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Government General Degree College Nakashipara
Department of Mathematics
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TEACHING PLAN FOR THE ACADEMIC SESSION 2022-23
ODD SEMESTER

Semester-I (2022-23 Batch)

(As per syllabus effective from the academic session 2021-22)

Course Code	Course Title
B.Sc. Mathematics Hons.	
MATH-H-CC-T-01	Calculus & Analytical Geometry
MATH-H-CC-T-02	Algebra
General Elective Course (B.Sc. Hons. other than Mathematics)	
MATH-H-GE-T-01	Algebra & Analytical Geometry
B.Sc. Programme/ General	
MATH-G-CC-T-01	Algebra & Analytical Geometry

Teaching Plan

B.Sc. Mathematics (Honours)
SEMESTER-I
Course: MATH-H-CC-T-01
Course title: Calculus & Analytical Geometry
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Hyperbolic functions and its derivative, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$ ● Pedal equations. ● Curvature, radius of curvature, centre of curvature, circle of curvature ● Asymptotes. ● Singular points, concavity, and inflection points. ● Curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves. ● L'Hospital's rule, applications in business, economics, and life	Mr. Prabir Chakraborty	25L

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	sciences.		
2	● Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx, \int \cos^n x\,dx, \int \tan^n x\,dx, \int \sec^n x\,dx, \int (log\ x)^n dx, \int \sin^n x \cos^m x\,dx$ ● 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.	Mr. Prabir Chakraborty	16L
3	● Transformation of coordinate axes, pair of straight lines, reflection properties of conics, canonical form second degree equations, classification of conics using the discriminant, polar equations of conics. ● Straight lines in 3D, sphere, cylindrical surfaces. central conicoids, paraboloids, plane sections of conicoids, generating lines, classification of quadrics, illustrations of graphing standard quadric surfaces like cone, ellipsoid.	Mr. Prabir Chakraborty	30L
Graphical Demonstration (Teaching Aid)			
1. Plotting of graphs of function $e^{ax+b}, \log(ax+b), \frac{1}{ax+b}$, $\sin(ax+b), \cos(ax+b), \lvert ax+b \rvert$ and to illustrate the effect of a and b on the graph. 2. Plotting the graphs of polynomials of degree 4 and 5, the derivative graph, the second derivative graph and comparing them. 3. Sketching parametric curves (e.g., trochoid, cycloid, epicycloids, hypocycloid). 4. Obtaining the surface of the revolution of curves. 5. Tracing of conics in Cartesian coordinates/ polar coordinates. 6. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, and hyperbolic paraboloid using Cartesian coordinates.		Mr. Prabir Chakraborty	4L

B.Sc. Mathematics (Honours)
SEMESTER-I
Course: MATH-H-CC-T-02
Course title: Algebra
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications. Direct	Dr. Biswajit Saha	30L

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	and inverse circular form of trigonometric and hyperbolic functions. Exponential & Logarithm of a complex number. Definition of a^z ● Relation between roots and coefficients, transformation of equation, Descartes rule of signs, solution of cubic equation (Cardan's method). ● 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.		
2	● Equivalence relations and partitions. Functions, composition of functions, Invertible functions, one to one correspondence and cardinality of a set. ● Permutations, cycle notation for permutations, even and odd permutations. ● Definition and elementary properties of groups. Symmetries of a square, dihedral groups, quaternion groups (through matrices). Permutation group, alternating group, finite groups: s_3, V_4 . The group Z_n of integers under addition modulo n and the group U_n of units under multiplication modulo n. ● Order of an element, order of a group, simple properties.	Dr. Biswajit Saha	25L
3	● Orthogonal matrix and its properties. Rank of a matrix, inverse of a matrix, characterizations of invertible matrices. Row reduced and echelon forms, Normal form, and congruence operations. ● Solutions of systems of linear equations of the form $Ax = b$ and their applications.	Dr. Biswajit Saha	20L

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B.Sc. Other than Mathematics (Honours)
SEMESTER-I
Course: MATH-H-GE-T-01
Course title: Algebra & Analytical Geometry
General Elective Course
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Complex umbers De Moivre's theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of a^z. Inverse circular and hyperbolic functions. ● Polynomials: Fundamental theorem of algebra (Statement only). Polynomials with real coefficients, nature of roots of an equation (surd or complex roots occur in pairs). Statement of Descartes rule of signs and its applications. Relation between roots and coefficients, transformations of equations. Cardan's method of solution of a cubic equation. ● Rank of a matrix: Determination of rank either by considering minors or by sweep-out process. Consistency and solution of a system of linear equations with not more than 3 variables by matrix method. ● Equivalence relations and partitions. Functions, composition of functions, invertible functions, one to one correspondence and cardinality of a set ● Definition and elementary properties of groups. Concepts of permutation Group, alternating group, finite groups: S_3, V_4. The group Z_n of integers under addition modulo n. ● Order of an element, order of a group, subgroups, and examples of subgroups.	Mr. Prabir Chakraborty	40L
2	● Transformations of rectangular axes: Translation, rotation, and their combinations. Invariants. ● General equation of second degree in x and y: Reduction to canonical forms. Classification of conics. ● Pair of straight lines: Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of two lines joining the origin to the points in which a line meets a conic. ● Polar equation of straight lines and circles, polar equation of a conic refers to a focus as a pole, polar equation of chord joining two points, polar equations of tangents and normals.	Mr. Prabir Chakraborty	35L

