Government General Degree College Chapra

Department of Mathematics

PO and CO (NEP)

First Semester

Programme Outcome:

On successful completion of the B.Sc. Mathematics Major/Minor/MDC 1st Semester, students will be able to:

1. Demonstrate comprehensive knowledge of foundational and advanced topics in mathematics, including set theory, algebra, calculus, real and complex analysis.

2. Develop strong analytical and logical reasoning skills to solve complex mathematical problems, including those involving the use of De Moivre's theorem, group theory, matrix operations.

3. Apply mathematical concepts and tools to model and analyze real-world problems in various fields such as physics, economics, computer science, and engineering.

4. Understand and apply abstract mathematical structures, including groups, permutations, equivalence relations, and functions, fostering a deeper theoretical understanding of modern mathematics.

5. Perform statistical analysis and data interpretation using measures of central tendency, dispersion, skewness, and kurtosis, and create graphical representations of data for effective communication.

6. Communicate mathematical ideas effectively through written, verbal, and visual means, demonstrating clarity and coherence in logical argumentation and proof-writing.

7. Pursue advanced studies or research in mathematics or related disciplines and apply their knowledge to academic, industrial, or governmental roles requiring mathematical expertise.

Course Outcome:

Course code & title	Syllabus	Course Outcome
MATH-M-T-01: Calculus & Analytical Geometry	**Unit 1. [25L]** Hyperbolic functions and its derivative, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)\sin x$, $(ax+b)^n\cos x$. Pedal equations. Curvature, radius of curvature, centre of curvature, circle of curvature Asymptotes Envelopes. 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 sciences. **Unit 2. [16L]** 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. **Unit 3. [30L]** Transformation of coordinate axes, pair of straight line, reflection properties of conics, rotation of axes and 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.	After successfully completing this course, a student will be able to: **CO1**: Understand and apply derivatives of hyperbolic and trigonometric functions, including higher-order derivatives using Leibniz's rule, in problems involving exponential and trigonometric combinations. **CO2**: Derive and apply pedal equations, curvature, radius/centre/circle of curvature, and understand the geometrical behavior of curves through tracing techniques in Cartesian and polar coordinates. **CO3**: Analyze the nature of curves using concepts like asymptotes, envelopes, singular points, concavity, and inflection points. **CO4**: Apply L'Hospital's Rule in evaluating limits and understand its relevance in real-world applications such as economics, business, and life sciences. **CO5**: Derive and utilize reduction formulae for evaluating integrals involving trigonometric and logarithmic functions. **CO6**: Compute arc length, surface area, and volume of revolution using parametric forms and sketch standard parametric curves and conics. **CO7:** Understand and apply coordinate transformations, classification of conics using discriminants, and analyze

	Graphical Demonstration (Teaching Aid) [4L] 1. Plotting of graphs of function e^{ax+b}, $\log(ax+b)$, $1/(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $\lvert ax+b\rvert$ 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 (Eg. 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.	three-dimensional surfaces like spheres, cones, and quadrics. **CO8**: Develop graphical intuition by plotting and comparing functions and surfaces using various parameters and coordinate systems.
MATH-SEC-T-01: Logic & Boolean Algebra	**Unit 1. [15L]** Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contrapositive and inverse propositions and precedence of logical operators. Propositional equivalence, Logical equivalences. Predicates and quantifiers: Introduction, quantifiers, binding variables and negations. **Unit 2. [10L]** • Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle. • Lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms.	After successfully completing this course, a student will be able to: **CO1**: Understand propositions, truth tables, and logical connectives including implications, biconditionals, and their related forms such as converse and contrapositive. **CO2**: Analyze and simplify logical expressions using propositional and logical equivalences. **CO3**: Use predicates and quantifiers effectively in formal logical statements, including their negation and binding. **CO4**: Understand the structure and properties of ordered sets

