जननायक चन्द्रशेखर विश्वविद्यालय, बलिया-277001 (उ.प्र.)

Jananayak Chandrashekhar University, Ballia-277001 (U. P.)

FACULTY OF SCIENCE

B.A./B.Sc. (Mathematics) Yearly Syllabus

Course Structure

1st Year

Paper Number	Paper Name	External Marks	Internal Marks	Total Marks
101	Differential Calculus	80	20	100
102	Integral Calculus	80	20	100
103	Matrices & Differential Equations	80	20	100
104	Geometry	80	20	100
			TOTAL	400

2nd Year

Paper Number	Paper Name	External Marks	Internal Marks	Total Marks
201	Algebra	80	20	100
202	Mathematical Methods	80	20	100
203	Differential Equations	80	20	100
204	Mechanics	80	20	100
			TOTAL	400

3rd Year

Paper Number	Paper Name	External Marks	Internal Marks	Total Marks
301	Analysis	80	20	100
302	Linear & Abstract Algebra	80	20	100
303	Numerical Analysis	80	20	100
304	Differential Geometry & Tensor Analysis	80	20	100
			TOTAL	400
			GRAND TOTAL	1200

Note: There will be 9 questions in each paper and candidate has to attempt only 5 questions. Q. 1 will carry short answers and will be **compulsory** based on units I-IV. Two questions will be set from each unit, out of which one questions has to be attempted. Candidate must obtain minimum pass marks in Theory Examinations *Based on papers I-IV.

All papers of 100 MM., each with following distribution of marks:

20 Marks- Internal assessment based on Project work/assignment/activities/attendance.

80 Marks- Annual examination theory paper.

B.A./B.Sc.-1st Year Paper-1

(Differential calculus)

Maximum Marks 100[External(80)+Internal(20)]

Learning Objective: The learning objective is to give foundation for pursuing research in Mathematics as well as to provide quantitative skills.

UNIT 1: Definition of a sequence, Theorems on limits of sequences, Bounded and Monotonic sequences, Cauchy's convergence criterion, Cauchy sequence, limit superior and limit inferior of a sequence, subsequence, Series of non-negative terms, convergence and divergence, Comparison tests, Cauchy's integral test, Ratio test, nth root test, Raabe's, logarithmic, De Morgan and Bertrand's test.

UNIT 2: Limits, Continuity and differentiability of functions of single variable, Cauchys's definition, Heine's definition, equivalence of definition of Cauchy and Heine, Uniform continuity, Intermediate value theorem, Extreme value theorem, Darbaux's intermediate value theorem for derivatives, Chain rule, Indeterminate forms.

UNIT 3: Successive differentiation, Leibnitz theorem, Maclaurin's and Taylor's series, Rolle's theorem, Lagrange and Cauchy mean value theorems, Partial differentiation, Euler's theorem on homogeneous function.

UNIT 4: Asymptotes, Curvature, Envelopes and evolutes, tests for concavity and convexity, Points of inflexion, Multiple points, Tracing of curves in Cartesian and Polar forms.

Activities for internal assessment:

Books Recommended:

1) R. G. Bartle and D. R. Sherbert, Introduction to Real analysis, John Wiley & Sons.
2) T. M. Apostol, Calculus Vol.1, John Wiley & Sons Inc.
3) S. Balachandra Rao & C. K. Shantha, Differential Calculus, New Age Publication.

B.A./B.Sc.-1st Year Paper-2

(Integral Calculus)

Maximum Marks 100[External(80)+Internal(20)]

Learning Objective: The main objective of the course is to equip the student with necessary analytic and technical skills. By applying the principles of integral he learns to solve a variety of practical problems in science and engineering.

UNIT 1: Definite integrals as limit of the sum, Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean value theorems of integral calculus, Differentiation under the sign of integration.

UNIT 2: Improper integrals: their classifications and convergence, Comparison test, μ-test, Abel's test, Dirichlet's test, Beta and Gamma functions: Properties and convergence.

