

MATHEMATICS / MATHEMATICS WITH STATISTICS

(DEGREE STANDARD)

CODE NO: 276

UNIT I

ALGEBRA AND TRIGONOMETRY:

Theory of Equations: Polynomial equations; Imaginary and irrational roots; Symmetric functions of roots in terms of coefficient; Sum of r th powers of roots; Reciprocal equations; Transformations of equations.

Descartes' rule of signs: Approximate solutions of roots of polynomials by Newton - Raphson Method - Horner's method; Cardan's method of solution of a cubic polynomial.

Summation of Series: Binomial, Exponential and Logarithmic series theorems; Summation of finite series using method of differences - simple problems.

Expansions of $\sin x$, $\cos x$, $\tan x$ in terms of x ; $\sin nx$, $\cos nx$, $\tan nx$, $\sin nx$, $\cos nx$, $\tan nx$, hyperbolic and inverse hyperbolic functions - simple problems.

Symmetric; Skew Symmetric; Hermitian; Skew Hermitian; Orthogonal and Unitary Matrices; Rank of a matrix; Consistency and solutions of Linear Equations; Cayley Hamilton Theorem; Eigen values; Eigen Vectors; Similar matrices; Diagonalization of a matrix.

Equivalence relations; Groups; subgroups – cyclic groups and properties of cyclic groups - simple problems; Lagrange's theorem; Prime number; Composite number; decomposition of a composite number as a product of primes uniquely (without proof); divisors of a positive integer n ; congruence modulo n ; Euler function; highest power of a prime number p contained in $n!$; Fermat's and Wilson's theorems - simple problems.

Sums of sines and cosines of n angles which are in A.P.; Summation of trigonometric series using telescopic method, $C + i S$ method.

UNIT II

CALCULUS, COORDINATE GEOMETRY OF 2 DIMENSIONS AND DIFFERENTIAL GEOMETRY

n th derivative; Leibnitz's theorem and its applications; Partial differentiation. Total differentials; Jacobians; Maxima and Minima of functions of 2 and 3 independent variables - necessary and sufficient conditions; Lagrange's method – simple problems on these concepts.

Methods of integration; Properties of definite integrals; Reduction formulae - Simple problems.

Conics - Parabola, ellipse, hyperbola and rectangular hyperbola - pole, polar, co-normal points, con-cyclic points, conjugate diameters, asymptotes and conjugate hyperbola.

Curvature; radius of curvature in Cartesian coordinates; polar coordinates; equation of a straight line, circle and conic; radius of curvature in polar coordinates; p-r equations; evolutes; envelopes.

Methods of finding asymptotes of rational algebraic curves with special cases. Beta and Gamma functions, properties and simple problems. Double Integrals; change of order of integration; triple integrals; applications to area, surface and volume.

UNIT III

DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

First order but of higher degree equations – solvable for p, solvable for x, solvable for y, Clairaut's form – simple problems.

Second order differential equations with constant coefficients with particular integrals for e^{ax} , x^m , $e^{ax} \sin mx$, $e^{ax} \cos mx$

Second order differential equations with variable coefficients $ax^2 \frac{d^2y}{dx^2} + bx \frac{dy}{dx} + cy = q(x)$;

Method of variation of parameters; Total differential equations, simple problems.

Partial Differential equations : Formation of P.D.E by eliminating arbitrary constants and arbitrary functions; complete integral; Singular integral ; general integral; Charpit's method and standard types $f(p,q)=0$, $f(x,p,q)=0$, $f(y,p,q)=0$, $f(z,p,q)=0$, $f(x,p)=f(y,q)$; Clairaut's form and Lagrange's equations $Pp+Qq=R$ – simple problems.

Laplace transform; inverse Laplace transform (usual types); applications of Laplace transform to solution of first and second order linear differential equations (constant coefficients) and simultaneous linear differential equations – simple problems.

