DEPARTMENT OF MATHEMATICS

T R I P U R A U N I V E R S I T Y

B.A./B.Sc.
MATHEMATICS
General & Honours
Syllabus
2008

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

MATHEMATICS

Paper-I

Group –A
(Algebra and Trigonometry – 50 Marks)

Unit-1 (15+2 Marks)

1.1 Theory of equations: Polynomials with real coefficient, synthetic division, statement of fundamental theorem of classical algebra. Surds and complex roots occur in pairs

1.2 Statement of Descartes' rule of sign and its applications. Relations between root and coefficient, symmetric functions of roots. Transformation of equations. Standard form of cubic and bi – quadratic equations. Cardan's solution of cubic equations. Descartes' and Ferrari's method of solving bi – quadratic equations.

1.3 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

Unit-2 (15+2 Marks)

2.1 DeMoivre's theorem and its applications.

2.2 Exponential sine, cosine and logarithm of complex number. Direct and inverse circular and hyperbolic functions.

2.3 Expansion of trigonometry functions, Gregory's series. Summation of series.

Unit-3 (15+1 Marks)

3.1 Revision of definition of vectors and its algebra. Rectangular solution of vector. Bination, linier 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.

3.2 Scalar and vector product of two vectors. Scalar and vector triple product. Product of four vectors. Reciprocal vectors.

3.3 Simple applications to geometry. Vector equations of straight line, plane and circle. Applications to mechanics: work done, torque.

Group –B
(Calculus – 50 Marks)

Unit-4 (15+2 Marks)

4.1 Idea of ε-δ 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

4.2 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)

4.3 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.

Unit-5 (15+2 Marks)

5.1 Functions of several variables -1 : 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.

5.2 Functions of several variables-2 : Jacobian, maxima, minima, saddle points of functions of two points (examples only)

5.3 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-6 (15+1 Marks)

6.1 Definite integral as limit of the sum. Geometric interpretation of definite integral. Fundamental theorem of integral calculus. Properties of definite integral. Evaluation of definite integral.

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

6.3 Reduction formulae such as $\int e^x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$, $\int \sin^n x dx$ $\int \cos^n x dx$ $\int \sin^m x \cos^n x dx$ $\int \sin^m x \cos x dx$ etc where m and n are non-negetive inetegers. Summation of infinite series using definition of definite integral.

B.A. / B. Sc. Part-II (General)

MATHEMATICS

Paper-II
(Algebra, Calculus, Differential Equations and Vector Analysis)
Group-A(50)
(Algebra)
Unit-1(15+1)
(Matrix Theory)

1.1 Symmetric and skew symmetric matrices, Hermitian and Skew-Hermitian matrices, minor and cofactors, orthogonal and singular matrix, adjoint and inverse of matric upto 3□3 matrices, applicqation of matrices to a system linear equations (both homogeneous and non-homogeneous) with not more than three unknowns, theorem on consistency of a system of linear equations.

1.2 Rank of a metrix. Linear independent of row and column matrices. Row rank and column rank of two matrices. Equality of row rank , column rank and rank of a matrix. Finding rank of a matrix by considering minor or sweep out process. Rank of sum and product of two matrices.

1.3 Eigen-values, eigen vectors and the characteristic equation of matrix, Caley-Hamilton theorem and its use in finding inverse of matrix, some basic theorems.

Unit-2(15+2)
(Abstract algebra)

2.1 Revision of set theory, relation and mapping. Equivalence relation, partition of a set, equivalence classes, composition of functions. Some basic theorems on equivalence relation and mapping.

2.2 Binary operation, 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, intersection and union of two subgroups, cyclic group, order of a group and order of an element.

2.3 Ring, integral domain domain, field, subring, subfield, skew-field, necessary and sufficient condition of a non-empty subset of a group is a subring/subfield, intersection and union of two subring/subfield.

Unit-3(15+2)
(Linear Algebra)

3.1 Vector space/Linear space (Def. and examples), linear span, basis and dimention (Def. and examples).

3.2 Subspace (Def. and examples), intersection and union of subspaces, linear sum of two subspaces, direct sum of subspaces, dimension of sum and subspaces.

3.3 Linear transformation and their representation as matrices, kernal and range of a linear transformation, the algebra of linear transformations, the rank nullity theorem(statement).

