Department of Mathematics

Programme Specific Outcome

PSO 1 B.Sc. graduates apply their broad knowledge of science across a range of fields, with in-depth knowledge in at least one area of study, while demonstrating an understanding of the local and global contexts in which science is practiced.

PSO 2 Articulate the methods of science and explain why current scientific knowledge is both contestable and testable by further inquiry. Apply appropriate methods of research, investigation and design, to solve problems in science.

PSO 3 Mathematics UG student at Indraprastha New Arts, Commerce and Science College, Wardha will be able to apply critical thinking skills to solve problems that can be modelled mathematically, to critically interpret numerical and graphical data, to read and construct mathematical arguments and proofs, to use computer technology appropriately to solve problems and to promote understanding, to apply mathematical knowledge to a career related to mathematical sciences or in post - UG studies.

Course Outcomes

Course/Semester/ Paper : B.Sc. Sem I Paper I
Name of Paper: M-1: Elementary Mathematics

CO1: Apply De Movie's Theorem to find powers and roots of complex numbers, and solve polynomial equations involving complex roots.

CO2: Analyse and manipulate matrices using various techniques, including determining the rank of a matrix, transforming matrices to row canonical form, solving systems of equations, and applying the Cayley Hamilton theorem to derive properties of a matrix.

CO3: Students will gain a comprehensive understanding of various theorems and techniques for analysing and solving equations, including relations between roots and coefficients, Descartes' rule of signs, Horner's

process, transformation of equations, reciprocal equations, and solutions for cubic and biquadratic equations.

CO4: Students will be able to understand and apply the division algorithm, greatest common divisor, Euclidean algorithm, Diophantine equations, the fundamental theorem of arithmetic, properties of congruence, linear congruence, and the Chinese remainder theorem.

Course/Semester/ Paper : B.Sc. Sem I Paper II
Name of Paper: M2: Differential and Integral Calculus

CO1: Students will be able to find out expansion of various functions.

CO2: Students can find limit and continuity of functions of two variables.
CO3: Students will able to solve problems of maxima and minima of functions of two variables.

CO4: Students learn how to find nth derivative of functions by using reduction formulae.

Course/Semester/ Paper : B.Sc. Sem II Paper I

Name of Paper: M3: Geometry, Differential & Difference Equations

CO1: Students get idea about sphere and they can find the equation of sphere. CO2: Students get idea about various Differential equations and they solve the problems.

CO3: Students learn second order linear equation they are able to solve the problems.

CO4: They learn definition of difference equation and are able to find the solutions of difference equations.

Course/Semester/ Paper : B.Sc. Sem II Paper II

Name of Paper: M-4: Vector Analysis

CO1: Students will be able to effectively apply vector differentiation techniques, understand concepts of differential geometry, and confidently work with gradient, divergence, and curl operations.

CO2: Students will possess the skills to successfully perform double integration, evaluate double integrals, apply double integrals in various applications, work with area in polar coordinates, perform triple integration, understand the gamma function, its transformation and relation with the beta function, and evaluate and manipulate the beta function including its symmetric property and transformation.

CO3: Students will have the ability to effectively integrate vectors over curves, calculate line integrals, perform surface integrals, and evaluate volume integrals.

CO4: Students will be able to apply Green's theorem in the plane and its applications, understand and utilize the Gauss divergence theorem, and apply Stokes' theorem to solve various problems in vector calculus.

Course/Semester/ Paper : B.Sc. Sem III Paper I

Name of Paper: M5: Partial differential equation and Calculus of variations

CO1: Students learn PDE and come to know how to solve the PDE.

CO2: Students are able to find linear PDE by various method.

CO3: Students know the various method of solving linear PDE with constant coefficients.

CO4: Students get idea of definition of functional and able to find functional.

Course/Semester/ Paper : B.Sc. Sem III Paper II

Name of Paper: M-6: Modern Algebra

CO1: Students will have a solid understanding of the definition and examples of groups, the concept of subgroups, and a counting principle related to group theory.

