CONTENT

B.A. / B. Sc. Mathematics (General)

Semester-I
Paper-I: Mark : 20+80=100
Unit-I(20+20=40): Classical Algebra & Vector Algebra
Unit-II(20+20=40): Abstract Algebra & Linear

Semester-II
Paper-II: Mark : 20+80=100
Unit-I(20+20=40):Differential Calculus
Unit-II(20+20=40):Integral Calculus

Semester-III
Paper-III:Mark : 20+80=100
Unit-I(20+20=40):Geometry-Two Dimension and Three Dimension
Unit-II(20+20=40):Differential Equations

Semester-IV
Paper-IV:Mark : 20+80=100
Unit-I(20+20=40):Linear Programming Problem
Unit-II(20+20=40):Probability Theory & Vector Calculus

Semester-V
Paper-V: Mark : 50(Theory)+50(Practical)=100
Theory Mark : 10+40=50
Unit-I(20): Numerical analysis
Unit-II(20): Computer Science
Practical(40):(Practical-Simple C-Programming
and Numerical analysis through C Programming)

Semester-VI
Paper-VI: Mark : 20+80=100
PROJECT

B.A. / B. Sc. Mathematics (Honours)

Semester-I
Paper-I:Mark : 20+80=100
Unit-I(20): Classical Algebra & Number Theory 15 + 20
Unit-II(20):Abstract Algebra-I
UNIT-III(20):Abstract Algebra-II
Unit-IV(20) :Vector Algebra

Semester-II
Paper-II:Mark : 20+80=100
Unit-I (20) : Linear Algebra-I
Unit II (20): Linear Algebra-II
Unit-III(20):Geometry-Two Dimension
Unit-IV(20):Geometry-Three Dimension

Semester-III
Paper-III:Mark : 20+80=100
UNIT I(20): Calculus-I
Unit-II(20):Calculus-II
Unit-III(20):Calculus-III
Unit-IV(20):Vector Calculus

Semester-IV
Paper-IV:Mark : 20+80=100
Unit-II(20): Differential Equations-I
Unit-II(20):Differential Equations-II
Unit-III(20):Linear Programming Problem-I
Unit-IV(20):Linear Programming Problem-II

Semester-V
Paper-V:Mark : 20+80=100
Unit-I(20):Analysis-I
Unit-II(20):Analysis-II
Unit-III(20):Analysis-III
Unit-IV(20):Analysis-IV

Paper-VI:Mark : 20+80=100
Unit-I(20):Probability
Unit-II(20):Statistics
Unit-III(20):Tensor Analysis
Unit-IV(20):Dynamics of Particle

Semester-VI
Paper-VII:Mark : 20+80=100
Unit-I(20):Numerical analysis-I
Unit-II(20):Numerical Analysis-II
Unit-III(20):C Programming-I
Unit-IV(20):C Programming-II

Paper-VIII:Mark : 20+80=100 (Practical)
Group-A: (Numerical Analysis)Mark=40
Group-B: (C-Programming)Mark=40

B.A. / B. Sc. Semester-I (General)

MATHEMATICS
Paper-I
Mark : 20+80=100

Unit-I(20+20=40)
(Classical Algebra & Vector Algebra)

1. Inequalities : A. M. ≥G.M ≥ H.M. Their generalization like the theorem of weighted mean and m^{th} power theorem. Statement of Cauchy-Schwartz inequality, Weierstrass inequality and their application. DeMoivre's theorem and its applications.

2. Exponential sine, cosine and logarithm of complex number. Direct and inverse circular and hyperbolic functions. Expansion of trigonometry functions, Gregory's series. Summation of series. Revision of definition of vectors and its algebra. Rectangular solution of vector, linear dependent and independent of vectors. Two vectors are linier dependent iff one is scalar multiple of other. Every super set of linearly dependent set of vectors is linearly dependent. The set of non-zero vectors are linearly iff one of them is scalar combination of others.

3. Scalar and vector product of two vectors. Scalar and vector triple product. Product of four vectors. Reciprocal vectors. Simple applications to geometry. Vector equations of straight line, plane and circle. Applications to mechanics: work done, torque.

Unit-II(20+20=40)
(Abstract Algebra & Linear)

1. Revision of set theory, relation and mapping. Equivalence relation, partition of a set, equivalence classes, composition of functions. Congruence modulo n. Binary operation. Group Theory: Group, Abelian group, identity and inverse element in a group is unique. Subgroups, necessary and sufficient condition of a non-empty subset of a group is a subgroup, cyclic group, order of a group and order of an element.

2. Rings and Fields: Properties of Rings directly following from the definition, Unitary and commutative rings. Divisors of zero, Integral domain, Every field is an integral domain, every finite integrals domain is a field. Definitions of Sub-ring and sub-field. Statement of Necessary of sufficient condition for a subset of a ring (field) to be sub-ring (resp. subfield). Matrix: Matrices of real and complex numbers : Algebra of matrices. Symmetric and skew-symmetric matrices, Solution of linear equation with not more than three unknown by matrix method. Rank of a matrix. Characteristics polynomial, characteristics equations, Eigen value & Eigen Vector. Cayley Hamilton theorem(statement only).

3. Vector space/Linear space (Def. and examples), Linear combination, independence and dependence, linear span, basis and dimention (Def. and examples). Subspace (Def. and examples), intersection and union of subspaces, linear sum of two subspaces, direct sum of subspaces, dimension of sum and subspaces. Linear transformation and their representation as matrices, kernal and range of a linear transformation, the algebra of linear transformations, the rank nullity theorem(statement only).

