Programme: B.A./B.Sc.I

Programme Outcome:

1. Logical and analytical thinking will be developed in students.
2. Students will acquire basic skills, technical knowledge along with knowledge of Physics and Chemistry.
3. Students will be aware of and able to develop solution oriented approach towards various social, economical and environmental issues
4. Provide students sufficient knowledge and skills enabling them to undertake further studies in Mathematics and its allied areas on multiple disciplines concerned with mathematics.
5. Students will be able to present mathematics clearly and precisely, make vague ideas precise by formulating them in the language of mathematics, describe mathematical ideas from multiple perspectives.

Programme Specific Outcome:

1. Familiarize the students with suitable tools of mathematical analysis to handle issues and problems in mathematics and related sciences.
2. Students will possess basic subject knowledge, required for higher studies, professional and applied courses like management studies, M.C.A. etc.
3. Acquire good knowledge and understanding to solve specific theoretical and applied problems in advanced areas of Mathematics.
4. The skills and knowledge gained has intrinsic beauty, which also leads to proficiency in analytical reasoning.
5. Enabling students to develop positive attitude towards Mathematics as an interesting and valuable subject of study.

Course Outcome:

B.A./B.Sc. I

Course: Algebra and Trigonometry

Students will be able

1. To understand the divisibility of integers and congruence relations

2. To understand the theory of equations by using some special methods like Descarte's method, Cardon's method, Ferrari's method.
3. To understand the groups like cyclic group, permutation group, normal group and their properties.
4. To understand to compare two different algebraic structures and study transfer of properties in between these structures through homomorphism and isomorphism.
5. To construct rigorous mathematical proofs of important theorems like Lagrange's theorem, Cayley's theorm and Fundamental Theorem of homomorphism.
6. To learn De Moivre's Theorem and its applications, Gregory's series and summation of series
7. To understand Euler's theorem, and elementary complex functions like exponential , hyperbolic and inverse hyperbolic, logarithmic functions

Course: Calculus

Students will be able to

1. Do successive differentiation, Leibnitz Theorem
2. use Maclaurin's Theorem, Taylor's Theorem ,
3. use Euler's Theorem for homogeneous functions and total differentiation
4. find and sketch asymptotes, curvature, envelopes, evolutes and tracing of curves.
5. Define Beta and Gamma functions with their properties
6. Evaluate areas bounded by curves, length of curves and volumes of solids of revolution

Course: Differential equations

Students will be able to

1. solve differential equations of first order and first degree
2. Solve differential equations of first order but not of first degree, such as Clairaut's form and to search for their singular solutions.

3. identify and solve linear differential equations with constant coefficients
4. Apply various methods to solve differential equations of second order with variable coefficients
5. To apply Laplace transforms to solve various types of differential equations

Course: Analytical Geometry

Students will be able to

1. Solve problems related to confocal conics, conicoids such as ellipsoid, hyperboloid, paraboloid and their properties
2. Find polar equations of conics
3. Identify and write equations of planes in various forms , straight lines and spheres, cones and cylinders
4. Reduce general equations of second degree in different forms of conics and to understand plane sections and generating lines.

B.A./B.Sc.II

Course: Abstract Algebra

Students will be able to

1. Identify ring, integral domain, field, principal ideal ring, Euclidean ring, polynomial ring.
2. Apply Eisenstein criterion and unique factorization domain for polynomials
3. Define & recognize vector spaces, linear dependence/ independence of vectors, linear sum, direct sum, quotient space.
4. Understand concept of linear transformation, dual space, change of basis.
5. Apply matrices to solve system of linear equations (homogeneous and non-homogeneous).
6. Construct the proof of Cayley –Hamilton theorem and use to find inverse of a matrix, eigen values and eigen vectors, diagonalization

Course: Real Analysis

Students will be able to

1. Describe fundamental properties of real numbers using Dedekind's theory.
2. Demonstrate an understanding of limits and how these are used in infimum, supremum, continuity, differentiability. sequence and series, convergence of improper integral.
3. Understand the concept of partitions of an interval and use it to find Riemann Integral and R-S integral.

Course: Advanced Calculus and Numerical Analysis

Students will be able to

1. Understand the concepts of limit and continuity of a function of two variables, Jacobians, Taylor's Theorem.
2. Solve practical problems based on maxima and minima of several variables.
3. Understand the process of vector differentiation, Integration and their applications through Gauss, Stokes and Green theorem.
4. Establish relations among various difference operators and their applications in polynomial interpolation and extrapolation, numerical differentiation and integration.

Course: Statics and Dynamics

Students will be able to

1. Solve problems on stable and unstable equilibrium, coplanar forces and equilibrium of coplanar forces.
2. Solve problems on principle of virtual work, catenary.
3. Break down the motion of an object into its components such as translational and rotational motions and solve problems based on rectilinear motion, motion in resisting medium, motion on smooth and rough plane curves.

