Syllabus Module
Dept. Of Mathematics
Session : 2018-2019
Khatra Adibasi Mahavidyalaya

Semester -1			
COURSE CODE	**COURSE TITLE**	**COURSE TOPIC**	**Teachers**
SH/MTH/ 101/C-1	**Calculus, Geometry & Differential Equation**	**Unit 1** Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of types $e^{ax+bsinx}$, $e^{ax+bcosx}$, $(ax+b)^n sinx$, $(ax+b)^n cosx$, concavity and inflection points, envelopes, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.	AI
		Unit 2 Reduction formulae, derivations and illustrations of reduction formulae of the type $\int sin^n x\, dx$, $\int cos^n x\, dx$, $\int tan^n x\, dx$, $\int sec^n x\, dx$ $\int (logx)^n\, dx$, $\int sin^m x cos^n x\, dx$, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution. Techniques of sketching conics.	AI
		Unit 3 Reflection properties of conics, rotation of axes and second degree equations, classification of conics	SD

		using the discriminant, polar equations of conics. Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, Generating lines, classification of quadrics, Illustrations of graphing standard quadric surfaces like cone, ellipsoid.	
		Unit 4 Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.	**SD**
SH/MTH/ 102/C-2	**Algebra**	**Unit 1** Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications. Theory of equations: Relation between roots and coefficients, Transformation of equation, Descartes rule of signs, Cubic and biquadratic equation. Inequality: The inequality involving $AM \geq GM \geq HM$, Cauchy-Schwartz inequality.	**MN**
		Unit 2 Equivalence relations. Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set. Well-ordering property of	**MN**

		positive integers, Division algorithm, Divisibility and Euclidean algorithm. Congruence relation between integers. Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.	
		Unit 3 Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, linear independence.	**MN**
		Unit 4 Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of Rn, dimension of subspaces of Rn, rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix	**MN**
SH/MTH/ 103/GE-1	**Calculus, Geometry & Differential Equation (GE T1)**	**Unit 1** Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of types $e^{ax+bsinx}$, $e^{ax+bcosx}$, $(ax+b)^n sinx$, $(ax+b)^n cosx$, concavity and inflection points, envelopes, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.	**AI**
		Unit 2	**AI**

		Reduction formulae, derivations and illustrations of reduction formulae of the type $\int sin^n x\, dx$, $\int cos^n x\, dx$, $\int tan^n x\, dx$, $\int sec^n x\, dx \int (logx)^n\, dx$, $\int sin^m x cos^n x\, dx$, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution. Techniques of sketching conics.	
		Unit 3 Reflection properties of conics, rotation of axes and second degree equations, classification of conics using the discriminant, polar equations of conics. Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, Generating lines, classification of quadrics, Illustrations of graphing standard quadric surfaces like cone, ellipsoid.	**SD**
		Unit 4 Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.	**SD**
SEMESTER – II			
COURSE CODE	**COURSE TITLE**	**COURSE TOPIC**	**Teachers**

SH/MTH/ 201/C-3	**Real Anlysis**	**Unit 1** Review of Algebraic and Order Properties of R, ε-neighbourhood of a point in R. Idea of countable sets, uncountable sets and uncountability of R. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets. Suprema and Infima. Completeness Property of R and its equivalent properties. The Archimedean Property, Density of Rational (and Irrational) numbers in R, Intervals. Limit points of a set, Isolated points, Open set, closed set, derived set, Illustrations of Bolzano-Weierstrass theorem for sets, compact sets in R, Heine-Borel Theorem.	**AI**
		Unit 2 Sequences, Bounded sequence, Convergent sequence, Limit of a sequence, lim inf, lim sup. Limit Theorems. Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria. Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.	**MN**
		Unit 3 Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Integral test. Alternating series, Leibniz test. Absolute and Conditional convergence.	**MN**
SH/MTH/	**Differential**	**Unit 1**	**CD**