UNIT IV

VECTOR CALCULUS, FOURIER SERIES AND FOURIER TRANSFORMS

Vector Differentiation : Gradient, divergence, curl, directional derivative, unit normal to a surface.

Vector integration: line, surface and volume integrals; theorems of Gauss, Stokes and Green – simple problems.

Fourier Series: Expansions of periodic function of period 2π ; expansion of even and odd functions; half range series.

Fourier Transform: Infinite Fourier transform (Complex form, no derivation); sine and cosine transforms; simple properties of Fourier Transforms; Convolution theorem; Parseval's identity.

UNIT V

ALGEBRAIC STRUCTURES

Groups: Subgroups, cyclic groups and properties of cyclic groups – simple problems; Lagrange's Theorem; Normal subgroups; Homomorphism; Automorphism ; Cayley's Theorem, Permutation groups.

Rings: Definition and examples, Integral domain, homomorphism of rings, Ideals and quotient Rings, Prime ideal and maximum ideal; the field and quotients of an integral domain, Euclidean Rings.

Vector Spaces: Definition and examples, linear dependence and independence, dual spaces, inner product spaces.

Linear Transformations: Algebra of linear transformations, characteristic roots, matrices, canonical forms, triangular forms.

UNIT VI

REAL ANALYSIS

Sets and Functions: Sets and elements; Operations on sets; functions; real valued functions; equivalence; countability; real numbers; least upper bounds.

Sequences of Real Numbers: Definition of a sequence and subsequence; limit of a sequence; convergent sequences; divergent sequences; bounded sequences; monotone sequences; operations on convergent sequences; operations on divergent sequences; limit superior and limit inferior; Cauchy sequences.

Series of Real Numbers: Convergence and divergence; series with non-negative numbers; alternating series; conditional convergence and absolute convergence; tests for absolute convergence; series whose terms form a non-increasing sequence; the class l^2 .

Limits and metric spaces: Limit of a function on a real line; metric spaces; limits in metric spaces.

Continuous functions on Metric Spaces: Functions continuous at a point on the real line, reformulation, functions continuous on a metric space, open sets, closed sets, discontinuous functions on the real line.

Connectedness Completeness and compactness: More about open sets, connected sets, bounded sets and totally bounded sets, complete metric spaces, compact metric spaces, continuous functions on a compact metric space, continuity of inverse functions, uniform continuity.

Calculus: Sets of measure zero, definition of the Riemann integral, existence of the Riemann integral properties of Riemann integral, derivatives, Rolle's theorem, Law of mean, Fundamental theorems of calculus, Taylor's theorem.

Sequences and Series of Functions. Pointwise convergence of sequences of functions, uniform convergence of sequences of functions.

UNIT VII

COMPLEX ANALYSIS

Complex numbers: Point at infinity , Stereographic projection

Analytic functions: Functions of a complex variable , mappings, limits , theorems of limits, continuity, derivatives, differentiation formula, Cauchy-Riemann equations, sufficient conditions Cauchy-Riemann equations in polar form, analytic functions, harmonic functions.

Mappings by elementary functions: linear functions, the function $1/z$, linear fractional transformations , the functions $w=z^n$, $w=e^z$, special linear fractional transformations.

Integrals: definite integrals, contours , line integrals, Cauchy-Goursat theorem, Cauchy integral formula, derivatives of analytic functions, maximum moduli of functions.

Series: convergence of sequences and series, Taylor's series, Laurent's series, zero's of analytic functions.

Residues and poles: residues, the residue theorem, the principal part of functions, poles, evaluation of improper real integrals, improper integrals, integrals involving trigonometric functions, definite integrals of trigonometric functions

UNIT VIII

DYNAMICS AND STATICS

DYNAMICS: kinematics of a particle, velocity, acceleration, relative velocity, angular velocity, Newton's laws of motion, equation of motion, rectilinear motion under constant acceleration, simple harmonic motion.

