Teaching Plan for the Semester-I **Department of Mathematics**			
The Name of the Teacher	Paper	Topic	Classes(Hours)
Prof. Rebati Mohan Roy	CT-2	Complex Number, Polar representation of complex numbers, n^{th} roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, Sine, Cosine and Logarithm of a Complex number. Definition of . Gregory's series, Inverse circular function and Hyperbolic function. Theory of equations: Fundamental theorem of Classical Algebra (statement only) ,Nature of roots of an equation, Statement of Rolle's theorem, Relation between roots and coefficients, transformation of equation, Descartes rule of signs, Reciprocal, cubic and bi-quadratic equation. Inequality: The inequality involving AM≥GM≥HM, Cauchy-Schwartz inequality.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.	60
	DSC1A & GE1 (Prog)	Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy of remainder, Taylor's series, Maclaurin's series of Maxima and Minima, Indeterminate forms.	30
Dr. Santanu Raut	CT-1	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. 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.	50
	DSC1A & GE1 (Prog)	Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.	40

Prof. Ashis Biswas	CT-1 & CT-2	Hyperbolic functions, Higher order derivatives, Leibnitz rule and its applications, 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. Reduction formulae, derivations and illustrations of reduction formulae, parametric equations, parameterizing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution, techniques of sketching conics. 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.	45+20
	DSC1A & GE1 (Prog)	Tangents and normals, Curvature, Asymptotes, Envelope, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.	20
Kalyan Roy	CT-2	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. Vector spaces, subspaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of Rn, dimension of subspaces of R^n.	40

Teaching Plan for the Semester-III
Department of Mathematics

The Name of the Teacher	Paper	Topic	Classes(Hours)
P rof. Rebati Mohan Roy	CT-5	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.	50
	DSC1C (Prog)	Sequences and series of functions, Pointwise and uniform convergence. Mn-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.	40
Dr. Santanu Raut	CT-7	Partial Differential Equations – Basic concepts and definitions, Mathematical Problems. First-Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations. Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first – order partial differential equations. Heat equation, Wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms. Solution of linear partial differential equations with constant coefficients.	60
	CT-7 Practical	Plotting of a solution of Cauchy problem for first order PDE. Plotting the characteristics for the first order PDE. Plot the integral surfaces of a given first order PDE with initial data. Plotting of a solution of wave equations. Plotting of a solution of heat equation, Plotting of a solution of Laplace's equation.	30
Prof. Ashis Biswas	CT-6	Definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), Elementary properties of groups. Subgroups and examples of subgroups, Centralizer, Normaliser, centre of a group, Product of two subgroups.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.External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups. Group homomorphisms, properties of homomorphisms, Cayley's isomorphisms, First, Second and Third isomorphism theorems.	65
	SEC1 (Prog)	Integration by Partial fractions, integration of rational and irrational functions. Properties of definite integrals. Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and of their combinations. Areas and lengths of curves in the	30

		plane, volumes and surfaces of solids of revolution. Double and Triple integrals.	
Kalyan Roy	CT-5	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.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 function, trigonometric functions, Taylor's series and Maclaurin's series expansions of exponential function.	25
	DSC1C(Prog)	Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem. Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).	25

Teaching Plan for the Semester-V
Department of Mathematics

The Name of the Teacher	Paper	Topic	Classes(Hours)
P rof. Rebati Mohan Roy	CT-12	Laplace Transform: Laplace of some standard functions, Existence conditions for the Laplace Transform, Shifting theorems, Laplace transform of derivatives and integrals, Inverse Laplace transform and their properties, Convolution theorem, Initial and final value theorem, Laplace transform of periodic functions, error functions, Heaviside unit step function and Dirac delta function, Applications of Laplace transform to solve ODEs . Riemann integration and Improper integral: inequalities of upper and lower sums, Darboux integration, Darboux 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. Improper integrals. Convergence of Beta and Gamma functions. Series of functions: 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, derivability and integrability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test. Fourier series, Trigonometric Fourier series and its convergence. Fourier series of even and odd functions, Fourier half-range series.	60
	SEC3 (Prog)	Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, continuous distributions: uniform, normal, exponential.	30
Dr. Santanu Raut	CT-11	Expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function and calculation of covariance, linear regression for two variables. Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Concept of population and Sampling. Sampling distribution of Statistic. Estimates of Population characteristic or parameter. Unbiased and consistent estimates. Sample characteristic as estimates of the corresponding population characteristic. Sampling distributions of the sample mean and variance. Exact sampling distributions for the normal	40

