DEPARTMENT OF MATHEMATICS | **PSO/CO**

PROGRAMME SPECIFIC OUTCOMES AND COURSE OUTCOMES OF MATHEMATICS (UG & PG)

DEPARTMENT OF MATHEMATICS | PSO/CO

VISION

The vision of the Department of Mathematics is to generate skilled mathematical minds with all scientific aptitude for every comer of the knowledge-based society. We feel that it's a continuous process to provide Mathematical entrepreneurs with not only pure and natural science but also Commerce, Economics, and various other social sciences. The future of the world will depend upon a knowledge-based society and in the panorama of the knowledge mathematical application occupy a central position, so the generation of the skillful mathematician to stand before a knowledge-based society is our primary vision. Our next step vision is to produce both applied and basic mathematical knowledge, besides revival of the basic ancient traditional mathematical knowledge of India.

MISSION

In order to adopt our vision, our mission framed with the thought keep in mind that **"Mathematics is the central tool used in all the branches of science as well social science"**. So with this quotation our mission is –

- To generate interest among students for scientific validation of traditional Indian mathematical knowledge.
- To train undergraduate and postgraduate students with strong skills and knowledge of mathematical science.
- To induce younger to undertake challenges of research for the improvement of knowledge.
- Our department is dedicated to improve logical and analytical thinking ability, problem solving abilities, to the students and experienced a change in their attitude. They also acquire a high level of confidence for self-study to undertake advanced courses in mathematics.
- To create a pleasant environment for research among students of various degree levels.
- To create stakeholders with both basic and applied mathematical knowledge.

UNDER GRADUATE WITH MATHEMATICS
(BACHLER OF SCIENCE)
PROGRAM OUTCOME

- **PO1. Knowledge and theory –**
  Apply their board 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.
- **PO2. Application –**
  Apply appropriate methods of research, investigation and design.
- **PO3. Proficiency in technology -**
  Recognize the need for information employ highly developed conceptual, analytical, quantitative and technical skills and are adept with a range of technologies.
- **PO4. Team work –**
  Work effectively in groups to meet a shared goal with people whose disciplinary and cultural backgrounds differ from their own.
- **PO5. Communicate –**
  Clearly and convincingly about science and technology ideas practices.
- **PO6. Professional and ethical behavior-**
  Demonstrative personal and professional integrity by respecting diverse point of view and the intellectual contribution of others.
- **PO7. Problem solving and critical thinking-**
  Critically evaluate ideas and arguments by gathering relevant information, assessing its credibility and synthesizing evidence to formulate a position.
- **PO8. Environment Sensitivity –** To sensitize young ones towards environment and sustainability and significance of sustainable development.

SCHEME OF EXAMINATION

Subject	Paper	Max. Mark	Total Marks	Min. Marks	
Environmental Studies		**75**	**100**	**33**	
Field Work		**25**			
Foundation Course					
Hindi Language	I	75	75		26
English Language	I	75	75		26
नोट– प्रत्येक खंड में से 2 दो प्रश्न हल करने होंगे। सभी प्रश्नपत्र समान अंक के होगें।					
Three Elective Subject:					
1. Physics	I		50		
	II		50	100	33
	Practical			50	17
2. Chemistry	I		33		
	II		33	100	33
	III		34		
	Practical			50	17
3. Mathematics	I		50		
	II		50	150	50
	III		50		
4. Botany	I		50		
	II		50	100	33
	Practical			50	17
5. Zoology	I		50		
	II		50	100	33
	Practical			50	17
6. Geology	I		50		

DEPARTMENT OF MATHEMATICS | PSO/CO

COURSE	BSC I ALGEBRA AND TRIGONOMETRY
CO No.	**Course Outcomes - This course will enable the student to learn about**
CO 1	Elementary operations on matrices, Inverse of a matrix. Linear independence of row and column matrices, Row rank, column rank and rank of a matrix.
CO 2	Application of matrices to a system of linear (both homogeneous and nonhomogeneous) equations. Theorems on consistency of a system of linear equations.
CO3	Mappings, Equivalence relations and partitions. Congruence modulo n. Definition of a group with examples and simple proper ties. Subgroups, generation of groups,
CO4	Homomorphism and Isomorphism of groups. The fundamental theorems of homomorphism.
CO5	De-Moivre's theorem and its applications. Direct and inverse circular and hyperbolic functions.

