DURGAPUR WOMEN'S COLLEGE
DEPARTMENT OF MATHEMATICS

LESSON PLAN

3 YEARS DEGREE WITH MATHEMATICS/ 4 YEARS DEGREE WITH MATHEMATICS HONOURS/ 4 YEARS DEGREE WITH MATHEMATICS HONOURS WITH RESEARCH

SEMESTER-I

MAJOR COURSE-1

Course Name: Classical Algebra, Calculus and Analytical Geometry

Course Code: BSCMTMMJ101

ASHIMA MONDAL
(A.M)

Classical Algebra

Unit 1: Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications, complex functions and their applications.

Unit 2: Theory of equations: Relation between roots and coefficients, Transformation of equation, Descartes rule of signs, Cubic and biquadratic equations. Reciprocal equation, separation of the roots of equations, Strum's theorem.

Unit 3: Inequality: The inequality involving $AM \geq GM \geq HM$ and simple theorems, Cauchy-Schwartz inequality, Weierstrass inequality, Problems on maxima-minima.

(25 Classes)

AMIT SARKAR
(A.S)

Calculus

Unit 4: Hyperbolic functions, higher order derivatives, Successive differentiation, Leibnitz rule and its applications to problems of type$(ax+b)n$;eaxsin$(bx+c)$; eaxcos$(bx+c)$; $loge(ax+b)$etc. L'Hospital's rule. concavity and inflection points, envelopes, asymptotes, Maxima and Minima, Curvature. (13 Classes)

Unit 5: Reduction formulae, derivations and illustrations of reduction formulae for the integration of $sinnx$,$cosnx$,$tannx$,$secnx$,$(logx)n$,$sinnx.sinmx$, etc. parametric equations, parametrizing a curve, arc length, arc length of parametric curves, areas and volumes of surfaces of revolution. (12 Classes)

PALASH ROY
(P.R)

Analytical Geometry

Unit 6: Reflection properties of conics, translation, rotation and rigid motion of axes and second degree equations, classification of conics using the discriminant, Tangent, Normal, pole, polar, Diameter and conjugate diameters, Asymptotes. Polar equations of conics. (12 Classes)

Unit 7: Planes, Straight lines in 3D, Spheres. Cylindrical surfaces, Cone. Central conicoids, paraboloids, plane sections of conicoids, Generating lines, classification of quadrics, Tangent plane, Normal. (13 Classes)

MINOR COURSE-1

Course Name: Classical Algebra, Calculus and Analytical Geometry

Course Code: BSCMTMMN101

ASHIMA MONDAL
(A.M)

Classical Algebra

Unit 1: Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications, complex functions and their applications.

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Unit 3: Inequality: The inequality involving $AM \geq GM \geq HM$ and simple theorems, Cauchy-Schwartz inequality, Weierstrass inequality, Problems on maxima-minima.

(25 Classes)

SUTAPA MONDAL
(S.M)

Calculus

Unit 4: Hyperbolic functions, higher order derivatives, Successive differentiation, Leibnitz rule and its applications to problems of type$(ax+b)n$;eaxsin$(bx+c)$; eaxcos$(bx+c)$; $loge(ax+b)$etc.

L'Hospital's rule. concavity and inflection points, envelopes, asymptotes, Maxima and Minima, Curvature. (13 Classes)

Unit 5: Reduction formulae, derivations and illustrations of reduction formulae for the integration of $sinnx, cosnx, tannx, secnx, (logx)n, sinnx.sinmx$, etc. parametric equations, parametrizing a curve, arc length, arc length of parametric curves, areas and volumes of surfaces of revolution. (12 Classes)

PALASH ROY
(P.R)

Analytical Geometry

Unit 6: Reflection properties of conics, translation, rotation and rigid motion of axes and second degree equations, classification of conics using the discriminant, Tangent, Normal, pole, polar, Diameter and conjugate diameters, Asymptotes. Polar equations of conics.

