Bhairab Ganguly College

Mathematics Program Outcomes

Students will be able to:

PO 1 define arithmetic, algebraic, geometric, spatial, and statistical concepts

1. **calculate** arithmetic, algebraic, geometric, spatial, and statistical quantities *using appropriate technology*.
2. **estimate** arithmetic, algebraic, geometric, spatial, and statistical solutions
3. **solve** arithmetic, algebraic, geometric, spatial, and statistical expressions, equations, functions, and problems *using appropriate technology*.
4. **represent** mathematical information numerically, symbolically, graphically, verbally, and visually *using appropriate technology*.
5. **develop** mathematical and statistical models such as formulas, functions, graphs, tables, and schematics *using appropriate technology*.
6. **interpret** mathematical and statistical models such as formulas, functions, graphs, tables, and schematics, drawing conclusions and making inferences based on those models.
7. **explore** mathematical systems *utilizing rich experiences that encourage independent, nontrivial, constructive exploration in mathematics*.
8. **communicate** mathematical thoughts and ideas clearly and concisely to others in the oral and written form.

MathematicsHonours COURSE Outcomes

SEM1	Course	Course Outcomes
	Calculus, Geometry and ordinary differential equations	After successful completion of the courses students will acquire knowledge of 1. 1 Leibnitz's rule and higher order derivatives 2. Concept of 2 dimensional and 3 dimensional geometry 3. Reduction formula for integration 4. 4.Find out area of surface of revolution 5. 5, Trace of a Curve 6. 6. Identify types of differential equations and solve differential equations such as Exact, homogeneous,
	Algebra	After successful completion of the courses students will acquire knowledge of 1. Algebra of complex numbers

		2. Solve problems on inequality 3. Solve algebraic equations by using Cardan's method and Ferrari,s method 4. Relations and mappings and congruence relation 5. Theory of integers 6. Matrix algebra and eigen vectors , eigen values 7. Solution of system of linear equations
SEM II	Real Analysis	Upon successful completion of the course, 1. Students can identify algebraic and order properties of real numbers 2. Students will get the knowledge ofconvergence and divergence of Sequence and Series of real numbers
	Differential Equation and Vector Calculus	After completing the course, students will able to solve 1. Linear homogeneous and non-homogeneous equations of higher order differential equations with constant coefficients, 2. Euler's equation, 3. In method of undetermined coefficients, method of variation of parameters. 4. System of linear differential equations by operator method 5. Can convert linear systems in normal form having two equations in two unknown functions. 6. Get idea about equilibrium points, phase plane, 7. Power series solution of a differential equation 8. Acquire knowledge in vector calculus
SEMIII	Theory of Real functions	Upon successful completion of the course, students will able to 1.Find limits of real valued functions (ε - δ approach) 2. Idea of properties of continuous functions and uniform continuity 3.get idea of differentiability, Rolle's theorem, Mean value theorem, 4. expand a function in Taylor Series and Maclaurin's series
	Group Theory–I	After completing the course, students will able to learn 1. definition and examples of groups including permutation groups, Symmetries of a square, Dihedral groups, 2. Idea of subgroups and cyclic subgroups 3. Lagrange's Theorem , Farmat's little theorem 4. External direct product of a finite number of groups, normal subgroups, factor groups, 5. Group homomorphisms, Cayley's theorem, properties of isomorphisms,

	Numerical Methods	After taking this course, the student should be able to 1.solve transcendental and polynomial equations by using bisection method, Newton's method, Secant method, Regulafalsi method, fixed point iteration, Newton-Raphson method. 2. get an idea of interpolation: Lagrange and Newton's methods, 3. Numerical Integration: Newton Cotes formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpsons 3/8th and differentiation 4.solve ordinary differential equations: The method of successive approximations, Euler's method, Runge-Kutta methods of orders two and four.
	Numerical Methods Lab	After taking this course, the student should be able to Solve different problems of Numerical by using C programming.
	C-Programming Language (SEC 01M)	On completion of the course, students are able to: 1. Understand what is Computer and Basic concepts of computer. 2. Prepare Algorithm and Flowchart of Program. 3. declaration of data type ,printf(),scanf(), compilation etc. 4. Understand operators, expressions and preprocessors. 5. Understand arrays , it's declaration and uses. 6. use of if-else statement, for loop, while loop and do-while loop; controlling loop execution: break and continue, nested loop 7. use of one dimensional array to finding maximum,minimum, simple sorting and searching. 8. use of multi-dimensional arrays memory allocation and deallocation: *malloc()* and *free()* functions 9. use of Functions, Pointers, arrays as function parameters, *return* statement, Header files and their role. 10. Illustrate different examples like swapping values, compute n!, nCr, find max/minfrom a list of elements, sort a set of numbers, matrix addition/multiplication etc
SEM IV	**Riemann Integration and Series of Functions**	Upon successful completion of the course, 1. Students will be able to demonstrate knowledge and understanding of compact sets and its implications for continuous functions. 2. Students will be acquainted to concept of Riemann integrability of a bounded function on a closed & bounded interval and learn important results concerning Riemann integration. 3. Students will get acquainted with different types of improper integrals and study their convergence. 4. Students will able to recognize the difference between point-wise and uniform convergence of sequence and series of functions. 5. Students will be able to illustrate the effect of uniform convergence on the limit function and sum function

