Mathematics (Subject Code -15)

PAPER – I

Linear Algebra

Vector space, bases, dimension of a finitely generated space, 'Linear Transformations, Rank and nullity of a linear transformation, Cayley-Hamilton theorem, Eigenvalues and Eigen vectors.

Matrix of a linear transformation, Row and Column reduction. Echelon form. Equivalence, Congruence and similarity. Reduction to canonical forms.

Orthogonal, Symmetrical, skew-symmetrical, unitary, Hermitian and skew-Hermitian matrices-their eigenvalues, orthogonal and unitary reduction of quadratic and Hermitian forms. Positive definite quardratic forms, simultaneous reduction.

Calculus :

Real numbers, limits, continuity, differentiability, Mean-value theorem, Taylor's theorem, indeterminate forms, Maxima and Minima, Curve Tracing.

Asymptotes :

Functions of several variables, partial derivatives maxima and minima, Jocobian. Definite and indefinite integrals, Double and triple integrals (techniques only). Application to Beta and Gamma Functions. Areas, Volumes; centre of gravity.

Analytic Geometry of Two and Three Dimensions

First and second degree equations in two dimensions in Cartesian and polar co-ordinates, Plane, sphere, paraboloid, Ellipsoid, hyperboloid of one and two sheets and their elementary properties, curves in space, curvature and torsion, Frenet's formulae.

Differential Equations :

Order and Degree of a differential equaltion; differential equation of first order and first degree, variables separable. Homogeneous, linear and exact differential equations. Differential equations with constant coefficients. The complimentary function and the particular integral of e^{ax}, COS^{ax}, sinax, X^{m}, e^{ax}, Cosbx, e^{ax}, sinbx.

Vector, Tensor, Statics, Dynamics and Hydrostatics

(i) Vector Analysis – Vector Algebra, Differentation and Vector function of a scalar variable, Gradient, divergence and curl in Cartesian, cylindrical and spherical coordinates and their physical interpretation. Higher order derivaties. Vector identifies and Vector equations, Gauss and Stokes Theorems.

(ii) Tensor Analysis : Definition of a Tensor, Transformation of coordinates, contravariant and covariact tensors. Addition and multiplication of tensors, contraction of tensors, Inner product, fundamental tensor, christoffel symbols, covariant differentiation. Gradient, Curl and divergence in tensor notation.

(iii) Statics – Equilibrium of a system of particles, work and potential energy. Friction, Common category. Principles of Virtual work. Stability of equilibrium. Equilibrium of forces in three dimensions.

(iv) Dynamics – Degree of freedom and constraints. Rectilinear motion. Simple harmonic motion. Motion in a plane. Projectiles. Constrained motion. Work and energy. Motion under impulsive forces. Kepler's laws. Orbits under cenral forces. Motion of varying mass. Motion under resistance.

(v) Hydrostatics – Pressure of heavy fluids, Equilibirum of fluids under given system of forces. Centre of pressure Thrust on curved surfaces. Equilibrium of floating bodies. Stability of equilibrium and Pressure of gases, problems of relating to atmosphere.

PAPER – II

Section – A : Algebra, Real Analysis, complex, Analysis, Partial differential equations.

Section – B : Mechanics, Hydrodynamics, Numerical Analysis, Statistics including probability. Operational research.

Algebra : Group, Sub-groups, normal sub-groups, homomorphism of groups, quotient groups. Basic isomorphism theorems. Sylow theorems. Permutation Groups. Cayley's theorem. Rings and ideals, Principal ideal domains, unique factorization domains and Euclidean domains. Field Extensions, finite fields.

Real Analysis : Metric spaces, their topology with special reference to R^n,sequence in a metric space Cauchy sequence, Completeness, Completion, Continuous functions, Uniform Continuity. Properties of continuous functions on Compact sets. Riemann Steiltjes' Integral, Improper intergrals and their conditions of existance. Differentiation of functions of several variables. Implicit function theorem, maxima and minima., Absolute and Conditional Convergence of series of real and Complex terms, Rearrangement of series. Uniform convergence infinite products. Continuity, differentiability and integrability for series, Multiple integrals.

Complex Analysis: Analytic functions, cauchy's theorem, Cauchy's integral formula, power series, Taylor's series, Singularities, Cauchy's Residue theorem and Contour integration.

Partial Differential Equations : Formation of partial differential equations, Types of Integrals of Partial differential equations of first order, Charpits methods, Partial differential equation with constant coefficients.

Mechanics : Generalised Co-ordinates, Constraints, holonomic and non-holonomic systems, D'Alembert's principle and Langranges' equations, Moment of Inertia, Motion of rigid bodies in two dimension.

Hydrodynamics : Equation of continuity, momentum and energy, Inviscid Flow Theory: Two dimensional motion, Streaming motion, sources and Sinks.

Numerical Analysis : Transcedental and Polynomial Equations : Methods of solution, bisection, regula-false secant and Newton-Raphson and order of its convergence.

Interpolation and Numerical Differentiation: Polynomial interpolation with equal or unequal step size. Spline interpolation – Gubic Splines. Numerical differentiation formulae with error terms.

Numerical Intergration : Problems of approximate quadrative, quadrature formulae with equispaced arguments, Caussian quadrature Convergence.

Ordinary Differential Equations : Euler's method, multisytep Predector-Corrector Methods – Adam's and Milne's method, Convergence and stability, Runge-Kutta methods. Probability and Statistics.

1. Statistical Methods : Concept of statistical population and random sample. Collection and presentation of date. Measure of location and dispersion. Moment and Shepard's corrections. Comulants. Measures of Skewness of Kurtosis.

   Curve fitting by least squares Regression, correlation and correlation ratio. Rank correlation, partial correlation co-efficient and Multiple correlation co-efficient.

2. Probability : Discrete sample space, Events, their union and intersection etc. Probability – Classical relative frequency and exiomatic approaches, Probability in continnum, Probability space conditional probability and independence, Basic laws of Probability, Probability of combination of events, Bayes theorem, Rondom variable Priobability function, Probability density function, Distribution function, Mathematical expectation, Marginal and conditional distributions, conditional expectation.

3. Probability distributions : Binomial, Poison, Normal Gamma, Beta, Cauchy, Multinmial, Hypergeometric, Negative Bionomial, Chebychev's lemma (Weak) law of large numbers, Central limit theorem for independent and identical varieties.

Standard errors, Sampling distribution of to Fand Chi-square and their uses interests of significance. Large sample tests for mean and proportion.

Operational Research :

Mathematical Programming : Definition and some elementary properties of convex sets, simplex methods, degeneracy, duality, and sensitivity analysis, rectangular games and their solutions, Transportation and assignment problems. Kuha Tucker condition for non-linear programming. Bellman's optimality principle and some elementary applications of dynamic programming.

Theory of Queues : Analysis of steady – State and transient solutions for quenqueing system with Pission arrivals and exponential service time.

Deterministic replacement models, Sequencing problems with two machines n jobs, 3 machines, n jobs (Special case) and n machines 2 jobs.