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B.Sc. Mathematics (GENERAL)
SEMESTER-I
Course: MATH-G-CC-T-01
Course title: Algebra & Analytical Geometry
General Elective Course
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Complex umbers De Moivre's theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of a^z. Inverse circular and hyperbolic functions. ● Polynomials: Fundamental theorem of algebra (Statement only). Polynomials with real coefficients, nature of roots of an equation (surd or complex roots occur in pairs). Statement of Descartes rule of signs and its applications. Relation between roots and coefficients, transformations of equations. Cardan's method of solution of a cubic equation. ● Rank of a matrix: Determination of rank either by considering minors or by sweep-out process. Consistency and solution of a system of linear equations with not more than 3 variables by matrix method. ● Equivalence relations and partitions. Functions, composition of functions, invertible functions, one to one correspondence and cardinality of a set ● Definition and elementary properties of groups. Concepts of permutation Group, alternating group, finite groups: S_3, V_4. The group Z_n of integers under addition modulo n. ● Order of an element, order of a group, subgroups, and examples of subgroups.	Mr. Prabir Chakraborty	40L
2	● Transformations of rectangular axes: Translation, rotation, and their combinations. Invariants. ● General equation of second degree in x and y: Reduction to canonical forms. Classification of conics. ● Pair of straight lines: Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of two lines joining the origin to the points in which a line meets a conic. ● Polar equation of straight lines and circles, polar equation of a conic refers to a focus as a pole, polar equation of chord joining two points, polar equations of tangents and normals.	Mr. Prabir Chakraborty	35L

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Semester-III (2021-22 Batch)

(As per syllabus effective from the academic session 2021-22)

Course Code	Course Title
B.Sc. Mathematics Hons.	
MATH-H-CC-T-05	Theory of Real & Vector Functions
MATH-H-CC-T-06	Group Theory I
MATH-H-CC-T-07	Numerical Methods (Theory) & Numerical Methods Lab
MATH-H-SEC-T-01	Programming in 'C'
General Elective Course (B.Sc. Hons. other than Mathematics)	
MATH-H-GE-T-03	Algebra & Analytical Geometry
B.Sc. Programme/ General	
MATH-G-CC-T-03	Real Analysis
MATH-G-SEC-T-01	Logic and Sets

Teaching Plan

B.Sc. Mathematics (Honours)
SEMESTER-III
Course: MATH-H-CC-T-05
Course title: Theory of Real & Vector Functions

Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
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, neighbourhood property. Sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, ● Bolzano's Theorem, intermediate value theorem. Location of roots theorem, preservation of intervals theorem. ● Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.	Dr. Biswajit Saha	25L
2	● Differentiability of a function at a point and in an interval. ● Caratheodory's theorem. ● Algebra of differentiable functions. ● Darboux's theorem.	Dr. Biswajit Saha	20L
3	● Rolle's theorem. ● Lagrange's and Cauchy's mean value theorems.	Dr. Biswajit Saha	20L

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	●Taylor's theorem with Lagrange's and Cauchy's forms of remainder. ● Application of Taylor's theorem to convex functions. ●Applications of mean value theorem to inequalities and approximation of polynomials. ● Relative extrema, interior extremum theorem. ● Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, $\log(1+x)$, $\frac{1}{ax+b}$, $(1+x)^n$. ● Application of Taylor's theorem to inequalities.		
4	● Vector products. ● Introduction to vector functions, operations with vector-valued functions. ● Limits and continuity of vector functions. ● Differentiation and integration of vector functions of one variable $\left(\int_a^b \overrightarrow{f(t)}\, dt\right)$. ● Gradient, divergence, curl of vector functions.	Dr. Biswajit Saha	10L

B.Sc. Mathematics (Honours)
SEMESTER-III
Course: MATH-H-CC-T-06
Course title: Group Theory-I
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Subgroups, examples and properties of subgroups. ● Product of two subgroups. ● Cyclic group, examples and properties of cyclic group. ● Classification of subgroups of cyclic groups. ● Cosets and their properties. ● Lagrange's theorem and consequences including Fermat's little theorem.	Dr. Biswajit Saha	30L
2	● External direct product of a finite number of groups. ● Centre of a group, centralizer, normalizer. ● Normal subgroups. ● Factor groups. ● Cauchy's theorem for finite abelian groups.	Dr. Biswajit Saha	25L
3	● Group homomorphisms, basic properties of homomorphisms. ● Cayley's theorem. ● Properties of isomorphisms. ● First, second and third isomorphism theorems.	Dr. Biswajit Saha	20L

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B.Sc. Mathematics (Honours)
SEMESTER-III
Course: MATH-H-CC-T-07
Course title: Numerical Methods (Theory) & Numerical Methods Lab
Credit-6 (4+2) (Theory + Practical)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Numerical Methods (Theory)

