Government General Degree College, Chapra

Department of Mathematics

B.Sc. (General) with mathematics	
Programme outcomes	Construct and elaborate various mathematical arguments in a logical manner. Further, when information is needed, the student will be able to identify, evaluate, locate and effectively use that knowledge for handling issues or solving problems at hand. Achieve good understanding and knowledge in advanced areas of mathematics and its applications. More specifically- 1. Enabling students to develop a very positive attitude towards mathematics as a precious and attractive subject of study. 2. A student should acquire a relational knowledge of mathematical concepts and concerned structures, and should be able to chase the patterns involved, mathematical reasoning. 3. Having enough concepts to analyze a problem, identify and define the computing requirements, which may be adequate to its solution. 4. Introduction to various courses like group theory, ring theory, field theory, Real Analysis, Complex Analysis, metric spaces and number theory. 5. Enhancing students' overall development and to equip them with mathematical modelling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment. 6. Having enough knowledge to pursue advanced studies and research in pure and applied mathematical science.
	Students will be able to implement their knowledgeable thinking skills to analyze problems that can be modeled mathematically, to critically interpret numerical and graphical data, to understand and construct mathematical arguments and proofs, to use computer technology appropriately to solve problems and to promote understanding, to apply mathematical knowledge to a career related to mathematical sciences thus cultivating a proper attitude for higher learning in mathematics. Students will be able to 1. Think in a critical manner. 2. Know when the information is needed, to be able to identify, locate, evaluate, and effectively use that information for the issue or problem at hand. 3. Formulate and develop mathematical arguments in a logical manner. 4. Acquire good knowledge and understanding in advanced areas of mathematics and statistics, chosen by the student from the given courses. 5. Understand, formulate and use quantitative models arising in social science, business and other contexts.