CO2: Students will have a comprehensive understanding of normal subgroups and quotient groups, homomorphisms, and permutation groups.

CO3: Students will have a thorough understanding of the definition and examples of rings, various special classes of rings, homomorphisms, ideals, and quotient rings.

CO4: Students will have a deep understanding of the field of quotients of an integral domain, Euclidean rings, a specific Euclidean ring, and polynomial rings.

Course/Semester/ Paper : B.Sc. Sem IV Paper I

Name of Paper: M-7: Real Analysis

CO1: Students are able to find the open sets interior point and limit point of a set, they are able to solve the examples.

CO2: Students are able to find the convergent and divergent sequence

CO3: Students learn the infinite series and able to solve the various problems.

CO4: Students will be familiar with remain integral and properties of integral function.

Course/Semester/ Paper : B.Sc. Sem IV Paper II

Name of Paper: M-8: Mathematical Methods

CO1: Students will possess a comprehensive understanding of the introduction to series solutions, power series review, the series solution of

first-order equations, second-order linear equations, ordinary and singular points, regular and irregular singular points, as well as Legendre's and Bessel's equations.

CO2: Students will have a solid grasp of Legendre's and Bessel's functions, including their properties, generating functions, recurrence relations, and the concept of orthogonality of functions.

CO3: Students will have a comprehensive understanding of the Laplace transform and its application, including the transformation of elementary functions, properties of Laplace transforms, inverse Laplace transforms, transforms of derivatives and integrals, Laplace transform of t·f(t), Laplace transform of f(t)/t, the convolution theorem, and the solution of ordinary differential equations with constant coefficients as well as simultaneous ordinary differential equations.

CO4: Students will have a comprehensive understanding of Fourier coefficients, convergence issues, even and odd functions, halfrange cosine and sine series, and the extension of Fourier series to arbitrary intervals.

Course/Semester/ Paper : B.Sc. Sem V Paper I

Name of Paper: M-9: Complex Analysis

CO1: Students will have a comprehensive understanding of functions of complex variables, including their definition, limits, continuity, differentiability, analyticity, the necessary and sufficient conditions for a function to be analytic, the Cauchy-Riemann equations in polar form, orthogonal curves, harmonic functions, and methods for finding conjugate functions using the Milne-Thomson method.

CO2: students will have a comprehensive understanding of transformations, including conformal transformations, linear transformations, magnification, rotation, inversion, reflection, their combinations, bilinear transformations, and the Schwarz-Christoffel transformation.

CO3: Students will have a comprehensive understanding of complex integration, including the Cauchy integral theorem, Cauchy integral formula, Morera's theorem, Cauchy's inequality, and Liouville's theorem.

CO4: Students will possess a comprehensive understanding of the convergence of series with complex terms, Taylor's theorem, Laurent's theorem, singular points, residues, residue theorem, evaluation of real definite integrals using contour integration, and evaluation of improper indefinite integrals.

Course/Semester/ Paper : B.Sc. Sem V Paper II

Name of Paper: M10:Metric Space , Boolean Algebra & Graph Theory

CO1: Students get idea of metric space, interior point, open sets and closed sets.

CO2: Students solve the problems of metric space and compact sets.

CO3: Students learn the properties of lattices.

CO4: Students know basic concept of graph theory and solve the problems. And learn how to find metric representation of graphs.

Course/Semester/ Paper : B.Sc. Sem V Paper II

Name of Paper: M-11: Mechanics (Optional)

CO1: Students will have a comprehensive understanding of forces acting at a point, parallel forces, moments, couples, coplanar forces, reduction theorems, equilibrium under three forces, general conditions of equilibrium, and the concept of the centre of gravity.

CO2: Students will have developed a thorough understanding of work and energy principles, virtual work applications, the behaviour of flexible strings, and the characteristics of the common catenary.

