BACHELOR OF SCIENCE (B.Sc.)

(THREE YEAR DEGREE COURSE)

Course code - 109

SUBJECT

MATHEMATICS

Subject code – 03

B.Sc.(MATHEMATICS)

COURSE STRUCTURE

FIRST YEAR

PAPER I – BSMT-101: ALGEBRA AND TRIGONOMETRY 50 MARKS

PAPER II – BSMT-102: CALCULUS 50 MARKS

PAPER III – BSMT-103: GEOMETRY AND VECTOR CALCULUS 50 MARKS

PAPER IV – BSMT-104P: PRACTICAL/ Viva Voce 50 MARKS

(Based on Papers 101, 102, 103)

SECOND YEAR

PAPER I – BSMT-201: LINEAR ALGEBRA AND MATRICES 50 MARKS

PAPER II – BSMT-202: DIFFERENTIAL EQUATIONS AND INTEGRAL TRANSFORMS 50 MARKS

PAPER III – BSMT-203: MECHANICS 50 MARKS

PAPER IV – BSMT-204P: PRACTICAL / Viva Voce 50 MARKS

(Based on Papers 101, 102, 103)

THIRD YEAR

PAPER I – BSMT-301: REAL ANALYSIS 50 MARKS

PAPER II – BSMT-302: COMPLEX ANALYSIS 50 MARKS

PAPER III – BSMT-303: NUMERICAL ANALYSIS AND PROGRAMMING IN C 50 MARKS

PAPER IV – BSMT-304P : PRACTICAL/Viva Voce 50 MARKS

(Based on Papers 101, 102, 103)

B.Sc.(MATHEMATICS)

FIRST YEAR DETAILED SYALLBUS

PAPER I – BSMT-101 ALGEBRA and TRIGONOMETRY

Course Outcomes (CO):

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

1. Have the knowledge of real valued functions such assequence and series.
2. Know about convergence of sequence and series.
3. Understand the basic concepts of Group, Ring theory and their properties.
4. Separate Complex functions into real and imaginary parts.
5. Describe direct and inverse trigonometric and hyperbolic functions and determine the sum of the series.

Algebra

Unit 1.

Sequence and its convergence (basic idea), Convergence of infinite series, Comparison test, ratio test, root test, Raabe's test, Logarithmic ratio test, DeMorgan and Bertrand test and higher logarithmic ratio test. Alternating series, Leibnitz test, Congruence modulo *m* relation, Equivalence relations and partitions.

Unit 2.

Definition of a group with examples and simple properties, Permutation groups, Subgroups, Centre and normalizer, Cyclic groups, Coset decomposition, Lagrange's theorem and its consequences.

Unit 3.

Homomorphism and isomorphism, Cayley's theorem, Normal subgroups, Quotient group, Fundamental theorem of homomorphism, Conjugacy relation, Class equation, Direct product.

Unit 4.

Introduction to rings, subrings, integral domains and fields, Characteristic of a ring, Homomorphism of rings, Ideals, Quotient rings.

Trigonometry

Unit 5.

Complex functions and separation into real and imaginary parts, Exponential, direct and inverse trigonometric and hyperbolic functions, logarithmic function, Gregory's series, Summation of series.

Reference Book-

1. Algebra and Trigonometry – (Dr. Goyal, Dr. Singh, Dr. Raghav.) Kedar Nath Ram Nath Publication, Meerut.
2. Algebra and Trigonometry- (Dr.A.R.Vasishtha) Krishna Prakashan Media

PAPER II – BSMT-102 CALCULUS

Course Outcome (CO):

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

1. Discuss the continuity and differentiability of the functions, Calculate the successive differentiation and apply Leibnitz's Theorem.
2. Expand the functions (in Taylor's and Maclaurin's series), explain indeterminate forms, Use of partial differentiation .
3. Determine maxima and minima for functions of two variables and have knowledge about curvature, envelope and evolutes
4. Trace the curve in polar, Cartesian as well as parametric form and calculate the area.
5. Know about Reduction formulae, Beta and Gamma function and calculate the multiple integral.

Unit 1.

Definition of the limit of a function, Continuous functions and classification of discontinuities, Differentiability, Chain rule of differentiability, Rolle's theorem, First and second mean value theorems, Taylor's theorems with Lagrange's and Cauchy's forms of remainder, Successive differentiation and Leibnitz's theorem.

Unit 2.

Expansion of functions (in Taylor's and Maclaurin's series), indeterminate forms, Partial differentiation and Euler's theorem, Jacobians.