Class/Paper/Semester	Title	Course Outcome (CO)
Mathematics UG (CBCS) Semester-I		
Mathematics-UG Paper-MATH-G-CC-T-01 (Theory) Sem-I	Algebra& Analytical Geometry	**Upon completion of the course, students will be able to learn the concept of Algebra like as:** • Complex umbers De Moivre's theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Inverse circular and hyperbolic functions. • Polynomials: Fundamental theorem of algebra (Statement only). Polynomials with real coefficients. Statement of Descartes rule of signs and its applications. Relation between roots and coefficients, transformations of equations. Cardan's method. • Rank of a matrix. System of linear equations with not more than 3 variables. • Equivalence relations and partitions. Functions and cardinality of a set. • Elementary group Theory. Some important finite • Groups: S_3 V_3 and $\mathbf{Z}_n$. Order of an element, order of a group, Subgroups. **Upon completion of the course, students will be able to learn the concept of Analytical Geometry as like:** • Transformations of rectangular axes. Invariants. • General equation of second degree, Canonical forms. • Classification of conics. • Pair of straight lines. 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, circles, a conic refers to a focus as a pole, chord joining two points, tangents and normals.
Mathematics UG (CBCS) Semester-II		
Mathematics-UG Paper- MATH-G-CC-T-02 (Theory) Sem-II	Calculus & Differential Equations	**Upon completion of the course, students will be able to learn the concept of Calculus like as:** • Real-valued functions defined on an interval, limit and Continuity of a function (using $\varepsilon-\delta$). Algebra of limits. Differentiability of a function. Successive derivative Leibnitz's theorem and its applications. Partial derivatives. Euler's theorem. 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. • Application of the principle of maxima and minima for a function of a single variable. • Reduction formulae, derivations and illustrations of reduction formulae. **Upon completion of the course, students will be able to learn the concept of Differential Equations like as:** • 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.
Mathematics UG (CBCS) Semester-III		
Mathematics-UG Paper- MATH-G-CC-T-03 (Theory) Sem-III	Real Analysis	**Upon completion of the course, students will be able to learn the concept of Real Analysis like as:** • 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 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). • 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). • Infinite series, Convergence and divergence of infinite series, Cauchy's criterion. 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).
Mathematics-UG Paper-MATH-G-SEC-T-1A (Theory) Sem-III	Logic & Sets	**Upon completion of the course, students will be able to learn the concept of Logic like as:** • 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. **Upon completion of the course, students will be able to learn the concept of Sets like as:** • 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. • 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.
Mathematics-UG Paper-MATH-G-SEC-T-1B (Theory) Sem-III	Vector Calculus	**Upon completion of the course, students will be able to learn the concept of Vector Calculus like as:** • Differentiation and partial differentiation of a vector function. Derivative of sum, dot product and cross product of two vectors. Gradient, divergence and curl with applications. • Vector integration: Line, surface and volume integrals. Green's theorem (statement only), surface integrals, integrals over parametrically defined surfaces. Stoke's theorem (statement only), divergence theorem (statement only). Applications of Green's, Stoke's and divergence theorems.
Mathematics UG (CBCS) Semester-IV		
Mathematics-UG Paper- MATH-G-CC-T-04 (Theory) Sem-IV	Linear Programming Problems & Game Theory	**Upon completion of the course, students will be able to learn the concept of Vector Calculus like as:** • Introduction to linear programming problems, Graphical solution of LPP. Convex sets. Basic solutions and non-basic solutions. Reduction of B.F.S from B.S. • Simplex method, two-phase method, Big-M-method and their comparison. 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's approximation method for determination of initial basic solution. Algorithms for solving transportation problems. Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem. **Upon completion of the course, students will be able to learn the concept of Game Theory like as:** • Game theory: formulation of two-person zero sum games. Solving two-person zero sum games. Games with mixed strategies. Graphical solution procedure. Solving game Using Simplex Algorithm.
Mathematics-UG Paper-MATH-G-SEC-T-2A (Theory) Sem-IV	Graph Theory	**Upon completion of the course, students will be able to learn the concept of Game Theory like as:** • Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs isomorphism of graphs. • Eulerian circuits, Eulerian graphs, semi-Eulerian graphs, Hamiltonian cycles. Representation of a graph by matrix, the adjacency matrix, incidence matrix, weighted graph. • Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm.
Mathematics-UG Paper-MATH-G-SEC-T-2B (Theory) Sem-IV	Operating System (Linux)	**Upon completion of the course, students will be able to learn the concept of Operating System (Linux) like as:** • Linux – The operating system: Linux history, Linux features, Linux distributions, Linux's relationship to Unix, overview of Linux architecture, installation, startup scripts, system processes (an overview), Linux security. • The Ext2 and Ext3 file systems: General characteristics of the Ext3 file system, file permissions. User management: types of users, the powers of root, managing users (adding and deleting): using the command line and GUI tools. • Resource management in Linux: file and directory management, system calls for files process Management, signals, IPC: Pipes, FIFOs, System V IPC, message queues, system calls for processes, memory management, library and system calls for memory.

Mathematics UG (CBCS) Semester-V		
Mathematics-UG Paper- MATH-G-DSE-T-1A (Theory) Sem-V	Group Theory & Linear Algebra	**Upon completion of the course, students will be able to learn the concept of Group Theory like as:** • Definition and examples of groups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of a group, examples of subgroups including the center of a group. Cosets, Index of subgroups, Lagrange's theorem, order of an element. Normal subgroups, their definition, examples, and characterizations, Quotient groups. **Upon completion of the course, students will be able to learn the concept of Linear Algebra like as:** • Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. • Characteristic Polynomial, Eigen values and Eigenvectors. Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Dual Space, Dual Basis, Change of basis. Matrices in diagonal form. Reduction to diagonal form up to matrices of order 3.
Mathematics-UG Paper- MATH-G-DSE-T-1B (Theory) Sem-V	Complex Analysis	**Upon completion of the course, students will be able to learn the concept of Complex Analysis like as:** • Regions in the complex plane, functions of complex variables, limits, limit involving the point at infinity, continuity. • Derivatives of functions, analytic functions, examples of analytic functions, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. • Definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy-Goursat theorem (Statement only), Cauchy integral formula and applications. • Liouville's theorem and the fundamental theorem of algebra. • Convergence of sequences and series. Absolute and uniform convergence of power series. Taylor series and its examples.
Mathematics-UG Paper-MATH-G-SEC-T-3A (Theory)	Theory of Probability	**Upon completion of the course, students will be able to learn the concept of Theory of Probability like as:** • Sample space, probability axioms, real random

