Program outcomes

(Government Jajwalyadev Naveen Girls College Janjgir C.G.)

M.Sc. Mathematics

Program outcomes

By the end of a M.Sc. programme a students will be able to

- **PO1:** Recognize and appreciate the connections between theory and applications.
- **PO2: E**nhance mathematical skills and understand the fundamental concepts of pure and applied mathematics.
- **PO3: I**nclude the curiosity for mathematics in students and to prepare them for future research.
- **PO4:** Exhibit positive attitudes and values towards the discipline so that they can contribute to dynamics society.
- **PO5: I**ncrease collaborative learning and application of mathematics to real life situations.

Specific Outcomes

- **PSO1:** Be familiar with different areas of mathematics.
- **PSO2:** Prepare with good motivation for research studies in mathematics related field.
- **PSO3:** Crack lectureship and fellowship exams approved by UGC like CSIR and SET.
- **PSO4:** Identify challenging problems in mathematics and fine appropriate solutions.
- **PSO5:** Apply the knowledge of mathematical concepts in interdisciplinary fields.

Course Outcome

M.Sc. Mathematics Previous Year

Course name - Advanced Abstract Algebra (1st sem.)

Course outcome - Upon successful completion of this course, the student will be able to

- CO1: Define the Concept of normal subgroup and related theorems.
- CO2: Prove isomorphism theorem.
- CO3: Define centre of group ,quotient group.
- CO4: Understand the basic concept of normal series inner automorphism.
- CO5: Prove Jordan holder theorem.
- CO6: Define solvable group , nilpotent group.
- CO7: Concept of maximal and Prime ideals, nilpotent and nil ideas.
- CO8: Prove zorm's Lemma

Course name - Advanced Abstract Algebra (2nd sem.)

Course outcome - Upon successful completion of this course the student will be able to

- CO1: Explain sub modules ,quotient module, direct sum, homomorphism of modules.
- CO2:Prove isomorphism theorems.
- CO3: Represent linear mapping.
- CO4:Define extension field ,algebraic and transcendental Extensions, separable and inseparable extensions.
- CO5:Familiar with normal extension perfect fields,finite fields, primitive element.
- CO6:Prove fundamental theorem of galois theory.
- CO7:Prove the most important theorem any two finite field having the same number of elements are isomorphic.
- CO8:Explain general concept of Noetherian and artinian modulus and ring.
- CO9:Prove every homeomorphic image of a Noetherian models is Noetherian.
- CO10:Prove Hilbert basis theorem.
- CO11:Prove Wedderburn artin theorem.

Course name - Real Analysis(1st sem.)

Course outcome - Upon successful completion of this course students will be able to

- CO1:Explain the concept of Riemann Stieltjes integral and properties of integral.
- CO2:Define partition, refinement ,upper and lower Riemann Stieltjes sum.
- CO3:Familiar with rectifiable curve and related theorem.
- CO4:Prove the theorem every continuous function is Riemann Stieltjes integral.

- CO5: Prove Mean Value theorem.
- CO6: Know Concept of power series and the theorems.
- CO7:Define pointwise and uniform convergence.
- CO8:Introduce the various types of test for uniform convergence of sequence and series of function such as Mn test, Weierstrass's M-test ,Abel's test, Dirichlet's test.
- CO9:Prove Weierstrass approximation theorem.
- CO10:Define general concept of functions of several variables.
- CO11:Prove inverse function theorem.
- CO12:Prove implicit function theorem.

Course name - Real Analysis (2nd sem.)

Course outcome - Upon successful completion of this course ,the student will be able

- CO1:Define measurable set, lebesgue outer measure , lebesgue measure and their properties.
- CO2:Familiar with Borel sets.
- CO3:Define general concept of measurable functions.
- CO4:Prove Riesz theorem.
- CO5:Explain lebesgue integral of a bounded functions.
- CO6: Compare the Riemann integral and Lebesgue integral.
- CO7:Prove Bounded convergence theorem.
- CO8:Prove the most important lemma like Fatou's lemma.
- CO9:Prove Monotonic convergence theorem.
- CO10:Prove Lebesgue dominated convergence theorem.
- CO11:Define absolutely continuous function.
- CO12:Familiar with l'p space .
- CO13:Prove Holder and Minkowski inequalities.

Course name - Topology(1st sem.)

Course outcome - Upon successful completion of this course students will able to

- CO1:Understand terms, definition and theorems related to topology.
- CO2:Understand the concept such as open and closed set ,interior and exterior point and closure.