CO3: Students will have acquired a comprehensive understanding of motion in a plane, including velocity and acceleration components, angular velocity and acceleration, the relationship between angular and linear velocities, tangential and normal components of velocity and acceleration, Newton's Laws of motion, and projectile motion.

CO4: Students will have developed a comprehensive understanding of Lagrange's dynamics, constraints, generalized coordinates, the principle of virtual work and D'Alembert's principle, Lagrange's equations, the reduction of the two-body central force problem to the equivalent one-body problem, motion in a plane under central force, differential equations of an orbit, the inverse square law of force, and the Virial theorem.

Course/Semester/ Paper : B.Sc. Sem VI Paper I

Name of Paper: M-12: Linear Algebra

CO1: Students are able to find that given set is a vector space or not.

CO2: They learn definition of linear transformation and solve the problems.

CO3: They come to know the application the theory of ordinary DE.

CO4: Students get the idea of linear operation of matrices.

Course/Semester/ Paper : B.Sc. Sem VI Paper II

Name of Paper: M13: Numerical Methods (Optional)

CO1: Students will have developed a strong understanding of various numerical methods for solving equations, including the bisection method,

the method of false position, iteration methods, the Newton Raphson method, Ramanujan's method, the secant method, Muller's method, and techniques for solving systems of non-linear equations.

CO2: Students will have a solid understanding of finite differences, differences of a polynomial, Newton's formulae for interpolation, central difference interpolation formulae, interpolation with unevenly spaced points, divided differences and their properties, as well as inverse interpolation.

CO3: Students will have acquired a comprehensive understanding of numerical differentiation, determining maximum and minimum values of a tabulated function, numerical integration techniques, and the application of the Euler-Maclaurin formula.

CO4: Students will have developed a solid understanding of various numerical methods, including solution by Taylor's series, Picard's method of successive approximation, Euler's method, Runge-Kutta method, predictor-corrector method, cubic spline method, and techniques for solving simultaneous and higher-order equations.

Course/Semester/ Paper: B.Sc. Sem VI Paper II

Name of Paper: M-14: Special Theory of Relativity (Optional)

CO1: Students will have developed a solid comprehension of Newtonian mechanics, covering topics such as inertial frames, the speed of light and Galilean relativity, the relative nature of space and time, the postulates of the special theory of relativity, the geometric interpretation of Lorentz transformation equations, and the group properties associated with Lorentz transformations.

CO2: Students will have gained a comprehensive understanding of relativistic kinematics, including the composition of parallel velocities, the relativistic addition law for velocities, transformation equations for velocity

and acceleration components, the transformation of Lorentz contraction factor, length contraction, and time dilation.

CO3: Students will have developed a comprehensive understanding of the geometrical representation of space-time in the context of relativity, including the four-dimensional Minkowskian space-time, space-like and time-like intervals, proper time, the concept of the light cone or null cone, and the use of four-vectors and tensors in Minkowskian space-time.

CO4: Students will have developed a comprehensive understanding of relativistic mechanics and electromagnetism, covering topics such as the variation of mass with velocity, the equivalence of mass and energy, transformation equations for mass, momentum, and energy, relativistic force and its components, relativistic Lagrangian and Hamiltonian, Maxwell's equations in vacuum, propagation of electric and magnetic field strengths, the fourpotential, and transformation equations for electromagnetic four-potential vector, electric and magnetic field strengths.

Programme Specific outcomes (PSOs) in M.Sc. (Mathematics)

After completing M.Sc. (Mathematics), students will:

PSO1: Get advanced knowledge of various branches of Mathematics.

PSO2: Be able to apply their skills, mathematical ideas and tools to solve mathematical

problems.

PSO3: Develop abilities for logical reasoning, critical thinking, analysing, and problem solving.

PSO4: Develop research culture.

Master of Science (M.Sc.) in Mathematics

Course outcomes

Title of paper Algebra I

Course Code PG- MATHEMATICS

After successful completion of this course, students will:

CO1: Understand basic group theory and advanced group theory.