References:

1. Adnaced Higher Algebra-Chakroborty and Ghosh, U.N.Dhur and Sons.
2. Algebra-R.M.Khan, New Central Book Agency.
3. Higher Algebra(Abstract and Linear)-Mapa, Ashok Publications.

Group-B(50)

(Calculus, Differential Equations and Vector Analysis)

Unit-4(15+1)

(Calculus)

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.

Unit-5(15+2)

(Differential Equation)

5.1 Linear equation and equations reducible to the linear form. Exact differential equations. First order higher degree equations solvable for x, y, p. Clairaut's form and singular solutions.

5.2 Geometrical meaning of differential equations. Orthogonal trajectories. Linear differential equations with constant coefficients. Homogeneous linear ordinary differential equations. Linear differential equations of second order.

5.3 Transformation of the equation by changing the dependent variables / the independent variable. Method of variation of parameters. Ordinary simultaneous differential equations.

References:

1. Integral Calculus-Das and Mukherjee,U.N.Dhur and Sons
2. Integral Calculus-Maity and Ghosh, New Central Book Agency.

Unit-6(15+2)

(Vector Analysis)

6.1 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.

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

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

References:

1. Vector Analysis-Maity and Ghosh, New Central Book Agency.
2. Vector Analysis- Schaum's series, Tata McGrawHill

Paper-III
(Geometry, Complex Analysis, Linear Programming Problem and Dynamics)

Group-A(50)

(Geometry, Complex Analysis)

Unit-1(15+1)

(Geometry-Two Dimension)

1.1 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.

1.2 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.

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

Unit-2(15+2)

(Geometry-Three Dimension)

2.1 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.

2.2 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.

2.3 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-3(15+2)

(Complex Analysis)

3.1 Complex function, limit, continuity, differentiability, relation between differentiability and continuity, analytic function.

3.2 Cauchy-Riemann equation(Statement), orthogonal family of curves, harmonic function, harmonic conjugate, Morle-Thomson theorem(statement).

3.3 Curve in complex plane, contour, complex definite integral of parametric complex function, length of a contour, contour or path integration in complex plane, modulus

of a contour integral, ML-theorem, Cauchy theorem for analytic function whose derivative is continuous in that region (Proof using Green's theorem) and their applications.

References:

1. Complex Variable-Schaum's Series, Tata McGrawHill.
2. Complex Variable-Kasana, Prentice Hall of India

Group-B(50)
(Linear Programming Problem, Dynamics)
Unit-4(15+2)
(Linear Programming Problem-I)

4.1 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.

4.2 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.

4.3 Slack, surplus and artificial variables, standard form of LPP, statement of fundamental theorem pf LPP and their applications, theory and application of the simplex method of solution of LPP.

Unit-5(15+2)
(Linear Programming Problem-II)

5.1 Charne's M-technique. The two phase method.

5.2 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.

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

(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.

Unit-6(15+1)
(Dynamics)

6.1 Simple Harmonic Motion, damped vibrations, forced vibration, damped forced oscillations, elastic string, Hook's law.

6.2 Tangent and normal acceleration.

6.3 Velocity and acceleration along radial and transverse directions.

References:

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

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

MATHEMATICS

Paper-V
(Numerical Analysis, Probability Theory, Statistics and Computer Science)

Group-A(70)
Unit-1(10+2)
(Numerical analysis-I)

1.1 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.

1.2 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.

Unit-2(10+1)
(Numerical analysis-II)

2.1 Solution of algebraic and transcendental equations: Bisection, Secent/Regula Falsi, Newton's-Raphson method, iteration method.

2.2 Solution of linear equations: Gause elimination , Gause-Jordan method. LU-Decomposition. Inversion of 3□3 non-singular matrices by Gause elimination and Gause-Jordan method.

Refernces:

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

Unit-3(10+2)
(Probability Theory)

3.1 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.

3.2 Moments of a probability distribution, skewness and kurtosis of a probability distributuin, moment generating function. Transformation of one dimensional random variable(simple applications).

Unit-4(10+1)
(Statistics)

4.1 Sampling theory: Universe and sample, cencus and sample, necessity of sampling, different methods of sampling, parameter and statistic,standard error. Chi-squre and

t-distributions (concepts only). Estimation and estimate of a population parameter, point and interval estimation for parameters of a Normal population(problems only). Testing of hypothesis: Type one and type two errors, testing of hypothesis of a Normal population parameters (problems only).