- CO3:Familiar with neighbourhood and their properties.
- CO4:Define Base for a topology and define limit point, derived set,adherent point and isolated point.
- CO5:Express T-1 ,T-2, T-3 and T-4 separation exioms and use them to prove various properties.
- CO6:Familiar with the Urysohn lemma and Tietze extension theorem.
- CO7:Understanding first and second countable space , Lindelof's theorem.
- CO8: Define a topology in terms of karatowski closuer operator.

Course name - Topology (2nd sem.)

Course outcome - Upon successful completion of this course, the students will able to

- CO1:Explain the general concept of connectedness and their properties.
- CO2:Prove most important theorem related to connectedness.
- CO3:Define connected set and disconnected set.
- CO4:Establish relation between locally connected space and discreate space.
- CO5:Define open cover, subcover ,compact.
- CO6:Familiar with FIP, BWP and total boundedness and lebesgue numbers.
- CO7:Prove lebesgue covering lemma.
- CO8:Prove Heine-Borel theorem.
- CO9:Define product space ,weak topology , projection mapping and related theorem.
- CO10:Prove the product space of Housdorff space is Housdorff.
- CO11:Established evaluation map, separate point, embedding.
- CO12:Prove Tychonoff theorem.
- CO13:Prove Urysohn Metrization theorem.

Course name - Complex Analysis(1st sem.)

Course outcome - Upon successful completion of this course students will able to

- CO1:Explain the concept of complex integration.
- CO2:Prove and apply Cauchy -Gourset theorem.
- CO3:Define contours and analytic function.
- CO4:Prove and apply Cauchy integral formula.

- CO5:Understand the Morea's theorem,Poisson's integral formula for a circle , Cauchy's inequity.
- CO6:Define entire function and prove a bounded entire function is constant.
- CO7:Familiar with zeros of an analytic function.
- CO8:Introduce the types of singularities such as isolated singularity ,pole, removable singularity.
- CO9:Define Meromorphic function , Schwartz's lemma, the Argument principle.
- CO10:Prove and apply Rouche's theorem.
- CO11:Explain the concept of Bilinear transformation and their properties.
- CO12:Define Bilinear transformation ,inverse transformation, critical point ,cross ratio fixed point.
- CO13: Define Conformal mapping and relation between coformal and anaytic mapping.

Course name - Complex Analysis(2nd sem.)

Course Outcome - Upon successful completion of this course, students will able to

- CO1Define entire function, Gramma function , Riemann Zeta function.
- CO2:Prove most important theorem Weierstrass's factorization theorem.
- CO3:Introduce Riemann's functional equation.
- CO4:Explain the statement of Runge's theorem and proof Mittagleffler's theorem.
- CO5:Familiar with analytic continuation and uniqueness of direct analytic continuation.
- CO5:Introduce power series method of analytic continuation.
- CO6:Define Schwartz's reflection principle.
- CO7:Familiar monodromy theorem and it's consequences.
- CO8:Define Canonical product, Jensen's formula, Poison Jensen's formula,Hadamard's three circle theorem.
- CO9:Explain exponent of convergence, Borel's theorem, Hadamard's factorization theorem.
- CO10:Define the range of an analytic function.
- CO11:Prove Bloch's theorem,the Little Picard's theorem.
- CO12:Prove Schottky's theorem .
- CO13:Define univarient theorem.

Course name - Advanced Discrete Mathematics(1st sem.)

Course outcome - Upon successful completion of this course student will be able to

- CO1:Concept of Boolean Algebra as a lattice and related theorem.
- CO2:Understand the concept of posets and lattice.

- CO3:Prove De-Morgan's law.
- CO4: Prove theorems based on properties of lattice.
- CO5:Understand totaly ordered set (Chain).
- CO6:Establish the equivalence of the two definition of a lattice.
- CO7:Understand the concept of lattice Homomorphism and related theorems.
- CO8:Define lattice as algebric system.
- CO9:Define sublattice ,complemented lattice and distributive lattice.
- CO10:Simplify functions by the Karnaugh map method.
- CO11: Define Semigroup and Monoid and understand their consequences results.

Course name - Advanced Discrete Mathematics(2nd sem.)

Course Outcome - Upon successful completion of this course students will be able to

- CO1:Recognise standard valid and invalid argument forms.
- CO2:Prove set identities.
- CO3:Check the truthness of statement.
- CO4:Define graph ,paths ,circuits cycle,subgraph.
- CO5: Understand the operatios on subgraphs,Connected , Disconnected graph, Regular graph, isomorphism of graphs,tree, minimally connected graph.
- CO6:Understand the concept of direct graph and Euler's formula for connected planar graph.
- CO7:State and prove Kuratowski's theorem.
- CO8:Understand the concept of finite state machines ,minimization of machine and finite autometa.
- CO9: Know Grammar and Language,types of Grammar ,regular language and Pumping lemma.

