Department of Mathematics

Faculty of Science and Technology

SRI RAM VIDYAPEETH, Ballia

B.A./B.Sc. I

There shall be three papers. The maximum marks for each paper shall be as follows:

Paper I	**:**	**65 Marks**
Paper II	**:**	**65 Marks**
Paper III	**:**	**70 Marks**

Paper I

Unit I

Matrices: Types of Matrices. Hermitian and Skew-Hermitian Matrices. Elementary row and column operation on a matrix. Row and Column equivalances. Echelon form of a matrix, Rank of matrix. Inverse of Matrix and methods of their computations (e.g. by using elementary row/column operations). Orthogonal and unitary matrices. Caley-Hamilton theorem and its use in finding matrix inverse.

Unit II

Solutions of the system of linear equations. Characteristic roots and Characteristic vectors of a matrix.

Theory of Equations- Relations between roots and coefficients of a general polynomial equation in one variable. Transformation of equations. Descartes rule of signs. Solution of cubic equations (Cardon method), Biquadratic equations.

Unit III

Trigonometry – DeMauvre's Theorem and its applications. Direct and inverse circular and hyperbolic functions. Gregory series. Logarithm of a complex quantity. Summation of series.

Unit IV

Coordinate Geometry-General equation of second degree. Tracing of conics. System of conics, confocal conics.

Paper II

Calculus

Unit I

Differential Calculus-The definition of the limit of a function(ε, δ definition), Basic properties of limits. Continuous functions. Classification of discontinuities, differentiability. Successive differention. Leibnitz theorem. Maclaurin's and Tayler series expansions. Asymptotes.

Unit II

Curvature. Multiple points. Curve tracing. Partial differentiations. Change of variables. Euler's theorem on homogeneous functions. Taylor's theorem for functions of two variables (without proof). Envelope, maxima, minima and saddle points of functions of two variables. Lagrange's multiplier method.

Unit III

Integral Calculus- Reduction formulae, definite integrals.

Unit IV

Integral Calculus-Quadrature, Rectification, Volumes and surface areas of solid of revolution.

Paper III

Mechanics

Unit I

Algebra and calculus of vectors: Scalar and vector products , triple products. Quadruple products. Reciprocal vectors. Differentiation of vectors. Gradient, divergence, and curl.

Unit II

Dynamics: Velocities and accelerations along radial and transverse directions and along tangential and normal directions. Simple harmonic motion, elastic string.

Unit III

Dynamics: Motion on smooth and rough plane curves. Resisting media. Central orbits. Kepler's laws of motion.

Unit IV

Statics: Analytical conditions of equations of equilibrium of coplanar forces. Virtual work, Catenary.

Books Recommended:

1. **S.L. Loney-An elementary treatise on Dynamics of Particles and of Rigid Bidies**
2. **M.Ray-Dynamics of a Particle.**
3. **R.S. Verma-A text book on Statics**

Department of Mathematics

Faculty of Science and Technology

SRI RAM VIDYAPEETH,-Ballia

B.A./B.Sc. II

There shall be three papers. The maximum marks for each paper shall be as follows:

Paper I	**:**	**65 Marks**
Paper II	**:**	**65 Marks**
Paper III	**:**	**70 Marks**

Paper I

Calculus, Ordinary Differential equations and Convergence

Unit I

Analysis: Definition and properties of continuous functions. Differentiability, Mean Value theorems with their geometrical interpretations. Darbous's theorem for derivatives. Taylor's theorem with various forms of remainders.

Definition and properties of beta and gamma functions. Double and triple integrals. Dirichelt's integrals. Change of order of integration in double integrals.

Unit II

Ordinary Differential Equations- Degree and order of a differential equation. Equations of first order and first degree. Equations of first order but not of first degree. Clairaut's form and singular solutions. Linear differential equations with constant coefficients.

Unit III

Differential Equations: Orthogonal trajectories. Homogeneous linear ordinary differential equations. Linear ordinary differential equations with variable coefficients. Solution when an integral including CF is known, normal form (removal of first order derivative), change of independent variable and variation of parameters.

Unit IV

Sequences: Limit of sequences. Supremum and Infimum of a sequence. Monotonic sequences. Cauchy's general principle of convergence, series of positive terms. Comparison tests, Cauchy's nth root and ratio tests. Series of monotonically decreasing terms. Raabe's logarithmic, and De Morgan's test. Leibnitz's theorem for alternating series.