B.A./B.Sc.III

Course: Metric Spaces

Students will be able to

1. Understand the concepts of metric spaces and their properties.

2. Classify and explain open and closed sets, closure, interior and boundary, convergence and continuity, base, axioms of countability, completeness, compactness, connectedness and separability of metric spaces.
3. Construct mathematical proofs of various theorems like Baire Category Theorem, Cantor's Theorem

Course: Complex Analysis and Calculus of variations

Students will be able to

1. State and prove Cauchy Riemann equations, Cauchy Theorem, Cauchy Residue Theorem, Morera's theorem, Liouville's Theorem, Jensen' Theorem etc.
2. Find the condition(s) for complex variable function to be analytic and/or harmonic, the Taylor's, Laurent's, Fourier series expansions of complex functions
3. Define and classify singularities of a function and, and evaluate complex integrals.
4. Define and find Fourier transform of a given function.
5. Understand what functional and variational principle are, and deduce Euler-Lagrange's equations for stationary paths subject to boundary conditions in simple cases.
6. Define and solve isoperimetric and Brachistochrone problems

Course: Tensors and Differential Geometry

Students will be able to

1. Understand concepts and properties of various types of tensors, Christoffel symbols,
2. Define and find curves in space and their tangents, normals, Binormals, curvatures and torsions, osculating plane and evolutes and involutes.
3. State and prove Serret- Frenet Formula, first and second fundamental forms, Gauss formulae, Weingarten's formulae, Meunier's Theorem, Euler's theorem, Beltrami and Enneper's theorem, Mainairdi- Codazzi equation

4. Define and obtain normal curvature, Gaussian curvature and mean curvature, lines of curvature, asymptotic lines and null lines, geodesic coordinates and geodesic curvature.

Course: Mechanics

Students will be able to

1. Solve problems of forces in three dimensions, Poinsot's central axis, wrenches, null lines and null planes, conjugate lines and conjugate forces
2. Understand Kepler's laws of planetary motion and central orbits, apses and apsidal distances
3. Solve problems based on motion of a particle in three dimension and motion on a smooth surface
4. Find moments and inertia of rigid bodies
5. State and prove D'Alembert's principle and solve problems related to motion of the centre of inertia, impulsive forces, compound pendulum and centre of percussions

Course: Linear Programming and Game Theory

Students will be able to

1. Solve linear programming problems using graphical and iterative methods.
2. Solve transportation od assignment problems
3. Understand the uses of game theory and solving problems based on it.
4. Understand concepts of convex sets and functions, and integer programming

Course: Special Theory of Relativity

Students will be able to

1. Understand the fundamental principle of special theory of relativity.

2. Understand meaning of basic concepts like equivalence principles, inertial frames, time dilation etc.
3. Explain the true nature of Newtonian mechanics and Lorentz Transformation.
4. Understand the concepts of null cone, proper time, Minkowskian space- time
5. Establish the non-existence of the hypothesized stationary aether through the null result of Michelson's -Morley experiment.
6. Explain various phenomena in light of Maxwell's field equations.

Course: Discrete Mathematics

Students will be able to

1. Understand basic principles and operations of sets, relations, functions and propositions, combinatorics.
2. Understand formal languages, finite state machines, discrete numeric functions and generating functions. Recurrence relations and their solutions
3. Understand various types of graphs, trees and related problems like shortest path, Eulerian path, Travelling-Salesman Problem.
4. Understand lattices, Boolean Algebra and their applications in swiching circuits.

Programme: M.A. /M.Sc., Mathematics

Programme Outcomes

1. Inculcate critical and logical thinking to carry out scientific investigation objectively, without being biased with preconceived notions.
2. Prepare students for pursuing research or careers industry, in Mathematical sciences and allied fields.
3. Continue to acquire relevant knowledge and skills appropriate to professional activities.

Programme Specific Outcome

1. Solve complex problems by critical understanding, logical thinking and analysis.
2. Provide advanced knowledge on topics in pure mathematics, empowering the students to pursue higher degrees at reputed academic institutions.
3. Provide a systematic understanding of the concepts and theories of mathematics and their application in the real world, to an advanced level and enhance career prospects in a huge array of fields.
4. Students will become employable; they will be eligible for career opportunities in DRDO, ISRO, Defense services, Civil services, Banking Services etc.
5. Assist students in preparing for competitive exams, e.g. NET, GATE, etc.