Unit	Topic	Teacher	No. of Lectures
1	● Algorithms, convergence, errors, relative, absolute, round-off, truncation errors. ● Interpolation, Lagrange and Newton's methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation. Central difference interpolation formula: Stirling and Bessel interpolation ● Numerical differentiation, methods based on interpolations, methods based on finite differences.	Mr. Prabir Chakraborty	10L
2	● Numerical integration, Newton Cotes formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule, Weddle's rule, Boole's rule. Midpoint rule, composite trapezoidal rule, composite Simpson's 1/3rd rule, Gauss quadrature formula.	Mr. Prabir Chakraborty	10L
3	● 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. ● System of linear algebraic equations, Gaussian elimination and Gauss Jordan methods, Gauss Jacobi method, Gauss Seidel method and their convergence analysis, LU decomposition	Mr. Prabir Chakraborty	10L
4	● The algebraic eigenvalue problem, power method. ● Approximation, least square polynomial approximation.	Mr. Prabir Chakraborty	10L
5	● Ordinary differential equations: The method of successive approximations, Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.	Mr. Prabir Chakraborty	10L

LIST OF PRACTICAL PROBLEMS (Using 'C' or Python programming)
[Two experiments are to be performed in the presence of External Examiner(s) (Marks: 7.5x2) and Viva (Marks: 5)]
(A practical note book must be maintained as a part of Internal Assessment)

Unit	Topic	Teacher	No. of Lectures
1	(i) Calculate the sum of infinite convergent series.		

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	(ii) Find the absolute value of an integer. (iii) Enter 100 integers into an array and sort them in an ascending order. (iv) Bisection Method. (v) Newton Raphson Method. (vi) Secant Method. (vii) Regula-Falsi Method. (viii) LU decomposition Method. (ix) Gauss-Jacobi Method. (x) SOR Method or Gauss-Seidel Method. (xi) Lagrange's Interpolation (xii) Trapezoidal Rule. (xiii) Simpson's rule.	Mr. Prabir Chakraborty	25L

B.Sc. Mathematics (Honours)
SEMESTER-III
Course: MATH-H-SEC-T-1A
Course title: Programming in 'C'
Skill Enhancement Course
Credit-2 (Theory)
Full Marks-50 (Internal Assessment: 10 marks; Semester-end Exam: 40 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Brief historical development. Computer generation. Basic structure and elementary ideas of computer systems, operating systems, hardware and software. ● Positional number systems: Binary, octal, decimal, hexadecimal systems. Binary arithmetic. ● BIT, BYTE, WORD. Coding of data -ASCII, EBCDIC, etc. ● Algorithms and flow chart: Important features, ideas about complexities of algorithms. Application in simple problems.	Mr. Prabir Chakraborty	7L
2	● Programming language and importance of 'C' programming. ● Constants, variables and data type of 'C'-Program: Character set. Constants and variables data types, expression, assignment statements, declaration. ● Operation and expressions: Arithmetic operators, relational operators, logical operators. ● Decision making and branching: Decision making with if statement, if-else statement, nesting if statement, switch statement, break and continue statement. ● Control statements: While statement, do-while statement, for statement.	Mr. Prabir Chakraborty	18L

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	● Arrays: One-dimension, two-dimensional and multidimensional arrays, declaration of arrays, initialization of one and multi-dimensional arrays. ● User-defined Functions: Definition of functions, scope of variables, return values and their types, function declaration, function call by value, nesting of functions, passing of arrays to functions, recurrence of function.		

B.Sc. Other than Mathematics (Honours)
SEMESTER-III
Course: MATH-H-GE-T-03
Course title: Algebra & Analytical Geometry
General Elective Course
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Complex umbers De Moivre's theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of a^z. Inverse circular and hyperbolic functions. ● Polynomials: Fundamental theorem of algebra (Statement only). Polynomials with real coefficients, nature of roots of an equation (surd or complex roots occur in pairs). Statement of Descartes rule of signs and its applications. Relation between roots and coefficients, transformations of equations. Cardan's method of solution of a cubic equation. ● Rank of a matrix: Determination of rank either by considering minors or by sweep-out process. Consistency and solution of a system of linear equations with not more than 3 variables by matrix method. ● Equivalence relations and partitions. Functions, composition of functions, invertible functions, one to one correspondence and cardinality of a set ● Definition and elementary properties of groups. Concepts of permutation Group, alternating group, finite groups: S_3, V_4. The group Z_n of integers under addition modulo n. ● Order of an element, order of a group, subgroups, and examples of subgroups.	Mr. Prabir Chakraborty	40L
2	● Transformations of rectangular axes: Translation, rotation, and their combinations. Invariants. ● General equation of second degree in x and y: Reduction to	Mr. Prabir Chakraborty	35L

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	canonical forms. Classification of conics. ● Pair of straight lines: Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of two lines joining the origin to the points in which a line meets a conic. ● Polar equation of straight lines and circles, polar equation of a conic refers to a focus as a pole, polar equation of chord joining two points, polar equations of tangents and normals.		

B.Sc. Mathematics (GENERAL)
SEMESTER-III
Course: MATH-G-CC-T-03
Course title: Real Analysis
Credit-6(5+1) (Theory + Tutorial);
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Review of algebraic and order properties of $\mathbb{R}$. ● Idea of countable sets, uncountable sets and uncountability of $\mathbb{R}$. Countability of $\mathbb{Q}$. ● Bounded above sets, 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. ● Intervals, ϵ-neighborhood of a point in $\mathbb{R}$, Interior points, Limit points of a set, isolated points, open set, closed set, union and intersection of open and closed sets. derived set, Closure of a set, Interior of a set. ● Bolzano-Weierstrass theorem for sets (statement only).	Dr. Biswajit Saha	25L
2	● Sequences, bounded sequence, convergent sequence, Sandwich theorem. ● Cauchy's convergence criterion for sequences. Cauchy's theorem on limits ● Monotone sequences, monotone convergence theorem (without proof).	Dr. Biswajit Saha	20L
3	● Infinite series, Convergence and divergence of infinite series, Cauchy's criterion.	Dr. Biswajit Saha	30L

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	● Series of positive terms, Geometric Series, p-Series. ● Tests for convergence: comparison test, limit comparison test, ratio test: D'Alembert's ratio test, Raabe's test, Cauchy's root test. ● Alternating series, Leibnitz test (without proof), definition and examples of Absolute and conditional convergence. ● Power series and radius of convergence (problems only).		