Books Recommended

1. Shanti Narayan - Mathematical Analysis
2. Gorakh Prasad - Text book on a Integral calculus
3. Gorakh Prasad - Text book on a Integral Calculus
4. W.T.H. Piaggio - Differential Equations
5. W.J. Ferrar - Convergence

Paper II

Algebra

Unit I

Statement of logical Connectives: Truth tables. Tautologies. Tautologies implication and equivalences. Quantifiers, Rules of inference. Equivalence relations and partitions. Groups, Their examples, subgroups. Generation of groups. Cyclic groups.

Unit II

Closet decompositions. Lagrange's theorem. Homomorphisms and isomorphisms. Normal subgroups. Quotient groups. The Fundamental theorem of homomorphism.

Groups: Permutaion groups. Even and odd permutations. The alternating groups, A_n . Cayley's theorem.

Unit III

Rings: Rings, subrings, integral domains, and field-basic ideas and simple result only. Characteristics of a ring.

Vector Space: Vector spaces, Subspaces, generation of subspaces. Quotient spaces, Linear dependence and independence. Basis and Dimensions. Direct sum of vector subspaces.

Unit IV

Vector space: Linear transformation and their representation as matrices. Dual of a vector space. Dual basis. Rank and nullity of a linear transformation. The rank nullity theorem for linear transformations.

Book Recommended

1. I.N. Herstein - Topics in Algebra
2. R. Balakrishnan, I.N. Ramabhadran - A Text Book of Modern Algebra
3. R.S. Mishra and N.N. Bhattacharya - Fundamental Structure in Modern Algebra

Paper III

Geometry and Dynamics

Unit I

Solid Geometry: Plane, straight line, sphere, cone and cylinder.

Unit II

General conicoids, tangent plane at a point of a central conicoid, normal , Polar planes , polar lines.

Vector Integration: Gauss, Stokes and Green's Theorems and problems based on these.

Tensors: Contravariant and covariant vectors, Transformation formulae.

Unit III

Dynamics of Rigid Body: D'Alembert's principle, Equations of motion under finite and impulsive forces, motion about a fixed axis. Compound pendulum. Reaction on the axis of rotation. Centre of percussion.

Unit IV

Dynamics of Rigid Body: Moment and product of Intertia, Momental ellipsoid, equimomental systems, Principal axes, Equation of motion in two dimension, kinetic energy and angular momentum in two dimensional fixed plane.

Books Recommended

1. R.S. Mishra - A course on vectors and its Applications
2. Barry Spain - Tensor Calculus.
3. Shanti Narayan - Analytical geometry of three dimensions.
4. S.L. Lony - Dynamics of Particles and Rigid Bodies.

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SYLLABUS OF B.A./B.Sc.Part-III

There shall be FOUR papers consisting of four units in each.Each Unit will consist of Two questions.Only one question has to be answered from each UNIT. In addition there shall be one compulsory question of TEN marks comprising of short answer type and/or objective type question covering all units of the paper. Compulsory question will contain six parts out of which five parts will have to be answered. In all five questions have to be answered in each paper of 3 hours duration. maximum marks for each paper shall be 75

PAPER-I(ANALYSIS)
UNIT-I

Metric Spaces:- Definition and examples of metric spaces. Open and closed ball. open and closed subsets. Metric topology. Accumulation points.Closure, interior, boundary and exterior of subsets. Sequences and their convergence cauchy sequences completeness Dense subsets,separable, second countable and first countable spaces, continuity.Compactness and conectedness, their properties and characterizations, characterization of connected subsets of R.Compactness and conectedness in relation to continuity, uniform continuity.

UNIT-II

Real Analysis:- Definition of Riemann integration. darboux theorems, Condition for integrability, properties of integrable functions, continuity and derivabiliy of integrable functions. Fundamental theorem of integral calculus. Mean value theorems of integral calculus.

UNIT-III

Real Analysis:- Holder and Minkowski's in qualities for finite sequences. Convergence of improper integrals. Absolute convergence. Tests for absolute convergence of the integrals of a product.Abel's theorem.Dirichect's theorem,Frullani's integral, integral as a function of a parameter, continuity. derivability and integrability of an integral of a function of a parameter. Differntiability under the integral sign with the parameter in the range of intigration.

UNIT-IV

Complex Analysis:- Complex numbers as ordered pairs and geometric representation of complex numbers. Continuity and differentiability of complex function. Analytical function. Cauchy's Riemann equations. Harmonic function. Mobius transformation Fixed points, cross ratios, inverse points and critical points.