Reference:

1. Advanced Higher Algebra: Ghosh and Chakraborty, U. N, Dhur.
2. Algebra: R.M.Khan, Central
3. Higher Algebra: Mapa, Ashok Pub.
4. Cordinate Geometry: S.B.Sengupta

B.A. / B. Sc. Semester-II (General)
MATHEMATICS
Paper-II
Mark : 20+80=100

Unit-I(20+20=40)
(Differential Calculus)

1. Idea of $\varepsilon-\delta$ definition of limit and continuity of a function. Indeterminate forms, statement of L'Hospital rule and its applications. Successive differentiation, leibnitz's theorem and its applications. Rolle's theorem and its geometric interpretation. Mean value theorem of Lagrange and Cuchy. Geometric interpretation of Lagrange's mean value theorem Statement of Taylor's and Maclaurin's theorem with Lagrange's and Cauchy's form of remainder. Taylor's and Maclaurin's series (Statement only). Expansions of functions in finite and infinite series like sin(X), Cos(X), exp(X), a_x, $(1+x)_n$, log(1+x) (with restrictions whenever necessary)

2. Sequence and series: Limit of sequence. Convergent and non convergent Cauchy sequence. Convergence of infinite. Statement and use of different tests for convergence of series of non-negative terms.

3. Functions of several variables: Limits and continuity (definition and examples only), Partial derivative. Total differentials. Statement of Schwartza and Youns's theorem on commutative property of mixed derivative. Euler's theorem of homogeneous functions of two variables. Statement of Taylor's theorem for functions of two variables. Jacobian, maxima, minima, saddle points of functions of two points (examples only). Application : Tangent normal sub tangent and sub normal. Length of tangent and normal. Differential of are length. Curvature and rectilinear asymptote for Cartesian and polar curve.

Unit-II(20+20=40)
(Integral Calculus)

1. Definition of improper integrals, example. Definition and simple properties of beta & Gamma functions & their uses (convergence and important relations being assumed)

3. Reduction formulae such as $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$, $\int \sin^n x \cos^m x dx$, $\int \sin^n x \cos mx dx$ etc where m and n are non-negetive inetegers.

4.1 Rectification of plane curves. Volume and surface area of solid formed by revolution of plane curves and areas about x-axis and y-axis.

4.2 Working knowledge of double and triple integrals, change of order of integration.

4.3 Differentiability and integrability of an integral of a function of a parameter. Differentiability under the sign of integration, statements of necessary theorems. Centroid. Centroid of arc, plane area, volume and surface area of revolution.

Reference:

1. Differential Calculus: Das and Mukherjee, U.N.Dhur
2. Integral Calculus: Das and Mukherjee, U.N.Dhur

B.A. / B. Sc. Semester-III (General)

MATHEMATICS
Paper-III
Mark : 20+80=100

Unit-I(20+20)
(Geometry-Two Dimension and Three Dimension)

1. Transformation of rectangular axes, translation, rotation and their combinations, theory of invariants. General equation of second degree in two variables, reduction into canonical form, lengths and position of the axes. Pair of straight lines: Condition that the general equation of second degree in two variables may represent a pair of straight lines. Point of intersection of two intersecting straight lines, angle between two lines given by $ax_2+2hxy+by_2$, equation of bisectors of the angle between the pair of straight lines, equation of two lines joining the origin to the point in which two curves meet. Polar coordinates, polar equation of straight lines, circles and conic referred to a focus as pole, equation of chord, tangent and normal.

2. Rectangular Cartesian co-ordinates in space, concept of geometric vector (directed line segment), projection of vector on a co-ordinate axis, inclination of a vector with an axis, co-ordinates of a vector, direction ratio and direction cosine of a vector. Distance between two points, division of directed line segment in given ratio. Equation of a plane in general form, intercept and normal form, signed distance of a point from a plane, equation plane passing through the intersection of two planes, angle between two intersecting planes, parallel and perpendicularity of two planes.

3. Straight lines in space, equation in symmetric and parametric form, canonical equation of line of intersection of two intersecting planes, angle between two lines, distance of a point from a line, condition of coplanarity of two lines. General equation of sphere , circle, sphere through the intersection of two sphere, radical plane, tangent, normal.

References:

1. Co-ordinate Geometry-S.B.Sengupta.
2. Co-ordinate Geometry-S.L.Lony, Macmillan and Co.

Unit-II(20+20=40)
(Differential Equations)

1. Significance of ordinary differential equation. Geometrical and physical consideration. Formation of differential equation by elimination of arbitrary constant. Meaning of the solution of ordinary differential equation. Concept of linear and non-linear differential equations. Equations of first order and first degree : Statement of existence theorem. Separable, Homogeneous and Exact equation. Condition of exactness, Integrating factor. Rules of finding integrating factor, (statement of relevant results only),Equations reducible to first order linear equations.

2. Equations of first order but not of first degree, Clairaut's equation. Singular solution, Applications : Geometric applications, Orthogonal trajectories. Higher order linear equations with constant co-efficients : Complementary function, Particular Integral, Symbolic operator D.

3. Method of undetermined co-efficients, Method of variation of parameters. Euler's homogeneous equation and Reduction to an equation of constant coefficients. Ordinary simultaneous differential equations.