202/C-4	**Equations and Vector Calculus**	Lipschitz condition and Picard's Theorem (Statement only). General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.	
		Unit 2 Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions.	**CD**
		Unit 3 Equilibrium points, Interpretation of the phase plane Power series solution of a differential equation about an ordinary point, solution about a regular singular point.	**CD**
		Unit 4 Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions.	**CD**
SH/MTH/ 203/GE-2	**Real Analysis (GE T3)**	**Unit 1** Review of Algebraic and Order Properties of R, ε-neighbourhood of a point in R. Idea of countable sets, uncountable sets and uncountability of R. Bounded	**AI**

		above sets, Bounded below sets, Bounded Sets, Unbounded sets. Suprema and Infima. Completeness Property of R and its equivalent properties. The Archimedean Property, Density of Rational (and Irrational) numbers in R, Intervals. Limit points of a set, Isolated points, Open set, closed set, derived set, Illustrations of Bolzano-Weierstrass theorem for sets, compact sets in R, Heine-Borel Theorem.	
		Unit 2 Sequences, Bounded sequence, Convergent sequence, Limit of a sequence, lim inf, lim sup. Limit Theorems. Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria. Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.	**MN**
		Unit 3 Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Integral test. Alternating series, Leibniz test. Absolute and Conditional convergence.	**MN**
SEMESTER – III			
COURSE CODE	**COURSE TITLE**	**COURSE TOPIC**	**Teachers**
SH/MTH/	**Theory of Real**	**Unit 1**	**MN**

301/C-5	**Functions & Introduction to Metric Space**	Limits of functions (ε - δ approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.	
		Unit 2 Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. Rolle's theorem. Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials.	**MN**
		Unit 3 Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, $ln(1 + x)$, $\frac{1}{ax+b}$ and $(1 + x)$. Application of Taylor's theorem to inequalities.	**MN**
		Unit 4 Metric spaces: Definition and	**SD**

		examples. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, subspaces, dense sets, separable spaces.	
SH/MTH/ 302/ C-6	**Group Theory-I**	**Unit 1** Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (through matrices), elementary properties of groups.	**AI**
		Unit 2 Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.	**AI**
		Unit 3 Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.	**AI**
		Unit 4 External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.	**AI**
		Unit 5 Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms. First, Second and Third isomorphism theorems.	**AI**
SH/MTH /303/C-7	**Numerical Methods Numerical Methods Lab**	**Unit 1** Algorithms. Convergence. Errors: Relative, Absolute. Round off. Truncation.	**SD**
		Unit 2	**SD**

		Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Rate of convergence of these methods.	
		Unit 3 System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis. LU Decomposition	**SD**
		Unit 4 Interpolation: Lagrange and Newton's methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation. Numerical differentiation: Methods based on interpolations, methods based on finite differences.	**MN**
		Unit 5 Numerical Integration: Newton Cotes formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpsons 3/8th rule, Weddle's rule, Boole's Rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpson's 1/3rd rule, Gauss quadrature formula. The algebraic eigenvalue problem: Power method. Approximation: Least square polynomial approximation.	**MN**
SH/MTH / 304/GE-3	**Algebra (GET2)**	**Unit 1** Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications. Theory of equations: Relation between roots and coefficients, Transformation of equation,	**SD**

		Descartes rule of signs, Cubic and biquadratic equation. Inequality: The inequality involving AM≥GM≥HM, Cauchy-Schwartz inequality.	
		Unit 2 Equivalence relations. Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set. Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm. Congruence relation between integers. Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.	**SD**
		Unit 3 Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $Ax = b$, solution sets of linear systems, applications of linear systems, linear independence.	**MN**
		Unit 4 Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of R^n, dimension of subspaces of R^n, rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix	**MN**
SH/MTH / 305/SEC-1	**Programming using C (New)**		**AI**

SEMESTER - IV			
COURSE CODE	**COURSE TITLE**	**COURSE TOPIC**	**Teachers**
SH/MTH /401/C-8	**Riemann Integration and Series of Functons**	**Unit 1** Riemann integration: inequalities of upper and lower sums, Darbaux integration, Darbaux theorem, Riemann conditions of integrability, Riemann sum and definition of Riemann integral through Riemann sums, equivalence of two Definitions. Riemann integrability of monotone and continuous functions, Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions. Intermediate Value theorem for Integrals. Fundamental theorem of Integral Calculus.	**AI**
		Unit 2 Improper integrals. Convergence of Beta and Gamma functions.	**AI**
		Unit 3 Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.	**AI**
		Unit 4 Fourier series: Definition of Fourier coefficients and series, Reimann Lebesgue lemma, Bessel's	**CD**

