integers: Division Algorithim, the Greatest Common Divisor. The Euclidean Algorithm. The Diophantine Equations ax+by = c. Fundamental Theoem of Arithmetic.

Course Core(CC- 06): Complex Analysis

CO1: The students have begun generating ideas for Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential. trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations.

CO2: Improvements in the students' understanding of Contour integral. Cauchy's theorem. Cauchy's integral formula, Liouville's theorem.

CO3: The students will be conversant with the Taylor's theorem, Maximum modulus Principle. Schwarz's Lemma, Laurent Series. Isolated singularities, Meromorphic function, Mittag-Leffler's theorem The argument principle. Rouche's theorem, fundamental theorem of algebra. Power series.

CO4: Growth of the students' knowledge of Residues. Cauchy's residue theorem. Evaluation of integral, Branches of any valued functions with special reference to argz, logz and Bilinear transformations. their properties and classifications, definition and examples of conformal mappings. Mobius Transformations.

Course Core(CC- 07): Differential and Integral Equation

CO1: The students will be conversant with the Initial Value problem and the equivalent integral equation, n order equation in d dimension as a first order system. Concepts of local existence, existence and uniqueness of solution with examples.

CO2: The students will be acquainted with the Integral Equations and their classifications. Eigen values and eigen functions. Fredholm Integral equations of Second Kind, Iterative Scheme and method of successive approximations.

CO3: Growth of the students' knowledge of Ascoli- Arzela theorem, a theorem on convergence of solutions of a family of Initial value problems. Picard- Lindelof theorem, Peano's existance theorem Corollaries, Kamke's convergence theorem.

CO4: Strengthening of the students' knowledge of Gronwall's inequality, maximal and minimal solution, Differential inequalities,

Uniqueness theorem, Nagumo's and Osgood's criteria, successive approximations,

Course Core(CC- 08): Measure Theory

CO1: The students have begun generating ideas for Lebesgue outer measure, Measurable sets Measuribility, Measurable functions, Borel and Lebesque measurability, non-measurable sets.

CO2: Strengthening of the students' knowledge of Integration of non-negative functions, the general integral, Integration of series, Riemann and Lebesgue integrals.

CO3: The students will be acquainted with the Four Derivatives, function of bounded variation. Lebesgue differentiation Theorems. Differentiation and Integration.

CO4: The students will be introduced with the Measure and outer measure, extension of measures,uniqueness of extension, Completion of a measure, measurable spaces. Integration with respect to a measure.
CO5: The convex functions, Jensen inequality Holder's and Minkowski's Inequalities, completeness of spaces, convergence in measure, Almost uniform Convergence.

Course Core(CC- 09): Topology
CO1: Strengthening of the students' knowledge of topological spaces, closed sets, dense subsets, Neighbourhood, interior, exterior, boundary and accumulation points. Derived Sets, Bases and subbases. Subspaces and Relative topology.
CO2: The students have begun generating ideas for Continuous functions and homeomorphism, characterisation of continuity in Terms of open sets, closed sets and closure. First and second countable topological spaces Lindelof's theorem, separable Spaces, second countability and separability.
CO3: The students will be acquainted with the Separation axioms To T and T: spaces and their basic properties. compactness. Continuous function and compact sets, basic properties of compactness and Finite intersection property.
CO4: The students will be connected with the connectedness, continuous function and connected sets characterization of Connectedness in terms of a discrete two point space, connectedness on real line.
CO5: Strengthening of the students' knowledge of Regular and Normal spaces Ty and T. spaces, characterisations and basic properties, Urysohn's lemma and Tietze extension Theorems.

Course Outcome: Semester-III

Course Core(CC- 10): Number Theory
CO1: The students will be acquainted with the Divisibility, G.C.D and LCM., Primes, Fermat numbers, congruences and residues, theorems of Euler, Fermat and Wilson, solutions of congruences, linear congruences, Chinese remainder theorem.
CO2: The students have begun generating ideas for Arithmetical functions (n), p(n) and d(n)and o(n), Moebius inversion formula, congruences of higher degree, congruences of prime power modulli and prime modulus, power residue.
CO3:
Students' improvement of their knowledge of Quadratic residue, Legendre symbols, lemma of Guass and reciprocity law. Jacobi symbols, Farey series, rational approximation, Hurwitz theorem, irrational numbers, irrationality of e and x. Representation of the real numbers by decimals.
CO4: The students will be familiar with the Finite continued fractions, simple continued fractions, infinite simple continued fractions, periodic continued fractions, approximation by convergence, best possible approximation, Pell's equations, Lagrange four sphere theorem.

Course Core(CC- 11): Functional Analysis
CO1: The students have begun generating ideas for 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.