References:

1. Differential Equations: Ghosh and Chakraborty, U.N.Dhur
2. Differential Equations: M.D.Raisinghania, S. Cand.

MATHEMATICS
Paper-IV
Mark : 20+80=100

Unit-I(20+20=40)

(Linear Programming Problem)

1 What is LPP ? Mathematical form of LPP formulation. LPP in matrix notation. Graphical solution of LPP. Basic solution, Basic feasible solution, degenerate and non-degenerate BFS. Euclidean space, hyperplane, convex set, extreme points, convex functions and concave functions, the hyperplane in convex set. Intersection of two convex sets is convex set, the collection of all feasible solution of a LPP constitutes a convex set. A BFS to a LPP corresponds to an extreme point of convex set of feasible solutions.

2. Slack, surplus and artificial variables, standard form of LPP, Fundamental theorem pf LPP and their applications, theory and application of the simplex method of solution of LPP. Charne's M-technique.

3. Duality. Transportation problem. TP in LPP form, Balanced TP. Optimality test of BFS. Assignment problem. Solution of AP [(Maximization, unbalanced, negative cost and impossible assignment. Traveling salesman problem.

(Problem should be set on simplex and Charne's method, two phase method in such ay that it may contain at most three or four tableau with approximate marks.)

References:

1. Linear Programming Problem- Chakroborty and Ghosh-U.N.Dhur and Sons
2. Operations Research-Kantiswarup et. al, Sultan Chand and Sons.
3. Linear Programming and Theory of Games, P.M.Karak, Central Book Agency.

Unit-II(20+20=40)

(Probability Theory & Vector Calculus)

2. Frequency and Axiometic definition of probability.Random variables. Probability Distribution function. Discrete and continuous random variable, probability mass function and probability density function, mathematical expectation, mean and variance (simple problems only). Binomial, Poission, uniform, Normal, Beta and Gamma Distributions. Moments of a probability distribution, skewness and kurtosis of a probability distributuin, moment generating function. Transformation of one dimensional random variable(simple applications).

2. Vector function, limit and continuity, derivative of vector, derivative of sums and product of vector functions. A necessary and sufficient condition that a proper vector â (i) has a constant length that â.dâ/dt = 0, (ii) always remains parallel is that â×dâ/dt=Õ.

3. Vector integration, scalar and vector fields, directional derivatives, gradient of a scalar point function, ∇ operator, divergence, curl and Laplacian.

Line, surface and volume integral. Statement of Gauss's, Stoke's theorem and problem based on these.

References:

1. Ground Work of Mathematical Probability and Statistics-Amritabha Gupta, Academic Pub.
2. Statistical Methods,Vill-I and II-N.G.Das
3. Vector Analysis-Maity and Ghosh, New Central Book Agency.
4. Vector Analysis- Schaum's series, Tata McGrawHill

B.A. / B. Sc. Semester-V (General)

MATHEMATICS
Paper-V
Mark : 50(Theory)+50(Practical)=100
Theory Mark : 10+40=50

Unit-I(20)

(Numerical analysis)

1. Approximate numbers and significant figures, rounding off numbers. Error and Absolute, relative and percentage errors. Linear operation, Difference, finite difference interpolation. Lagrange interpolation. Newton's forward and backward difference formula. Differentiation formula based on Newton's forward and backward difference formula. Numerical integration, deduction of Trapezoidal, Simpson's 1/3 rule from Newton's forward difference formula.
2. Solution of algebraic and transcendental equations: Bisection, Secent/Regula Falsi, Newton's-Raphson method, iteration method.
3. Solution of linear equations: Gause elimination, Gause-Jordan method. LU Decomposition. Inversion of 3 $\times$3 non-singular matrices by Gause elimination and Gause-Jordan method.

Refernces:

1. Numerical Analysis-S.A.Mollah, New Central Book Agency.

Unit-II(20)

(Computer Science)

1. Introduction to ANSI-C : Character set in ANSI-C. Key words: int, char, float, while etc. Constant and Variables, expressions, assignment statements, formatting source files. Header files.Data types, declarations, different types of integers, different kinds of integer constants, floating-point types, initialization, standard input/output. finding address of an object,
2. Operations and expressions, precedence and associatively, unary plus and minus operators, binary arithmetic operators, arithmetic assignment operators, increment and decrement operators, comma operator, relational operators, logical operators.
3. Control flow, conditional and unconditional bracing, looping, nested loops. if-else, do-while, for, switch, break, continue, goto statements etc., Infinite loops.

Arrays and Pointers

References:

1 Programming in ANSI-C-E.Balaguruswami, Tata MacGrawHill.
2 Let Us C- Kanethkar,BPB Pub.

Practical(40)

(Practical-Simple C-Programming and Numerical analysis through C programming):

(Laboratory Work Book:5,Viva-Voci-5, C-Programming-30)

1. Ascending / Descending order. Finding Largest / smallest.
2. Sum of finite series. Mean and variance.
3. Conversion of binary to decimal and decimal to binary.
4. Checking whether a number is prime or not. Generation prime numbers.
5. Solution of Quadratic equation. Newtone-Raphson's method. Lagrange interpolation.
6. Bisection method. Newton-Raphson method.
7. Trapezoidal Rule. Simpson's 1/3 rule.
8. Value of Determinant.
9. Cramer's Rule (for two variables).
10. Matrix addition, subtraction, transposition.

MATHEMATICS
Paper-VI
PROJECT
Mark : 20+80=100

This paper is a Dissertation paper. Each student will select an advanced topic in Mathematics and undergo critical study under the guidance of a teacher. At the end of semester he/she will submit his study note book (40-50 pages). He/she will deliver an open power point presentation and will face questions from the teachers and spectators on his topic during his/her presentation.