COURSE	BSC I CALCULUS
CO No.	**Course Outcomes - This course will enable the student to learn about**
CO 1	Basic properties of limits. Continuous functions and classification of discontinuties. Differentiability.
CO 2	Asymptotes. Curvature. Tests for concavity and convexity. Points of inflexion. Multiple points.
CO3	Integration of transcendental functions. Reduction formulae. Definite integrals.
CO4	Degree and order of a differential equation. Equations reducible to the linear form. Exact differential equations.
CO5	Linear differential equations of second order. Transformation of the equation by changing the dependent var iable/the independent var iable.

COURSE	BSC I VECTOR ANALYSIS AND GEOMETRY
CO No.	**Course Outcomes - This course will enable the student to learn about**
CO 1	Scalar and vector product of three vectors. Product of four vectors. Reciprocal Vectors. Vector differentiation. Gradient, divergence and curl.
CO 2	Vector integration. Theorems of Gauss, Green, Stokes and problems based on these.
CO3	General equat ion of second degree. Tracing of conics. System of conics. Confocal conics. Polar equation of a conic.
CO4	Sphere. Cone. Cylinder.
CO5	Central Conicoids. Paraboloids. Plane sections of conicoids. Genera ting lines. Confocal Conicoids. Reduction of second degree equations.

DEPARTMENT OF MATHEMATICS | PSO/CO

COURSE	BSC II ADVANCED CALCULUS
CO No.	**Course Outcomes - This course will enable the student to learn about**
CO 1	Sequence, Series of non-negative terms, Convergence of Sequence and Series
CO 2	Continuity, differentiability, and Mean value theorems and their geometrical interpretations.
CO3	Limit and continuity of functions of two variables. Partial differentiation.
CO4	Envelopes, evolutes. Maxima, minima and saddle points of functions of two variables. Lagrange's
CO5	Beta and Gamma functions, Double and triple integrals, Dirichlet's integrals.
COURSE	BSC II DIFFERENTIAL EQUATIONS
CO No.	**Course Outcomes - This course will enable the student to learn about**
CO 1	Series solutions of differential equations
CO 2	Laplace Transformation
CO3	Partial differential equations of the first order.
CO4	Partial differential equations of second and higher orders,
CO5	Calculus of Variations- Variational problems with fixed boundaries-
COURSE	BSC II MECHANICS
CO No.	**Course Outcomes - This course will enable the student to learn about**
CO 1	Analytical conditions of Equilibrium, Stable and unstable equilibrium. Virtual work, Catenary.
CO 2	Forces in three dimensions, Poinsot's central axis, Null lines and planes.
CO3	Simple harmonic motion. Elastic strings. Velocities and accelerations along radial and transverse directions, Projectile, Central orbits.
CO4	Kepler's laws of motion, velocities and acceleration in tangential and normal directions, motion on smooth and rough plane curves.
CO5	Motion in a resisting medium, motion of particles of varying mass, motion of a particle in three dimensions, acceleration in terms of different co-ordinate systems.
COURSE	BSC III ANALYSIS
CO No.	**Course Outcomes - This course will enable the student to learn about**
CO 1	Definition and examples of metric spaces.
CO 2	Uniform continuity, isometry and homeomorphism. Equivalent metrics. Compactness, sequential compactness.
CO3	Complex numbers as ordered pairs. Geometrical representation of complex numbers.