CO2: Be prepared for basic Algebra.

CO3: Get basics of ring theory and field theory, Galois theory etc.

Title of paper Real Analysis I

Course Code PG- MATHEMATICS

After successful completion of this course, students will:

CO1: Develop mathematical understanding of Real analysis.

CO2: Gain confidence in proving theorems and solving problems on Uniform Convergence.

CO3: Understand the generalized concept of Sequence and Series of Functions.

CO4: Appreciate the concept of Manifolds and Lie Groups.

Title of paper Topology I

Course Code PG- MATHEMATICS

After successful completion of this course, students will:

CO1: Understand the concepts of topological spaces, and their role in mathematics.

CO2: Have ability to prove results about completeness, compactness, connectedness.

CO3: Have knowledge of convergence of sequences in topological spaces.

CO4: Will form a basis for advanced topology.

Title of paper Ordinary Differential Equations

Course Code PG- MATHEMATICS

After successful completion of this course, students will:

CO1: Get basic notions in Differential Equations and use the results in developing advanced mathematics.

CO2: Have ability to solve application problems modelled by linear differential equations

CO3: Use power series methods to solve differential equations about ordinary points and regular singular points.

CO4: Understand the concepts of existence and uniqueness of solutions.

Title of paper Integral Equations

Course Code PG- MATHEMATICS

After successful completion of this course, students will:

CO1: Have knowledge of preliminary concepts of integral equations.

CO2: Have ability to use the results in other branches of mathematics.

CO3: Have capability to solve Voltera and Fredholm equation.

Title of paper Algebra-II

Course Code PG- MATHEMATICS

After successful completion of this course, students will:

CO1: Understand advanced group theory and abstract algebra.

CO2: get idea about s rings, ideals, homeomorphism rings and modules.

CO3: have enhanced thinking power in algebra and motivation for research.

Title of paper Real Analysis II

Course Code PG- MATHEMATICS

After successful completion of this course, students will:

CO1: Understand the generalized concept of measure and integration.

CO2: The student will gain confidence in proving theorems and solving problems.

CO3: develop mathematical maturity.

CO4: Student will understand the need to generalize the concept of integration.

Title of paper Topology II

Course Code PG- MATHEMATICS

After successful completion of this course, students will:

CO1: Get the advanced concepts of topological spaces.

CO2: Have ability to prove results about completeness, compactness, connectedness.

CO3: Have knowledge of convergence of countability and separation axioms.

CO4: Have motivation for research.

Title of paper Differential geometry

Course Code PG- MATHEMATICS

After successful completion of this course, students will:

CO1: Get fundamentals of Differential geometry.

CO2: Have clarity on theory of curves and surfaces in 3-spaces.

CO3: Derive fundamental quadratic forms of the surfaces and Gauss-Bonnet theorem.

Title of paper Classical Mechanics

Course Code PG- MATHEMATICS

After successful completion of this course, students will:

CO1: Have ability to derive Lagrange Equation and Conservation Theorems.

CO2: Have knowledge of Legendre Transformations and Canonical Transformations.

CO3: Understand Hamilton Principle and Variational Principle.

Title of paper Complex Analysis

Course Code PG- MATHEMATICS

After successful completion of this course, students will:

CO1: Become familiar with the concepts of Complex numbers and their properties and operations with Complex number.

CO2: Evaluate limits and checking the continuity of complex function.

CO3: Checking differentiability and Analyticity of functions.

CO4: Evaluate Complex integrals and applying Cauchy integral.

CO5: Understand how complex numbers provide a satisfying extension of the real numbers.

CO6: To understand certain theorems like Casorti-wierstrass theorems, Hadamards three circle theorem.

Title of paper Functional Analysis

Course Code PG- MATHEMATICS

After successful completion of this course, students will be able to:

CO1: Appreciate how functional analysis uses and unifies ideas from vector spaces, the theory of metrics, and complex analysis.