Course outcome

M.A. /M.Sc. Semester I:

Course: Groups and Canonical forms:

Students will be able to

1. Define class equation of a finite group and related problems.
2. Discuss group automorphism, inner automorphism, composition series and Jordan Holder Theorem.
3. Define solvable group, nilpotent group, Cauchy's theorem and Sylow's theorems

4. Define nilpotent transformations.
5. Discuss canonical forms Jordan forms and Jordan blocks.

Course: Topology-I

Students will be able to

1. Identify topological spaces, neighbourhoods of a point, local base for a point, base and subbase for a topology, closed sets, limit points of a set, interior points, closure of a set, subspaces
2. Define the continuous functions, homeomorphic mappings, hereditary and topological properties
3. Define compact, countably compact, sequentially compact spaces, Lindelof spaces, separable spaces, first and second countable spaces and one-point compactification.

Course: Differential and Integral equations

Students will be able to

1. Define series solution by various methods
2. Discuss Legendre, Bessel and hypergeometric functions and their properties.
3. Define integral equations, in particular Volterra and Fredholm integral equations
4. Define Hilbert Schmidt theory for symmetric kernels.

Course: Riemannian Geometry

Students will be able to

1. Define curvature of curve and Geodesic and its applications.
2. Define congruences and orthogonal ennuples and Ricci's coefficients of rotation, curvature of congruence.
3. Discuss Riemannian curvature of n-dimensional space and Schur's theorem.
4. Define projective and conformal transformation (Weyl's projective)

Course: Hydrodynamics

Students will be able to

1. Define Lagrangian and Eulerian methods and related problems.
2. Discuss irrotational and rotational equations.
3. Discuss Bernoulli's theorem and related problems.
4. Discuss Blasius theorem, motion of sphere and cylinder.

Course: Operations Research-I

Students will be able to

1. Formulate and solve problems as networks and graphs
2. Use CPM and PERT techniques to plan, schedule and control project activities.
3. Develop LP models for shortest paths, maximum flow, critical path, minimum cost flow.
4. Formulate and analyse the general non-linear programming problems.
5. Explain Lagrange's multipliers and show Kuhn-Tucker optimality conditions.
6. Solve multi-level decision problems, using dynamic programming method, sequencing problems.

Course: Programming in C (with ANSI features)

Students will be able to

1. Understand arithmetical and functional hierarchial code organization.
2. Define and manage various type of data and data- structures based on problems subject domain.
3. Have ability to work with textual information, characters, strings and arrays.
4. Have ability to handle possible errors during program execution.
5. Define various types of functions and able to apply various types of decision making, statements/loops.
6. Able to apply in various fields of Mathematics

M.A./M.Sc. Semester-II

Course: Field Extension and Modules

Students will be able to

1. Understand extension of field, algebraic extension of a field, splitting field polynomials, Galois field, normal extension
2. State and prove fundamental theorem of Galois theory
3. Have basic concepts of construct ion by ruler and compass using algebra.
4. Define module theory as linear algebra over general rings.
5. Construct special classes of modules e.g., cyclic modules , simple module, semi-simple module, Noetherian and Artinian module, free modules.

Course: Topology-II

Students will be able to

1. Understand the separation axioms, Urysohn's lemma, Tietze Extension Theorem
2. Discuss nets, filters and their convergence.
3. Understand product of two and more topological spaces and quotient spaces

Course: Partial Differential Equations

Students will be able to

1. Solve partial differential equations of first order, using Lagrange's solution, Cauchy's method and Charpit's method.
2. Solve partial differential equations of second order and higher orders including .Monge's method.
3 Solve Laplace, wave and diffusion equations using method of separation of variables.

Course: Differential Geometry of Manifolds

Students will be able to

1. Define differentiable manifolds, differentiable curves, Tangent space, vector fields, lie bracket.

2. Explain covariant differentiation, Torsion, curvature, Lie derivative

3. Define Riemannian manifold, Riemannian connection, Riemannian curvature tensor, Ricci tensor, mean curvature, equations of gauss and Codazzi and are able to explain related concepts.

Course: Fluid Dynamics

Students will be able to

1. Explain concepts of wave motion in gas, speed of light,, subsonic , sonic and supersonic flows of gas , shock formation and shock waves

2. Define stress components in a real fluid, Navier-Stokes equations of motion,

3. Explain concepts of Steady viscous flow, diffusion of vorticity, Reynolds number.

Course: Operations Research-II

Students will be able to

1. explain meaning of out-output, Leontief static model, Inter-industrial relation and related concepts.

2. classify inventory and are able to define various type of models

3. Define various replacement models and find their solutions.

4. formulate and solve dynamic programming problems

M.A./M.Sc. Semester III

Course: Advanced Real Analysis

Students will be able to

1. test poinwise and uniform convrgence of Series and sequence of continuous functions.