Mark Distribution:
Internal assessment: 20
Dissertation note book: 20
Power point presentation: 40
Viva:20
Total:100

B.A. / B. Sc. Semester-I (Honours)

MATHEMATICS
Paper-I
Mark : 20+80=100

Unit-I(20)
(Classical Algebra & Number Theory)

1. Inequalities : A. M. ≥G.M ≥ H.M. Their generalization like the theorem of weighted mean and m^{th} power theorem. Statement of Cauchy-Schwartz inequality, Weierstrass inequality and their application. DeMoivre's theorem and its applications. Expotential sine, cosine and logarithm of complex number.

2. Direct and inverse circular and hyperbolic functions. Expansion of trigonometrical functions. Gregory's series. Summation of series. Statements of well ordering principle, first principle of mathematical induction, second principle of mathematical induction. Proofs of some simple mathematical results by induction. The division algorithm, The greatest common divisor (g.c.d.) of two integers a and b. Relatively prime integers.

3. The equation ax+ by = c has integral solution iff (a,b) divides c. (a , b, c are integers). Prime numbers. Euclid's first theorem: If some prime p divides ab, then p divides either a or b. Euclid's second theorem: There are infinitely many prime integers. Unique factorization theorem. Statement of Chinese Remainder Theorem and simple problems. Euler ϕ function.

Unit-II(20)
(Abstract Algebra-I)

1. Set theory: Revision of set theory and algebra, relation and mapping. Order relations, equivalence relations and partitions. Congruence modulo n. Further theory of sets and mapping, Cardinality of sets, countable and uncountable sets, $\aleph_0$ and $\aleph_1$. Binary operation.

2. Group Theory: Semi-group, Definition, examples and simple properties of Group, Some special groups like Z_n, U(n), Dihedral groups, etc., Abelian group. Subgroup, the necessary and sufficient condition of a non-empty subset of a group is a subgroup, intersection and union of two subgroups.

3. Cyclic groups and its various properties. Order of a group and order of an element of a group, Permutation : Cycle, transposition, Statement of the result that every permutation can be expressed as a product of disjoint cycles. Even and odd permutations, Permutation Group. Symmetric group. Alternating Group. Order of an alternating group.

UNIT-III(20)
(Abstract Algebra-II)

1. Group Homomorphism, Automorphism, Endomorphism and Isomorphism. Cosets and their various properties, index of a subgroup, Lagrange's theorem and its applications, Normal subgroups:Definition, examples and properties.

2. Rings and Fields: Properties of Rings directly following from the definition, Unitary and commutative rings. Divisors of zero, Integral domain, Every field is an integral domain, every finite integrals domain is a field.

3. Definitions of Sub-ring and sub-field. Necessary of sufficient condition for a subset of a ring (field) to be sub-ring (resp. subfield). Characteristic of ring and integral domain. Ring and field Homomorphism, Isomorphism. Quotient-ring.

Unit-IV(20)
(Vector Algebra)

1 Vector Algebra: Vector (directed line segment) Equality of two free vectors. Addition of Vectors. Multiplication by a Scalar. Position vector, Point of division, Conditions of collinearity of three points and co-planarity of four points. Rectangular components of a vector in two and three dimensions. Product of two or more vectors. Scalar and vector products, scalar triple products and Vector triple products. Product of four vectors.

2. Direct application of Vector Algebra in (i) Geometrical and Trigonometrical problems (ii) Work done by a force, Moment of a force about a point.

3. Vector equations of straight lines and planes. Volume of a tetrahedron. Shortest distance between two skew lines.

Reference:

1. Advanced Higher Algebra: Ghosh and Chakraborty, U.N.Dhur.
2. Algebra: R.M.Khan, Central
3. Higher Algebra: Mapa, Ashok Pub.
4. Number Theory: S.B.Malik, New Age Pub.
5. Cordinate Geometry: S.B.Sengupta

B.A. / B. Sc. Semester-II (Honours)
MATHEMATICS
Paper-II

Mark : 20+80=100

Unit-I (20)
(Linear Algebra-I)

1 Matrix: Matrices of real and complex numbers : Algebra of matrices. Symmetric and skew-symmetric matrices. Hermitian and skew-Hermitian matrices. Orthogonal matrices. Inverse of a Matrix, Solution of linear equation with not more than three unknown by matrix method. Rank of a matrix, Row rank, Column Rank, determination of rank either by considering minor or sweep out process. Row rank = column rank = Rank of the matrix, Rank (A+B)<RankA + RankB, Rank(AB)< Min(RankA, RankB)(statement only).

2. Characteristics polynomial & minimal polynomials, characteristics equations, Eigen value & Eigen Vector. Cayley Hamilton theorem(statement only), Simple properties of eigenvalues and eigenvectors.

3. Vector / Linear space : Definitions and examples, Subspace, Union and intersection of subspaces. Linear sum of two subspaces.

Unit II (20)
(Linear Algebra-II)

1. Linear combination, independence and dependence. Linear span. Basis of vector space. Finite dimensional vector space. Replacement Theorem, Extension theorem, Statement of the result that any two bases of a finite dimensional vector space have same number of elements. Dimension of a vector space. Extraction of basis, formation of basis with special emphasis on R^n ($n \leq 4$).

2. Row space and column space of matrix. Row rank and column rank of matrix. Equality of row rank, column rank and rank of a matrix. Linear homogeneous system of equations : Solution space. For a homogeneous system AX = 0 in n unknowns, Rank X(A) + Rank A = n; AX = 0 contains non-trivial solution if Rank A < n. Necessary and sufficient condition for consistency of a linear non-homogeneous system of equations. Solution of system of equations (Matrix method).