4.2 Bi-variate data: Principle of least square, linear and quadratic least-square curve fitting. Covariace and Correlation coefficient, rank correlation.

References:

1. Ground Work of Mathematical Probability and Statistics-Amritabha Gupta, Academic Pub.
2. Statistical Methods,Vill-I and II-N.G.Das

Unit-5(10+2)
(Computer Science-I)

5.1 Binary, octal, decimal and hexadecimal numbers and conversion between them. BIT, BITE and Word. Programming Languages: Machine language, assembly language, high level language. Computer programmes: Source programme and object programme. Compiler, assembler and interpreter.

5.2 Algorithm and flowcharts with simple examples. Bracing and loping.

Unit-6(10+2)
(Computer Science-II)

6.1 Introduction to ANSI-C : Character set in ANSI-C. Key words: int, char, float, while etc. Data type: character, integer, floating point etc. Constant and Variables. Operator: = , = = , !! , < , > etc. Arithmetic, assignment, relational, logical, incremental operations. Standard input/output.

6.2 Header files, Bracing and loping operation in ANCI-C : if-else, do-while, for.

References:

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

Group-B(30)
(Practical-Simple C-Programming and Numerical analysis through C programming):

(Laboratory Work Book:5,Viva-Voci-5, C-Programming-20)

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.

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

MATHEMATICS

Paper-I

(Algebra and Trigonometry – 100 Marks)

Group –A
(50 Marks)

Unit-I (15+2 Marks)

1.1 Theory of equations : Polynomials with real coefficient, Synthetic division, statement of fundamental theorem of classical algebra. Surds and complex roots occur in pairs.

1.2 Statement of Descartes' rule of sign and its applications. Relations between root and coefficients, symmetric functions of roots. Transformation of equations. Standard form of cubic and bi- quadratic equations. Cardan's solution of cubic equations. Descartes and Ferrari's method of solving bi-quadratic equations.

Unit-II (15+2 Marks)

2.1 Matrix: Adjoint , Reciprocal & skew symmetric, orthogonal matrix and their properties, inverse of matrix, solution of linear equation with not more than three unknown by matrix method…..

2.2 Rank of a matrix, Row rank, Column Rank, determination of rank either by considering minor or sweep out process. Row rank = column U rank = Rank of the matrix, Rank (A+B)<RankA + RankB, Rank(AB)≤ Min(RankA, RankB).

2.3 Characteristics polynomial & charactertics equations, Eigen value & Eigen Vector. Caley Hamilton theorem. Real quadratic forms, Index, Rank, Signature. Applicatiob of matrix to a system of linear equation with not more than three unknown. Theorem of consistency of a system of linear equations

Unit-III (15+1 Marks)

3.1 Revision of definition of vectors and its algebra. Rectangular resolution of vector. Linear combination, Linear dependent and independent of vectors. Two vectors are linear 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.

3.2 Scalar and vector product of two vectors. Scalar and vector triple product. Product of four vectors Reciprocal vectors.

3.3 Simple applications to geometry. Vector equation of straight line, plane and circle. Applications to mechanics: work done, torque.

Group – B
(50 Marks)

Unit-IV (15+2 Marks)

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

4.2 Group Theory: Definition and examples Group, 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, Cyclic group. Order of a group and order of an element of a group.

4.3.1 Ring and field : Definition and examples of Rings and Field, integral domain, skew field, subring and subfield, necessary and sufficient condition of a non empty subset of a ring (field) to be a subring (subfield)

Unit-V (15+2 Marks)

5.1 DeMoivre's theorem and its applications.

5.2 Expotential sine, cosine and logarithm of complex number. Direct and inverse circular and hyperbolic functions.

5.3 Expansion of trigonometrical functions. Gregory's series. Summation of series

Unit-VI (15+1 Marks)

6.1 Definitation and examples of vector space / linear space. Linear span, basis and dimension.

6.2 Vector subspace, necessary and sufficient condition of a non-empty subset of a vector space to be a subspace, intersection and linear sum of two subspace, direct sum of two subspaces.

6.3 Linear transformations and their representation as metrices. The algebra of linear transformations, rank and nullity theorem

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

Paper –II

(Calculus – 100 Marks)

Group – A

(50 Marks)

Unit-I (15+2 Marks)

1.1 Idea of ε-δ 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 cauchy. Geometric interpretation of Lagrange's mean value theorem.

1.2 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 restriction whenever necessary.

