Khatra Adibasi Mahavidyalaya

Khatra, Bankura, West Bengal

Department of Mathematics

Syllabus Module (2019-2020)

Syllabus Module
Dept. Of Mathematics
Session : 2019-2020
Khatra Adibasi Mahavidyalaya

Semester -1					
Course Code	**Course Title**	**Course Topics**	**Teachers**	**No. of lectures per topic**	**Total no. of lectures**
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.	**CDG**	**15**	
		Unit 2	**CDG**	**15**	

		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.	**MN**	**15**	
		Unit 4 Differential equations and mathematical models. General, particular, explicit, implicit and singular	**AI**	**15**	**60**

		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.			
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≥GM≥HM, Cauchy-Schwartz inequality.	**AI**	**15**	
		Unit 2 Equivalence relations. Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set. Well-ordering	**AI**	**15**	

		property of 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**	**15**	
		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**	**15**	**60**

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.	**CDG**	**15**	
		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.	**CDG**	**15**	
		Unit 3	**CDG**	**15**	

		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.			
		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.	**CDG**	**15**	**60**
Tentative dates of Internal Assessment is first week of November 2019					

SEMESTER – II

Course Code	Course Title	Course Topics	Teachers	No. of lectures per topic	Total no. of lectures
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**	**15**	
		Unit 2 Sequences, Bounded sequence,	**RB**	**15**	

		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.			
		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.	**RB**	**20**	**50**
SH/MTH/ 202/C-4	**Differential Equations and Vector Calculus**	**Unit 1** Lipschitz condition and Picard's Theorem (Statement only). General solution of homogeneous	**CDG**	**15**	

		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**	**15**	
		Unit 3 Equilibrium points, Interpretation of the phase plane Power series solution of a differential equation about an ordinary point, solution about a	**CDG**	**15**	

		regular singular point.			
		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.	**MN**	**15**	**60**
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 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	**AI**	**15**	

		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.	**RB**	**15**	
		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.	**RB**	**20**	**50**

Tentative dates of Internal Assessment is September 2020

SEMESTER – III

Course Code	Course Title	Course Topics	Teachers	No. of lectures per topic	Total no. of lectures
SH/MTH/301/C-5	**Theory of Real Functions & Introduction to Metric Space**	**Unit 1** 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.	**MN**	**15**	
		Unit 2 Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable	**MN**	**15**	

		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.			
		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, $ln(1 + x)$, $1/ax + b$ and $(1 + x)^{n.}$ Application of Taylor's theorem to inequalities.	**MN**	**15**	
		Unit 4 Metric spaces: Definition and examples. Open and closed balls, neighbourhood, open	**CDG**	**15**	**60**

		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.	**MN**	**15**	
		Unit 2 Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.	**MN**	**15**	
		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.	**MN**	**15**	

		Unit 4 External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.	**MN**	**15**	
		Unit 5 Group homomorphisms , properties of homomorphisms, Cayley's theorem, properties of isomorphisms. First, Second and Third isomorphism theorems.	**MN**	**15**	**75**
SH/MTH /303/C-7	**Numerical Methods Numerical Methods Lab**	**Unit 1** Algorithms. Convergence. Errors: Relative, Absolute. Round off. Truncation.	**CDG**	**15**	
		Unit 2 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.	**CDG**	**15**	
		Unit 3 System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method,	**AI**	**15**	

		Gauss Seidel method and their convergence analysis. LU Decomposition			
		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.	**AI**	**15**	
		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.	**AI**	**15**	**75**
SH/MTH /	**Algebra**	**Unit 1**	**MN**	**15**	

304/GE-3	**(GET2)**	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.			
		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.	**MN**	**15**	
		Unit 3 Systems of linear	**MN**	**15**	

		equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, linear independence.			
		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**	**15**	**60**

Tentative dates of Internal Assessment is first week of November 2019

SEMESTER – IV

Course Code	Course Title	Course Topics	Teachers	No. of lectures per	Total no. of lecture

				topic	s
SH/MTH /401/C-8	**Riemann Integration and Series of Functions**	**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.	**MN**	**15**	
		Unit 2 Improper integrals. Convergence of Beta and Gamma functions.	**MN**	**15**	
		Unit 3 Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the	**MN**	**15**	

		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.			
		Unit 4 Fourier series: Definition of Fourier coefficients and series, Reimann Lebesgue lemma, Bessel's inequality, Parseval's identity, Dirichlet's condition. Examples of Fourier expansions and summation results for series.	**MN**	**15**	
		Unit 5 Power series, radius of convergence, Cauchy Hadamard Theorem. Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.	**MN**	**15**	**75**
SH/MTH/402/C-9	**Multivariate Calculus**	**Unit 1** Functions of several variables, limit and continuity of functions of two or more variables	**AI**	**15**	

		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			
		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	**AI**	**15**	
		Unit 3 Definition of vector field, divergence and	**AI**	**15**	

		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**	**15**	**60**
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.	**CDG**	**15**	
		Unit 2 Ring homomorphisms, properties of ring homomorphisms. Isomorphism theorems I, II and III, field of quotients.	**CDG**	**15**	
		Unit 3 Vector spaces, subspaces, algebra of subspaces,	**RB**	**15**	

		quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.			
		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.	**RB**	**15**	**60**
SH/MTH /404/GE-4	**Differential Equations and Vector Calculus (GET4)**	**Unit 1** 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	**CDG**	**15**	