2. compute RS-Integrals and variations of functions and prove their properties
3. define and prove properties of the exterior measure on R
4. Measurable sets and Lebesgue measure, construction of non-measurable sets , measurable functions
5. Compute Lebesgue measures
6. Establish measurability or non-measurability of sets and functions.
7. Extend the concepts of measures and integration

Course: Banach Spaces

Students will be able to

1. Understand the Banach spaces, Holder's and Minkowski's inequalities Bounded linear operators, open mapping theorem, closed graph theorem
2. Define uniform boundedness principle, Hahn- Banach Theorem
3. Understand Dual spaces of some important Banach spaces, reflexive space

Course: Advanced Complex Analysis

Students will be able to

1. Explain analytic continuation, power series,, Riemann surfaces, gamma and Zeta functions and reltaed concepts,
2. State and prove Hadamard's multiplication theorem, maximum-modulus theorem, Schwarz;s lemma , Vitali's Convergence Theorem, Hadamard' three circle theorem.
3. Explain conformal transformations, Radius of convergence of power series and related concepts.

Course: Dynamics of Rigid bodies

Studen ts will be able to

1. Explain harmonic oscillators, damped and forced oscillations, motion of a rigid body and kinetic and moment of momentum in two –dimensions.
2. Explain motion of a billiard ball , motion of system of particles, momentum of a rigid body
3. Define Euler's equations of motion, kinetic energy of a rigid body

4.Explain motion relation to earth's surface.

Course: Special Functions-I

Students will be able to

1. Define Gamma function, Analytic characters, Euler's limit formula, duplication formula and hypergeometric function.
2. Define Legendre function, complete solution of Legendre's differential equation, Integral representation and recurrence formula for $P_n(z)$ and $Q_n(z)$.

Course: General Relativity

Students will be able to

1. Define principal of equivalence, Mach principle, Geodesic postulate.
2. Define Einstein's field equation and discuss related problems.
3. Discuss crucial tests in general relativity.
4. Define analogues of Kepler's law, energy momentum tensor and killing equation.

M.A./M.Sc. Semester IV

Course: Lebesgue Integration

Students will be able to

1. Compute Lebesgue integrals, applications to volume calculations and Fourier analysis.
2. Decide under which conditions the fundamental theorem of calculus is applicable in the context of Lebesgue integration
3. Understand the properties of Lebesgue integration, convergence theorems for Lebesgue integrals
4. Establish Connection between differentiation and integration in the context of Lebesgue theory.

Course: Hilbert Spaces

Students will be able to

1. Explain inner product spaces and Hilbert spaces, parallelogram law, ,orthonormal vectors, projective operators and related properties.
2. Define polarisation identiy, Bessel's inequality
3. Construct proof of Riesz-Frechet representation theorem.
4. Explain Hilbert adjoint operators and their properties.
5. Explain self-adjoint operators, normal operators, unitary operators and orthogonal projection operators and their properties.

Course: Discrete Mathematics

Students will be able to

1. Define semigroups , monoids, quotient semigroups, and related concepts.
2. Explain lattice, distributive lattices, complemented lattices and related concepts.
3. Explain Boolean algebra and its properties, Switching algebra, atoms, minterms, join-irreducible elements
4. Define various types of graphs: paths, circuits, planar graphs, connected graphs, trees.

Course: Analytical Dynamics

Students will be able to

1. Classify dynamical systems, and define generalized coordinates, generalized components of momentum and effective applied forces
2. Define Lagrange's equations for energy, impulsive motion.
3. Explain Hamiltonian's equations of motion, principle of least action, Poisson's brackets, Lagrange's equation of small oscillations.
4. Define normal modes and normal coordinates and related concepts.

Course: Special Functions-II

Students will be able to

1. Define Bessel's differential equation and its series solution, Recurrence formula for $J_n(z)$ and generating function for $J_n(z)$.
2. Discuss connection between Bessel and Hankel function and complete solution of Bessel's equation
3. Define elliptic functions of Weirstass, Periodic function, the irreducible poles and zeros of an elliptic function and their properties.

Course: Cosmology

Students will be able to

1. Define various types of cosmological models
2. Differentiate between Einstein universe and De-sitter universe
3. Explain geometrical features of R-W metric, Big-bang theory, c-field theory, steady state theory
4. Define cosmological equations.

Programme: Ph.D. Mathematics

Programme Outcomes

Students have/capable of

- Undergone relevant (taught) courses required for undertaking specialized research.
- Identifying unsolved yet relevant problem in a specific field.
- Articulating ideas and strategies for addressing a research problem.
- Undertaken original research on a particular topic.
- Effectively communicating research, through journal publications and conference presentations, to the mathematics community.
- Disseminating research to a broader audience.

Program Specific Outcomes

- Generate publications in reputed mathematical journals.
- Provide scope for interaction with international researchers and developing collaborations.
- Demonstrate the highest standard of ethics in research.
- Produce next generation researchers in Mathematics.