1.3 Sequence and Series: Limit of sequence. Convergent and non convergent sequence, Cauchy sequence. Convergence of infinite series.

Unit-I I(15+2 Marks)

2.1 Functions of several variables –1 : 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.

2.2 Functions of several variables –2 : Jacobian, maxima, minima, saddle points of functions of two points (example only)

2.3 Application: tangent normal sub tangent and sub normal. Length of tangent and normal. Differential of arc lrngth. Curvature and rectilinear asymptote for Cartesian and polar curve.

Unit-III (15+1 Marks)

3.1 Elements of point set theory : Neibourhood, interior points, open sets, closed sets, theorem on open set and closed sets. Bolzano-Weierstrass's theorem. Denumerability of rational numbers, non-enumerability of real numbers of an interval, covering and copactness, lindelof and heine Borel theorem, uniform continuity

3.2 Subsequences, bounded and convergent subsequence. Limit inferior and limit superior, Nested intervals, theorem on nested intervals. Cauchy first and second limit theorem.

3.3 Test of convergence of infinite series, condensation test. Upper and lower limit criterion for comparison test, Cauchy's root test, D'Alembert ration test, logarithmic test Raabe's test. Bertrand's and Gauss' test. Alternating series, Leibnitz's test. Absolute and conditional convergent series. Rearrangement of series through examples.

Paper –II

(Calculus – 100 Marks)

Group – B

(50 Marks)

Unit-IV (15+2 Marks)

4.1 Definite integral as limit of the sum. Geometric interpretation of definite integral. Fundamental theorem of calculus. Properties of definite integral. Evaluation of definite integral.

4.2 Definition of improper integrals, examples. Definition and simple properties of beta & gamma functions & their uses (convergence and important relations being assumed).

4.3 Reduction formulae such as $\int e^x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$, $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \sin^m x \cos^n x dx$, $\int \sin^m x \cos nx dx$ etc

Unit-V (15+2 Marks)

5.1 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.

5.2 Evaluation of double and triple integrals, Dirichlet's integrals, change of order of integration in double integrals.

5.3 Differentiability and integrability of an integral of a function of a parameter. Differentiation under the sign of integration

Unit-IV (15+1 Marks)

6.1 Linear equation and equations reducible to the linear form. Exact differential equations. First order higher degree equations solvable for x, y, p. Clairaut's form and singular solutions.

6.2 Geometrical meaning of differential equations. Orthogonal trajectories. Linear differential equations with constant coefficients. Homogeneous linear ordinary differential equations. Linear differential equations of second order.

6.3 Transformation of the equation by changing the dependent variables / the independent variable. Method of variation of parameters. Ordinary simultaneous differential equations.

B.A. / B. Sc. Part-II (Honours)

MATHEMATICS

Paper-III

(Advanced Abstract Algebra, Geometry, Vector Analysis, Advanced Differential Equations and Metric Spaces)

Group-A(50)

(Advanced Abstract Algebra, Geometry)

Unit-I(15+2)

(Advanced Abstract Algebra)

1.1 Permutation, cycle and transposition, even and odd permutation, permutation group, symmetric group, alternating group.

1.2 Coset decomposition of a group, Lagranges' theorem, factor group. Product of subgroups. Normal subgroups and quotient subgroups,

1.3 Homomorphism, Automorphism , endomorphism and isomorphism of a group, kernal and image of a group homomorphism, 1^{st} and 2^{nd} group isomorphism theorems, Cayley's theorem.

References:

1. Topics in Abstract Algebra-M.K.Sen et. al. – University Press.
2. Advanced Higher Algebra-Chakroborty and Ghosh-U.N. Dhur and Sons.
3. Algebra(Abstract anl Linear)-Mapa-Ashok Pub.
4. Algebra-R.M.Khan-New Central Book Agency.

Unit-II(15+1)

(Geometry-Two Dimension)

2.1 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.

2.2 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.

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

Unit-2(15+2)

(Geometry-Three Dimension)

3.1 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.

3.2 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.

3.3 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:

3. Co-ordinate Geometry-S.B.Sengupta.
4. Co-ordinate Geometry-S.L.Lony, Macmillan and Co.

Group-B(50)
(Vector Analysis, Advanced Differential Equations and Metric Spaces)

Unit-4(15+2)
(Vector Analysis)

4.1 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.