Sem-V		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. • 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.
Mathematics-UG Paper-MATH-G-SEC-T-3B (Theory) Sem-V	Boolean Algebra	**Upon completion of the course, students will be able to learn the concept of Boolean Algebra like as:** • Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements. Lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. • Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials. Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.
Mathematics UG (CBCS) Semester-VI		
Mathematics-UG Paper- MATH-G-DSE-T-2A (Theory) Sem-VI	Dynamics of a Particle	**Upon completion of the course, students will be able to learn the concept of Dynamics of a Particle like as:** • Motion in a straight line, motion under attractive and repulsive forces, motion under acceleration due to gravity. • Simple Harmonic Motion, Horizontal Oscillation, Composition of two S.H.M.'s, damped harmonic motion, forced oscillation, damped forced oscillation. • Motion in a resisting medium: Vertical and curvilinear motion in a resisting medium. Motion of varying mass: Equations of motion. • Work, Power and Energy: Definitions. Work done in stretching an elastic string. Conservative forces. Conservation of energy. Impulse and impulsive forces: Impulse of a force. Impulsive forces. Conservation of linear momentum. • Collision of elastic bodies: Elasticity. Impact of smooth bodies. Impact on a fixed plane. Direct and oblique impact of two smooth

		spheres. Loss of kinetic energy. Angle of deflection. • Motion in a Plane: Velocity and acceleration of a particle moving on a plane in Cartesian and polar coordinates. Motion of a particle moving on a plane refers to a set of rotating rectangular axes. Angular velocity and acceleration. Circular motion. Tangential and normal accelerations. • Central orbit: Characteristics of central orbits. Areal velocity. Law of force for elliptic, parabolic and hyperbolic orbits. Velocity under central forces. Orbit under radial and transverse accelerations. Stability of nearly circular orbits. • Planetary motion: Newtonian law. Orbit under inverse square law. Kepler's laws of planetary motion. Time of description of an arc of an elliptic, Parabolic and hyperbolic orbit. Effect of disturbing forces on the orbit. Artificial Satellites: orbit round the earth. Parking orbits. Escape velocity.
Mathematics-UG Paper- MATH-G-DSE-T-2B (Theory) Sem-VI	Numerical Methods	**Upon completion of the course, students will be able to learn the concept of Numerical Methods like as:** • Errors, relative, absolute, round-off, truncation errors. Interpolation, Lagrange and Newton's methods. Finite difference operators. Gregory forward and backward difference interpolation. Numerical differentiation, Methods based on interpolations, methods based on finite differences. • Numerical Integration, Newton Cotes formula, Trapezoidal rule, Simpson's 1/3rd rule, composite trapezoidal rule, composite Simpson's 1/3rd rule. • Transcendental and polynomial equations, Bisection 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. • The method of successive approximations, Euler's method, the modified Euler method, Runge-Kutta method of order two.
Mathematics-UG Paper-MATH-G-SEC-T-4A (Theory) Sem-VI	Programming in 'C'	**Upon completion of the course, students will be able to learn the concept of Programming in 'C' like as:** • 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. • Programming language and importance of C programming. Constants, Variables and Datatype 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. 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. • Programming in 'C' a) Calculate the area of a triangle. b) Solution of quadratic equation. c) Sum of n numbers. d) A.M. and G.M. of n numbers. e) Find the magnitude of a Vector. f) Arrange the numbers in ascending and descending orders. g) Addition and Subtraction of two matrices. h) Multiplication of two matrices.
Mathematics-UG Paper-MATH-G-SEC-T-4A (Theory) Sem-VI	Programming in Python	**Upon completion of the course, students will be able to learn the concept of Programming in Python like as:** • 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.

		• Overview of Programming: Structure of a Python Program, Elements of Python. Introduction to Python: Python Interpreter, Using Python as calculator, Python shell, Indentation. Atoms, Identifiers and keywords, Literals, Strings, Operators (Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator, Increment or Decrement operator). • Creating Python Programs: Input and Output Statements, Control statements (Branching, Looping, Conditional Statement, Exit function, Difference between break, continue and pass.), Defining Functions, default arguments.