CO4	Series of arbitrary terms. Convergence, divergence and oscillation. Abel's and Dirichlet's test. Multiplication of series. Double series. Partial derivation and differentiability of real-valued functions of two variables.
CO5	Riemann integral. Intergrability of continuous and monotonic functions. The fundamental theorem of integral calculus.
COURSE	**BSC III ABSTRACT ALGEBRA**
CO No.	**Course Outcomes - This course will enable the student to learn about**
CO 1	Automorphism of groups and their computations, Sylow's theorems, Sylow subgroup, Structure theorem for finite Abelian groups.
CO 2	Ring theory-Ring homomorphism. Ideals and quotient rings.
CO3	Definition and examples of vector spaces. Subspaces
CO4	Linear transformations and their representation as matrices.
CO5	Inner Product Spaces-Cauchy-Schwarz inequality. Orthogonal vectors.
COURSE	**BSC III NUMERICAL ANALYSIS**
CO No.	**Course Outcomes - This course will enable the student to learn about**
CO 1	Programmer's model of a computer
CO 2	**Solution of Equations:** Bisection, Secant, Regula Falsi, Newton's Method, Roots of Polynomials. **Interpolation:**
CO3	**Linear Equations:** Direct Methods for Solving Systems of Linear Equations
CO4	**Ordinary Differential Equations:** Euler Method, Single-step Methods, Runge-Kutta's Method
CO5	Random number generation, congruential generators, statistical tests of pseudo-random numbers. Random variate generation, inverse transform method

POST GRADUATION IN MATHEMATICS (MASTER OF SCIENCE)

PROGRAMME OUTCOME (POS):

By the end of M.Sc. Mathematics (2 year) programme, students will be able to:

- **PO1** Communicate mathematical ideas with clarity and coherence, both written and verbally.
- **PO2** They will be able to conduct independent research in specialized areas of mathematics, teach courses in mathematics or subjects with high mathematical content at school and college level.
- **PO3** Various branches of Mathematics are so selected and designed for M.Sc Mathematics course aiming at mathematical reasoning, sophistication in thing and acquaintance with enough number of subjects including application oriented ones to suit the present needs of various allied branches in Engineering and Science as well as provision of opportunities to pursue research in higher mathematics.
- **PO4** This programme also offers training in problem solving skills.
- **PO5** The student will be able to develop logical reasoning techniques and Techniques for analyzing the situation.

PROGRAM SPECIFIC OUTCOMES (PSOs) :

At the end of the program, the student will be able to:

- PSO1 Apply the knowledge of mathematical concepts in interdisciplinary fields.
- PSO2 Understand the nature of abstract mathematics and explore the concepts in further details.
- PSO3 Model the real-world problems in to mathematical equations and draw the inferences by finding appropriate solutions.
- PSO4 Identify challenging problems in mathematics and find appropriate solutions.
- PSO5 Pursue research in challenging areas of pure/applied mathematics.
- PSO6 Employ confidently the knowledge of mathematical software and tools for treating the complex mathematical problems and scientific investigations.
- PSO7 Effectively communicate and explore ideas of mathematics for propagation of knowledge and popularization of mathematics in society.
- PSO8 Qualify national level tests like NET/GATE etc.

PROGRAM SCHEME

The MA/M.Sc. Mathematics program is a two-year degree course divided into four semesters.

M.A./M.Sc. (MATHEMATICS)

Semester-I (Code 209)

There shall be five papers. Each paper shall have 100 marks. **Overall tally ofmarks will be 500.**

PAPER	DESCRIPTION	THEORY	SESSIONAL	PRACTICAL	TOTAL MARKS
I	Advanced Abstract Algebra (I)	80	20	-	100
II	Real Analysis (I)	80	20	--	100
III	Topology	80	20	--	100
IV	Advanced Complex Analysis (I)	80	20	--	100
V	Advanced Discrete Mathematics (I)	80	20	--	100

Paper I - Advanced Abstract Algebra I

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Demonstrate capacity for mathematical reasoning through analyzing, Proving and explaining concepts from advanced algebra.
- **CO2** Understand the concept of Normal and subnormal series, solvable group, state and prove Jordan-Holder theorem.
- **CO3** Understand the concepts of fields, extension of fields and splitting fields of polynomials.
- **CO4** Identify and analyze different types of algebraic structures such as Algebraically closed fields, Splitting fields, Finite field extensions to understand and use the fundamental results in Algebra. Design, analyze and implement the concepts of Gauss Lemma, Einstein's irreducibility criterion,separable extensions etc.
- **CO5** Create, select and apply appropriate algebraic structures such as Galois extensions, Automorphisms of groups and fixed fields, Fundamental theorem of Galois theory to understand and use the Fundamental theoremof Algebra, solvability of polynomials.