B.Sc. Mathematics (GENERAL)
SEMESTER-III
Course: MATH-G-SEC-T-1A
Course title: Logic & Sets
Skill Enhancement Course
Credit-2 (Theory)
Full Marks-50 (Internal Assessment: 10 marks; Semester-end Exam: 40 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contrapositive and inverse proportions and precedence of logical operators. ● Propositional equivalence: Logical equivalences. ● Predicates and quantifiers: Introduction, quantifiers, binding variables and negations.	Dr. Biswajit Saha	10L
2	● Sets, subsets, set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. ● Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.	Dr. Biswajit Saha	7L
3	● Difference and Symmetric difference of two sets. Set identities, generalized union and intersections. ● Relation: Product set. Composition of relations, types of relations, partitions, equivalence Relations with example of congruence modulo relation. Partial ordering relations, n-ary relations.	Dr. Biswajit Saha	8L

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Semester-V (2020-21 Batch)

(As per syllabus effective from the academic session 2018-19)

Course Code	Course Title
B.Sc. Mathematics Hons.	
MATH-H-CC-T-11	Partial Differential Equations and Applications
MATH-H-CC-T-12	Group Theory-II
MATH-H-DSE-T-01	Linear Programming
MATH-H-DSE-T-02	Probability & Statistics
B.Sc. Programme/ General	
MATH-G-DSE-T-01	Complex Analysis
MATH-G-SEC-T-03	Theory of Equations

Teaching Plan

B.Sc. Mathematics (Honours)
SEMESTER-V
Course: MATH-H-CC-T-11
Course title: Partial Differential Equations & Applications

Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	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.	Mr. Prabir Chakraborty	20L
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.	Mr. Prabir Chakraborty	20L
3	The Cauchy problem, Cauchy-Kowalewskaya theorem, Cauchy problem of an infinite string. Initial 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	Mr. Prabir Chakraborty	30L

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	separation of variables, solving the vibrating string problem. Solving the heat conduction problem.		
Graphical Demonstration (Teaching aid)			
	1. Solution of Cauchy problem for first order PDE. 2. Finding the characteristics for the first order PDE. 3. Plot the integral surfaces of a given first order PDE with initial data. 4. Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions: (a) $u(x,0) = \phi(x),\ u_t(x,0) = \psi(x),\ x \in R,\ t > 0.$ (b) $u(x,0) = \phi(x),\ u_t(x,0) = \psi(x), u(0,t) = 0\ x \in (0,\infty),\ t > 0$ 5. Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions: (a) $u(x,0) = \phi(x),\ u\ (o,t) = a, u\ (l,t) = b,\ 0 < x < l, t > 0.$ $u(x,0) = \phi(x),\ x \in R,\ 0 < t < T.$	Mr. Prabir Chakraborty	5L

B.Sc. Mathematics (Honours)
SEMESTER-V
Course: MATH-H-CC-T-12
Course title: Group Theory II
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
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.	Dr. Biswajit Saha	25L
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.	Dr. Biswajit Saha	20L
3	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 $n \geq 5$, non-simplicity tests.	Dr. Biswajit Saha	30L

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B.Sc. Mathematics (Honours)
SEMESTER-V
Course: MATH-H-DSE-T-1A
Course title: Linear Programming
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	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.	Mr. Prabir Chakraborty	30L
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.	Mr. Prabir Chakraborty	25L
3	Game theory: formulation of two persons zero sum games, solving two-person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.	Mr. Prabir Chakraborty	20L

B.Sc. Mathematics (Honours)
SEMESTER-V
Course: MATH-H-DSE-T-2A
Course title: Probability and Statistics
Department Specific Elective Course
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
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,	Mr. Prabir Chakraborty	25L

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	discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.		
2	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, bivariate normal distribution, correlation coefficient.	Mr. Prabir Chakraborty	20L
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.	Mr. Prabir Chakraborty	20L
4	Random Samples, Sampling Distributions, Estimation of parameters, Testing of hypothesis.	Mr. Prabir Chakraborty	10L

B.Sc. Mathematics (GENERAL)
SEMESTER-V
Course: MATH-G-DSE-T-1B
Course title: Complex Analysis
Discipline specific Elective Course
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	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.	Dr. Biswajit Saha	20L
2	Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions.	Dr. Biswajit Saha	20L
3	Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.	Dr. Biswajit Saha	20L
4	Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples.	Dr. Biswajit Saha	10L
5	Laurent series and its examples, absolute and uniform convergence of power series.	Dr. Biswajit Saha	5L

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B. Sc. Mathematics (GENERAL)
SEMESTER-V
Course: MATH-G-SEC-T-3A
Course title: Integral Calculus
Skill Enhancement course
Credit-2 (Theory)
Full Marks-50 (Internal Assessment: 10 marks; Semester-end Exam: 40 marks)