(12 Classes)

Unit 7: Planes, Straight lines in 3D, Spheres. Cylindrical surfaces, Cone. Central conicoids, paraboloids, plane sections of Conicoids, Generating lines, classification of quadrics, Tangent plane, Normal. (13 Classes)

SKILL ENHANCEMENT COURSE-1

Course Name: Graph Theory

Course Code: BSCMTMSE101

PALASH ROY
(P.R)

Unit -1: Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bipartite graphs isomorphism of graphs. (10 Classes)

Unit -2: Paths and circuits,Eulerian circuits, Eulerian graph, semi-Eulerian graph and theorems, Hamiltonian cycles and theorems. Representation of a graph by a matrix, the adjacency matrix, incidence matrix, weighted graph, Königsberg bridge problem; Subgraphs. (20 Classes)

SUTAPA MONDAL
(S.M)

Unit -3: Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Shortest path and Dijkstra's algorithm, Warshall algorithm. (15 Classes)

MULTI DISCIPLINARY COURSE-1

Course Name: Business Mathematics

Course Code: MD113

SURAJIT KARMAKAR
(S.K)

Algebra

A.P. and G.P Series, Convergence and Divergence of G.P. series

Logarithms: Definition-Base and index of logarithm, general properties of logarithm.

(3 Classes)

Permutations: Definition, Factorial notation, Theorems on permutation - Permutations with repetitions, Restricted permutations, Combinations: Definition, Theorems on combination; Basic identities - Restricted combinations. Binomial Theorem: Statement of the theorem for positive integral index, General term, middleterm, Equidistant terms – Simple properties of binomial coefficients. (5 Classes)

Sets and subsets – set operations -Venn diagram – DeMorgan's Law. (2 Classes)

Definition of matrix – Different types of Matrix, Symmetric and skew symmetric matrices, Equality, Addition, Subtraction and Multiplication of matrices – Transpose of a matrix,

Determinant of a squarematrix (upto third order), properties of determinants – minors and co-factors – Inverse of a matrix. Solution of a system of simultaneous equations in 2 and 3 unknowns using Cramer's rule and matrix rule. (10 Classes)

Differential and Integral Calculus

Function: Type, Domain (Trigonometric functions excluded). Limit of a function, Existence, Evaluation by factorization and rationalization, limit when $x \to \infty$, Standard limits (L'Hospital's rule excluded): limx→axn− anx−a=nan−1,$limx \to 0$log (1+x)x=1,limx→0ax−1x= loge a (a>0),limx→0ex−1x=1 (10 Classes)

Continuity of a function: Continuity at a point and in an interval, geometrical interpretation,

Simple examples. Derivative of a function, Geometrical interpretation, Derivatives of composite and parametric functions, Logarithmic differentiation, Second order derivative, Convexity, concavity and point of inflexion, Maximum and minimum values of a function.

(10 Classes)

Function of several variables, Partial differentiation of simple algebraic functions, Homogeneous functions and their properties, Euler's theorem (without proof), The concept of total differential of a function, Differentiation of implicit function with the help of total differential. (5 Classes)
Integration, Indefinite integration as the inverse process of differentiation, Illustration with integral of simple algebraic functions, Definite integral (for simple algebraic and exponential functions). (5 Classes)

SEMESTER-III

MAJOR COURSE-3
Course Name: Real Analysis I
Course Code: BSCMTMMJ301

SURAJIT KARMAKAR
(S.K)

Unit - 1: Review of Algebraic and Order Properties of $\mathbb{R}$, ε-neighbourhood of a point in $\mathbb{R}$. Idea of countable sets, uncountable sets and uncountability of $\mathbb{R}$. Bounded above& Bounded below sets, Bounded Sets, Unbounded sets. Suprema and Infima.Completeness Property of $\mathbb{R}$ and its equivalent properties. The Archimedean Property, Density of Rational (and Irrational) numbers in $\mathbb{R}$, Intervals. Limit points of a set, Isolated points, Open set, closed set, derived set, Illustrations of Bolzano-Weierstrass theorem for sets, compact sets in $\mathbb{R}$, Heine-Borel Theorem. (15 Classes)
Unit- 2: Sequences, Bounded sequence, Convergent sequence, Limit of a sequence, Limit Theorems. Monotone Sequences, Convergence criterion on Monotone sequence. Subsequence and its convergence, Divergence Criterion of sequences and subsequences.Bolzano-Weierstrass theorem for sequences. Limit superior and Limit inferior of a sequence, Cauchy sequence, Cauchy's Convergence Criterion. Sequence of functions: pointwise convergence, uniform convergence, consequences of uniform convergence.
(20 Classes)
Unit-3: ε - δ definition of limit of a real-valued function, Algebra of limits, Limit at infinity and infinite limits; Continuity of a real-valued function, Algebra of continuity, sequential criteria for continuity, Properties of continuous functions, Bolzano's theorem, Fixed pointproperty. Intermediate value theorem, Geometrical interpretation of continuity, Types of discontinuity; Uniform continuity, Relation between continuity and uniform continuity.
(20 Classes)

