

## 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 – Exponential and 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  $\phi(N)$  – Congruences – Fermat's, Wilson's and Lagrange's theorems.

Expansions of Power of  $\sin x$ ,  $\cos x$ ,  $\tan x$  – Summation by  $C + iS$  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**

$n^{\text{th}}$  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 Equations - Formation of Partial 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  $2\pi$  - 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  $\mathbb{R}$  – Functions – Real Valued functions, Equivalence and Countability – Infimum and Supremum of a subset of  $\mathbb{R}$  – 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 – Continuity 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 Rouché'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  $2 \times n$  or  $m \times 2$  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.

**PHYSICS****DEGREE STANDARD****Unit – 1 Mechanics**

Newton's laws – Impulse and impact – laws of impact – direct impact and oblique impact between two smooth spheres – loss of K.E – motion of two interacting bodies – reduced mass – centre of gravity – centre of gravity of a solid hemisphere – hollow hemisphere – tetrahedron and solid cone – friction – types of friction – angle of friction – equilibrium of rigid bodies – moment of inertia – angular momentum and kinetic energy of a revolving body – moment of inertia of sphere, shell and cylinder – parallel and perpendicular axes theorem – rolling – Kepler's laws of planetary motion – Newton's law of gravitation – determination of G by Boy's method – gravitational field and potential – variation of acceleration due to gravity on height, depth and altitude – orbital and escape velocities – earth and geostationary satellites – limitations of Newton's laws.

**Unit – 2****Thermal Physics**

Kinetic theory of gases – postulates – mean free path – ideal gas equation – degrees of freedom – Boltzmann's law of equipartition of energy – Maxwell's law of distribution of molecular speed – atomicity of gases – specific heat capacity of gases ratio of  $c_p$  and  $c_v$  – calculation for monoatomic and diatomic gases – Mayer's relation – experimental determination of  $c_p$  and  $c_v$  – Joule-Kelvin effect – theory and experiment – liquefaction of gases – hydrogen, oxygen, air, helium – thermal conductivity of solids – Forbes's and Lee's disc method – Stefan's law – determination of Stefan's constant – solar constant – temperature of the Sun – first law of thermodynamics – isothermal, adiabatic, isochoric, isobaric, cyclic processes – Carnot's engine – Carnot's cycle – second law of thermodynamics – Carnot's theorem – entropy – reversible and irreversible process – Maxwell's thermodynamic relations and their applications – third law of thermodynamics.

**Unit – 3****Properties of Matter and Acoustics**

Moduli of elasticity – relations among three moduli of elasticity – bending moment – uniform and non-uniform bending – couple per unit twist – torsional oscillation – elastic constants and their determination – viscosity – determination of highly viscous liquid by Stokes' method – streamline and turbulent flow – Reynold's number – Poiseuille's flow – applications of viscosity – surface tension – capillary rise – method of drops – surface tension of mercury – Quicnke's method.

Simple harmonic motion – combination of two SHMs in straight line and right angles – Lissajou's figures – free, damped, forced oscillations – laws of transverse vibrations – sonometer, and Melde's string – resonance – intensity and loudness of sound – beats – Doppler effect – velocity of sound in solids and gasses – ultrasonic – production, properties and applications – acoustics of auditoria.

**Unit – 4****Electricity and Magnetism**

Coulomb's law – permittivity – relative permittivity – electric field intensity – due to point charge – Gauss' theorem and its applications – electric potential – relation between potential and intensity – electric dipole moment – potential and intensity due to dipole – capacitance – capacity of parallel plates, spherical and cylindrical capacitors – energy stored in a capacitor – electrometers – measurement of potential and dielectric constant – Ohm's law – resistivity and conductivity – Kirchhoff's laws for a loop and a junction – internal resistance of a cell and emf – thermoelectricity – Peltier, Thomson coefficients.

Biot-Savarts law – Ampere's law – magnetic field around current carrying conductors magnetic force on charge and current elements – force between two current carrying parallel conductors – Faraday's laws of electromagnetic induction – self and mutual induction – induction coil and its uses – eddy currents – transformers – energy losses – skin effect – advantages of ac over dc – dynamos and motors – magnetic poles – magnetic moments – susceptibility and permeability – dia, para and ferro magnetism – hysteresis – B-H curve – energy loss due to hysteresis.

**Unit – 5****Atomic and Nuclear Physics**

Bohr's atom model – hydrogen atom – spectra of hydrogen and hydrogen like atoms – Rydberg's constant – special quantisation – Sommerfeld model – quantum numbers – vector atom model – electronic structures – Pauli's exclusion principle – electronic configuration – magnetic moment due to orbital motion and electron spin – Bohr magneton – Stern and Gerlach experimental – fine structure of sodium d line – Zeeman effect – anomalous Zeeman effect – theoretical explanation.