Unit	Topic	Teacher	No. of Lectures
1	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.	Dr. Biswajit Saha	25L
2	Areas and lengths of curves in the plane, volumes and surfaces of solids of revolution. Double and Triple integrals.	Dr. Biswajit Saha	25L

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TEACHING PLAN FOR THE ACADEMIC SESSION 2022-23
EVEN SEMESTER

Semester-II

(As per syllabus effective from the academic session 2021-22)

Course Code	Course Title
B.Sc. Mathematics Hons.	
MATH-H-CC-T-03	Real Analysis
MATH-H-CC-T-04	Differential Equations
General Elective Course (B.Sc. Hons. other than Mathematics)	
MATH-H-GE-T-02	Calculus & Differential Equations
B.Sc. Programme/ General	
MATH-G-CC-T-02	Calculus & Differential Equations

Teaching Plan

B.Sc. Mathematics (Honours)
SEMESTER-II
Course: MATH-H-CC-T-03
Course title: Real Analysis
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75(Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● The natural numbers Peano's axioms. ● Review of algebraic and order properties of R . ● Bounded above sets, bounded below sets, bounded sets, unbounded sets. L.U.B. (supremum) and G.L.B. (infimum) of a set and its properties. L.U.B. axiom or order completeness of R . ● Idea of countable sets, uncountable sets and uncountability of . Countability of Q . ● The Archimedean property, density of rational (and irrational) numbers in R .	Dr. Biswajit Saha	17L
2	● Intervals, ε-neighbourhood of a point in R , interior points and open sets, limit points and closed sets, union and intersection of open and closed sets, isolated points, adherent point, derived set, closure of a set,	Dr. Biswajit Saha	18L

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	interior of a set. ● Illustrations of Bolzano-Weierstrass theorem for sets. Upper and lower limits of a subset of R ● Compact set in R basic properties of compact sets. Lindelöf covering theorem (statement only). Heine-Borel theorem and its application. Converse of Heine-Borel theorem.		
3	● Sequences, bounded sequence, convergent sequence, limit of a sequence, $\lim inf x_n$, $\lim sup x_n$. ● Limit theorems. Sandwich theorem. Nested interval theorem. ● Monotone sequences, monotone convergence theorem. ● Subsequences, divergence criteria. Monotone subsequence theorem (statement only). ● Bolzano Weierstrass theorem for sequences. ● Cauchy sequence, Cauchy's convergence criterion, Cauchy's 1st and 2nd limit theorems.	Dr. Biswajit Saha	20L
4	● Infinite series, convergence and divergence of infinite series, Cauchy criterion. ● Tests for convergence: comparison test, limit comparison test, ratio test: D'Alembert's ratio test, Raabe's test, Cauchy's root test, Gauss test (Statement only), integral test, Cauchy's condensation test with examples. ● Alternating series, Leibnitz test. Absolute and conditional convergence.	Dr. Biswajit Saha	15L
Graphical Demonstration (Teaching Aid)			
1. Plotting of recursive sequences. 2. Study the convergence of sequences through plotting. 3. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot. 4. Study the convergence/divergence of infinite series by plotting their sequences of partial sum. 5. Cauchy's root test by plotting nth roots. 6. Ratio test by plotting the ratio of nth and (n+1)th term.		Dr. Biswajit Saha	4L

B.Sc. Mathematics (Honours)
SEMESTER-II
Course: MATH-H-CC-T-04
Course title: Differential Equations

Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Differential equations and mathematical models. ● General, particular, explicit, implicit and singular solutions of a differential equation. ● Separable equations and equations reducible to this form.	Mr. Prabir Chakraborty	15L

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	● Exact differential equations and integrating factors. ● Linear equation and Bernoulli equations, special integrating factors and transformations. ● First order and higher degree differential equations, solvable for x, y and p , Clairaut's Equations general and singular solutions.		
2	● Lipschitz condition and Picard's Theorem (Statement only). ● General solution of homogeneous equation of second order, principle of superposition 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.	Mr. Prabir Chakraborty	15L
3	● 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.	Mr. Prabir Chakraborty	15L
4	● Equilibrium points. ● Interpretation of the phase plane. ● Power series solution of a differential equation about an ordinary point, solution about a regular singular point.	Mr. Prabir Chakraborty	10L
5	● Partial differential equations – Basic concepts and definitions. Mathematical problems. ● First- order equations: classification, construction and geometrical interpretation, Lagrange's method, Charpit's method. ● 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.	Mr. Prabir Chakraborty	15L
Graphical Demonstration (Teaching Aid)			
1. Plotting a family of curves which are solutions of second order differential equations. 2. Plotting a family of curves which are solutions of third order differential equations.		Mr. Prabir Chakraborty	5L