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

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

References:

3. Vector Analysis-Maity and Ghosh, New Central Book Agency.
4. Vector Analysis- Schaum's series, Tata McGrawHill

Unit-5(15+1)
(Advanced Differential Equations)

5.1 Second order ordinary differential equations with variable coefficients reducible to known forms. Wronskian. Normal form of the equation of the second order. Method of variation of parameters. Simple eigen value problems.

5.2 Total and partial differential equations of the form Pdx+Qdy+Rdz=0, $\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}$ and P*p*+Q*q*=R, Lagrange's equation.

5.3 Ordinary and regular point. Series solution of ordinary differential equations. Hypergeometric, Legendre and Bessel equations and their series solution with basic properties and generating functions.

References:

1. Advanced Differential Equation-M.D.Raisinghania-S.Chand.
2. Simplified course in differential equation-M.D.Raisinghania-S.Chand.

Unit-6(15+2)

(Metric Spaces)

6.1 Metric and metric space, bounded metric, open ball, interior point, exterior point, boundary point, limit point, open sets and closed sets, closure and interior, dense subset, equivalent metrics.

6.2 Continuous function, uniform continuity, isometry and homeomorphism. Cauchy sequence, completeness and completeness of $\mathbb{R}$,$\mathbb{C}$, $\mathbb{R}^n$, $\mathbb{C}^n$, C[a,b], l_2 etc. Cantor intersection theorem, contraction principle.

6.3 Covering subcovering, compactness, Hiene-Borel teorem, continuous image of compact set, uniform continuity and compact set. Connectedness, continuous image of connected set, connected subsets of $\mathbb{R}$.

References:

1. Metric Spaces:J.Sengupta-U.N.Dhur and Sons.
2. Metric Spaces:Jain and Gupta-New Age International Pub.

Paper-IV
(Statics, Dynamics, Complex Analysis and Linear programming problem)

Group-A(50)
(Statics and Dynamics)
Unit-1(15+2)
(Statics)

1.1 Reduction of a system of coplanar forces. Stability of equilibrium, energy test of stability.

1.2 Principle of Virtual Work, Deduction of conditions of equilibrium of a particle under coplanar forces from the principle of virtual work, converse of the principle of virtual work.

1.3 Common catenary and catenary of uniform strength. Forces in three dimension, Poinsot's central axis and its equation, wrenches.

References:

1. Analytical statics-Ghosh
2. A text book on statics-M.Ray-S.Chand

Unit-2(15+2)
(Dynamics-I)

2.1 Simple Harmonic Motion, damped vibrations, forced vibration, damped forced oscillations, elastic string, Hook's law.

2.2 Tangent and normal acceleration. Velocity and acceleration along radial and transverse directions.

2.3 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.

Unit-2(15+2)

(Dynamics-II)

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

3.2 Motion in resisting medium. Motion of particle of varying mass.

3.3 Motion of a particle in three dimensions. Accelerations in terms of different coordinates.

References:

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

Group-B(50)

(Complex Analysis and Linear programming problem)

Unit-4(15+2)

(Complex Analysis)

4.1 Stereographic projection, idea of simply connected and multiply-connected region in complex plane, complex function, limit, continuity, differentiability, relation between differentiability and continuity, analytic function.

4.2 Cauchy-Riemann equation, orthogonal family of curves, harmonic function, harmonic conjugate, Morle-Thomson theorem.

4.3 Curve in complex plane, contour, complex definite integral of parametric complex function, length of a contour, contour or path integration in complex plane, modulus of a contour integral, ML-theorem, Cauchy theorem of contour integration in simply connected region for analytic function whose derivative is continuous in that region (Proof using Green's theorem), extension to multiply connected region and their applications.

References:

3. Complex Variable-Schaum's Series, Tata McGrawHill.
4. Complex Variable-Kasana, Prentice Hall of India

Unit-5(15+2)

(Linear Programming Problem-I)

5.1 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.

5.2 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.

5.3 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-6(15+2)

(Linear Programming Problem-II)

6.1 Degeneracy. The two phase method.

6.2 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.

6.3 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:

3. Linear Programming Problem- Chakroborty and Ghosh-U.N.Dhur and Sons
4. Operations Research-Kantiswarup et. al, Sultan Chand and Sons.

B.A. / B. Sc. Part-III (Honours)

MATHEMATICS

Paper-V

(Real Analysis, Integral Transforms and Integral Equations)

Group-A(50)

(Real Analysis)

Unit-1(15+1)

(Real Analysis-I)

1.1 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.

