UGTRB
MATHEMATICS

UNIT-1 ALGEBRA and TRIGONOMETRY

Polynomial Equations – Imaginary and Irrational Roots – Relation between Roots and Coefficients symmetric function of Roots in terms of coefficient - Transformation of equation – Reciprocal equation -Increase or Decrease the roots of given equation – Removal of terms – Descartes's rule of signs – Approximate solution of roots of polynomial by Horner's Method–Cardan's method of solution of cubic polynomial – Summation of series using Binomial – Exponentialand Logarithmic series. Symmetric – Skew symmetric, Hermitian – Skew Hermitian, Orthogonal Matrices, Unitary Matrices – Eigen Values – Eigen Vectors – Cayley-Hamilton Theorem – Similar Matrices – Diagonalization of Matrices. Prime Number, Composite Number, Decomposition of a Composite Number as a Product of primes uniquely – Divisor of a positive Integer – Euler Function. Congruence Modulo *n*, Highest power of prime number *p* Contained in *n*! – Application of Maxima and Minima – Prime and Composite numbers – Euler's function ∅(N) – Congruences – Fermat's,

Wilson's and Lagrange's theorems.
Expansions of Power of sinnX, cosnX, tannx – Summation by C + *i* S method, Telescopic Summation - Expansion of sin*x*, cos*x*, tan*x* in terms of *x* - Sum of Roots of Trigonometric Equation, Formation of Equation With Trigonometric Roots - Hyperbolic Functions – Relation Between Circular and Hyperbolic Function – Inverse Hyperbolic Function – Logarithm of a complex number – Principal Value and General Values.

UNIT II DIFFERENTIAL CALCULUS, INTEGRAL CALCULUS and ANALYTICAL GEOMETRY

n th derivatives –Trigonometrical Transformations — Leibnitz Theorem – Implicit functions – Partial Differentiation – Maxima / Minima of a function of two variables – Lagrangian multiplier method - Radius of curvature in Cartesian and
Polar forms – Angle between radius vector and tangent – Slope of tangent of a polar curve – p-r equations – Center of Curvature – Evolutes, Envelopes –Asymptotes of Algebraic curves - Asymptotes by inspection – Intersection of a curve with asymptotes. Evaluation of Double and Triple integrals – Applications of Multiple Integrals in finding volumes, surface areas of

solids – Areas of curved surfaces – Jacobians – Transformation of Integrals using Jacobians – Indefinite integrals - Beta and Gamma Functions and their properties – Evaluation of Integrals using Beta and Gamma Functions. Pole and Polar – Conjugate points and Conjugate lines, Conjugate diameters - Polar Coordinates – General Polar Equation of a Straight line – General Polar Equation of a Conic

UNIT-III DIFFERENTIAL EQUATIONS and LAPLACE TRANSFORMATIONS

Ordinary Differential Equations - Homogeneous Equations - Exact equations - Integrating Factors - Linear equations - Reduction of order – Second order Linear differential equations – General solution of homogeneous Equations Homogeneous equation with constant coefficients – Method of undetermined coefficients – method of Variation of Parameters - System of first order equations – Linear systems - Homogeneous linear systems with constant coefficients.

Partial Differential Differential Equations - Formation of Partial Differential Differential Equations by eliminating

arbitrary constants and arbitrary functions. Solving PDEs: Complete integral - Singular integral - general integral - Lagrange's equation Pp+Qq=R - Charpit's method and special types of first order equations. Laplace transform of elementary functions – Laplace transforms of special functions like unit step function. Dirac Delta function – Properties of Laplace Transformation and Laplace Transforms of derivatives and integrals – Evaluation of integrals using Laplace transform - Initial value theorem - Final value theorem – Laplace transform of periodic functions – Inverse Laplace transforms – Convolution theorem – Application of Laplace transformations in solving first and second order linear differential equations and simultaneous linear ordinary differential equations.

UNIT –IV VECTOR CALCULUS and FOURIER SERIES, FOURIER TRANSFORMS

Vector Differentiation – Velocity and Acceleration – Vector valued functions and Scalar potentials – Gradient – Divergence – Curl – Directional Derivative – Unit normal to a surface – Laplacian double operator – Harmonic functions.

Vector Integration – Line Integral – Conservative force field – Determining Scalar Potential from a conservative

force field – Work done by a force – Surface Integral – Volume integral – Theorems of Gauss, Stokes, and Green. Fourier Series – Expansions of Periodic functions of period 2Λ - Expansion of even and odd functions – half range series – Evaluation of Infinite Series using Fourier Series expansions – Fourier Transforms – Infinite Fourier Transform – Fourier 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, Lagrange's Theorem – Counting Principles – Normal subgroups, Quotient groups, Homomorphism, Automorphism, Cayley's theorem, Permutation groups – Rings – Some special classes of Rings – Integral domain, Homomorphism of rings – Ideal and Quotient rings – Prime ideal, Maximum Ideals –the field and quotients of an integral domain – Euclidean rings – Algebra of Linear transformation, Characteristic roots, matrices, Canonical forms, Triangular Forms – Problems of converting Linear Transformation to

Matrices and vice-versa – Vector Space – Definition and examples – Linear dependence – Independence, Sub spaces and Dual spaces – Inner product spaces.