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B.Sc. Other than Mathematics (Honours)
SEMESTER-II
Course: MATH-H-GE-T-02
Course title: Calculus & Differential Equations
General Elective Course
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Real-valued functions defined on an interval, limit and Continuity of a function (using $\in -\delta$). Algebra of limits. Differentiability of a function. ● Successive derivative Leibnitz's theorem and its application to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$ ● Partial derivatives. Euler's theorem on homogeneous function of two and three variables. ● Indeterminate Forms L'Hospital's Rule (Statement and Problems only). ● Statement of Rolle's Theorem and its geometrical interpretation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's theorems with Lagrange's and Cauchy's forms of remainders. Taylor's and Maclaurin's infinite series of functions like $e^x, \sin x, \cos x, (1+x)^n, \log(1+x)$ with restrictions wherever necessary. ● Application of the principle of maxima and minima for a function of a single variable.	Mr. Prabir Chakraborty	35L
2	●Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx, \int \cos^n x\,dx, \int \tan^n x\,dx,$ $\int \sec^n x\,dx, \int (log\ x)^n dx, \int \sin^n x \cos^m x\,dx$	Mr. Prabir Chakraborty	15L
3	● First order equations: (i) Exact equations and those reducible to such equations. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations General and Singular solutions. ● Second order differential equation: (i) Method of variation of parameters, (ii) Method of undetermined coefficients.	Mr. Prabir Chakraborty	25L

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B.Sc. Mathematics (GENERAL)
SEMESTER-II
Course: MATH-G-CC-T-02
Course title: Calculus & Differential Equations
General Elective Course
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Real-valued functions defined on an interval, limit and Continuity of a function (using $\in -\delta$). Algebra of limits. Differentiability of a function. ● Successive derivative Leibnitz's theorem and its application to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$ ● Partial derivatives. Euler's theorem on homogeneous function of two and three variables. ● Indeterminate Forms L'Hospital's Rule (Statement and Problems only). ● Statement of Rolle's Theorem and its geometrical interpretation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's theorems with Lagrange's and Cauchy's forms of remainders. Taylor's and Maclaurin's infinite series of functions like $e^x, \sin x, \cos x, (1+x)^n, \log(1+x)$ with restrictions wherever necessary. ● Application of the principle of maxima and minima for a function of a single variable.	Mr. Prabir Chakraborty	35L
2	●Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx, \int \cos^n x\,dx, \int \tan^n x\,dx,$ $\int \sec^n x\,dx, \int (log\ x)^n dx, \int \sin^n x \cos^m x\,dx$	Mr. Prabir Chakraborty	15L
3	● First order equations: (i) Exact equations and those reducible to such equations. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations General and Singular solutions. ● Second order differential equation: (i) Method of variation of parameters, (ii) Method of undetermined coefficients.	Mr. Prabir Chakraborty	25L

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Semester-IV (2021-22 Batch)

(As per syllabus effective from the academic session 2021-22)

Course Code	Course Title
B.Sc. Mathematics Hons.	
MATH-H-CC-T-08	Ring Theory and Linear Algebra
MATH-H-CC-T-09	Multivariate Calculus& Tensor Analysis
MATH-H-CC-T-10	Linear Programming Problems & Game Theory
MATH-H-SEC-T-02	Graph Theory
General Elective Course (B.Sc. Hons. other than Mathematics)	
MATH-H-GE-T-04	Calculus & Differential Equation
B.Sc. Programme/ General	
MATH-G-CC-T-04	Linear Programming Problems & Game Theory
MATH-G-SEC-T-02	Graph Theory

Teaching Plan

B.Sc. Mathematics (Honours)
SEMESTER-IV
Course: MATH-H-CC-T-08
Course title: Riemann Integration and Series of Functions

Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Definition and examples of rings. Properties of rings. ● Subrings. ● Integral domains and fields. Characteristics of a ring. ● Ideal, ideal generated by a subset of a ring. ● Factor rings. ● Operations on ideals. ● Prime and maximal ideals.	Dr. Biswajit Saha	20L
2	● Ring homomorphisms, properties of ring homomorphisms. ● Isomorphism theorems I, II and III. ● Field of quotients.	Dr. Biswajit Saha	20L
3	● Concept of Vector space over a field: Examples, concepts of Linear combinations, linear dependence and independence of a finite number of vectors. ● Sub- space, concepts of generators and basis of a finite dimensional vector space. ● Replacement theorem. Extension theorem. Deletion theorem and their applications. ● Row space, column space. ● Euclidean Spaces. Orthogonal and orthonormal vectors. Gram-Schmidt	Dr. Biswajit Saha	20L

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	process of orthogonalization.		
4	● Linear transformations. Null space. Range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. ● Eigenvalues, eigen vectors and characteristic equation of a matrix. Matric polynomials, Cayley-Hamilton theorem and its use in finding the inverse of a matrix. ● Diagonalization, Canonical forms.	Dr. Biswajit Saha	15L

B.Sc. Mathematics (Honours)
SEMESTER-IV
Course: MATH-H-CC-T-09
Course title: Multivariate Calculus& Tensor Analysis

Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Functions of several variables, limit and continuity of functions of two or more variables. ● Differentiability and total differentiability. Partial differentiation. ● Sufficient condition for differentiability. Schwarz Theorems, Young's Theorems. ● Chain rule for one and two independent parameters. ● Homogeneous function and Euler's theorem on homogeneous functions and its converse. ● Jacobians and functional dependence. ● Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems.	Dr. Biswajit Saha	20L
2	● Double integration over a rectangular region. Double integration over non-rectangular regions. Double integrals in polar coordinates. ● Triple integrals. Triple integral over parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical coordinates. ● Change of variables in double integrals and triple integrals.	Dr. Biswajit Saha	15L
3	● Directional derivatives. The gradient, maximal and normal property of the gradient. ● Line integrals, applications of line integrals: Mass and work. Fundamental theorem for line integrals, conservative vector fields, independence of path. ● Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The divergence theorem. pplications of Green's, Stoke's and divergence theorems.	Dr. Biswajit Saha	15L
4	● A tensor as a generalized concept of a vector in E^2 and its generalization in E^n . Space of n –dimension. Transformation of coordinates. Summation convention. ● Definition of scalar or invariant. Contravariant, covariant vectors and tensors, mixed tensors of arbitrary order. Kronecker delta.	Dr. Biswajit Saha	25L