CO2: Weak convergence and bounded linear transformation, normed linear spaces of bounded linear transformations, dual spaces with examples, uniform boundness theorem and some of its consequences.
CO3: Students' improvement of their knowledge of Open mapping theorem and closed graph theorem, Hahn- Banach Theorem on real linear spaces, complex linear spaces and normed linear spaces, Reflexive spaces.
CO4: The students will be connected with the inner product spaces, Riesz lemma on Hilbert space, orthonormals sets and Parseval's identity, structure of Hilbert spaces, Projection theorem Riesz Representation Theorem.
CO5: Students' advancement in their knowledge of Adjoint of an operator on a Hilbert space. Reflexivity of Hilbert spaces, Self- adjoint Operators, positive operator. Projection. Normal and unitary operators.

Course Core(CC- 12): Fluid Dynamics

CO1: Students' improvement of their knowledge of Lagrangian and Eulerian methods. Equation of Continuity, Boundary Surfaces, Stream lines, Path lines and Streak lines, velocity potential, irrotational and rotational motions, vortex lines.
CO2: The students will be conversant with the Lagrange's and Euler's equations of motion, Bernoulli's theorem, equation ofmotion by flux method, equation referred to moving axis, implusive actions.
CO3: Students' improvement of their knowledge of Irrotational Motion in two dimension, stream function, complex velocity potential, sources, sinks, doublets and their images, conformal mapping, Milne-Thompson circle theorem.
CO4: The students have begun generating ideas for two dimensional irrotational motion produced by motion of a circular. coaxial and elliptic cylinders in an infinite mass of liquid, kinetic energy of a liquid, Theorem of Blasius, motion of a sphere through a liquid at rest at infinity, liquid streaming past a fixed sphere. Equation of motion of a sphere, Stoke's stream function
CO5: The students will be familiar with the Vortex motion and its elementary properties, Kelvin's proof of permanence.

Course Core(CC- 13): Classical Mechanics (Rigid Dynamics)

CO1: Students' advancement in their knowledge of Generalised Co-ordinates, Holonomic and Non Holonomic systems. Lagrange'sequations of motion, energy equations for conservative fields.
CO2: Students' improvement of their knowledge of Hamilton's canonical equations, Rouths equations, Hamilton' Principle, Principle of Least Action.
CO3: The students will be conversant with the Small Oscillations, normal Co-ordinates, normal mode of vibration.
CO3: The students will be acquainted with the Contact transformations, Lagrange brackets and Poisson brackets, the most general infinitesimal contact transformation, Hamilton-Jacobi equation.
CO4: The students will be familiar with the Motivating problem of Calculus of variation, Euler-Lagrange equation shortest distance, minimum surfaces of revolution. Brachistochrone problem.

Course Core(CC- 14): Optimization Techniques

CO1: Students' advancement in their knowledge of Simplex method for unrestricted variable. Two

phase method. Dual simplex method. Parametric Linear programming. Upper Bound technique, Interior point algorithm, Linear Goal programming

CO2: The students will be acquainted with the Integer programing, Branch and bound technique, Gomory's algorithm.

CO3: Students' advancement in their knowledge of One and multi-variable unconstrained optimization, Kuhn- Tucker condition for constrained optimization, Wolfe's and Beale's methods.

CO4: The students have begun generating ideas for Game theory. Two person- Zero sum games with mixed strategies, Graphical solution by expressing as a linear programming problem.

CO5: students' advancement in their knowledge of Inventory theory. Different costs of inventory model, Deterministic Economic lot size model, EOQ with uniform demand and several productions of unequal length / production runs of equal length EOQ models- Shortages not allowed, shortages allowed.

Course Outcome: Semester-IV

1. Elective Course(EC-01): Operations Research

CO1: students' growth in their knowledge of Queuing Theory- Poisson probability law. Distribution of inter-arrival time. Distribution of time between successive arrivals. Differential difference equation of queuing models.

CO2: Students' enhancements to their knowledge of Information Theory: Description of communication system, Mathematical definition of information. Axiomatic approach to information, Measures of uncertainty. Entropy In two dimensions-property, conditional entropy.

CO3: The students have begun generating ideas for Channel capacity. Efficiency and redundancy. Encoding. Fano-encoding procedure, Necessary and sufficient condition, average length of encoded message.

CO4: The students will be familiar with the Replacement Model- introduction concepts of present value, replacement of items whose maintenance cost increase with time and value of money also changes Replacement of items that fail completely, individual and group replacement policy.

CO5: Students' enhancements to their knowledge of Sequencing N jobs and 2 machines, N jobs and 3 machines, N jobs M machines.

2. Elective Course(EC-02): Galoris Theory

CO1: The students have begun generating ideas for Rings, examples of ringd, ideals, prime and maximal ideals. Integral domains. Euclidean Domains, Principal Ideal Domains and Unique Factorizations Domains. Polynomial rings over UFD's.

CO2: Students' enhancements to their knowledge of Fields, Characteristic and prime subfields, field extensions, finite, algebraic and finitely generated field extensions, algebraic closures.

CO3: Students' growth in their knowledge of Splitting fields, normals extension, Multiple roots, Finite fields, separable Extension

CO4: The students will be familiar with the Galois group. Fundamental Theorem of Galois Theory. Solvability by radicals. Galois theoem on solvability. Cyclic and abelian extensions. Classical ruler and Compass constructions.