		inequality, Parseval's identity, Dirichlet's condition. Examples of Fourier expansions and summation results for series.	
		Unit 5 Power series, radius of convergence, Cauchy Hadamard Theorem. Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.	**CD**
SH/MTH/402/C-9	**Multivariate Calculus**	**Unit 1** Functions of several variables, limit and continuity of functions of two or more variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes, Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems	**MN**
		Unit 2 Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates. Change of variables in double integrals and triple integrals	**MN**
		Unit 3 Definition of vector field,	**AI**

		divergence and curl. Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path.	
		Unit 4 Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.	**AI**
SH/MTH /403/C-10	**Ring Theory and Linear Algebra-I**	**Unit 1** Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.	**MN**
		Unit 2 Ring homomorphisms, properties of ring homomorphisms. Isomorphism theorems I, II and III, field of quotients.	**MN**
		Unit 3 Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.	**CD**
		Unit 4 Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms. Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.	**CD**
SH/MTH /404/GE-4	**Differential Equations and**	**Unit 1** Lipschitz condition and Picard's	**CDG**

	Vector Calculus (GET4)	Theorem (Statement only). General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.	
		Unit 2 Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions.	**CDG**
		Unit 3 Equilibrium points, Interpretation of the phase plane Power series solution of a differential equation about an ordinary point, solution about a regular singular point.	**CDG**
		Unit 4 Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions.	**CDG**
SH/MTH / 405/SEC-2	**Graph Theory (SEC T4)**	**Unit 1** Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi - partite graphs isomorphism of graphs.	**MN**

		Unit 2 Eulerian circuits, Eulerian graph, semi-Eulerian graph, theorems, Hamiltonian cycles, theorems Representation of a graph by matrix, the adjacency matrix, incidence matrix, weighted graph,	**MN**
		Unit 3 Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm.	**MN**

3RD YEAR

Part –III	**Paper – V**	**Group – A** **Analysis – III (50 marks)** Sequence of real numbers. Notion of convergence and limit. Monotone sequences subsequences and their convergence, upper and lower limits of a sequence, algebra of limit superior and limit inferior. Cauchy's general principle of convergence. Bolzano-Weierstrass theorem, Heine-Borel theorem. Series of non negative terms. Test for convergence: Comparison test, Ratio test, Cauchy's root test, Raabe's test, Logarithmic test, Gauss's test, Cauchy's condensation test. Alternating series, Leibnitz's test. Series of arbitrary numerical terms. Absolutely and conditionally convergent series, Riemann's rearrangement theorem (Proof not required) Sequences and series of functions and their convergence. Uniform convergence. Cauchy's criterion of uniform convergence. Continuity of a limit function of a sequence of continuous functions. Continuity of the sum function of a uniformly convergent series of continuous functions. Term-by-term differentiation and integration of a uniformly convergent series of functions. Fourier series of a function. Dirichlet's condition (statement only). Uniformly convergent trigonometric series as a Fourier series. Riemann-Lebesgue theorem on Fourier series. Series of odd and even functions. Convergence of Fourier series of piece-wise monotone functions (Proof not required) Functions of several variables (two and three variables): Theory of maxima and minima, Lagrange's method of multiplier. Jacobian, Implicit function theorem (Proof not required). Inverse function theorem (statement only). Change of variables of multiple integrals. Differentiation and integrals under the sign of integration. Integral as a function of parameter. Change of order of integration for repeated integrals	**MN**

		Group-B **Complex Analysis (20 Marks)** Introduction of complex numbers as ordered pair of real numbers (*a*, *b*) and their representation as *a + ib*, the complex plane $\mathbb{C}$ and its basic geometric and topological aspects, continuity, differentiability of complex valued functions, Cauchy-Riemann (C-R) equations, analytic functions. Power series, radius of convergence and Cauchy-Handamard theorem, infinite differentiability of sum function of power series, introduction of exp (*z*), cos*z*, sin*z*, log*z* and its branch-their elementary properties. Extended complex plane $\mathbb{C}_\infty$, stereographic projection and spherical representation of $\mathbb{C}_\infty$.Bilinear transformations: The group of Mobius transformation and its generators-the inversion, dilations; fixed point and uniqueness of a Mobius transformation by its action at three distinct points; cross ratio, cross ratio and circle preserving property of Mobius transformation; orientation principle and construction of bijective analytic functions from one side of a circle onto one side of another circle in $\mathbb{C}_\infty$.	**MN**
		Group-C **Metric Spaces (30 Marks)** Definition of Metric spaces, examples including the standard ones such as discrete metric space, the real line $\mathbb{R}$, the complex plane $\mathbb{C}$, Euclidian spaces $\mathbb{R}_{nn}$, unitary spaces $\mathbb{C}_{nn}$, (with sup metric and integral metric), . Open ball, closed ball, metric topology, distance between a point and a set, distance between two sets, boundedness of a set, properties of open and closed sets, limit point, interior point, closure, interior, boundary of subsets and relation between them; dense subsets, nowhere dense subsets, basis, separable space, LindelÖf space, second countable space and relation between them; Hausdorff property, Cauchy sequence, Convergence of sequences,	MN