SUTAPA MONDAL
(S.M)

Unit-4: Differentiability of a real-valued function, Geometrical interpretation of differentiability, Relation between differentiability and continuity, Differentiability and monotonicity, Chain rule of differentiation; Darboux's theorem, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Geometrical interpretation of mean value theorems; Maclaurin's and Taylor's theorems for expansion of a function in an infinite series, Taylor's theorem in finite form with Lagrange, Cauchy and Schlomilch-Roche forms of remainder. (20 Classes)

MAJOR COURSE-4

Course Name: Abstract Algebra-I and Number Theory

Course Code: BSCMTMMJ302

AMIT SARKAR
(A.S)

Unit-1: Equivalence relations and partitions, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set. Binary Compositions; Groupoids, Semigroups, Monoids, Groups: Examples & elementary Properties; Abelian group; Permutation groups; Finite groups: symmetric group, alternating group, Klein's 4-group, group of all n-th roots of unity; Examples of infinite groups; Order of an element, symmetry and dihedral groups. (15 Classes)

Unit-2: Subgroups: definitions,examples and elementary properties;Centre of a group; Centraliser of an element in a group;Cyclic groups: definitions,examples and elementary properties; Properties of Cosets; Lagrange's theorem. Normal Subgroups and their properties; Simple group; Normaliser of a subgroup; Self-conjugate subgroup; Quotient group; Conjugacy relation in a group; Class equation of a group. (20 Classes)

Unit – 3:. Linear Diophantine equation.statement of Fundamental Theorem of Arithmetic. Prime counting function, Theorems on Prime numbers, Goldbach conjecture, Twin-prime conjecture, Odd perfect numbers conjecture, Fermat and Mersenne primes. (15 Classes)

SUTAPA MONDAL
(S.M)

Unit – 3: Well-ordering property of positive integers, Principles of Mathematical Induction, Division algorithm, Divisibility and Euclidean algorithm

Unit – 4: Congruence relation between integers, modular arithmetic. Linear congruence and Chinese remainder theorem, Fermat's little theorem, Wilson's theorem, Number theoreticfunctions for sum and number of divisors, Multiplicative function, The Möbius inversion formula, Greatest integer function, Euler's phi-function and properties, Euler's theorem. . (15 Classes)

MINOR COURSE-3

Course Name: Real Analysis and Complex Analysis

Course Code: BSCMTMMN301

SURAJIT KARMAKAR
(S.K)

Unit - 1: Sequences, Bounded sequence, Convergent sequence, Limit of a sequence, Limit Theorems. Monotone Sequences, Convergence criterion on Monotone sequence. Subsequence and its convergence, Divergence Criterion of sequences and subsequences Bolzano Weierstrass Theorem for Sequences (statement only). Limit superior and Limit inferior of a sequence of real numbers, Cauchy sequence, Cauchy's Convergence Criterion.
(15 Classes)
Unit-2: Infinite series, convergence and divergence of infinite series, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Raabe's test, Gauss test, Cauchy condensation test, Integral test. Alternating series, Leibniz test. (8 Classes)
Unit – 3: ε - δ definition of limit of a real-valued function, Algebra of limits, Limit at infinity and infinite limits; Continuity of a real-valued function, Algebra of continuous functions, sequential criteria for continuity, Properties of continuous functions, Intermediate value theorem, Geometrical interpretation of continuity, Types of discontinuity; Uniform continuity. (12 Classes)

SUTAPA MONDAL
(S.M)

Unit-4: Differentiability of a real valued function, Geometrical interpretation of differentiability, Relation between differentiability and continuity, Chain rule of differentiation; Darboux's theorem, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Geometrical interpretation of mean value theorems; Maclaurin's and Taylor's theorems for expansion of a function in an infinite series, Taylor's theorem in finite form with Lagrange and Cauchy forms of remainder. (15 Classes)
Unit-5: Complex numbers and their representations, algebra of complex numbers; Complex plane, Open set, Domain and region in complex plane; Stereographic projection and Riemann mapping; complex functions, limits & continuity. Differentiability of a complex valued function, Cauchy-Riemann equations, Harmonic functions, Analytic functions, necessary and sufficient conditions for analyticity. Transformations, Examples of isogonal and conformaltransformations, some general transformations: translation, rotation, magnification, inversion; Bilinear transformation, fixed points of a bilinear transformation, cross ratio. (20 Classes)
Unit-6: Complex line integrals, Cauchy's theorem on line integral, evaluations of line integrals using Cauchy's integral formula. (5 Classes)