UNIT 3: Rectification, Volumes and Surfaces of solid of revolution, Multiple integrals, change of order of double integration, Dirichlet's theorem.

UNIT 4: Vector differentiation, Gradient, Divergence and Curl, Normal on a surface, Directional derivative, Vector integration, Theorems of Gauss, Green, Stokes and related problems.

Activities for internal assessment:

Books Recommended:

1) T. M. Apostol, Calculus Vol.2, John Wiley Publication.
2) Shanti Narayan & Dr. P. K. Mittal, Integral Calculus, S. Chand.
3) Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.

B.A./B.Sc.-1st Year
Paper-3 (Matrices & Differential Equations)
Maximum Marks 100[External(80)+Internal(20)]

Learning Objective: The subjects of the course are designed in such a way that they focus on developing mathematical skills in working with matrices and solving differential equations.

UNIT 1: Types of Matrices, Elementary operations on Matrices, Rank of a Matrix, Echelon form of a Matrix, Normal form of a Matrix, Inverse of a Matrix by elementary operations, System of linear homogeneous and non homogeneous equations, Theorems on consistency of a system of linear equations.

UNIT 2: Eigen values, Eigen vectors and characteristic equation of a matrix, Caley-Hamilton theorem and its use in finding inverse of a matrix, Complex functions and its separation into real and imaginary parts, Exponential and Logarithmic functions, Inverse trigonometric and hyperbolic functions.

UNIT 3: Formation of differential equations, Geometric meaning of differential equation, Equation of first order and first degree, Equations in which the variables are separable, Homogeneous equations, Exact differential equations and equations reducible to the exact form, Linear equations.

UNIT 4: First order higher degree equations solvable for x, y, p, Clairaut's equation and singular solutions, orthogonal trajectories, Linear differential equation of order greater than one with constant coefficients, Cauchy-Euler form.

Activities for internal assessment:

Books Recommended:

1) Stephen. H. Friedberg, A.J. Insel & L. E. Spence, Linear Algebra, Pearson.
2) B. Rai, D.P. Chaudhury & H. I. Freedman, A course in Ordinary Differential Equations, Narosa.
3) D. A. Murray, Introductory Course in Differential Equations, Orient Longman.

B.A./B.Sc.-1st Year
Paper-4 (Geometry)
Maximum Marks- 100[External(80)+Internal(20)]

Learning Objective: The students learn and visualize the fundamental ideas about coordinate geometry and learn to describe some of the surfaces by using analytical geometry.

UNIT 1: General equation of second degree, System of conics, Tracing of conics, Confocal conics, Polar equation of conics and its properties.

UNIT 2: Three Dimensional Coordinates, Projection and Direction cosine, Plane (Cartesian and vector form), Straight line in three dimension (Cartesian and vector form).

UNIT 3: Sphere, Cone and Cylinder.

UNIT 4: Central conicoids, Plane section of conicoids, Generating lines, Confocal conicoids, Reduction of second degree equations.

Activities for internal assessment:

Books Recommended:

1) Robert J. T. Bell, Elementary Treatise on Coordinate Geometry of three dimensions, Macmillan India Ltd.
2) P. R. Vittal, Analytical Geometry 2D & 3D, Pearson.

B.A./B.Sc.-2nd Year
Paper-1 (Algebra)
Maximum Marks- 100[External(80)+Internal(20)]

Learning objective: Group theory is one of the building blocks of modern algebra. Objective of this course is to introduce students to basic concepts of Group, Ring theory and their properties.

UNIT 1: Equivalence relations and partitions, Congruence modulo n, Definition of group with examples and simple properties, Subgroups, Generators of a group, Cyclic groups.

UNIT 2: Permutation groups, Even and odd permutations, the alternating group, Cayley's theorem, Direct products, Coset decomposition, Lagrange's theorem and its consequences, Fermat and Euler theorems.