		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**	**15**	
		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**	**15**	**60**

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.	**RB**	**15**	
		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,	**RB**	**15**	
		Unit 3 Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm.	**RB**	**20**	**50**
Tentative dates of Internal Assessment is in September2020					
SEMESTER – V					
Course Code	**Course Title**	**Course Topics**	**Teachers**	**No. of lectures per topic**	**Total no. of lectures**
SH/MTH /	**Partial**	**Unit 1**	**AI**	**15**	

501/C-11	**Differential Equations and Applications**	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.			
		Unit 2 Derivation of 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.	**AI**	**15**	
		Unit 3 The Cauchy problem, Cauchy-Kowalewskaya theorem, Cauchy problem of an infinite string. Initial	**AI**	**15**	

		Boundary Value Problems. Semi-Infinite String with a fixed end, Semi-Infinite String with a Free end. Equations with non-homogeneous boundary conditions. Non- Homogeneous Wave Equation. Method of separation of variables, Solving the Vibrating String Problem. Solving the Heat Conduction problem			
		Unit 4 Central force. Constrained motion, varying mass, tangent and normal components of acceleration, modelling ballistics and planetary motion, Kepler's second law.	**AI**	**15**	**60**
SH/MTH / 502/C-12	**Group Theory - II**	**Unit 1** Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties.	**MN**	**15**	

		Unit 2 Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups.	**MN**	**15**	
		Unit 3 Group actions, stabilizers and kernels, permutation representation associated with a given group action. Applications of group actions. Generalized Cayley's theorem. Index theorem.	**MN**	**15**	
		Unit 4 Groups acting on themselves by conjugation, class equation and consequences, conjugacy $in\ S_n$, p-groups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of A_n for n ≥ 5, non-simplicity tests.	**MN**	**15**	**60**
SH/MTH / 503/ DSE-1	**Linear Programming (DSE T1)**	**Unit 1** Introduction to linear programming problem. Theory of simplex method, graphical solution, convex sets, optimality and	**CDG**	**15**	

		unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two - phase method. Big - M method and their comparison.			
		Unit 2 Duality, formulation of the dual problem, primal - dual relationships, economic interpretation of the dual. 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.	**CDG**	**15**	
		Unit 3 Game theory: formulation of two person zero sum games, solving two person zero sum	**CDG**	**20**	**50**

		games, games with mixed strategies, graphical solution procedure, linear programming solution of games.			
SH/MTH / 504/ DSE-2	**Probability and Statistics (DSE T4)**	**Unit 1** 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, geometric, negative binomial, continuous distributions: uniform, normal, exponential.	**AI**	**15**	
		Unit 2 Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional	**AI**	**15**	

		expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.			
		Unit 3 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, Markov Chains, Chapman-Kolmogorov equations, classification of states.	**AI**	**15**	
		Unit 4 Random Samples, Sampling Distributions, Estimation of parameters, Testing of hypothesis.	**AI**	**15**	**60**
Tentative dates of Internal Assessment is first week of November 2019					

SEMESTER – VI

Course Code	Course Title	Course Topics	Teachers	No. of lectures per topic	Total no. of lectures
SH/MTH / 601/C-13	**Metric Spaces and Complex Analysis**	**Unit 1** Metric spaces: Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces, Cantor's theorem.	**RB**	**15**	
		Unit 2 Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Connectedness, connected subsets of R. Compactness: Sequential compactness, Heine-Borel property, Totally bounded spaces, finite intersection property, and continuous functions on compact sets. Homeomorphism. Contraction mappings. Banach Fixed point Theorem and its application to ordinary differential equation.	**RB**	**15**	

		Unit 3 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.	**AI**	**15**	
		Unit 4 Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, and definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.	**AI**	**15**	
		Unit 5 Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples.	**AI**	**15**	
		Unit 6 Laurent series and its	**AI**	**15**	**90**

		examples, absolute and uniform convergence of power series.			
SH/MTH / 602/C-14	**Ring Theory and Linear Algebra II**	**Unit 1** Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, and unique factorization in Z [x]. Divisibility in integral domains, irreducible, primes, unique factorization domains, Euclidean domains.	**RB**	**15**	
		Unit 2 Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms.	**CDG**	**15**	
		Unit 3 Inner product spaces and norms, Gram-Schmidt	**CDG**		

		orthogonalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator. Least Squares Approximation, minimal solutions to systems of linear equations. Normal and self-adjoint operators. Orthogonal projections and Spectral theorem.			
SH/MTH / 603/ DSE-3	**Number Theory (DSE T7)**	**Unit 1** Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues, Chinese Remainder theorem, Fermat's Little theorem, Wilson's theorem.	**MN**		
		Unit 2 Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function, Euler's phi - function, Euler's theorem, reduced set of	**MN**	**15**	

		residues. some properties of Euler's phi-function.			
		Unit 3 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. Public key encryption, RSA encryption and decryption, the equation $x^2 + y^2 = z^2$, Fermat's Last theorem.	**MN**	**20**	**50**
SH/MTH/ 604/ DSE-4	**Project Work**		**AI**		

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