3. Linear transformations and their representation as matrices. The algebra of linear transformations, rank and nullity theorem.

Reference:

1. Advanced Higher Algebra: Ghosh and Chakraborty, U. N, Dhur.
2. Algebra: R.M.Khan, Central
3. Higher Algebra: Mapa, Ashok Pub.

Unit-III(20)
(Geometry-Two Dimension)

1 Transformation of rectangular axes, translation, rotation and their combinations, theory of invariants. General equation of second degree in two variables, reduction into canonical form, lengths and position of the axes.

2 Pair of straight lines: Condition that the general equation of second degree in two variables may represent a pair of straight lines. Point of intersection of two intersecting straight lines, angle between two lines given by $ax_2+2hxy+by_2$, equation of bisectors of the angle between the pair of straight lines, equation of two lines joining the origin to the point in which two curves meet.

3 Polar coordinates, polar equation of straight lines, circles and conic referred to a focus as pole, equation of chord, tangent and normal.

Unit-IV(20)

(Geometry-Three Dimension)

1 Rectangular Cartesian co-ordinates in space, concept of geometric vector (directed line segment), projection of vector on a co-ordinate axis, inclination of a vector with an axis, co-ordinates of a vector, direction ratio and direction cosine of a vector. Distance between two points, division of directed line segment in given ratio. Equation of a plane in general form, intercept and normal form, signed distance of a point from a plane, equation plane passing through the intersection of two planes, angle between two intersecting planes, parallel and perpendicularity of two planes.

2 Straight lines in space, equation in symmetric and parametric form, canonical equation of line of intersection of two intersecting planes, angle between two lines, distance of a point from a line, condition of coplanarity of two lines, shortest distance between two skew lines.

3 General equation of sphere , circle, sphere through the intersection of two sphere, radical plane, tangent, normal. General equation of cone and cylinder, right circular cone and cylinder.

References:

1. Co-ordinate Geometry-S.B.Sengupta.
2. Co-ordinate Geometry-S.L.Lony, Macmillan and Co.

B.A. / B. Sc. Semester-III (Honours)
MATHEMATICS
Paper-III

Mark : 20+80=100

UNIT I(20)
(Calculus-I)

1. Limit and continuity of a real valued function at a point (the point must be a limit point of the domain set of the function). Algebra of limits. Sandwich rule. Continuity of composite functions. Bounded functions. Neighbourhood properties of continuous functions regarding boundedness and maintenance of same sign. Continuous function on [a,b] is bounded and attains its bounds. Intermediate value theorem.

2. Discontinuity of function, type of discontinuity. Step function. Piecewise continuity. Monotone function. Monotone function can have only jump discontinuity. Set of points of discontinuity of a monotone function is at most countable. Definition of uniform continuity and examples. Lipschitz condition and uniform continuity. Functions continuous on a closed and bounded interval is uniformly continuous.

3. Infinite Series of real numbers: Convergence, Cauchy's criterion of convergence. Series of non-negative real numbers: Tests of convergence – Cauchy's condensation test. Comparison test (ordinary form and upper limit and lower limit criteria), Ratio Test , Root test, Raabe's test, Bertrand's test, Logarithmic test and Gauss's test. Alternating series, Leibnitz's test. Absolute and conditional convergent series. Rearrangement of series through examples.

Unit-II(20)
(Calculus-II)

1. Definition of differentiability. Meaning of sign of derivative. Chain rule.
Successive differentiation : Leibnitz theorem and its applications. Statement of L' Hospital's rule and its applications. Darboux theorem, Rolle's theorem, Mean value theorems of Lagrange and Cauchy – as an application of Rolle's theorem.

2. Taylor's theorem on closed and bounded interval with Lagrange's and Cauchy's form of remainder deduced from Lagrange's and Cauchy's mean value theorem respectively. Maclaurin's theorem as a consequence of Taylor's theorem. Statement of Maclaurin's Theorem on infinite series expansion. Expansion of e^x, $\log(1+x)$, $(1+x)^m$, $\sin x$, $\cos x$ with their range of validity.

3. Functions of several variables: Limits and continuity (definition and examples only), Partial derivative. Total differentials. Statement of Schwartzs and Young's theorem on commutative property of mixed derivative. Euler's theorem of homogeneous functions of two variables. Statement of Taylor's theorem for functions of two variables.

Unit-III(20)
(Calculus-III)

1. Point of local extremum (maximum, minimum) of a function in an interval. Sufficient condition for the existence of a local maximum/minimum of a function at a point (statement only). Determination of local extremum using first order derivative. Application of the principle of maximum/minimum in geometrical problems. Jacobian, maxima, minima, saddle points of functions of two variables (example only).

2. Tangent, normal, sub tangent and sub normal. Length of tangent and normal. Angle of intersection of curves. Pedal equation of a curve, pedal of a curve. Differential of arc lrngth. Curvature-Radius of curvature, centre of curvature, chord of curvature,
evolute of a curve. Rectilinear asymptotes for Cartesian and polar curves. Envelopes of families of straight lines and curves (Cartesian and parametric equations only).

3. Reduction formulae such as $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$, $\int \sin^n x \cos^m x dx$, $\int \sin^n x \cos mx dx$ etc.