MULTI DISCIPLINARY COURSE-3
Course Name: Indian Mathematics
Course Code: MD305

AMIT SARKAR
(A.S)

Unit-I: Multiplication:EkadhikenPurven method (multiplication of two numbers of two digits,multiplication of two numbers of three digits),UrdhvaTiragbhyam method (multiplication of two numbers of three digits), NikhilamNavtashchramamDashtaha (multiplication of two numbers of three digits), Combined Operations. (10 Classes)

Unit-2: Division and Divisibility:

Part A: Division: NikhilamNavtashchramamDashtaha (two digits divisor), ParavartyaYojyet method (three digit divisor)

Part B: Divisibility: Ekadhikenpurven method (two digits divisor), Eknunenpurven method (two digit divisor), (15 Classes)

Unit-3: LCM and HCF (5 Classes)

Unit-4: Power and Root:

Power: (i) Square (two-digit number), (ii) Cube (two-digit number).

Root: (i) Square root (four-digit number) (ii) Cube root (six-digit number) (10 Classes)

Unit-5: Work of Indian Mathematicians in Arithmetic

1. Aryabhata

2. Brahmagupta (5 Classes)

SEMESTER-V

MAJOR COURSE-7

Course Name: Real Analysis II

Course Code: BSCMTMMJ501

AMIT SARKAR
(A.S)

Unit-1: Series: Infinite series, series of positive terms, convergence and divergence of infinite series, Cauchy's principle of convergence, Tests for convergence: Comparison test, Limit form, D' Alemberts Ratio test, Cauchy's root test, Raabe's test, Logarithmic test, Kummer's test, Gauss test, Cauchy condensation test, series of arbitrary terms, D' Alemberts Ratio test, root test, Alternating series, Absolute and Conditional convergence, Leibniz test. Abel's test, Dirichlet's test. (18 Classes)

Unit- 2: Riemann Integration: Definitions, Consequences of refinement of partition, norm of a partition, Condition for integrability, Darboux theorem, Integrability of continuous and monotonic functions, inequalities on Riemann integrals, Fundamental theorem of integral calculus, Integration by parts, First mean value theorem, Bonnet and Weierstrass forms of second mean value theorems. (17 Classes)

SURAJIT KARMAKAR
(S.K)

Unit- 3: Uniform convergence and Improper integral: Pointwise and uniform convergence of sequence and series of functions, Weierstrass's M-test, Dirichlet test and Abel's test for uniform convergence, Uniform convergence and continuity, Uniform convergence and differentiability, Improper integrals, Test of convergence of Improper integrals of first and second kind, Dirichlet test and Abel's test for improper integrals. Beta, gamma functions.
(20 Classes)

Unit-4: Fourier Series: Periodic functions. Definition of Fourier Series. Dirichlet's conditions of convergence and statement for sufficient condition for a trigonometric series to be a Fourier series.Derivation of Fourier Coefficients.Examples of Fourier expansions andsummation results for series. Use of odd & even functions in evaluating Fourier coefficients– Half range sine & cosine series, Differentiation and integration of Fourier series. Statements of absolute and uniform convergence of Fourier series, Riemann- Lebesgue lemma, Bessel's inequality and Parseval's identity.The complex form of Fourier series. (20 Classes)

MAJOR COURSE-8

Course Name: Probability, Statistics and Linear Programming Problem

Course Code: BSCMTMMJ502

PALASH ROY
(P.R)

Unit-1: Basic notions of probability, Conditional probability and independence, Bayes' theorem, Discrete and continuous Random variables, Cumulative distribution function, Probability mass/density functions; Transformations, Mathematical expectation, Variance, Moments, Moment generating function, Characteristic function. Bernoulli Trial, Distribution functions and its properties: Binomial, Negative binomial, Geometric, Poisson; Poisson approximation to the binomial distribution. Uniform, Normal, Beta and Gamma, Exponential, Chi-square distributions. (20 Classes)

Unit-2: Joint cumulative distribution function and its properties, Joint probability density function, Marginal distributions, Expectation of a function of two random variables, Joint moment generating function, Conditional distributions and expectations. (10 Classes)

Unit-3: Covariance, Correlation coefficient, Calculation of covariance from joint moment generating function, Independent random variables, Linear regression for two variables, The method of least squares, Bivariate normal distribution, Statements of Chebyshev's theorem, Strong law of large numbers, Central limit theorem and weak law of large numbers.