Unit 3.

Maxima and Minima (for functions of two variables), Tangents and normals (polar form only), Curvature, Envelopes and evolutes.

Unit 4.

Asymptotes, Tests for concavity and convexity, Points of inflexion, Multiple points, Tracing of curves in Cartesian and polar co-ordinates, Reduction Formulae, Beta and Gamma Functions.

Unit 5.

Qudrature, Rectification, Volumes and surfaces of solids of revolution, Pappus theorem, Double and triple integrals, Change of order of integration, Dirichlet's and Liouville's integral formulae.

Reference Book-

1. Calculus – (Dr. Goyal, Dr. Singh, Dr. Raghav.) Kedar Nath Ram Nath Publication, Meerut.
2. Calculus - (Dr.A.R.Vasishtha) Krishna Prakashan Media

PAPER III – BSMT-103 GEOMETRY AND VECTOR CALCULUS

Course Outcome (CO):

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

1. Learn and visualize the fundamental ideas about coordinate geometry and learn to describe some of the surface by using analytical geometry.
2. Have gained knowledge about regular geometrical figures like Plane, Straight line,Sphere, Cone and Cylinder and their properties.
3. Describe Elementary Concepts of Central Conicoids.
4. Have basic knowledge of vector algebra and compute gradient, divergence and curl..
5. Use of Gauss's divergence, Stokes and green's theorems.

Geometry

Unit 1.

General equation of second degree, Tracing of conics, System of conics, Polar equation of a conic.

Unit 2.

Three dimensional system of co-ordinates, Projection and direction cosines, Plane, Straight line.

Unit 3.

Sphere, Cone and Cylinder, Elementary Concepts of Central Conicoids.

Vector Calculus

Unit 4.

Scalar and vector product of three vector, Product of four vectors, Reciprocal Vectors, vector differentiation, gradient, divergence and curl.

Unit 5.

Vector Integration, Line integrals, Theorems of Gauss, Green and Stokes (with out proof) and problems based on these.

Reference Book-

1. Geometry and Vector Calculus – (Dr. Goyal, Dr. Singh, Dr. Raghav.) Kedar Nath Ram Nath Publication, Meerut.
2. Geometry and Vector Calculus – (Dr.A.R.Vasishtha) Krishna Prakashan Media

PAPER IV – BSMT- 104P PRACTICAL /VIVA VOCE

SECOND YEAR DETAILED SYALLBUS

PAPER – 201 LINEAR ALGEBRA AND MATRICES

Course Outcome (CO):

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

1. Understand vector spaces over a field and subspaces and apply their properties.
2. Understand linear independence and dependence.
3. Find basis and dimension of vector space and understand change of basis.
4. Compute linear transformations, kernel and range and inverse linear transformations and find matrices of general linear transformations
5. Understand linear functional, dual space and find dual basis of the basis set.
6. Understand inner product on a vector space.
7. Understand the concept of Orthogonality in inner product spaces.
8. Create orthogonal basis, Gram-Schmidt process.
9. Understand algebra of matrices, Ajoint, inverse and rank of a matrices.
10. Find Eigen values and Eigen vectors of a matrices and inverse of a matrix using Crylay-Hamilton Theorem

Linear Algebra

Unit 1.

Vector spaces and their elementary properties, Subspaces, Linear dependence and independence, Basis and dimension, Direct sum, Quotient space.

Unit 2.

Linear transformations and their algebra, Range and null space, Rank and nullity, Matrix representation of linear transformations, Change of basis.

Unit 3.

Linear functionals, Dual space, Bi-dual space, Natural isomorphism, Annihilators, Bilinear and quadratic forms, Inner product spaces, Cauchy-Schwarz's inequality, Bessel's inequality and orthogonality.

Matrices

Unit 4.

Symmetric and skew-symmetric matrices, Hermitian and skew-Hermitian matrices, Orthogonal and unitary matrices, Triangular and diagonal matrices, Rank of a matrix, Elementary transformations, Echelon and normal forms, Inverse of a matrix by elementary transformations.

Unit 5.

Characteristic equation, Eigen values and Eigen vectors of a matrix, Clayey- Hamilton's theorem and its use in finding inverse of a matrix, Application of matrices to solve a system of linear (both

homogeneous andnon-homogeneous) equations, Consistency and general solution.