References:

1. Differential Equations: Ghosh and Chakraborty, U.N.Dhur
2. Differential Equations: M.D.Raisinghania, S. Cand.

Unit-IV(20)

(Vector Calculus)

1 Vector function, limit and continuity, derivative of vector, derivative of sums and product of vector functions. A necessary and sufficient condition that a proper vector â (i) has a constant length that â.dâ/dt = 0, (ii) always remains parallel is that â×dâ/dt=Õ.

2 Vector integration, scalar and vector fields, directional derivatives, gradient of a scalar point function, ∇ operator, divergence, curl and Laplacian.

3 Line, surface and volume integral. Gauss's, Stoke's theorem and problem based on these.

References:

Vector Analysis-Maity and Ghosh, New Central Book Agency.

Vector Analysis- Schaum's series, Tata McGrawHill

B.A. / B. Sc. Semester-IV (Honours)
MATHEMATICS
Paper-IV
Mark : 20+80=100

Unit-II(20)
(Differential Equations-I)

1. Significance of ordinary differential equation. Geometrical and physical consideration. Formation of differential equation by elimination of arbitrary constant. Meaning of the solution of ordinary differential equation. Concept of linear and non-linear differential equations. Equations of first order and first degree : Statement of existence theorem. Separable, Homogeneous and Exact equation. Condition of exactness, Integrating factor. Rules of finding integrating factor, (statement of relevant results only),Equations reducible to first order linear equations.

2. Equations of first order but not of first degree, Clairaut's equation. Singular solution, Applications : Geometric applications, Orthogonal trajectories. Higher order linear equations with constant co-efficients : Complementary function, Particular Integral, Symbolic operator D.

3. Method of undetermined co-efficients, Method of variation of parameters. Euler's homogeneous equation and Reduction to an equation of constant coefficients.

Unit-II(20)
(Differential Equations-II)

1. Exact differential equations of higher order, method of solution, Non-linear exact equations, linear equations of some special forms,

2. Second order linear equations with variable co-efficients, Reduction of order when one solution the homogeneous part is known. Complete solution. Method of variation of parameters.

3. Reduction to Normal form. Change of independent variable. Operational Factors. Simple eigenvalue problems. Simultaneous linear differential equations.

References:

1. Differential Calculus-Das and Mukherjee, U.N. Dhur & Sons.
2. Integral Calculus-Das and Mukherjee, U.N. Dhur & Sons.
1. Advanced Differential Equation-M.D.Raisinghania-S.Chand.
2. Simplified course in differential equation-M.D.Raisinghania-S.Chand.

Unit-III(20)
(Linear Programming Problem-I)

1 What is LPP ? Mathematical form of LPP formulation. LPP in matrix notation. Graphical solution of LPP. Basic solution, Basic feasible solution, degenerate and non-degenerate BFS.

2 Euclidean space, hyperplane, convex set, extreme points, convex functions and concave functions, the hyperplane in convex set. Intersection of two convex sets is convex set, the collection of all feasible solution of a LPP constitutes a convex set. A BFS to a LPP corresponds to an extreme point of convex set of feasible solutions.

3 Slack, surplus and artificial variables, standard form of LPP, Fundamental theorem pf LPP and their applications, theory and application of the simplex method of solution of LPP. Charne's M-technique.

Unit-IV(20)
(Linear Programming Problem-II)

1 Degeneracy. The two phase method.

2 Duality theory. The dual of the dual is primal, relation between the objective function value of dual and primal problems. Relation between their optimal values. Statement of fundamental theorem of duality. Dual simplex method.

3 Transportation problem. TP in LPP form, Balanced TP. Optimality test of BFS. Assignment problem. Solution of AP [(Maximization, unbalanced, negative cost and impossible assignment. Traveling salesman problem.

(Problem should be set on simplex and Charne's method, two phase method in such ay that it may contain at most three or four tableau with approximate marks.)

References:

1. Linear Programming Problem- Chakroborty and Ghosh-U.N.Dhur and Sons
2. Operations Research-Kantiswarup et. al, Sultan Chand and Sons.
3. Linear Programming and Theory of Games, P.M.Karak, Central Book Agency.

B.A. / B. Sc. Semester-V (Honours)
MATHEMATICS
Paper-V

Mark : 20+80=100

Unit-I(20)
(Analysis-I)

1. Bounded subset of R, L.U.B. (supremum) and G.L.B. (infimum) of a set. Least upper bound axiom. Characterization of R as a complete ordered field. Definition of an Archimedean ordered field. Archimedean property of R. Q is Archimedean ordered field but not ordered complete. Neighbourhood of a point. Interior point. Open set. Union, intersection of open sets. Limit point and isolated point of a set. Bolzano-Weierstrass. Complement of open set and closed set. Dense set in R.

2. Covering and compactness, Heine Borel theorem. Sequences of real numbers : Bounded sequence. Convergence and divergence. Examples. Every convergent sequence is bounded and limit is unique.

3. Monotone sequences and their convergence. Sandwich rule. Nested interval theorem. Cauchy's first and second limit theorems. Subsequence. Subsequential limits. Lim sup upper (limit) and lim inf (lower limit) of a sequence using inequalities. Bolzano-Weierstrass theorem for sequence. Cauchy's general principle of convergence

Unit-II(20)
(Analysis-II)

1 Riemann integration on [a,b] . Riemann approach Riemann sum and Riemann integrability. Darbaux's approach: upper sum U(P,f) and lower sum L(P,f), upper and lower integral, Darboux's theorem, necessary and sufficient condition of Riemann integrability. Equality of Riemann and Darboux's approach.