(10 Classes)

ASHIMA MONDAL
(A.M)

Unit-4: Introduction to linear programming problem. graphical solution, convex sets, extreme points, theorems on convex sets, optimal solutions, Unique and alternative solutions, Basic Solution, degeneracy, Feasible and Basic feasible solution, unbounded and bounded solution, Fundamental theorem of LPP, theory of simplex method, the simplex algorithm, simplex method in tableau format, Artificial variables, two-phase method. Big-M method and their comparison. Duality, Formation of the dual problem, theorems on primal-dual relationships, economic interpretation of the dual, Dual Simplex method. Transportation and Assignment problems. (35 Classes)

MAJOR COURSE-9

Course Name: Numerical Methods and Numerical Lab

Course Code: BSCMTMMJ503

ASHIMA MONDAL
(A.M)

Numerical Methods (50 marks)

Unit-1: Errors: Relative, Absolute, Percentage, Round off and Truncation. (2 Classes)

Unit-2: Algebraic and Transcendental equations: Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Algorithms, error and rate of convergence of these methods. [Geometrical Interpretations as and where applicable] (7 Classes)

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. [Geometrical Interpretations as and where applicable] (6 Classes)

Unit-4: Interpolation: Finite difference operators, Newton's Forward and Newton's Backward method, Lagrange and Newton's divided difference, Error bound. Gregory forward and backward difference interpolations.

Numerical differentiation: Methods based on interpolations, methods based on finite differences. (10 Classes)

Unit–5: Numerical Integration: Newton Cotes formula, Trapezoidal rule, Simpson's 1/3rd rule, Midpoint rule, Composite Trapezoidal rule, Composite Simpson's 1/3rd rule and, Gauss quadrature formula. The algebraic eigen value problem: Power method.

[Geometrical Interpretations as and where applicable] (10 Classes)

Unit -6: Numerical solution of Ordinary Differential Equations: The method of successive approximations, Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four. [Geometrical Interpretations as and where applicable] (10 Classes)

SUTAPA MONDAL
(S.M)

Numerical Methods Lab (using C programming) (Total Marks: 50)

• Continuous assessment (internal): Total 30 marks.

Students have to prepare a practical note book containing working formula, algorithm, flowchart and program with input and output of all practical problem listed below.

• End Semester Examination (External): Total 20 marks.

Lab notebook & Viva Voce: 5 marks

One practical problem: 15 marks (Working formula: 2, Algorithm: 3, Program: 8, Result: 2)

List of practical problems (using C programming):

1. Solution of transcendental and algebraic equations by

(a) Newton Raphson method.
(b) RegulaFalsi method.
2. Solution of system of linear equations

(a) Gaussian elimination method
(b) Gauss-Seidel method
3. Interpolation: Lagrange Interpolation
4. Numerical Integration

(a) Trapezoidal Rule
(b) Simpson's one third rule
5. Solution of 1st order ordinary differential equations: Euler's and Fourth order Runge Kutta method.

MINOR COURSE-5

Course Name: Numerical Analysis and Partial Differential Equations

Course Code: BSCMTMMN501

SURAJIT KARMAKAR
(S.K)

Unit-1: Errors: Relative, Absolute, Percentage, Round off and Truncation. (2 Classes)
Unit-2: Algebraic and Transcendental equations: Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Algorithms, error and rate of convergence of these methods. (10 Classes)
Unit-3: Interpolation: Finite difference operators, Newton's Forward and Newton's Backward method, Lagrange and Newton's divided difference. (10 Classes)
Unit–4: Numerical differentiation: Methods based on interpolations, methods based on finite differences. (4 Classes)
Unit-5: Numerical integration: Newton Cotes formula, Trapezoidal rule, Simpson's 1/3rd rule, Midpoint rule, Composite Trapezoidal rule, Composite Simpson's 1/3rd rule.
(6 Classes)
Unit -6: Numerical solution of Ordinary Differential Equations: The method of successive approximations, Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four. (8 Classes)