Reference Book-

1. Linear Algebra And Matrices – (Dr. Goyal, Dr. Singh, Dr. Raghav.) Kedar Nath Ram Nath Publication, Meerut.
2. Linear Algebra And Matrices – (Dr.A.R.Vasishtha) Krishna Prakashan Media

PAPER – 202

DIFFERENTIAL EQUATIONS AND INTEGRAL TRANSFORMS

Course Outcome (CO):

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

1. Identify the type of a given differential equation And select and apply the appropriate analytical technique for finding the solution.
2. Solve first order differential equation utilizaing the standard the standard teachniques separable exat, linear homogeneous.
3. Determine solution of linear and Non linear ordinary differential equation of I and II order.
4. Determine the complete solution of differential equations with constant coefficients by variation of parameters.
5. Evaluate the Laplace and Inverse Laplace Transform of function of one variables.
6. Find Fourier transforms (finite and infinite), Apply Fourier transform to boundary value problems.

Differential Equations

Unit 1.

Formation of a differential equation (D.E.), Degree, order and solution of a D.E., Equations of first order and first degree : Separation of variables method, Solution of homogeneous equations, linear equations and exact equations, Linear differential equations with constant coefficients, Homogeneous linear differential equations,

Unit 2.

Differential equations of the first order but not of the first degree, Clairaut's equations and singular solutions, Orthogonal trajectories, Simultaneous linear differential equations with constant coefficients, Linear differential equations of the second order (including the method of variation of parameters).

Unit 3.

Order, degree and formation of partial differential equations, Partial differential equations of the first order, Lagrange's equations, Charpit's general method, Linear partial differential equations with constant coefficients.Partial differential equations of the second order, Monge's method.

Unit 4.

The concept of transform, Integral transforms and kernel, Linearity property of transforms, Laplace transform, Inverse Laplace transform, Convolution theorem, Applications of Laplace transform to solve ordinary differential equations.

Unit 5.

Fourier transforms (finite and infinite), Fourier integral, Applications of Fourier transform to boundary value problems, Fourier series.

Reference Book-

1. Differential Equations And Integral Transforms – (Dr. Goyal, Dr. Singh, Dr. Raghav.) Kedar Nath Ram Nath Publication, Meerut.
2. Differential Equations And Integral Transforms – (Dr.A.R.Vasishtha) Krishna Prakashan Media

PAPER – 203 MECHANICS

Course Outcome (CO):

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

1. Have knowledge of basic mechanics such as Velocity and acceleration, simple harmonic motion, motion under other laws and forces.
2. Understand Motion in resisting medium, Constrained motion (circular and cycloidal only).
3. Explain Motion on smooth and rough plane curves, Rocket motion, Central orbits
4. Describe Common catenary, Stable and unstable equilibrium.
5. Calculate Centre of gravity in two and three dimensions.
6. Go for higher problems in mechanic such as hydrodynamics, this will be helpful in getting employment in industry.

Dynamics

Unit 1.

Velocity and acceleration along radial and transverse directions, and along tangential and normal directions, Simple harmonic motion, Motion under other laws of forces.

Unit 2.

Motion in resisting medium, Constrained motion (circular and cycloidal only).

Unit 3.

Motion on smooth and rough plane curves, Rocket motion, Central orbits and Kepler's law, Motion of a particle in three dimensions.

Statics

Unit 4.

Common catenary, Stable and unstable equilibrium.

Unit 5.

Centre of gravity in two and three dimensions, forces in three dimensions.

Reference Book-

1. Mechanics – (Dr. Goyal, Dr. Singh, Dr. Raghav.) Kedar Nath Ram Nath Publication, Meerut.
2. Mechanics – (Dr.A.R.Vasishtha) Krishna Prakashan Media

PAPER – 204 PRACTICAL / VIVA VOCE

THIRD YEAR DETAILED SYALLBUS

PAPER – 301 REAL ANALYSIS

Course Outcome (CO):

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

1. Describe the fundamental properties of the real number that underpin formal development of real analysis.
2. demonstrate understanding of the theory of sequences and series, continuity and uniform convergence of sequences and series of functions.
3. Determine limit and continuity of functions of two variables by Taylor's theorem
4. Calculate Riemann integral and test the convergence of improper integrals.
5. Define metric spaces and its properties.

Unit 1.

Axiomatic study of real numbers, Completeness property in R, Archimedean property, Countable and uncountable sets, Neighbourhood, Interior points, Limit points, Open and closed sets, Derived sets, Dense sets, Perfect sets, Bolzano- Weierstrass theorem.

Unit 2.

Sequences of real numbers, Subsequences, Bounded and monotonic sequences, Convergent sequences, Cauchy's theorems on limit, Cauchy sequence, Cauchy's general principle of convergence, Uniform convergence of sequences and series of functions, Weierstrass M-test, Abel's and Dirichlet's tests.