Course Outcome

M.Sc.Mathematics (Final year)

Course name - Integration theory (3rd semester)

Students will be able to,

- **CO1:** Prove Hahn decomposition theorem .
- **CO2:** Define signed measure and mutually singular measure.
- **CO2:** Understand the concepts of Lebesgue decomposition.
- **CO4:** Prove Radon Nikodym theorem.
- **CO5:** Construct counter example to disprove a statement.
- **CO6:** Understand the concept of Housdorff measure differentiation and integration.
- **CO7:** Prove Fubini's theorem , Tunelli's theorem.
- **CO8:** Define Baire sets and Baire measure .
- **CO9:** Recognized regularity of measure on locally compact space.

Course name-Functional Analysis (4th semester)

Students will be able to

- **CO1:** Define Normed linear space , Banach space and dual space.
- **CO2:** Prove the Closed range theorem.
- **CO3: Understand** examples related to Banach space and dual space .
- **CO4:** Understand the concept of real linear space, complex linear space and normed linear space
- CO5: Define continuous Linear transformation and it's norm, equivalent norms.
- **CO5:** Prove Riesz lemma,Hanh Banach theorem for real linear space and complex space.
- **CO6: Explain** Open mapping and Closed graph theorem.
- CO7:Prove Schwartz's Inequality, Parallelogram law, Pythagoras theorem
- CO8: Define Orthogonal complement of a subset of Hilbert space and it's properties.
- **CO9:**Prove and apply Projection theorem and Riese representation theorem.
- **CO10:**Define Adjoint operator,self adjoint operators , positive , projection, normal and unitary operators.
- **CO11::**Define ortho-normal sets Bessel's inequality and Riesz lemma.
- **CO12:**Understand the concept of basic properties of finite dimensional normal linear space and compactness.

Course name- Partial Differential Equation ,Mechanics and Gravitation (3rd semester)

Course outcome: Upon successful completion of this course , students will be able to

- **CO1:** Understand the Laplace Equation, fundamental solution, mean value formulae , properties of harmonic function, Green function, energy method.
- **CO2:** Define Heat equation , Fundamental solution of heat equation, properties of solution , energy method.

- **CO3:** Define Wave Equation , solution by spherical means , Homogeneous equations , energy method.
- **CO4:** Understand Non-linear first order PDE, Hamilton-Jacobi equation , compatible system of first order PDE.
- **CO5:** Familiar with elementary idea of Laplace and inverse transforms and it's application.
- **CO6:** Understand Fourier transform, Fourier integral formula and it's application.
- **CO7:** Familiar with attraction of Rod , Disc , Spherical shell and Sphere, spherical shell of finite thickness.

Course name- PDE , Mechanics and Gravitation II (4th semester)

Course outcome : Upon successful completion of this course students , will be able to

- **CO1:** Understand generalized coordinates, Holonomic and Non Holonomic systems Scleronomic and Rheonomic system ,generalised potentials.
- **CO2:** Derive Lagrange's equation of first kind, Lagrange equation of second kind , uniqueness of solution energy , equation for conservation fields.
- **CO3:** Understand Hamilton's variable, cyclic coordinates Routh's equations.
- **CO4:** Familiar with Poisons Bracket , Jacobi Poison theorem, Lagrange's Bracket , minimum surface of revolution , Isoperimetric problem, fundamental lemma of calculus of variations.
- **CO5:** Understand Potential of Rod , Disc, Spherical shell and Sphere, Spherical shell of finite thickness, Distributions for a given potential, Equipotential surface.

Course Name - Fuzzy Sets And Fuzzy Logic (3rd semester)

Course Outcome - Upon Successful Completion of this Course

students will able to

- CO1: Explain Fuzzy sets definition and types of fuzzy sets , all basic definition and properties of alpha cuts , convex fuzzy sets.
- CO2: Understand Basic operations on fuzzy sets , representation of fuzzy sets , First & Second Decomposition theorem , Extension principal , theorems on fuzzy complement , t - norms and t-conorms . Characterization for t- norms and t - conorms , fuzzy complement and combination of operations on fuzzy sets .
- CO3: Define Fuzzy Arithmetic , Fuzzy numbers , Arithmetic operations of Fuzzy numbers , Lattice of fuzzy numbers and Fuzzy equations .
- CO4: Understand fuzzy Relations on fuzzy sets , Fuzzy binary & Fuzzy equivalence relations , Fuzzy morphism , it's standard composition , Sup - i compositions and inf - wi composition of fuzzy relations .

- CO5: Understand Fuzzy Relations Equations , Solution methods , Fuzzy relation equations based upon sup - i composition and inf - wi composition , approximation solution .