CO2: Understand and apply fundamental theorems from the theory of normed and Banachspaces, including the Hahn-Banach theorem, the open mapping theorem and the closed graph theorem.

CO3: Appreciate the role of Inner product space

CO4: Understand and apply ideas from the theory of Hilbert spaces to other areas.

CO5: Understand the fundamentals of spectral theory, and appreciate some of its power.

Title of paper Mathematical Methods

Course Code PG- MATHEMATICS

After successful completion of this course, students will:

CO1: Have ability to solve Differential Equations with initial conditions using Laplace Transforms.

CO2: Develop skills to evaluate Fourier Transform of continuous function and be familiar with its basic properties.

CO3: Appreciate Finite Hankel Transform, Finite Legendre Transform and Finite MellinTransform.

Title of paper Fluid Dynamics-I

Course Code PG- MATHEMATICS

At the end of this course students will be able to:

CO1: Develop appreciation properties of fluid.

CO2: Derive Euler's equation, Bernoulli's equation and discuss the case of steady motions under conservative body forces.

CO3: Apply concepts of mass, momentum and energy conservation to flows.

CO4: Prove Milne-Thomson circle theorem and derive some application.

CO5: Understand the concept of elements of thermodynamics and explain Entropy-Maxwell's Thermodynamics relations.

Title of paper Operation Research-I

Course Code PG- MATHEMATICS

At the end of this course students will be able to:

CO1: Solve many financial decision-making problems by using linear programming technique.

CO2: Explain the graphical solution of linear programming problem by different method.

CO3: Develop all skill and technique of problem solving.

CO4: Acquire the knowledge and understanding of Queuing system.

Title of paper Dynamical Systems

Course Code PG- MATHEMATICS

At the end of this course students will be able to:

CO1: understand fundamental concepts related to modelling time dependent phenomena.

CO2: extend their knowledge of calculus to solve problems in difference (and maybedifferential) equations.

CO3: improve problem solving skills.

CO4: Develop Research Attitude.

Title of paper Partial Differential Equations

Course Code PG- MATHEMATICS

Upon successful completion this course, the student will be able to:

CO1: Find solutions of partial differential equations and determine the existence, uniqueness of solution of partial differential equation.

CO2: Find out the complete integral by Charpits method and also find the particular integral, singular integral

CO3: Solve simple eigenvalue problems of Sturm-Liouville type.

CO4: Classify partial differential equations into Linear equation, Semi-linear, Quasi-linear and nonlinear equations.

CO5: Understand the Dirichlet problem, Neumann problem and apply to solve problem for half plane.

Title of paper Advanced Numerical Methods

Course Code PG- MATHEMATICS

After the completion of the course, Students will be able to:

CO1: Enhances their theoretical view towards numerical methods.

CO2: Clear core linear algebra as well as numerical methods.

CO3: Understand different types of methods to calculate LU factorization, floating point numbers.

CO4: Appreciate different types of methods to calculate LU factorization, floating point numbers.

Title of paper Fluid Dynamics II

Course Code PG- MATHEMATICS

After the completion of the course, Students will be able to:

CO1: Apply scientific method strategies to fluid mechanics to analyse qualitatively and quantitatively the problem situation, propose hypotheses and solutions.

CO2: Define and illustrate Viscous Flow, apply to solve problems.

CO3: Understand concept of Magneto hydrodynamics and derived Maxwell's electromagnetic field equation.

CO4: Acquire the knowledge of boundary layer and apply to solve problems.

Title of paper Operation Research-II

Course Code PG- MATHEMATICS

At the end of this course a student will be able to:

CO1: Solve Linear Programming Problem by Revised Simplex Method.

CO2: Understand Integer Programming and Post Optimality Analysis.

CO3: Develop all skill and technique of problem solving.

CO4: Acquire the knowledge and understanding of Queueing Theory and Inventory Control.

CO5: Appreciate Bounded Variable Technique for solve Linear Programming Problem.