Paper II- Real Analysis

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understand the concept of sequences and series of functions and apply thetest for their convergence.
- **CO2** Understand the concept of convergence and divergence of power series and apply Abel's and Tauber's theorems.
- **CO3** Understand the concept of functions of several variables and properties ofsets of vectors in R^n.
- **CO4** Understand the concept of maxima and minima of real valued functionsfrom R to R and from R^n to R.
- **CO1** Understand the concept of Integration theory that is closely related to thetheory of Euclidean spaces and derivatives of functions of several variables.

Paper III - Topology

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understand the concept of countable and uncountable sets and its properties.
- **CO2** Understand the concept of topological spaces and its examples, bases, sub-bases, subspaces and relative topology.
- **CO3** Understand the concept of countable, separable spaces and separation axioms with their characterizations and basic properties.
- **CO4** Understand the concept and properties of compactness, continuous functions.
- **CO5** Understand the concept and properties of countable compactness in metricspaces.

Paper IV – Complex Analysis

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understand the fundamental concept of complex analysis. Evaluate Complex integrals with the help of theorems mention in the contents. Identity singularities.
- **CO2** Understand the concept of maximum modulus principle, and Inverse function theorem.
- **CO3** Understand the concept of residues and apply Cauchy's residue theorem toevaluate integrals.
- **CO4** Understand the concept of conformal mappings, bilinear transformations, their properties and classifications.
- **CO5** Understand the concept about the spaces of analytic functions.

Paper – V Advanced Discrete Mathematics

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understand the concept of formal Logic, quantifiers, predicates and their uses in truth tables.
- **CO2** Understand the concept of homomorphism of semi groups and monoids.
- **CO3** Understand the concept of lattices as algebraic systems, Boolean algebras as lattices.
- **CO4** Apply Boolean Algebra to switching theory (using AND, OR & NOT gates).
- **CO5** Understand grammars and languages.

M.A./M.Sc. (MATHEMATICS)

Semester-II (Code-210)

There shall be five theory papers. Each paper shall have 100 marks.

Overalltally of marks will be 500.

PAPER	DESCRIPTION	THEORY	SESSIONAL	PRACTICAL	TOTAL
I	Advanced Abstract Algebra (II)	80	20	-	100
II	Real Analysis (II)	80	20	--	100
III	General and Algebraic Topology	80	20	--	100
IV	Advanced Complex Analysis (II)	80	20	--	100
V	Advanced Discrete Mathematics (II)	80	20	--	100

Paper I Advanced Abstract Algebra II

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understand the concepts of modules, Noetherian and artinian modules.Prove Wedderburns theorem on finite division rings.
- **CO2** Discuss algebra of linear transformations and characteristics roots.
- **CO3** Find the metrics corresponding to linear transformation and differentcanonical forms like triangular and Jordan canonical form etc.
- **CO4** Prove and apply the Primary Decomposition Theorem, and the criterionfor diagonalisability.
- **CO5** Find rational canonical form and generalized Jordan form over any field.

Paper II Real Analysis II

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understand the concept of Riemann-Stieltjes integral and apply it to evaluate definite integrals arising in different fields of science and engineering.
- **CO2** Understand development of measure and integration theory and Borel, Lebesgue measurability.
- **CO3** Compare integration theory of Lebesgue and Riemann with examples and counter examples.
- **CO4** Understand the concept and properties of functions of bounded variation.
- **CO5** Understand the concept of L^p-spaces and convergence in measure.