Course name - Fuzzy sets and Fuzzy Logic (4th semester)

Course outcomes - Upon successful completion of this course

students will able to-

- CO1: Understand Possibility theorem , Fuzzy measure , Evidence theory , Possibility theory versus Possibility theory .
- CO2: Describe Fuzzy Logic , overview of classical logic , Multi valued Logics , Fuzzy propositions and Quantifiers , Linguistic Hedges , Inference from conditional and qualified fuzzy proposition , the compositional rule of inference .
- CO3: Understand Approximate reasoning , Fuzzy expert systems overview , Fuzzy implication and their selection , Multi conditional approximate reasoning , the role of fuzzy relation equations .
- CO4: Explain Fuzzy control introduction , Fuzzy controllers , rule base , inference engine , Fuzzification . Defuzzification and various Defuzzification methods (the centre of area and maxima , and the mean of maxima methods).
- CO5: Understand , Decision making in Fuzzy Environment , individual deicision making , multi person decision making , multi criteria decision making , multistage decision making , Fuzzy ranking methods and their linear programming .

Course name - Operation research (3rd semester)

Course Outcome - Upon successful completion of this course students will able to-

- CO1: Explain the importance of operation research in real life their need, development, introduction with definition of Operation research.
- CO2: Define allocation problem it's all types and importance in real life.
- CO3: Solve linear programming by graphical method of solution their definitions and formulation given problem as Linear programming problem.
- CO4: Understand development of simplex method, definitios and fundamental theorem of Linear programming problem.
- CO5: Find feasible solution by simplex method and two phase method and Big M method of solution to LPP.
- CO6: Understand duality in Linear programming problem in simplex method, duality theorems and dual simplex methods algorithm.

- CO7: Understand Parametric linear programming problem, upper bound technique, interior point algorithm, Linear goal programming problem.
- CO8: Understand assignment problem solution it's mathematical formulation and optimality test.
- CO9: Define transportation problem, north west corner method, least cost method, Vogels approximation method, U-V method for optimality test.
- CO10: Construct the Network diagram, shortest path problem, minimum spanning tree and maximum flow-l problem.
- CO11: Understand minimum cost flow problem, Network simplex method, project simplex method, project planning and control l with PERT and COM method.

Course name - Operation Research-ll (4th semester)

Course outcome - Upon successful completion of this course

students will able to-

- CO1: Understand dynamic programming problem, Bellmens principal of optimality in Dynamic programming, solution of multi-stage problem by Dynamic programming with finite number of stages.
- CO2: Define solution of linear programming problem and an Inventory problem as a Dynamic programming problem.
- CO3: Describe Game theory, two person, zero-sum Games, games with mix stratagies, Graphical and by linear programming solution.
- CO4: Understand integer programming, Gomory's LPP method, Mixed integer cutting plane algorithm, Branch-and-bound technique algorithm.
- CO5: Understand Queuing theory, classification of Queuing models, poission queuing system, model 1, model 2, model 3, model 4, model 5, model 6,model 7, model 8 power supply model.
- CO6: Define non linear programming problem, solution of GNLPP and NLPP, Kuhn-Tucker conditions for constrained optimization, Quadratic and separable programming problem, convex and non - convex programming.

Course name - Elementary Hydrodynamics (3rd semester)

Upon successful completion of this course , students will be able to

- **CO1:** Understand equation of continuity , equation of continuity in cartesian coordinates , equation of continuity in polar coordinates , equation of continuity in cylindrical coordinates.
- **CO2:** Familiar with streamlines, velocity potential , rotational motion and conditions at a boundary surface.
- **CO3:** Define equation of motion , conservative field of force.
- **CO4:** Familiar with Bernoulli's equation, Euler's dynamical equations , equation of motion under impulsive forces.
- **CO5:** Define motion in two dimensions complex potential , magnitude of velocity.
- **CO6:** Understand the concepts such as two-dimensional sources and sinks, image , image of a source and doublet in a straight line and in a circle.
- **CO7: Prove** theorem of Blasius.

Course Name -Elementary Hydrodynamics (4th semester)

Upon successful completion of this course , students will be able to

- **CO1:** Understand motion in three dimensions , motion of a sphere in a liquid at rest at infinite .
- **CO2:** Familiar with concentric sphere , equations of motion of a sphere, Stoke's stream function .
- **CO3:** Define Vortex motion, conservation of velocity strength of a vortex tube , rectilinear vertices with elliptic section .
- **CO4:** Understand Vortex pair, image of a vortex filament in a plane , motion of a vortex in the file of several vortices , Karman Street.
- **CO5:** Familiar with wave function, travelling waves , Surface waves ,Progressive wave on the surface of a Canal.
- **CO6:** Understand stationary or standing waves on the surface of a Canal .
- **CO7:** Familiar with Progressive waves, Capillary waves ,Long gravity waves and group velocity .