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	● Equality of tensors, addition, subtraction of two tensors. ● Outer product of tensors, contraction and inner product of tensors. ● Symmetric and skew symmetric tensors. ● Quotient law, reciprocal tensor of a tensor. ● Metric tensor, Christoffel symbol, covariant derivative.		

B.Sc. Mathematics (Honours)
SEMESTER-IV
Course: MATH-H-CC-T-10
Course title: Linear Programming Problems & Game Theory

Credit-6(4+2) (Theory + Practical)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Introduction to linear programming problems. Mathematical formulation of LPP. Graphical solution. ● Convex sets. Basic solutions (B.S.) and non-basic solutions. Reduction of B.F.S from B.S.	Mr. Prabir Chakraborty	10L
2	● Theory of simplex method. 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, economic interpretation of the dual.	Mr. Prabir Chakraborty	20L
3	● Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of initial basic solution. Algorithms for solving transportation problems. ● Assignment problem and its mathematical formulation, Hungarian method for solving assignment problems. ● Travelling Salesman Problems.	Mr. Prabir Chakraborty	25L
4	● Game theory: Formulation of two-person zero sum games. ● Solving two persons zero sum games. Games with mixed strategies. Graphical solution procedure. ● Solving game using simplex algorithm.	Mr. Prabir Chakraborty	20L

B.Sc. Mathematics (Honours)
SEMESTER-IV
Course: MATH-H-SEC-T-2B
Course title: Graph Theory

Skill Enhancement Course
Credit-2(Theory)
Full Marks-50 (Internal Assessment: 10 marks; Semester-end Exam: 40 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs isomorphism of graphs.	Mr. Prabir	8L

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		Chakraborty	
2	● Eulerian circuits, Eulerian graphs, semi-Eulerian graphs, Hamiltonian cycles. ● Representation of a graph by matrix, the adjacency matrix, incidence matrix, weighted graph.	Mr. Prabir Chakraborty	10L
3	● Travelling salesman's problem, shortest path, tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm.	Mr. Prabir Chakraborty	7L

B.Sc. Other than Mathematics (Honours)
SEMESTER-IV
Course: MATH-H-GE-T-04
Course title: Calculus & Differential Equation

General Elective Course
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Real-valued functions defined on an interval, limit and Continuity of a function (using $\in -\delta$). Algebra of limits. Differentiability of a function. ● Successive derivative Leibnitz's theorem and its application to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$ ● Partial derivatives. Euler's theorem on homogeneous function of two and three variables. ● Indeterminate Forms L'Hospital's Rule (Statement and Problems only). ● Statement of Rolle's Theorem and its geometrical interpretation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's theorems with Lagrange's and Cauchy's forms of remainders. Taylor's and Maclaurin's infinite series of functions like $e^x, \sin x, \cos x, (1+x)^n, \log(1+x)$ with restrictions wherever necessary. ● Application of the principle of maxima and minima for a function of a single variable.	Dr. Biswajit Saha	35L
2	●Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx, \int \cos^n x\,dx, \int \tan^n x\,dx,$ $\int \sec^n x\,dx, \int (log\ x)^n dx, \int \sin^n x \cos^m x\,dx$	Dr. Biswajit Saha	15L
3	● First order equations: (i) Exact equations and those reducible to such equations. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations General and Singular solutions. ● Second order differential equation: (i) Method of variation of parameters, (ii) Method of undetermined coefficients.	Dr. Biswajit Saha	25L

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Government General Degree College Nakashipara
Department of Mathematics
MURAGACHHA, NADIA, PIN- 741154
Phone No.: 03474-268008 web: www.muragachhagovtcollege.org e-mail: mgcnadia2015@gmail.com

Ref. No..... Date .....

B.Sc. Mathematics (GENERAL)
SEMESTER-IV
Course: MATH-G-CC-T-04
Course title: Linear Programming Problems & Game Theory

Credit-6(5+1) (Theory + Tutorial);
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Introduction to linear programming problems. Mathematical formulation of LPP. Graphical solution. ● Convex sets. Basic solutions (B.S.) and non-basic solutions. Reduction of B.F.S from B.S.	Mr. Prabir Chakraborty	10L
2	● Theory of simplex method. 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, economic interpretation of the dual.	Mr. Prabir Chakraborty	20L
3	● Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of initial basic solution. Algorithms for solving transportation problems. ● Assignment problem and its mathematical formulation, Hungarian method for solving assignment problems. ● Travelling Salesman Problems.	Mr. Prabir Chakraborty	25L
4	● Game theory: Formulation of two-person zero sum games. ● Solving two persons zero sum games. Games with mixed strategies. Graphical solution procedure. ● Solving game using simplex algorithm.	Mr. Prabir Chakraborty	20L

B.Sc. Mathematics (GENERAL)
SEMESTER-IV
Course: MATH-G-SEC-T-2A
Course title: Graph Theory