UNIT 3: Normal subgroups, Quotient groups, Homomorphism and isomorphism, Fundamental theorem of homomorphism, Theorems on isomorphism.

UNIT 4: Rings, Subrings, Integral domains and fields, Characteristic of a ring, Ideal and quotient rings, Ring homomorphism, Field of quotient of an integral domain.

Activities for internal assessment:

Books Recommended:

1) J. B. Fraleigh, A first course in Abstract Algebra, Addison-Wesley.
2) I. N. Herstein, Topics in Algebra, John Wiley & Sons.

B.A./B.Sc.-2nd Year
Paper-2 (Mathematical Methods)
Maximum Marks-100[External(80)+Internal(20)]

Learning Objective: The course aims to enhance students knowledge of Laplace transforms, Fouries series, boundary value problems and calculus of variations.

UNIT 1: Existence theorems for Laplace transforms, Linearity of Laplace transform and their properties, Laplace transform of the derivatives and integrals of a function, Convolution theorem, inverse Laplace transforms, Solution of the differential equations using Laplace transforms.

UNIT 3: Fourier series, Fourier expansion of piecewise monotonic functions, Half and full range expansions, Fourier transforms, Fourier integral.

UNIT 3: Inverse Fourier transform, Complex form of Fourier transform, Orthonormal and orthogonal sets of functions, Sturm-Liouville problems, Examples of Boundary-value problems which are not Sturm-Liouville problems.

UNIT 4: Calculus of variations- Variational problems with fixed boundaries, Euler's equation for functionals containing first order derivative and one independent variable, Extremals, Functionals dependent on higher order derivatives, Functionals dependent on more than one independent variable, Variational problems in parametric form.

Activities for internal assessment:

Books Recommended:

1) T. M. Apostol, Mathematical Analysis, Pearson.
2) G. F. Simmons, Differential Equations with Applications and Historical Notes, Tata McGrawHill.
3) Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons Inc.

B.A./B.Sc.-2nd Year Paper-3

(Differential Equations)

Maximum Marks 100[External(80)+Internal(20)]

Learning Objective: The objective of this course is to familiarize the students with various methods of solving differential equations, Partial differential equations and their applications.

UNIT 1: Second order linear differential equations with variable coefficients: Use of a known solution to find another, normal form, method of undetermined coefficient, variation of parameters, Series solutions of differential equations, Power series method.

UNIT 2: Bessel, Legendre and Hypergeometric functions and their properties, reoccurrence and generating relations.

UNIT 3: Origin of first order partial differential equations, Partial differential equations of first order and degree one, Lagrange's solution, Partial differential equation of first order and degree greater than one, Charpit's method of solution, Surfaces orthogonal to the given system of surfaces.

UNIT 4: Origin of second order PDE, Solution of partial differential equations of the second and higher order with constant coefficients, Classification of linear partial differential equations of second order, Solution of second order partial differential equations with variable coefficients, Monge's method of solution.

Activities for internal assessment:

Books Recommended:

1) G. F. Simmons, Differential Equations with Applications and Historical Notes, Tata McGrawHill.
2) B. Rai, D.P. Chaudhury & H.I. Freedman, A course in ordinary differential equations, Narosa.
3) Ian N. Snedden, Differential Equations and calculus of Variations, University press of Pacific.

B.A./B.Sc.-2nd Year
Paper-4 (Mechanics)
Maximum Marks 100[External(80)+Internal(20)]

Learning Objective: The object of the paper is to give students knowledge of basic mechanics like simple harmonic motion, motion under laws and forces.

UNIT 1: Frame of reference, work energy principle, Forces in three dimensions, Poinsot's central axis Wrenches, Null lines and planes.

UNIT 2: Virtual work, Stable and Unstable Equilibrium, Catenary, Catenary of uniform strength.