2 R-integrability of sum, product and quotient. R-integrability of f □ R-integrability of □f□. Integrability of monotone functions, continuous functions, piecewise continuous functions, function having (i) finite number of point of discontinuities, (ii) having finite number of limit points of discontinuities.

3 Function defined by the definite integral $\int_a^x f(t)dt$ and its properties. Primitives or indefinite integrals. First mean value theorem of integral calculus. Second mean value theorem of integral calculus (both Bonet's and Weierstrass's forms).

Unit-III(20)
(Analysis-III)

1. Improper integrals and their convergence, absolute and non-absolute convergence. Tests of convergence: Comparison test, m-test. Abel's and Dirichlet's test for convergence of integral of a product.

2. Beta and Gamma functions and their convergence, their properties and interrelation.

3. Geometric interpretation of definite integral. Fundamental theorem of integral, area enclosed by plane curves. Rectification of plane curves. Volume and surface area of solid formed by revolution of plane curves and areas about x-axis and y-axis.

Unit-IV(20)
(Analysis-IV)

1. Sequence and sequence of functions, pointwise and uniform convergence, boundness and continuity, integrability and differentiability of limit function in case of uniform convergence. Weierstrass M-test of uniform and absolute convergence. Power Series, radius of convergence using upper limit, uniform convergence of power series, properties, term by term integration and differentiation, uniqueness of power series.
2. Fourier series, Dirichlet's condition of convergence, Calculation of Fourier's coefficients, Fourier theorem, half range series, sine series, cosine series, Fourier series in arbitrary interval, Parseval's identity, basic theorems.
3. Evaluation of double and triple integrals, Dirichlet's integrals, change of order of integration in double integrals. Differentiability and integrability of an integral of a function of a parameter. Differentiation under the sign of integration

References:

1. Mathematical Analysis-W.Rudin- Tata McGreawHill.
2. Mathematical Analysis-Apostal- Narosa
3. Mathematical Analysis-Malik and Arora-New Age International Pub.

B.A. / B. Sc. Semester-V (Honours)
MATHEMATICS
Paper-VI
Mark : 20+80=100

Unit-I(20)
(Probability)

1.1 Frequency and Axiomatic definition of probability. Random Variable, distribution function, discrete and continuous distribution. Binomial, Poisson, Beta, Gama, Uniform and normal distribution. Poisson process. Transformation of random variables.

1.2 Two dimensional probability distributions, discrete and continuous distribution in two dimensions, Uniform distribution and two dimensional normal distribution. Conditional distribution. Transformation of random variables in two dimensions.

1.3 Mathematical expectation, mean, variance, moment, central moments, measures of dispersion, skewness and curtosis, median, mode, quartiles. Moment generating function, characteristic function, statement of their uniqeness. Two dimensional expectation, covariance, correlation co-eficient, joint characteristic function, multiplication rule for expectation, conditional expectation.

Unit-II(20)
(Statistics)

3.1 Random sample, concept of sampling and various types of sampling, sample and population. Collection, tabulation and graphical representation, grouping of data, sample characteristic and their computation, sampling distribution of statistic.

3.2 Estimates of population characteristic or parameter, point estimation and interval estimation, criterion of a good point estimate, maximum likelihood estimate. Interval estimation of population proportion, interval estimation of a Normal population parameters, estimate of population parameters with large sample when distribution of the population is unknown.

3.3 Testing of Hypothesis:null hypothesis and alternative hypothesis. Type one and type two error, testing of hypothesis for a population proportion and Normal population parameters and large sample test for population with unknown distribution. Chi-square test of goodness of fit.

References:

1. Ground Work of Mathematical Probability and Statistics-Amritabha Gupta, Academic Pub.
2. Mathematical Statistics-Gupta and Kapur-Sultan Chand.

Unit-III(20)
(Tensor Analysis)

1 Summation Convension, Kronecker symbol. n-dimensional space, transformation of coordinates in S_n. Invariants, covariant and contravariant vectors. Covariant, contravariant and mixed tensors. Algebra of tensors. Symmetric and skew-symmetric tensors. Contraction, outer and inner product of tensors. Quotient law, reciprocal tensor. Riemann space, the line element and metric tensor, raising and lowering of indices, associate tensor, magnitude of a vector, inclination of two vectors, orthogonal vectors. Christoffel symbols and their properties, law of transformation law of Christoffel symbols.

2 Covariant differentiation of tensors, covariant differentiation of sum, difference and product of tensors. Gradient, divergence, curl and Laplacian. Curvilinear coordinate system in E_3 : line element, lengthy of vector, angle between two vectors in E_3 in a curvilinear coordinate system. Basis in a curvilinear coordinate system, reciprocal base, covariant and contravariant

components of a vector in E_3, partial derivative of a vector. Sperical and cylindrical coordinate system.

3 Curves in E_3. Parallel vector fields along a curve in E_3, parallel vector field in E_3, parallel vector space in a Riemannian space, parallel vector field in a surface of a Riemannian space. Serret-Frenet formulas.

References:

1. A Text Book of Tensor Calculus-M.C.Chaki: Calcutta Publishers.
2. Tensor Calculus-U.C.De, A.A.Shaikh and J. Sengupta-Narosa.
3. Differentoa Geometry of Curves and Surfaces in E_3(Tensor approach)-U.C.De: Anamaya Publishers

Unit-IV(20)
(Dynamics of Particle)

1 Simple Harmonic Motion, Tangent and normal acceleration. Velocity and acceleration along radial and transverse directions.