Skill Enhancement Course Credit-2 (Theory)
Full Marks-50 (Internal Assessment: 10 marks; Semester-end Exam: 40 marks)

Unit	Topic	Teacher	No. of Lectures
1	● Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs isomorphism of graphs.	Mr. Prabir Chakraborty	8L
2	● Eulerian circuits, Eulerian graphs, semi-Eulerian graphs, Hamiltonian cycles. ● Representation of a graph by matrix, the adjacency matrix, incidence matrix, weighted graph.	Mr. Prabir Chakraborty	10L
3	● Travelling salesman's problem, shortest path, tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm.	Mr. Prabir Chakraborty	7L

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Semester-VI (2020-21 Batch)

(As per syllabus effective from the academic session 2018-19)

Course Code	Course Title
B.Sc. Mathematics Hons.	
MATH-H-CC-T-13	Metric Spaces and Complex Analysis
MATH-H-CC-T-14	Ring Theory and Linear Algebra II
MATH-H-DSE-T-03	Number Theory
MATH-H-DSE-T-04	Mechanics
B.Sc. Programme/ General	
MATH-G-DSE-T-02	Linear Programming
MATH-G-SEC-T-04	Probability and Statistics

Teaching Plan

B.Sc. Mathematics (Honours)
SEMESTER-VI
Course: MATH-H-CC-T-13
Course title: Metric Spaces and Complex Analysis
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	Metric spaces: sequences in metric spaces, Cauchy sequences. Complete metric spaces, Cantor's theorem.	Dr. Biswajit Saha	15L
2	Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Compactness and connectedness in metric spaceses. Compactness: Sequential compactness, Heine-Borel property, totally bounded spaces, finite intersection property, and continuous functions on compact sets. Homeomorphism..	Dr. Biswajit Saha	20L
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.	Dr. Biswajit Saha	20L
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.	Dr. Biswajit Saha	20L

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B.Sc. Mathematics (Honours)
SEMESTER-VI
Course: MATH-H-CC-T-14
Course title: Ring Theory and Linear Algebra II

Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	Ring homomorphisms, properties of ring homomorphisms. Isomorphism theorems I, II and III, field of quotients. 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].	Dr. Biswajit Saha	25L
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.	Dr. Biswajit Saha	20L
3	Diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms, Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements.	Dr. Biswajit Saha	30L

B.Sc. Mathematics (Honours)
SEMESTER-VI
Course: MATH-H-DSE-T-3B
Course title: Number Theory

Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
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.	Dr. Biswajit Saha	30L
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 residues, some properties of Euler's phi-function.	Dr. Biswajit Saha	25L
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	Dr. Biswajit Saha	20L

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	composite moduli. Public key encryption, RSA encryption and decryption, the equation x2 + y2= z2, Fermat's Last theorem. (statement)		

B.Sc. Mathematics (Honours)
SEMESTER-VI
Course: MATH-H-DSE-T-4A
Course title: Mechanics
Department Specific Elective Course
Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	Co-planar forces. Astatic equilibrium. Friction. Equilibrium of a particle on a rough curve. Virtual work.. Forces in three dimensions. General conditions of equilibrium. Centre of gravity for different bodies. Stable and unstable equilibrium.	Mr. Prabir Chakraborty	25L
2	Central force. Constrained motion, varying mass, tangent and normal components of acceleration, modelling ballistics and planetary motion, Kepler's second law.	Mr. Prabir Chakraborty	10L
3	Equations of motion referred to a set of rotating axes. Motion of a projectile in a resisting medium. Stability of nearly circular orbits. Motion under the inverse square law.Slightly disturbed orbits. Motion of artificial satellites. Motion of a particle in three dimensions. Motion on a smooth sphere, cone, and on any surface of revolution.	Mr. Prabir Chakraborty	20L
4	Degrees of freedom. Moments and products of inertia. Momental Ellipsoid. Principal axes. D'Alembert's Principle. Motion about a fixed axis. Compound pendulum. Motion of a rigid body in two dimensions under finite and impulsive forces. Conservation of momentum and energy.	Mr. Prabir Chakraborty	20L

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B.Sc. Mathematics (GENERAL)
SEMESTER-VI
Course: MATH-G-DSE-T-2A
Course title: Linear Programming

Discipline specific Elective Course; Credit-6(5+1) (Theory + Tutorial)
Full Marks-75 (Internal Assessment: 15 marks; Semester-end Exam: 60 marks)

Unit	Topic	Teacher	No. of Lectures
1	Introduction to linear programming problems. 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.	Mr. Prabir Chakraborty	20L
2	Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual.	Mr. Prabir Chakraborty	20L
3	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.	Mr. Prabir Chakraborty	20L
4	Game theory: formulation of two-person zero sum games, solving two-person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.	Mr. Prabir Chakraborty	10L

B.Sc. Mathematics (GENERAL)
SEMESTER-VI
Course: MATH-G-SEC-T-4A
Course title: Probability and Statistics

Skill Enhancement course
Credit-2 (Theory)
Full Marks-50 (Internal Assessment: 10 marks; Semester-end Exam: 40 marks)

Unit	Topic	Teacher	No. of Lectures
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, continuous distributions: uniform, normal, exponential.	Dr. Biswajit Saha	25L
2	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.	Dr. Biswajit Saha	25L

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