UNIT 3: Velocities and accelerations along radial and transverse directions and along tangential and normal directions, Simple Harmonic motion, Motion under other law of forces. Motion in resisting medium.

UNIT 4: Motion of particles of varying mass, Rocket motion, Central orbit, Kepler's laws of motion, Motion of particle in three dimensions, Rotating frame of reference, Rotating Earth.

Activities for internal assessment:

Books Recommended:

1) R. C. Hibbeler, Engineering Mechanics-Statics, Prentice Hall Publishers.
2) R. C. Hibbeler, Engineering Mechanics-Dynamics, Prentice Hall Publisher.
3) A. Nelson, Engineering Mechanics Statics and Dynamics, Tata McGrawHill.
4) J. L. Synge & B. L. Griffith, Principles of Mechanics by Tata McGrawHill.

B.A./B.Sc.-3rd Year
Paper-1(Analysis)
Maximum Marks 100[External(80)+Internal(20)]

Learning Objective: The course is aimed at exposing the students to the foundations of analysis which will be useful in understanding various physical phenomenons and gives the students the foundation in mathematics.

UNIT 1: Completeness property in □, Archimedean property, Countable and uncountable sets, Definition and examples of metric spaces, Neighborhoods, Interior points, Limit points, open and closed sets, Interior, exterior and boundary of a set, Convergent and Cauchy sequences, Completeness, Cantor's intersection theorem, continuity and Homeomorphism.

UNIT 2: Complex numbers as ordered pairs, Geometric representation of complex numbers, Stereographic projection, Continuity and differentiability of functions of complex variables, Analytic functions, Cauchy Riemann Equations, Harmonic functions.

UNIT 3: Complex integration, Cauchy-Goursat theorem, Cauchy's integral formula, Formulae for first, second and nth derivatives, Cauchy's inequality, Maximum Moduli theorem, Liouville's theorem, Elementary functions, Mapping by elementary functions.

UNIT 4: Taylor and Laurent Series, Absolute and uniform convergence of Power series, Residues and poles, Residue theorem, Zeros and poles of order m, Evolution of improper real integrals, conformal mapping.

Activities for internal assessment:

Books Recommended:

1) J. W. Brown & R. V. Churchill, Complex Variables and Applications, McGraw Hill.
2) S. C. Mallik & Savita Arora, Mathematical Analysis, New Age Publication.

B.A./B.Sc.-3rd Year
Paper-2 (Linear & Abstract Algebra)
Maximum Marks 100[External(80)+Internal(20)]

Learning Objective: The objective of this course is to introduce the students to the basics of algebra and linear algebra.

UNIT 1: Automorphism, Inner automorphism, automorphism groups and their computations, Conjugacy relations, Normaliser, Counting principle and the class equation of a finite group, Centre of group of prime power order.

UNIT 2: Prime and maximal ideals, Euclidean rings, Principal ideal rings, Polynomial rings, Polynomial over the Rational field, The Eisenstein criterion, Polynomial rings over commutative rings, Unique factorization domain.

UNIT 3: Vector spaces, Subspaces, Linear independence and dependence of vectors, Basis and dimension. Quotient space, Coordinates, Computation concerning subspaces, Linear transformations, The algebra of linear transformations, rank nullity theorem, their representation as matrices.

UNIT 4: Linear functionals, Dual space, Transpose of a linear transformation, Characteristic values, Annihilating polynomials, Cayley Hamilton theorem, Inner product spaces, Cauchy-Schwarz inequality, Orthogonal vectors, Orthogonal complements, Orthonormal sets and bases, Bessel's inequality for finite dimensional spaces, Gram-Schimdt orthogonalization process.

Activities for internal assessment:

Books Recommended:

1) I. N. Herstein, Topics in Algebra, John Wiley & Sons.
2) K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall India Learning.