Projectiles : Time of flight, horizontal range, range in an inclined plane. Impulse and impulsive motion, collision of two smooth spheres, direct and oblique impact-simple problems.

Central forces : Central orbit as plane curve, p-r equation of a central orbit, finding law of force and speed for a given central orbit, finding the central orbit for a given law of force.

Moment of inertia : Moment of inertia of simple bodies, theorems of parallel and perpendicular axes, moment of inertia of triangular lamina, circular lamina, circular ring, right circular cone, sphere (hollow and solid).

STATICS: Types of forces, Magnitude and direction of the resultant of the forces acting on a particle, Lami's Theorem, equilibrium of a particle under several coplanar forces, parallel forces, moments, couples-simple problems.

Friction: Laws of friction, angle of friction, equilibrium of a body on a rough inclined plane acted on by several forces, centre of gravity of simple uniform bodies, triangular lamina, rods forming a triangle, trapezium, centre of gravity of a circular arc, elliptic quadrant, solid and hollow hemisphere, solid and hollow cone, catenary-simple problems.

UNIT IX

OPERATIONS RESEARCH

Linear programming – formulation – graphical solution – simplex method

Big-M method – Two-phase method-duality- primal-dual relation – dual simplex method – revised simplex method – Sensitivity analysis.

Transportation problem – assignment problem.

Sequencing problem – n jobs through 2 machines – n jobs through 3 machines – two jobs through m machines – n jobs through m machines

PERT and CPM : project network diagram – Critical path (crashing excluded) – PERT computations.

Queuing theory – Basic concepts – Steady state analysis of M/M/1 and M/M/systems with infinite and finite capacities.

Inventory models : Basic concepts - EOQ models : (a) Uniform demand rate infinite production rate with no shortages (b) Uniform demand rate Finite production rate with no shortages – Classical newspaper boy problem with discrete demand – purchase inventory model with one price break.

Game theory : Two-person Zero-sum game with saddle point – without saddle point – dominance – solving $2 \times n$ or $m \times 2$ game by graphical method.

Integer programming : Branch and bound method.

UNIT X

MATHEMATICAL STATISTICS

Statistics – Definition – functions – applications – complete enumeration – sampling methods – measures of central tendency – measures of dispersion – skewness-kurtosis.

Sample space – Events, Definition of probability (Classical, Statistical & Axiomatic) – Addition and multiplication laws of probability – Independence – Conditional probability – Bayes theorem – simple problems.

Random Variables (Discrete and continuous), Distribution function – Expected values & moments – Moment generating function – probability generating function – Examples. Characteristic function – Uniqueness and inversion theorems – Cumulants, Chebychev's inequality – Simple problems.

Concepts of bivariate distribution – Correlation : Rank correlation coefficient – Concepts of partial and multiple correlation coefficients – Regression : Method of Least squares for fitting Linear, Quadratic and exponential curves - simple problems.

Standard distributions – Binomial, Hyper geometric, Poission, Normal and Uniform distributions – Geometric, Exponential, Gamma and Beta distributions, Inter-relationship among distributions.

Sampling Theory – sampling distributions – concept of standard error-sampling distribution based on Normal distribution : t, chi-square and F distribution.

Point estimation-concepts of unbiasedness, consistency, efficiency and sufficiency-Cramer Rao inequality-methods of estimation : Maximum likelihood, moments and minimum chi-square and their properties.

Test of Significance-standard error-large sample tests. Exact tests based on Normal, t, chi-square and F distributions with respect to population mean/means, proportion/proportions variances and correlation co-efficient. Theory of attributes – tests of independence of attributes based on contingency tables – goodness of fit tests based on Chi-square.

Analysis of variance : One way, two-way classification – Concepts and problems, interval estimation – confidence intervals for population mean/means, proportion/proportions and variances based on Normal, t, chi-square and F.

Tests of hypothesis : Type I and Type II errors – power of test-Neyman Pearson Lemma – Likelihood ratio tests – concepts of most powerful test –simple problems