		population.	
	DSE1(a)	Formulation of physical system, Existence and uniqueness of solution of a dynamical system, linear system, solution of linear system, fundamental matrix, Fundamental matrices of non autonomous system. Linear systems with periodic coefficients, stability of systems, stability of linear autonomous systems, stability of non-linear system using linearization, properties of orbits, Phase portrait.	30
	DSE1(A) (Prog.)	Linear transformations, Null space, range, Rank and nullity of a linear transformation, Matrix representation of a linear transformation, algebra of linear transformations. Dual Space, Dual Basis, Double Dual, Eigen values and Eigen vectors, Characteristic Polynomial.	20
Prof. Ashis Biswas	**DSE1(a)**	Introduction to linear programming problem. Theory of simplex method, Graphical solution, Convex sets, Optimality and unboundedness, The simplex algorithm, simplex method in tableau format, Introduction to artificial variables, two-phase method. Big-M method and their comparison. Duality, formulation of the dual problem, primal-dual relationships, Transportation problem and its mathematical formulation, Northwest-corner method, least Cost method and Vogel approximation method for determination of starting basic solution, Algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving Assignment problem.	35
	DSE2(A)	Introduction and basic Examples. Classification, Conversion to Volterra Equation to ODE, Conversion of IVP and BVP to Integral equation, Decomposition, Direct Computation, Successive approximation, Successive substitution method for Fredholm Integral equations. Series Solution. Successive approximation. Successive substitution method for Volterra integral equation. Volterra integral equation of first kind. Integral equation with separable kernel.	35
	DSE1(A) (Prog.)	Vector spaces, subspaces, Algebra of subspaces, Quotient spaces, linear combination of vectors, Linear span, Linear independence, Basis and dimension, Dimension of subspaces.	25
Kalyan Roy	CT-11	Random experiments, Simple and compound events. Event space. Multiplication rule of Probabilities. Bayes' thorem. Independent events. Independent random experiments. Independent trials. Bernoulli trials and binomial law. Poisson trials. Random variables. Probability distribution. Distribution function. Discrete and continuous distributions. uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential. Mathematical expectation, mean, variance, moments, central moments, dispersion, skewness and kurtosis. Median, mode, quartiles, moment generating function,	30

		Characteristic function.Joint probability density functions, marginal and conditional distributions, functions, Fourier half-range series.	
	SEC3(Prog)	Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables.	20

Teaching Plan for the Semester-II Department of Mathematics			
The Name of the Teacher	Paper	Topic	Classes(Hours)
Prof. Rebati Mohan Roy	CT-3	Sequences, bounded sequence, convergent sequence, limit of a sequence, liminf, lim sup. Limit theorems. Monotone sequences, monotone convergence theorem. Subsequences, divergence criteria. Monotone subsequence theorem (statement only), Bolzano Weierstrass theorem for sequences.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, Leibnitz test. Absolute and conditional convergence.	40
	DSC1B & GE2 **(Prog.)**	Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partialdifferential equation of first order, Lagrange's method, Charpit's method. Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.	45
Dr. Santanu Raut	CT-4 with practical	Equilibrium points, Interpretation of the phase plane. Power series solution of a differential equation about an ordinary point, solution about a regular singular point. Plotting of second order solution family of differential equation.Plotting of third order solution family of differential equation. Growth model (exponential case only). Decay model (exponential case only). Lake pollution model (with constant/seasonal flow and pollution concentration). Case of single cold pill and a course of cold pills. Limited growth of population (with and without harvesting). Predatory-prey model (basic volterra model, with density dependence, effect of DDT, two prey one predator). Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers). Battle model (basic battle model, jungle warfare, long range weapons). Plotting of recursive sequences. Study the convergence of sequences through plotting. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot. Study the convergence/divergence of infinite series by plotting their	60+25

		sequences of partial sum.	
Prof. Ashis Biswas	CT-3	Review of algebraic and order properties of R, ε-neighborhood 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.	50
	DSC1B & GE2 **(Prog.)**	First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order. Linear homogenous equations with constant coefficients, Linear non-homogenous equations.The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.	35
Kalyan Roy	CT-4	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.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.	50

Teaching Plan for the Semester-IV Department of Mathematics			
The Name of the Teacher	Paper	Topic	Classes(Hours)
P rof. Rebati Mohan Roy	CT-8	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.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.	50
	SEC2 **(Prog.)**	Differentiation and partial differentiation of a vector function. Derivative of sum, dot product and cross product of two vectors. Gradient, divergence and curl	35
Dr. Santanu Raut	CT-9 with practical	Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Milne's method.Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Antiderivatives, proof of antiderivative theorem, Cauchy-Goursat theorem, Cauchy integral formula. An extension of Cauchy integral formula, consequences of Cauchy integral formula, Mobius transformations. Practicals.	50+35