1.2 R-integrability of sum, product and quotient. R-integrability of $f \Rightarrow$ 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.

1.3 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-2(15+2)

(Real Analysis-II)

2.1 Improper integrals and their convergence, absolute and non-absolute convergence. Tests of convergence: Comparison test, μ-test. Abel's and Dirichlet's test for

convergence of integral of a product. Beta and Gamma functions and their convergence, their properties and interrelation.

2.2 Sequence of functions, pointwise and uniform convergence, boundness and continuity, integrability and differentiability of limit function in case of uniform convergence.

2.3 Series of functions, pointwise and uniform convergence, boundness and continuity of sum function in case of uniform convergence, term by term integration and differentiation, Abel's and Dirichlet's test, Weierstrass M-test of uniform and absolute convergence.

Unit-3(15+2)
(Real Analysis-III)

3.1 Power Series, radius of convergence using upper limit, uniform convergence of power series, properties, term by term integration and differentiation, uniqueness of power series.

3.2 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.

3.3 Function of bounded variation, total variation, continuous function of bounded variation, function of bounded variation expressed as the difference of the increasing function.

References:

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

Group-B(50)
(Integral Transforms and Integral Equations)

Unit-4(15+2)
(Laplace Transform)

4.1 Laplace transformation-Linearity of Laplace transformation, existence theorem, inverse Laplace transformation.

4.2 Laplace transformation of derivatives and integral, shifting theorems, differentiation and integration of Laplace transforms. Convolution theorem.

4.3 Applications of Laplace transformation. Solution of ordinary differential equation, simultaneous differential equation using Laplace transformation,solution of boundary value problems by Laplace

Refferences:

1. Laplace Transformation-Schaum's Outline series:Tata McGrawHill
2. Integral Transforms-M.D.Raisinghania-S.Chand.

Unit-5(15+1)
(Fourier Transform)

5.1 Fourier transforms, Fourier cosine transforms, Fourier sine transforms, Fourier transforms of derivative, Parseval's theorem for cosine and sine transforms. Multiple.

5.2 Inversion theorem for Fourier transform, inverse Fourier sine transform, inverse Fourier cosine transform, inverse , Inverse Fourier complex transformation, the convolution theorem, relationship between Fourier and Laplace transforms.

5.3 Applications of Fourier transforms, solution of integral equation.. Complex inversion formula for Laplace transform, solution of boundary value problems by Fourier transforms.

References:

1. I.N.Sneddon, The Use of Integral Transforms, Tata McGrawHill
2. B.P.Parasar, Differential equation and integral equation, SBS Publications
3. Integral Transforms-M.D.Raisinghania-S.Chand.

Unit-6(15+2)
(Integral Equations)

6.1 Integral Equation: Definition, different types of integral equations; kernels; eigen value and eigen function problem. Conversion of ordinary differential equations into integral equations; Green's function and its applications.

6.2 Fredholm integral equation of the second kind with separable kernels. Solution of Fredholm and Voltera integral equations by successive approximation.

6.3 Integral transform method of solution of integral equations.

References:

1. B.P.Parasar, Differential equation and integral equation, SBS Publications
4. Petrovsky, Integral Equation, Mir Publication
5. G.Yankovsky, Problems and exercise in Integral Equation, Mir Publication
6. R.R.Goldberg, Fourier Transform, Cambridge Univ. Press.
7. Integral Equations-M.D.Raisinghania-S.Chand.

Paper-VI
(Probability, Statistics, Numerical Analysis and Rigid Dynamics)

Group-A(50)
(Probability and Statistics)
Unit-I(15+2)
(Probability-I)

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 location, dispersion, skewness and curtosis, median, mode, quartiles.

Unit-2(15+1)
(Probability-II)

2.1 Moment generating function,characteristic function, statement of their uniqeness. Two dimensional expectation, covariance, correlation co-eficient, joint characteristic function, multiplication rule for exprctation, conditional expectation. Regression curves, least squre regression lines and parabolas.

2.2 Chi-squre and t-distribution and their important properties. Tchebychev's inequality.

2.3 Convergence in probability, Bernoulli's limit theorem, Law of large numbers, Poisson's approximation to binomial distribution and normal approximation to binomial distribution. Statement of central limit theorem in case of equal components.