AMIT SARKAR
(A.S)

Unit–7: Partial Differential Equations (PDEs) – Basic concepts and Definitions, Order and Degree. First-Order Equations: Classification, Formulation and Geometrical Interpretation of PDE. Lagrange method for obtaining general solution of quasi-linear PDEs.Integral surfaces passing through a given curve.Surfaces orthogonal to a given system of surfaces. GeometricalInterpretation of First order non-linear PDEs. Solution of first order non-linear PDEs by Charpit's general method. Origin and applications of second and higher order PDEs. Classification of second order PDE. Reduction of Second order PDE with constant or variable coefficients to canonical/normal form. Methods to find the general solution of homogeneous and non-homogeneous linear PDEs with constant coefficients. (35 Classes)

SEMESTER-VII

MAJOR COURSE-14

Course Name: Integral Transforms and Integral Equations

Course Code: BSCMTMMJ701

ASHIMA MONDAL
(A.M)

Unit-1: Fourier Transforms: Fourier Transforms as a limit of Fourier Series. Fourier Integral Theorem (statement only). Determination of Fourier Transform Pairs from Fourier Integral. Definition and properties of Fourier Transforms: Linearity, Change of Scale Property, Shifting Property, Modulation theorem. Fourier Transforms of Derivatives, Fourier Transforms of some useful functions. Fourier sine and cosine transforms. Inverse Fourier Transform and examples. Convolution Theorem, Parseval's relation, Application of Fourier transforms to solving ordinary and partial differential equations. (15 classes)

Unit-2: Laplace Transforms: Definition of Laplace Transform. Derivation of Laplace Transform from Fourier Integral and its relation with Fourier Transform. Laplace Transform of some elementary functions. Sufficient conditions for the existence of Laplace Transform (statement only) with counter examples. Properties of Laplace transforms: Linearity, First Shifting Property, Change of Scale Property, Laplace transforms of periodic functions, Second Shifting Property, Laplace transforms of derivatives and integrals. Statements of Initial and final value theorems. Inverse Laplace Transform: Definition and examples. Statement and applications of Convolution theorem. Application to Ordinary differential equations, Partial differential equations and linear integral equations. (15 classes)

AMIT SARKAR
(A.S)

Unit-3: Preliminary concepts of integral equations, Linear integral equations, Classification of linear integral equations, Volterra integral equations, Fredholm integral equations, conversion of initial and boundary value problems to integral equations and vice-versa, Different types of kernels, Integral equations with degenerate kernels, Homogeneous Fredholm integral equations, Fredholm theorems, Eigenvalue and eigenfunction of integral equation and their simple properties. (20 classes)

Unit-4: Existence and uniqueness of continuous solutions of Fredholm and Volterra's integral equations of second kind, Solution by the method of successive approximations, The method of successive substitutions, Resolvent kernel method,

Iterated kernel method, Solution of Volterra integral equation of first kind. (15 classes)

Unit-5: Integral equations with symmetric kernels, Orthogonal system of functions, fundamental properties of eigenvalues and eigenfunctions for symmetric kernels. Solution of Volterra integral equations with convolution type kernels. Singular integral equation, Solution of Abel's integral equation. (10 classes)

MAJOR COURSE-15

Course Name: General Topology

Course Code: BSCMTMMJ702

SURAJIT KARMAKAR
(S.K)

Unit-1: Set Theory: Countable and Uncountable Sets, Schroeder-Bernstein Theorem, Cantor's Theorem, Cardinal Numbers and Cardinal Arithmetic, Continuum Hypothesis, Zorns Lemma, Axiom of Choice, Well-Ordered Sets, Hausdorff's Maximal Principle, Ordinal Numbers, Fundamentals of Topological Spaces: Topological spaces, Bases and sub-bases, Closure & interior; exterior, boundary, accumulation points, derived sets, dense set, $G\delta$ and $F\sigma$ sets, Neighbourhood system, Order Topology, Discrete space, Subspace topology and its properties; Kuratowski closure operator, interior operator and neighbourhood systems; Continuous mappings, Open maps, Closed maps and Homeomorphisms, topological property, metric topology. (25 classes)

SUTAPA MONDAL
(S.M)

Unit-2: Product Spaces: Product and box topology, Projection maps, Quotient topology, Separation axioms, Countability axioms and Connectedness in product spaces, First and Second countable spaces, Separable spaces and Lindelöf spaces, Sequential characterizations of accumulation points, closure, closed sets, open sets and continuity. (20 classes)

Unit-3: Separation Axioms: Ti spaces (i = 0, 1, 2, 3, 3½, 4, 5), their characterizations and basic properties, Urysohn's lemma, Metrization theorem and Tietze's extension theorem.