B.A./B.Sc.-3rd Year Paper-3

(Numerical Analysis)

Maximum Marks 100[External(80)+Internal(20)]

Learning Objective: The aim of the course is to teach the students the applications of various numerical techniques for variety of problems occurring in daily life. At the end of the course the students will be able to understand the basic concept of Numerical Analysis and to solve algebraic and differential equation.

UNIT 1: Shift operator, Forward operator and backward difference operators and their relationships, Fundamental theorem of difference calculus, Interpolation, Newton-Gregory's forward and backward interpolation formulae.

UNIT 2: Divided differences, Newton's divided difference formula, Lagrange's interpolation formula, Central differences, Formulae based on central differences: Gauss, Striling, Bessel's and Everet's interpolation formulae, Numerical differentiation.

UNIT 3: Numerical integration, General quadrature formulae, Trapezoidal and Simpson's rules, Cote's formula, Numerical solution of first order differential equations, Euler's method, Picard's method, Runge-Kutta method and Milne's method, Numerical solution of linear homogeneous and simultaneous difference equations.

UNIT 4: Solution of trancedental and polynomial equations by iteration, bisection, Regula-Falsi and Newton Ralphson methods, Algebraic eigen value problems: Power and Jacobi method, Approximation: Different types of approximations, Least square polynomial approximation, Polynomial approximation using orthogonal polynomials, Legendre's approximation, Approximation with trigonometric functions, Exponential functions, Rational functions Chebyshev polynomials.

Activities for internal assessment:

Books Recommended:

1) M. K. Jain, S. R. K. Iyenger & R. K. Jain, Numerical Methods for Scientific and Engineering computation, New Age International.
2) S. S. Sastry, Introductory methods of Numerical Analysis, Prentice Hall of India.
3) B. Bradie, A friendly introduction to Numerical Analysis, Pearson Education.

B.A./B.Sc.-3rd Year
Paper-4 (Differential Geometry & Tensor Analysis)
Maximum Marks 100[External(80)+Internal(20)]

Learning Objective: The objective of the course is to learn basic concepts of tensors and understand the role of tensors in differential geometry.

UNIT 1: Local theory of curves-Space curves, Examples, Plane curves, Tangent and normal and binormal, Osculating plane, normal plane and rectifying plane, Helices, Serret-Ferret apparatus, contact between curve and surfaces, tangent surfaces, involutes and evolutes of curves, Bertrand curves, Intrinsic equations, fundamental existence theorem for space curves, Local theory of surfaces, Parametric patches on surface curve of a surface, Family of surfaces (one parameter), edge of regression, ruled surfaces, skew ruled surfaces and developable surfaces, surfaces of revolutions, Helicoids.

UNIT 2: Metric- first fundamental form and arc length, Local theory of surfaces, Direction coefficients, Families of curves, intrinsic properties, geodesics, canonical geodesic equations, normal properties of geodesics, geodesics curvature, geodesics polars, Gauss-Bonnet theorem, Gaussian curvature, normal curvature, Meusneirs theorem, mean curvature, umbilic points, lines of curvature, Rodrigues formula, Euler's theorem.

UNIT 3: Tensor Analysis: Contravariant and covariant vectors and tensors, Mixed tensors, Symmetric and skew-symmetric tensors, Algebra of tensors, Contraction and inner product, Quotient theorem, Reciprocal tensors, Christoffel's symbols, Covariant differentiation.

UNIT 4: Gradient of scalars, Divergence of a contra-variant vector, covariant vector and conservative vectors, Laplacian of an invariant, curl of a covariant vector, irrotational vector, Riemannian space, Riemannian curvatures and their properties, Ricci tensor and scalar curvature, Einstein space and Einstein tensor, intrinsic derivative, Geodesics, Geodesics coordinate, Parellelism of vectors.

Activities for internal assessment:

Books Recommended:

1) T. J. Willmore, An Introduction to Differential Geometry, Dover Publications.
2) J. A. Thorpe, Introduction to Differential Geometry, Springer- Verlag.