Prof. Ashis Biswas	CT-10	Ring theory: Definition and examples of rings, properties of rings, sub rings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, prime and maximal ideals, ring isomorphism(statement only). Linear algebra: Inner product space. Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphism, Isomorphism theorems, invertibility and isomorphism, change of coordinate matrix.	50
	DSC1D **(Prog.)**	Group, abelian and non-abelian groups, the group Zn of integers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GLn (n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions. Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.	35
Kalyan Roy	CT-8	Definition of vector field, divergence and curl. Line integrals, applications of line integrals. Fundamental theorem for line integrals, conservative vector fields, independence of path. Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stokes theorem, The Divergence theorem.	20
	CT-10	Metric spaces: Definition and examples of Metric Spaces. Neighbourhoods. Limit points. Interior points. Open and closed sets. Closure and Interior. Boundary points. Subspace of Metric Space. Cauchy Sequence. Completeness. Cantor Intersection Theorem. Construction of R as the completion of incomplete Metric Space Q (Deduction of no other completion process is required). Real number as a complete ordered field (No proof of the theorem).	20
	DSC1D **(Prog.)**	Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Zn the ring of integers modulo n, ring of real quaternions, rings ofmatrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields	20

Teaching Plan for the Semester-VI Department of Mathematics			
The Name of the Teacher	Paper	Topic	Classes(Hours)
P rof. Rebati Mohan Roy	DSE3	Linear diophantine equation, The fundamental theorem of arithmetic, statement of prime number theorem, Goldbach conjecture, linear congruences, reduced and complete set of residues. Chinese remainder theorem, Fermat's little theorem, Wilson's theorem. Number theoretic functions, sum and number of divisors, multiplicative and totally multiplicative functions, Mobius function, the Mobius inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, some properties of Euler's phi-function. Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruences with composite moduli. Pythagorean triple, primitive Pythagorean triple, Fermat's Last theorem.	50
	DSE1(B) (Prog.)	Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method, Secant method, LU decomposition, Gauss-Jacobi, Gauss-Siedel and SOR iterative methods.	35
Dr. Santanu Raut	CT-14 with practical	Errors: Relative, Absolute, Round off, Truncation. Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method. Rate of convergence of these methods. System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis. Interpolation: Lagrange and Newton's methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation. Numerical Integration: Trapezoidal rule, Simpson's 1/3rd rule. Composite Trapezoidal rule, Composite Simpson's 1/3rd rule. Ordinary Differential Equations: Euler's method. Runge-Kutta method of orders two and four. All practical	50
	SEC4 **(Prog.)**	Definition, examples and basic properties of weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd Warshall algorithm.	35

Prof. Ashis Biswas	**CT-13**	Motion in straight line under variable acceleration. Simple Harmonic Motion. Problems on elastic string. Expressions for velocity and acceleration of a particle moving on a plane in Cartesianand Polar coordinates. Motion of a particle moving on a plane with reference to a set of rotating axes. Central forces and central orbit. Tangential and normal accelerations. Circular motion. Simple cases of constrained motion of a particle. Motion of a particle in a plane under different laws of resistance. Motion of a projectile in a resisting medium. Trajectories in a resisting medium where resistance varies as some integral power of velocity. Terminal velocity. Motion under the inverse square law in a plane. Kepler's law and planetary motion. Escape velocity, time of describing an arc of an orbit, motion of artificial satellites. Equation of motion of a particle of varying mass. Problems of motion of varying mass such as those of falling raindrops and projected rockets.	65
	DSE1(B) (Prog.)	Lagrange and Newton interpolation: linear and higher order, finite difference operators. Numerical differentiation: forward difference, backward difference and central Difference. Integration: trapezoidal rule, Simpson's rule, Euler's method.	20
Kalyan Roy	DSE4	Boolean Algebra: Huntington postulates for Boolean algebra, Algebra of sets and switching algebra as examples of Boolean Algebra, duality principle, Boolean functions, Normal forms, minimal and maximal forms of Boolean polynomials .Karnaugh maps, Design of switching circuits, Logic gates. Discrete Mathematics: Principle of inclusion and exclusion, Pigeon-hole principle, Finite combinatorics, Generating functions, Partitions, Recurrence relations, Linear difference equations with constant coefficients. Partial and linear orderings, Chains and anti-chains, Lattices, Distributive lattices, Complementation, sub-lattices, products and homomorphisms.	40
	SEC4 **(Prog.)**	Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi partite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix	20