(15 classes)

SURAJIT KARMAKAR
(S.K)

Unit-4: Compactness: Compactness and its basic properties, Alexander sub-base theorem, Continuous functions and compact sets, Compactness of $\mathbb{R}$, Sequential compactness, BW Compactness and countable compactness, One-point compactification, Local compactness, Tychonoff theorem, Arzela-Ascoli theorem. (10 classes)

Unit-5: Connectedness: Connected and disconnected spaces, Path Connected Spaces, Connected Sets in $\mathbb{R}$, $\mathbb{R}n(n > 1)$, Local connectedness, Components, Totally disconnected sets, Connectedness in product topology. (5 classes)

MAJOR COURSE-16

Course Name: Functional Analysis

Course Code: BSCMTMMJ703

SURAJIT KARMAKAR
(S.K)

Unit-1: Banach Spaces: Normed Linear Spaces with some properties, Banach Spaces and its examples, Equivalent Norms, Finite dimensional normed linear spaces, Compactness of closed bounded sets with special reference to the closed unit ball, Quotient Space of normed linear spaces and its completeness, Riesz Lemma. Bounded Linear Transformations, Uniform Boundedness principle, Open Mapping Theorem, Closed Graph Theorem, Linear Functionals, Hahn-Banach Theorem, Dual Space, Reflexivity of Banach Spaces. (30 classes)

SUTAPA MONDAL
(S.M)

Unit-2: Inner Product Spaces: Inner product spaces with examples, Parallelogram law, polarization identity, Cauchy-Schwarz inequality, orthogonality, orthonormal vectors, complete orthonormal set of vectors, Pythagorean Theorem, Gram-Schmidt orthogonalization process, Bessel's Inequality, Parseval's Identity. (15 classes)

ASHIMA MONDAL
(A.M)

Unit-3: Hilbert Spaces: Hilbert Spaces with examples, Orthogonal Complement and Projection Theorem. Riesz Representation Theorem, Reflexivity of Hilbert Spaces, Adjoint of an Operator on a Hilbert Space, Self-adjoint Operators, Positive

PALASH ROY
(P.R)

Operators, Projection Operators, Normal Operators, Unitary Operators. Introduction to Spectral Properties of Bounded Linear Operators. Resolvent set, spectrum and

spectral radius of operators on Banach space, spectral mapping theorem for polynomials. (30 classes)

MAJOR COURSE-17

Course Name: Advanced Differential Equations and Special Functions

Course Code: BSCMTMMJ704

AMIT SARKAR
(A.S)

Unit-1: Power series solution of a differential equation about an ordinary point, solution about a regular singular point. Frobenius method, Legendre's equation, its solution, Legendre polynomials, Rodrigues formula, orthogonality, recurrence relations, Bessel's equation, Bessel functions, recurrence relations, generating function and orthogonality properties of Bessel function. (25 classes)

PALASH ROY
(P.R)

Unit-2: Ricati's equation, General solution of Riccati's equation, cross-ratio of particular integrals, Methods of solving Riccati's equation when three, two and one particular integrals are known. Chebyshev polynomials, Independent solutions of Chebyshev equation, Orthogonal properties of Chebyshev polynomials, First few Chebyshev polynomials, Generating functions for Chebyshev polynomials. (20 classes)

Unit-3: Hermite polynomials: generating functions, orthogonal properties, recurrence relations of Hermite polynomials. Laguerre polynomials: generating functions, orthogonal properties of Laguerre polynomials, Relation between Laguerre polynomial and their derivatives. Hypergeometric function, Gauss's hypergeometric equation and its solution, Symmetric property of hypergeometric function, Differentiation and integral representation of hypergeometric function. (20 classes)

AMIT SARKAR
(A.S)

Unit-4: Orthogonality, Orthogonal and orthonormal set of functions w.r.t. a weight function, Sturm-Liouville problem, Eigenfunctions and eigenvalues, Orthogonality of eigenfunctions, Reality of eigenvalues with examples. (10 classes)