	Unit-3 [20L] • Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal and maximal forms of Boolean polynomials. • Quinn-McCluskey method, Karnaugh diagrams, logic gates, switching circuits and applications of switching circuits.	and their mappings, and apply the duality principle. **CO5**: Define lattices, identify sublattices, and understand product lattices and homomorphisms. **CO6**: Differentiate between modular and distributive lattices and understand the structure and function of Boolean algebras. **CO7**: Represent and simplify Boolean expressions using Boolean polynomials, Karnaugh maps, and the Quinn-McCluskey method. **CO8**: Design and analyze logic gates and switching circuits, and understand their applications in digital systems.
MATH-MI-T-01: Algebra & Analytical Geometry	**Unit 1. [20L]** Complex Numbers: 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's 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 the sweep-out process. Consistency and solution of a system of linear equations (not more than 3 variables) by matrix method. Equivalence relations and partitions. Functions, composition of functions, invertible functions,	After successful completion of the course, a student will be able to: **CO1**: Apply De Moivre's theorem and understand exponential, trigonometric, and logarithmic forms of complex numbers, including inverse functions. **CO2**: Analyze polynomials, apply Descartes's Rule of Signs, understand the nature of roots, and solve cubic equations using Cardan's method. **CO3**: Determine the rank of matrices and solve systems of linear equations using matrix methods, ensuring consistency and interpretation of solutions. **CO4**: Understand equivalence relations, partitions, and

	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. **Unit 2. [30L]** 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. Equation of chord joining two points. Equations of tangents and normals. Sphere and its tangent planes. Right circular cone.	function types, including one-to-one correspondences and cardinality. **CO5**: Define and explore group structures, identify subgroups, and analyze group properties including permutations and finite groups like S_3, V_4, and Z_n. **CO6**: Perform transformations of rectangular axes and use them to reduce general second-degree equations to canonical forms. **CO7**: Classify and analyze conics and pairs of straight lines through algebraic conditions, bisectors, angles, and point intersections. **CO8**: Use polar coordinates for conics and straight lines, derive equations of tangents, normals, and chords, and explore 3D figures like spheres and cones.
MATH-MD-T-01 **Basic Mathematics**	**Unit 1. Set Theory: [5L]** • Introduction to sets and their representations. The empty set, finite and infinite sets, equal sets, subsets, power set, and Universal set. • Venn Diagrams, operations on sets, complement of a set, problems on union and intersection of sets. **Unit 2. Complex Numbers: [5L]**	After completing this course, the student will be able to: **CO1**: Understand the concept of sets, perform set operations using Venn diagrams, and solve problems involving union, intersection, and complement. **CO2**: Represent complex numbers in polar form and

	• Polar representation of complex numbers. • De Moivre's theorem (without proof) for rational indices and their applications. **Unit 3. Theory of Equations: [10L]** • Introduction and definition of equation. Types of equations. • Relation between roots and coefficients. Descartes's rule of signs. • Linear and quadratic equations and their solution. Nature of the roots of quadratic equations. **Unit 4. Matrix & Determinant: [10L]** • Definition of a Matrix. Types of Matrices. Elementary operations on Matrices. • Determinant of a square matrix (up to third order). Properties of determinants. Cofactors and minor of a determinant. • Transpose and Adjoint of a matrix. Symmetric and Skew Symmetric Matrices. • Inverse of a matrix. Solution of system of linear equations (up to third order) using matrix inversion method and Cramer's Rule. **Unit 5. [5L]** • Definition and scope of statistics, concepts of statistical population and sample. • Data: qualitative and quantitative, discrete and continuous data types, primary and secondary data. • Presentation of data: tabular and graphical. • Frequency distribution, cumulative frequency distribution and their graphical representations: histogram, frequency polygon, frequency curve, and O-gives.	apply De Moivre's Theorem to compute powers and roots. **CO3**: Identify and solve linear and quadratic equations; apply Descartes's Rule of Signs and use root-coefficient relationships. **CO4**: Understand the structure and types of matrices, compute determinants, and solve systems of equations using inverse and Cramer's Rule. **CO5**: Grasp the basic concepts of statistics, differentiate between types of data, and represent data effectively using tables and graphs. **CO6**: Calculate and interpret measures of central tendency and dispersion, and assess data distribution using skewness and kurtosis.

	Unit 6. [10L] • Measures of Central Tendency: mean, weighted mean, median, mode. • Measures of Dispersion: range, mean deviation, standard deviation, coefficient of variation, moments, skewness and kurtosis.	