Paper III General and Algebraic Topology

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understand the concept of Tychonoff product topology and related concepts.
- **CO2** Understanding the connectedness, compactness and countability properties in product space.
- **CO3** Understand embedding, metrization and its related theorems.
- **CO4** Understand the concept of net, filter and its various topological properties and their inter-relations.
- **CO5** Understand fundamental group and covering spaces.

Paper IV Advanced Complex Analysis

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understand the concept of Weierstrass' factorisation theorem, Riemann Zeta function, Gamma function and its properties..
- **CO2** Understand the concept of Analytic Continuation and its properties. Gain knowledge of power series of analytic function.
- **CO3** Understand the concept and properties of Harmonic functions on a disc.
- **CO4** Understand the concept of Canonical products, entire function and exponent of Convergence.
- **CO5** Understand the advanced concepts of Analytic functions and its properties.

Paper V Advanced Discrete Mathematics

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understand the basic concept and properties in Graph Theory .
- **CO2** Understand Trees and its properties. Apply Kruskal's.
- **CO3** Apply Dijkstra's Algorithm and Warshall's Algorithm.
- **CO4** Understand the concept of Finite State Machines.
- **CO5** Understand Deterministic, Non-deterministic Finite Automata, Moore andmealy Machines.

M.A./M.Sc. (MATHEMATICS)
Semester-III (Code 211)

There shall be five theory papers. Two compulsory and three optional. Each paper shall have 100 marks. Out of these five papers, the paper which has theory and practical both, the theory part shall have 70 marks and practical part shall have 30 marks. **Overall tally of marks in theory and practical will be 500.**

PAPER	DESCRIPTION		THEORY	SESSIONAL	PRACTICAL	TOTAL
I	Integration Theory and Functional Analysis (I)		80	20	--	100
II	Partial Differential Equations & Mechanics (I)		80	20	--	100
III	A	Fundamentals of ComputerScience (Object Oriented Programming and Data Structure)	70	--	30	100
	B	Fuzzy Set Theory & Its Applications (I)	80	20	--	100
	C	Relativity and Cosmology	80	20	--	100
IV	A	Operations Research (I)	80	20	--	100
	B	Wavelets (I)	80	20	--	100
V	A	Programming in C (with ANSI Features) (I)	70	--	30	100
	B	Graph Theory (I)	80	20	--	100
	C	Number Theory	80	20	--	100

Paper I Integration Theory and Functional Analysis

Course Outcomes: At the end of the course, the students will be able to :

- CO1 Understand the concept of Signed measure and its properties, Caratheodory's extension measure theory.
- CO2 Understand modern theory of measure and integration.
- CO3 Understand measure theory with respect to continuous functions, regularity of measures on locally compact spaces.
- CO4 Understand finite dimensional normed linear and its basic properties.
- CO5 Understand the concept of weak convergence and dual spaces.

Paper II Partial Differential Equations

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understand classification of partial differential equations in higher dimension.
- **CO2** Formulate and solve of PDEs like heat equation, initial value problem etc.
- **CO3** Understand basic concept related to discrete and continuous mechanicalsystem.
- **CO4** Describe and understand the motion of a mechanical system using Poissonformalism.
- **CO5** Understand and evaluate attraction and potential in the problem related torod, disc, spherical shells and sphere.

Paper III Relativity and Cosmology

Course Outcome

- **CO1** Cosmology is a branch of science in which we study physical universe as a whole. In the basic course, the P.G. students learn the techniques of developing mathematical models of the universe which matches with the present observational evidences regarding universe which are explored by the various observatories throughout the world. NASA is one of them. Dark energy models of the universe are the talk of the present day cosmology.

Paper IV Operations Research

Course Outcomes: At the end of the course, the students will be able to :

CO1. Understand the concept of operations research and its scope. Formulate real life problems into linear programming problem and understand the simplex method.

CO2. Analyze duality, sensitivity in linear programming problem.

CO3. Understand theoretical foundation and implementation of optimizationtechniques available in the scientific literature.