Unit 3.

Sequential continuity, Boundeness and intermediate value properties of continuous functions, Uniform continuity, Meaning of sign of derivative, Darboux theorem.

Limit and continuity of functions of two variables, Taylor's theorem for functions of two variables, Maxima and minima of functions of three variables, Lagrange's method of undetermined multipliers.

Unit 4.

Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean value theorems of integral calculus, Improper integrals and their convergence, Comparison test, m -test, Abel's test, Dirichlet's test, Integral as a function of a parameter and its differentiability and integrability.

Unit 5.

Definition and examples of metric spaces, Neighbourhoods, Interior points, Limit points, Open and

closed sets, Subspaces, Convergent and Cauchy sequences, Completeness, Cantor's intersection theorem.

Reference Book-

1. Real Analysis – (Dr. Goyal, Dr. Singh, Dr. Raghav.) Kedar Nath Ram Nath Publication, Meerut.
2. Real Analysis – (Dr.A.R.Vasishtha) Krishna Prakashan Media

PAPER – 302 COMPLEX ANALYSIS

Course Outcome (CO):

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

1. Identify curves and regions in the complex plane.
2. Describe when and where a given function is analytic.
3. Describe conformal mapping between various plane regions.
4. Describe basic properties of complex integration.
5. Calculate zeros and singularities of an analytic function.
6. Calculate definite integrals by Cauchy Residue theorem and its applications.

Unit 1.

Functions of a complex variable, Concepts of limit, continuity and differentiability of complex functions, Analytic functions, Cauchy-Riemann equations (Cartesian and polar form), Harmonic functions, Orthogonal system, Power series as an analytic function.

Unit 2.

Elementary functions, Mapping by elementary functions, Linear and bilinear transformations, Fixed points, Cross ratio, Inverse points and critical points, Conformal transformations.

Unit 3.

Complex Integration, Line integral, Cauchy's fundamental theorem, Cauchy's integral formula, Morera's theorem, Liouville theorem, Maximum Modulus theorem, Taylor and Laurent series.

Unit 4.

Singularities and zeros of an analytic function, Rouche's theorem, Fundamental theorem of algebra, Analytic continuation.

Unit 5.

Residue theorem and its applications to the evaluation of definite integrals, Argument principle.

Reference Book-

1. Complex Analysis – (Dr. Goyal, Dr. Singh, Dr. Raghav.) Kedar Nath Ram Nath Publication, Meerut.
2. Complex Analysis – (Dr.A.R.Vasishtha) Krishna Prakashan Media

PAPER – 303

NUMERICAL ANALYSIS AND PROGRAMMING INC

Course Outcome (CO):

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

1. Explain and measure errors in numerical computations,interpolation problems.
2. Find solutions of and differential equations
3. Solve numerical integration problems using different techniques and a system of linear equations
4. Derive solutions for algebraic equations.
5. Design and compare different numerical algorithms with respect to accuracy and efficiency of solution.
6. Have knowledge of Programming in C.

Numerical Analysis

Unit 1.

Shift operator, Forward 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's, Bessel's and Everett's interpolation formulae, Numerical differentiation.

Unit 3.

Numerical integration, General quadrature formula, Trapezoidal and Simpson's rules, Weddle's rule, 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, Generating functionmethod.

Unit 4.

Solution of transcendental and polynomial equations by iteration, bisection, Regula-Falsi and Newton-Raphson methods, Algebraic eigen value problems : Power method, Jacobi's method, Given's method, Householder's method and *QR*method, Approximation : Different types of approximations, Least square polynomial approximation, Polynomial approximation using orthogonal polynomials, Legendre approximation, Approximation with trigonometric functions, exponential functions, rational functions, Chebyshev polynomials.

Programming in C

Unit 5.

Programmer's model of computer, Algorithms, Data type, Arithmetic and input/out instruction, Decisions, Control structures, Decision statements, Logical and conditional operators, Loop case control structures, Functions, Recursion, Preprocessors, Arrays, Puppetting of strings Structures, Pointers, File formatting.

Reference Book-

1. Numerical Analysis and Programming in C – (Dr. Goyal, Dr. Singh, Dr. Raghav.) Kedar Nath Ram Nath Publication, Meerut.
2. Numerical Analysis and Programming in C – (Dr.A.R.Vasishtha) Krishna Prakashan Media

PAPER – 304 PRACTICAL/VIVA VOCE