		completeness and Cantor Intersection theorem. Continuous functions and their basic properties, algebra of real/ complex valued continuous	
	Paper – VI	**Group –A** **Elements of Continuum Mechanics (10 Marks)** Idea of continuum, idea of strain and stress at a point in a continuum, stress vector, stress matrix, ideal fluid, viscous fluid.	AI
		Group – B **Classical Dynamics, Dynamics of a system of Particles and rigid body (40 Marks)** Physical foundation of classical dynamics: Interpretation of Newton's laws of motion – body force and surface force with examples, inertial frames, law of superposition, closed systems, concepts of absolute time, concepts of absolute space, concepts of absolute simultaneity of events; Galilean transformation – form invariance of Newton's laws under Galilean transformation, limitations of direct applications of Newton's laws in solving problems of mechanics. Dynamics of a system of particles: Basic concepts, Centroid, linear momentum, angular momentum, kinetic energy, potential energy, work, power, conservative system of forces; Use of centroid – motion relative to the centroid, angular momentum and kinetic energy relative to the centroid; Conservation principles – linear momentum, angular momentum, total energy; Constraints – basic concepts with examples, D'Alembert Principle. Introduction to rigid body dynamics: Moments and product of inertia – basic concepts, radius of gyration, parallel and perpendicular axis theorems, a few examples (rod, rectangular plate, circular plate, elliptic plate, sphere, cone, rectangular parallelepiped, cylinder, ellipsoid of revolution etc.); Motion about a point and about fixed axes – angular momentum, inertia matrix, principal axes, principal moments of	AI

		inertia, kinetic energy, momental ellipsoid, equimomental surface, reaction of the axis of rotation, impulsive forces; General motion of rigid body – translational and rotational motion, kinetic energy and angular momentum (translational and rotational); Two-dimensional motion of rigid body - equation of motion, kinetic energy, angular momentum, problems illustrating laws of motion [motion of a uniform sphere (solid and hollow) along a perfectly rough plane, motion of a uniform heavy circular cylinder (solid and hollow) along a	
		Group – C **Statics (20 Marks)** **Prerequisite:** [Basic concepts – concurrent forces, parallel forces, moment of a force, couple, resultant of a force and a couple]. Forces in three-dimension – reduction to force and couple, Pointsot's central axis, wrench, pitch, screw, conditions of equilibrium, invariants; Virtual work – concept of virtual displacement, principle of virtual work, simple examples; Stability of equilibrium – stable and unstable equilibrium, energy test of stability, determination of positions of equilibrium, stability of a heavy body resting on a fixed body with smooth surfaces, simple examples; Equilibrium of flexible string – general equations of equilibrium of a uniform flexible string under the action of given coplanar forces, common catenary, parabolic chain, suspension bridge, catenary of uniform strength.	SD
		Group – D **Hydrostatics (30 Marks)** Basic concepts – fluid pressure and its elementary properties (such as in equilibrium it is same in every direction), density, specific gravity, compressible and incompressible fluid, homogeneous and non-homogeneous fluid; Equilibrium of fluid in a given field of force – equation of pressure, conditions of	SD