CO4. Find the optimal solutions of transportation and assignment problems.

CO5. Understand the constriction of networks of project and optimal scheduling using CPM and PERT. Find the optimal solution fornetworking problems.

Paper V Programming in C with ANSI features

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understanding the basic structure, operators and statements of C language.
- **CO2** Implementing simple C program, data types, operators and console I/Ofunctions.
- **CO3** Understand the decision control statements, loop control statements andcase control statements.
- **CO4** Understand the concept of operator and expression in C.
- **CO5** Understand the declaration, implementation of array, pointers, function andstructures.

M.A./M.Sc. (MATHEMATICS)
Semester-IV (Code 212)

There shall be five papers. Two compulsory and three optional papers. Each paper shall have 100 marks. The paper which has theory and practical both, the theory part shall have 70 marks and practical part shall have 30 marks. **Overall tally of marks in theory and practical will be 500.**

Paper	Description		Theory	Sessional	Practical	Total
I	Functional Analysis (II)		80	20	--	100
II	Partial Differential Equations &Mechanics (II)		80	20	--	100
III	A	Operating System and Database Management System	70	--	30	100
	B	Fuzzy Set Theory & Its Applications (II)	80	20	--	100
	C	Mathematical Epidemiology	80	20	--	100
IV	A	Operations Research (II)	80	20	-	100
	B	Wavelets (II)	80	20	-	100
V	A	Programming in C (with ANSIFeatures) (II)	70	--	30	100
	B	Graph Theory (II)	80	20	--	100
	C	Cryptography	80	20	--	100

Paper I Functional Analysis

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understand the concept of uniform boundedness in normed linear spaces and Banach spaces.
- **CO2** Understand and apply fundamental theorems in normed linear spaces.
- **CO3** Understand the concept of Inner product spaces, Hilbert spaces, orthonormality and its properties.
- **CO4** Explain the concept of projection and reflexivity of Hilbert spaces.
- **CO5** Understand and apply general properties of linear operators in Hilbert space.

Paper II Mechanics

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understand nonlinear first order partial differential equation and itsclassification.
- **CO2** Understand representation of solution, transforms, and potential function.
- **CO3** Understand asymptotic and power series.
- **CO4** Understand the concept of Hamiltonian's principle and canonical transformations.
- **CO5** Understand and apply methods for Lagrange and Poisson brackets.

Paper III Cosmology

Course Outcome

- **CO1** Cosmology is a branch of science in which we study physical universe as a whole. In the basic course, the P.G. students learn the techniques of developing mathematical models of the universe which matches with the present observational evidences regarding universe which are explored by the various observatories throughout the world. NASA is one of them. Dark energy models of the universe are the talk of the present day cosmology.

Paper IV Operations Research

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Investigate the concept of dynamic programming problems.
- **CO2** Formulate and solve of linear programming model of game theory.
- **CO3** Understand integer programming problem and solve using optimization techniques.
- **CO4** Understand the queuing system. Formulate and solve the queuing theory models.
- **CO5** Extend the knowledge of programming problem from linear to nonlinear.

Paper V Programming In C with ANSI Features

Course Outcomes: At the end of the course, the students will be able to :

- **CO1** Understand data storage classes and ANSI rules for the syntax and semantics of the storage-class.
- **CO2** Understand pointer arithmetic and various sorting algorithms.
- **CO3** Declare and call functions and the C processor.
- **CO4** Understand structure and union and dynamic memory allocation
- **CO5** Understand the I/O file operators, standard library for I/O.

PhD PROGRAMME (MATHEMATICS)

- **PSO-1.** Mastery of fundamental knowledge in mathematics.
- **PSO-2.** Ability to solve problems and communicate solutions in rigorous mathematical language.
- **PSO-3.** Ability to communicate mathematical concepts effectively.
- **PSO-4.** Ability to conduct independent research by synthesizing existing mathematical theory with new, original ideas.

KALYAN P.G. COLLEGE Sector-7 Dt..... BHILAI NAGAR

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