UNIT-VI REAL ANALYSIS

Sets – Countable and Uncountable sets – Real Number system R – Functions – Real Valued functions, Equivalence and Countability – Infremum and Supremum of a subset of R – Bolzano- Weierstrass Theorem – Sequences of real numbers – Convergent and Divergent Sequences – Monotone Sequences – Cauchy Sequences – Limit Superior and Limit Inferior of a sequence – Sub Sequences – Infinite series – Alternating Series – Conditional convergence and Absolute convergence – Tests of Absolute convergence – Continuity and Uniform Continuity of a real valued function of a real variable – Limit of a function at a point – Coninuity and Differentiability of real valued functions – Rolle's Theorem – Mean Value Theorems – Inverse function theorem, Taylor's Theorem with remainder forms – Power series expansion – Riemann Integrability – Sequences and Series of Functions.

Metric spaces – Limits of a function at a point in metric spaces – functions continuous on a metric space – various reformulations of continuity of a function in a metric space - open sets – closed sets – discontinuous functions on the real line.

UNIT VII COMPLEX ANALYSIS

Algebra of Complex Numbers – Function of Complex Variable – Mappings, Limits – Theorems on Limits, continuity, differentiability – Cauchy-Riemann Equations – Analytic Functions – Harmonic Function – Conformal mapping – Mobius Transformations – Elementary Transformation – Bilinear Transformations – Cross ratio – Fixed points of bilinear transformations – Special Bilinear transformations. Contours – Contour Integrals – Anti Derivatives – Cauchy-Goursat Theorem- Power Series – Complex Integration -Cauchy's theorem, Morera's theorem, Cauchy's Integral Formula – Liouville's Theorem – Maximum Modulus Principle -Schwarz's Lemma – Taylor's series – Laurent's series – Calculus of Residues – Residue Theorem -Evaluation of

Integrals - Definite integrals of Trigonometric functions – Argument principle and Rouche's Theorem.

UNIT VIII MECHANICS

Statics: Forces on a rigid body –Moment of a force – General motion of a rigid body – Equivalent system of forces -Parallel Forces – Forces along the sides of Triangle Couples. Resultant of several coplanar forces – Equation of line of action of the resultant – Equilibrium of rigid body under three Coplanar forces – Reduction of Coplanar forces into single force and couples – Laws of friction, angle of friction, Equilibrium of a body on a rough inclined plane acted on by several forces – Equilibrium of a uniform Homogeneous string – Catenary – Suspension bridge – Centre of Gravity of uniform rigid bodies. Dynamics: Velocity and Acceleration – Coplanar motion – Rectilinear motion under constant forces -Acceleration and retardation thrust on a plane – Motion along a Vertical line under gravity – Motion along an inclined plane – motion of connected particles – Newton's Laws of motion. Work, Energy and power – Work – Conservative field of force – Power – Rectilinear motion under varying force

Simple Harmonic Motion (S.H.M) – S.H.M along a horizontal line – S.H.M along a Vertical line – Motion under gravity in a
resisting medium.
Path of a projectile – Particle projected on an inclined plane – Analysis of forces acting on particles and rigid bodies on static equilibrium, equivalent systems of forces, friction, centroids and moments of inertia – Elastic Medium,
Impact – Impulsive force – Impact of sphere – Impact of two smooth spheres – Impact of two spheres of two smooth sphere on a plane – oblique impact of two smooth spheres.
Circular motion – Conical Pendulum motion of a cyclist on circular path – Circular motion on a vertical plane – relative rest in revolving cone – simple pendulum – Central Orbits – Conic as Centered Orbit – Moment of inertia

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 – Queuing Theory – Basic Concepts – Steady State analysis of M/M/1 and M/M/Systems with infinite and finite capacities. PERT-and CPM – Project network diagram – Critical path – PERT computations-Inventory Models- Basic Concept –EOQ Models – uniform Demand rate infinite and finite protection rate with no shortage – Classical newspaper boy problem with discrete demand – purchase inventory model with one price brake – Game theory – Two person Zero – Sum game with saddle point – without saddle point – Dominance – Solving 2xn or mx2 game by graphical method – Integer programming – Branch and bound method

UNIT—X STATISTICS/PROBABILITY

Measures of central tendency – Measures of Dispersion – Moments – Skewness and Kurtosis – Correlation – Rank Correlation – Regression – Regression line of *x* on *y* and *y* on *x* – Index Numbers – Consumer Price Index numbers – Conversion of chain base Index Number into fixed base index numbers – Curve Fitting – Principle of Least Squares – Fitting a straight line – Fitting a second degree parabola – Fitting of power curves – Theory of Attributes –

Attributes – Consistency of Data – Independence and Associate of data. Theory of Probability – Sample Space – Axioms of Probability – Probability function – Laws of Addition – Conditional Probability – Law of multiplication – Independent – Boole's Inequality – Bayes' Theorem – Random Variables – Distribution function – Discrete and continuous random variables – Probability density functions – Mathematical Expectation – Moment Generating Functions – Cumulates – Characteristic functions – Theoretical distributions – Binomial, Poisson, Normal distributions – Properties and conditions of a normal curve – Test of significance of sample and large samples – Z-test – Student's t-test – F-test – Chi square and contingency coefficient.