Unit-3(15+2)
(Statistics)

3.1 Random sample, concept of sampling and various types of sampling, sample and population. Collection, tabulation and graghical 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:

3. Ground Work of Mathematical Probability and Statistics-Amritabha Gupta, Academic Pub.

4. Mathematical Statistics-Gupta and Kapur-Sultan Chand.

Group-B(50)
(Numerical Analysis and Rigid Dynamics)
Unit-4(15+2)
(Numerical analysis-I)

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

4.2 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.

4.3 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-5(15+2)
(Numerical Analysis-II)

7.1 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 of convergence. Newtons method for multiple roots.

7.2 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.

7.3 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:

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

Unit-6(15+1)
(Rigid Dynamics)

6.1 Moment Ellipsoid, equimomental system, principle axis. D'Alemberts principle, D'Alembert's equation of motion, principles of conservation of linear and angular momentum. Independence of the motion of center of inertia and the motion relative to the center of inertia. Principle of conservation of energy.

6.2 Equation of motion of a rigid body about a fixed axis, expression for kinetic energy and moment of momentum of a rigid body moving about a fixed axis. Compound pendulum, interchangeability of the point of suspension and the point of oscillation, simple equivalent pendulum.

6.3 Equation of motion of a rigid body moving in two dimension, expression for kinetic energy and the angular momentum about the origin of a rigid body moving in two dimension. Equation of motion under impulsive forces.

References:

5. Dynamics of a Particle and of Rigid Bodies-S.L.Lony,Radha Publishing House.

6. Dynamics of Particle and Rigid Bodies-Chakroborty and Ghosh-U.N.Dhur and Sons

Paper-VII
(Number Theory, Tensor Analysis and Computer Science)

Group-A(50)
(Number Theory and Tensor Analysis)

Unit-1(15+2)
(Number Theory)

1.1 Division algorithm, GCD, LCM, Linear Diophantine equation, Fundamental theorem of arithmetic, there are infinite number of primes.

1.2 Congruences and its applications, residue system, tests of divisibility, Linear congruences, Chinese remainder theorem, solving polynomial congruences.

1.3 Fermat's Litle Theorem and its applications, Euler Generalization, Wilson's theorem, Euler's ϕ-function.

References:

1. Basic Number Theory-S.B.Malik, Vikas Publications.

Unit-II(15+2)
(Tensor Analysis-I)

2.1 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.

2.2 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.

2.3 Covariant differentiation of tensors, covariant differentiation of sum, difference and product of tensors. Gradient, divergence, curl and Laplacian.

Unit-II(15+1)
(Tensor Analysis-II)

3.1 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.

3.2 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.

3.3 Riemann-Christoffel curvature tensor, Ricci tensor, flate space, Bianchi identities, intrinsic differentiation, conformal curvature tensor, space of constant curvature.

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

Group-B(50)
(Computer Science)
Unit-1(15+2)
(Boolean Algebra and Computer Fundamentals)

4.1 Definition and example of Boolean Algebra, Boolean identities, Boolean functions, disjunctive and conjunctive normal forms, their conversion.Application to switching circuits.

4.2 Positional number system, Binary, octal, decimal and hexadecimal numbers and conversion between them.

4.3 Historical evolution of computer, computer generations, functional description, operating systems, hardware and software. Storing of data in computer : BIT, BITE and Word. Programming Languages: Machine language, assembly language, high level language. Computer programmes: Source programme and object programme. Compiler, assembler and interpreter.

Unit-5(15+2)
(C Programming-I)

5.1 Algorithm and flowcharts with simple examples. Bracing and loping.

5.2 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.

5.3 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, pointers

Unit-5(15+1)
(C Programming-II)

6.1 Control flow, conditional and unconditional bracing, loping, nested lopps. if-else, do-while, for, switch, break, continue, goto statements etc.Infinite loops.

6.2 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.

6.3 Array: One dimensional arrays and two dimensional arrays.

References:

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

Paper-VIII
(Practical)

Group-A(50)
Numerical Analysis

(Note Book-5, Viva Voce-5, Numerical Analysis-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. Euler Maclaurin's sum formula.
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 Gause elimination method, Gause-Jordan method and Gauss-Siedel method.
6. Finding inverse of a third order matrix without finding its determinant.
7. Runge-Kutta Method

Group-B(50)
C-Programming

(Note Book-5, Viva Voce-5, C-Programming-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 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.