		equilibrium, pressure gradient, equipressure surface, equilibrium of fluid rotating uniformly about an axis; Pressure in a heavy homogeneous liquid – thrust on a plane surface, centre of pressure, determining the position of the centre of pressure, effects on increasing depth, thrust on a curved surface, buoyancy, Archimedes principle, resultant thrust, Equilibrium of floating bodies – conditions of equilibrium of a freely floating body, body floating under constraints, equilibrium of fluids revolving uniformly about an axis, stability of equilibrium, metacentre, conditions of stability; Gases – relation among pressure, volume and temperature, Boyle's law, Charle's law, ideal gas, isothermal and adiabatic changes, heat capacities, internal	
	Paper – VII	**Group-A** **Mathematical Probability (40 Marks)** **Prerequisite:** [Concept of mathematical probility, addition and multiplication theorem of probability. Independent event, total probability, Bayes' theorem, Bernoulli trials, Binomial distribution]. Generalised addition and multiplication rule of probability continuity theory, Boole's inequality, Bonferroni's inequality; Poisson trials and Poisson law of probability, Multinomial law; Random variables, Discrete and continuous distribution functions: Poisson, Geometric, Negative Binomial, exponential, Hypergeometric, Uniforn, Normal, Gamma, Beta, Cauchy distributions,	AI
		Group -B **Statistics (20 Marks)** Method of least square, curve fitting (straight line, parabola and exponential curves). Sampling theory, simple random sampling, sampling distribution of the statistic; , and -distribution of the statistic. Theory of estimation, point estimation, unbiasedness, minimum variance, consistency, efficiency, sufficiently, maximum likelihood method; Interval estimation –	AI

		confidence interval, approximate confidence interval. Testing of hypothesis, Neyman-Pearson lemma, Likelihood ratio testing, application to Normal(m,)-population, Pearsonian -test for goodness of fit. Theory of errors 2	
		Group – C **Operations Research (Marks - 40)** **Prerequisite:** [General introduction to optimization problem, Definition of L.P.P., Mathematical formulation of the problem, Canonical & Standard form of L.P.P., Basic solutions, feasible, basic feasible & optimal solutions]. Reduction of a feasible solution to basic feasible solution. Hyperplanes, Convex sets and their properties, Convex functions, Extreme points, Convex feasible region, Convex polyhedron, Polytope, Supporting hyperplane, Separating hyperplane. Fundamental theorem of L.P.P., Replacement of a basis vector, Improved basic feasible solutions, Unbounded solution, Condition of optimality, Simplex method, Simplex algorithm, Artificial	SD
	Paper – VIII	**Group A** **Numerical Analysis (35 Marks)** Approximation of numbers, significant digits, Loss of significance, Algebraic manipulation for avoiding loss of significance. Errors: Absolute, Relative and Percentage errors; Inherent errors in numerical methods. Polynomial Interpolations: Existence and uniqueness of interpolating polynomials, error in interpolation, Lagrange's interpolating formula, Newton's divided difference interpolating formula, properties of divided differences, forward and backward difference operators and their relations, Newton's forward and backward difference interpolation formulae. Central difference and averaging operators, central interpolation formulae: Statement of Gauss, Stirling and Bessel's formulae and their applications. Concept of piece-wise	CD

		polynomial interpolation, Idea of Inverse interpolation. Numerical solution of non-linear equations: Solution of algebraic and transcendental equations (real roots only): (i) Method of Bisection, (ii) Regula Falsi Method (iii) Secant Method (iv) Newton – Raphson Method (v) Fixed point iteration method. Convergences and rate of convergence of these methods. Solution of a system of linear algebraic equation: Gauss' Elimination and Gauss Jordan methods, Pivoting methods, Jacobi and Gauss-Seidel methods with convergence criteria.	
		Group-B **Computer Programming (Marks – 15)** Computer Language: Concept of programming languages, Machine language, Assembly language, High-level language, Interpreter, Compiler, Source and Object programs. Number Systems: Binary, decimal, octal and hexadecimal number systems and their conversions. Programming Language in C: C-Character set, Keywords, Basic data types, Numeric constants and variables operators, Expressions, Assignment statements, I/0 – statements. Control Statements: Decision making and Looping statements in C, break continue and goto statements, Example of simple programs. Subscripted variables: Concept of array variables in programming language, Rules for one dimensional subscripted variable in C, Simple programs. Sub-program: Concept of sub-program, purpose of sub-program, Definition of function and function prototype, Simple programs.	CD
	Paper-IX	**Computer Aided Numerical Methods: Practical (using C programming) (Marks: 50) Sessional (Algorithm, Flowchart and Program with output) : 10 marks**	AI