3 Central orbits, central forces, motion of a particle under central force. Differential equation in polar and pedal coordinates, velocity under central force. Apse, apsidal distance and apsidal angle.

2.1 Kepler's laws of planetary motion, artificial satellites, Escape velocity, Geo stationary satelite Disturbed orbits.

References:

1. Dynamics of a Particle and of Rigid Bodies-S.L.Lony,Radha Publishing House.
2. Dynamics of Particle and Rigid Bodies-Chakroborty and Ghosh-U.N.Dhur and Sons

B.A. / B. Sc. Semester-VI (Honours)
MATHEMATICS
Paper-VII
Mark : 20+80=100

Unit-I(20)

(Numerical analysis-I)

1 Error in numerical analysis. Gross error, rounding off error, truncation error. Approximate numbers, significant figure. Absolute, relative and percentage error. General formula for error. Δ, ∇, E, δ, μ operators, their properties and interrelations. Equispaced arguments, differece table, propogation of error in difference table.

2 Interpolation: Statement of Weierstrass' approximation theorem, polynomial interpolation and error term in polynomial interpolation, deduction of Lagrange's interpolation formula, inverse interpolation, finding root of a equation by interpolation method. Deduction of Newton's forward and backward interpolation formula. Statement of Gauss's forward and backward interpolation formula. Starling's and Bessel's interpolation formulae. Error terms. Divided difference, Genaral interpolation formulae, deduction of Lagrange's, Newton's forward and backwards interpolation formula.

3 Numerical Differentiation based on Newtons's forward, Newton's backward and Lagrange interpolation formula. Error terms. Numerical integration: Integration of Newton's interpolation formula. Newton-Cotes formula. Deduction of Trapezoidal rule and simpson's 1/3 rule, statement of Weddle's rule. Statements of error terms.

Euler Maclaurin's sum formula.

Unit-II(20)

(Numerical Analysis-II)

2.1 Numerical Solution of non-linear equations: Location of a real roots by tabular method, Bisection method, secant/Regula-Falsi, fixed point iteration and Newton-Raphson method, their geometric significance and convergency, order ofconvergence. Newtons method for multiple roots.

2.2 Numerical solution of a system of linear equations: Gause elimination , Gause-Jordan method. Pivoting strategy in Gauss elimination.LU-Decomposition. Inversion of 3□3 non-singular matrices by Gause elimination and Gause-Jordan method. Gause-Siedel iteration method for system of linear equation.

2.3 Numerical solution of ordinary differential equation of first order: Euler's method, modified euler's method, Picard's method, Taylor's series method, Runge-Kutta method, Milne's method.

Refernces:

1. Numerical Analysis-S.A.Mollah, New Central Book Agency.

Unit-III(20)

(C Programming-I)

Algorithm and flowcharts with simple examples. Bracing and looping.

Introduction to ANSI-C : Character set in ANSI-C. Key words: int, char, float, while etc. Constant and Variables, expressions, assignment statements, formatting source files. Header files.Data types, declarations, different types of integers, different kinds of integer constants, floating-point types, initialization, mixing types, the void data type. Type defs. standard input/output. finding address of an object, Operations and expressions, precedence and associatively, unary plus and minus operators, binary arithmetic operators, arithmetic assignment operators, increment and decrement operators, comma operator, relational operators, logical operators.

Unit-IV(20)

(C Programming-II)

Control flow, conditional and unconditional bracing, looping, nested loops. if-else, do-while, for, switch, break, continue, goto statements etc., Infinite loops. Functions. Arrays and Pointers

References:

1. Programming in ANSI-C-E.Balaguruswami, Tata McGrawHill.
2. Let Us C-Kanethkar-BPB Pub.

B.A. / B. Sc. Semester-VI (Honours)
MATHEMATICS
Paper-VIII
Mark : 20+80=100

B.A. / B. Sc. Semester-VI (Honours)
MATHEMATICS
Paper-VIII
Mark : 20+80=100
(Practical)

(Numerical Analysis)Mark=40

(Note Book-5+Viva Voce-5+ Numerical Analysis-30=40)

1. Problems on Newton's forward and Backward interpolation. Lagrange interpolation formula. Inverse interpolation. Finding root of a equation by interpolation method.
2. Differentiation formula based on Newton's forward and backward interpolation formula.
3. Numerical integration by Trapezoidal, Simpson's 1/3 rule and Weddle's rule
4. Finding roots of an equation by Bisection method, Regula Falsi method, fixed point iteration method, Newton-Raphson method.
5. Solution of linear equation by Gauss elimination method, Gauss-Jordan method and Gauss-Siedel method.
6. Finding inverse of a third order matrix without finding its determinant.
7. Runge-Kutta Method

(C-Programming)Mark=40

(Note Book-5+Viva Voce-5+C-Programming-30=40)

1. Ascending / Descending order. Finding Largest / smallest.
2. Sum of finite series.
3. Sum of Convergent series.
4. Bisection method.
5. Checking whether a number is prime or not. Generation of prime numbers.
6. Solution of Quadratic equation
7. Newton's forward and Backward interpolation. Lagrange interpolation.
8. Bisection method. Newton-Raphson method. Regula Falsi method.
9. Trapezoidal Rule. Simpson's 1/3 rule.
10. Value of Determinant.
11. Matrix sum, subtraction, product, transposition.
12. Cramer's Rule (upto three variables).
13. Solution of linear equation by Gause elimination method, Gause-Jordan method.
14. Runge-Kutta Method.
15. Mean, variance, correlation coefficient, equation of regression lines.