BOOKS RECOMMENDED :-

1. E.T.Copson - Metric spaces.
2. G.F.Simmons - Introduction to topology and Modern Analysis.
3. R.R.Goldberg - Methods of Real Analysis.
4. Shanti Narayan - Mathemetical Analysis.
5. R.Churchill&J.Brown - Complex Analysis and Applications.
6. T.Pati - Theory of Function of complex variable

PAPER-II(ALGEBRA)
UNIT-I

Group- Isomorphism theorems, Automorphism, Inner automorphism, Automorphism groups and group actions. Stabilizers and orbits. Centre and normalizer. Conjugacy relation, Class equation and its applications commutator subgroups. Abelianizing of a group and its universal property Jordan Holder Theorem.

UNIT-II

Rings- Ideals, Quotient rings, Prime and maximal ideals. Ring homomorphism and the basic isomorphism theorem,Field of quotients of an integral domain Principal ideal domains. Polynomail rings.

UNIT-III

Linear Algebra- Algebra of linear transformation.Effect of the change of bases on the matrix of a linear transformation. Characterisitic roots and vector of a linear transformation. Diagonalization Annihilator of a subspace. Transpose of a linear transformation.

UNIT-IV

Linear Algebra- Inner product spaces,Cauchy Schwarz inequality Euclidean spaces. Orthogonal vectors orthogonal complements. Orthogonal sets and bases Bessel's inequality for finite dimensional spaces,Gram-Schmidt orthogonalization process.

BOOKS RECOMMENDED

1. I.N.Herstein - Topics in Algebra
2. B.B.Fraleigh - A first course in Abstract Algbra(Narosa)
3. P.Bhattacharya, S.K.Jain&S.R.Negpal - A first course in groups,Rings and fields.(Wiley Eastern)
4. K.Hoffman&R.Kunz- Linear Algebra(Prentice-Hall)
5. Surjit Singh - Modern Algebra
6. Surjit Singh - Linear Algebra

PAPER-III
UNIT-I

Quadrics:- Central conicoids,Parabloids.Plane sections,generating lines,confocal conicoids. Reductions of second degree equations.

UNIT-II

Diffrential Geometry:- Curves and their parametric representations,Tangent,normal binormal curvature and torsion,Serret-Frenet formulae.Osculating circle,osculating sphere,certain special space curves,parametric curves on surfaces,Direction coefficients,first and second fundamental forms. principal directions.

UNIT-III

diffrential geometric:- Curvature of curves on a surface,lines of curvatures conjugate lines,asymptotic lines,Geodsic and geodsic curvature,developable and ruled surface

UNIT-IV

Tensor Analysis:- Tensor of type (r,s)symmetric and skew-symmetric properties, contraction of tensors,quotient law inner products of vectors,Riemann metric, Christoffel symbols. Covariant derivative,fundamental theorem of local Riemannian geometry. Differential operators, Divergence,curl and gradients in a Riemannian manifolds.

BOOKS RECOMMENDED

1. R. S. Mishra - A course in tensors with applications Riemannian geometry.
2. R. J. T. Bell - Coordinate geometry of three dimensions.
3. T. J. Willmore - An introduction to differential geometry.
4. C. W. Weatherbum- Differential geometry of three dimensions.
5. B. B. Sinha - Differential geometry an introduction.

PAPER-IV(DIFFERENTIAL EQUATIONS AND NUMERICAL ANALYSIS)

UNIT-I

Solution in series and special function :- singular points,solution in series Bassel, Legendre and Hypergeometric differential equations,Bessel,Legendre and Hypergeometric Functions and their elementary properties viz. convergence,recurrence and genreting relations, Orthogonality.

UNIT-II

Integral Transforms:- Laplace transform of ordinary function,Unit step function and Periodic functions shifting theorems. Derivatives and integral of transforms. Applications of ordinary differential equations with constant and variable coefficients Fourier transforms and convolution theorem.

UNIT-III

Differential Equations:- Ordinary Differential equations with three variable, Partial differential equations of first order,Lagrange's linear equations,Non linear ones.Charpit and Monge method.Roots of algebric and transcendental equation by bisection method,Newton Raphson,Secant method.Lagrange and Newton interpolation Finite diffrence oprators,Interpolating polynomials,using finite diffrence oprator-Gregroy-Newton forward and backwerd interpolation.

UNIT-IV

Numerical differentiation,Errors of Approximations,Numerical differentiation based on interpolation and Difference oprators schemes.

Numerical integration:- Trapezoidel and Simpson's rule.

Solution of first order initial value by problems (i) explicit method Euler and Runge Kutta method.

BOOKS RECOMMENDED:-

1- M.K.Jain,S.R.K.Iyengar - Numerical method for Scientific and engineering Computations.

2- S.S.Shastry - Introductroy method of Numerical Analysis.