		with respect to continuity, integrability and differentiability. 6. Students will be familiar with concepts of power series, radius of convergence and illustrate properties and convergence of power series. 7. Students will get working knowledge of Fourier series, Half-range series.
	Multivariate Calculus	After completing this course 1. Students develop knowledge in the limit, continuity, differentiation of vector functions. 2. students learn the concepts of multiple integrals and their Application to area and volumes
	Ring Theory and Linear Algebra I	Upon successful completion of the course , the students will demonstrate knowledge of 1.Rings, subrings, integral domains and fields, Ideal, ideal generated by a subset of a ring, factor rings, prime and maximal ideals. 2.Ring homomorphisms, Isomorphism theorems **3.** Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. 4.linear transformations, Subspaces, dimension of subspaces, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, 5. Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix
	Logic and Sets(SEC 02M)	After completion students will be able to 1. Simplify and evaluate basic logic statements including compound statements, implications, inverses, converses, and contrapositives using truth tables and the properties of logic. 2.Express a logic sentence in terms of predicates, quantifiers, and logical connectives 3. concept of sets and operations, subsets, Set operations and the laws of set theory and Venn diagrams. 4.concept of Relation as Product set. Composition of relations, Types of relations, Partitions 5. acquire knowledge of equivalence relations with example of congruence modulo relation. Partial ordering relations, n- ary relations.
SEM V	**Partial Differential Equations, Applications of Ordinary Differential**	Upon successful completion of the course,students acquire knowledge of 1.Partial Differential Equations, Mathematical Problems First- Order, 2.Method of Separation of Variables for solving first order partial differential equations.

	Equations	3.Heat equation, Wave equation and Laplace equation. 4.Classification of second order linear equations as hyperbolic, parabolic or elliptic. 5.Reduction of second order Linear Equations to canonical forms 6.The Cauchy problem, Cauchy-Kowalewskaya theorem, Non-Homogeneous Wave Equation. Method of separation of variables, Solving the Vibrating String Problem. Solving the Heat Conduction problem 7.As applications of ordinary differential equations students understand central force, constrained motion, varying mass, tangent and normal components of acceleration, modelling ballistics and planetary motion, Kepler's second law.
	Group Theory II	Upon successful completion of the course , the students will demonstrate knowledge of 1.Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups 2.Properties of external direct products, the group of units modulo n as an external direct product, 3. Group actions, stabilizers and kernels, permutation representation associated with a given group action. 4. class equation and consequences, conjugacy in Sn, p-groups, Sylow's theorems and consequences, Cauchy's theorem.
	Linear Programming DSE 01 T	After completion of the course students 1.get idea of L.P.P and eligible to solve by using simplex method, graphical solution, 2. can define convex sets,optimality and unboundedness, 3.can solve by using two-phase method. Big-M method . 4. can formulate dual problem, and use duality method. 5.able to solve Transportation problem by using northwest-corner method, least cost method and Vogel approximation method 6.acquire knowledge about assignment problem and solve by Hungarian method 5. Describe the basic terminology concerning game theory . 6. solve simple two person zero sum games, 7. apply graphical solution procedure and linear programming solution of games.
	Probability and Statics (DSE 03 T)	1.Able to understand the basic knowledge on fundamental probability concepts, including random variable, probability of an event, additive rules and conditional 2 Able to understand the concept of Bayes' theorem

		3. Able to understand several well-known distributions, including Binomial, Geometrical, Negative Binomial, Pascal, Normal and Exponential Distribution 4.Able to apply the central limit theorem to sampling distribution 5.Can understand Joint cumulative distribution function and its properties, joint probability density functions, 6. Able to understand the concepts of various parameter estimation methods, like method of moments, maximum likelihood estimation and confidence intervals
SEM VI	Metric Spaces and Complex Analysis	Upon successful completion of the course , the students will demonstrate knowledge of 1. Metric spaces, open set, closed set, diameter of a set, subspaces, dense sets, separable spaces. 2. Sequences in Metric Spaces, Cauchy sequences. Complete Metric Spaces, Cantor's theorem. 3.Connectedness, Sequential compactness, Heine-Borel property, Totally bounded spaces, finite intersection property, 4.Homeomorphism, Contraction mappings, Banach Fixed point. Upon successful completion, students will have the knowledge and skills to: 5. Explain the fundamental concepts of complex analysis and their role in modern mathematics and applied contexts 6. Demonstrate accurate and efficient use of complex analysis techniques 7. Demonstrate capacity for mathematical reasoning through analysing, proving and explaining concepts from complex analysis 8. Apply problem-solving using complex analysis techniques applied to diverse situations in physics engineering and other mathematical contexts. 9.Capture technique of convergence of sequences and series of complex function
	Ring Theory and Linear Algebra II	After completing this course students can understand 1.Polynomial rings over commutative rings, division algorithm and consequences, unique factorization in Z [x]. 2. Divisibility in integral domains, unique factorization domains, Euclidean domains. 3.Dual spaces, dual basis, double dual, transpose of a linear transformation ,annihilators. 3.Eigen spaces of a linear operator, diagonalizability, canonical forms. **5.** Inner product spaces and norms, Orthogonal projections and Spectral theorem.

	Theory of Equations (DSE 04T)	After taking this course, the student should be able to 1.understand general properties of polynomials apply Descarte's rule of signs positive and negative rule, 2.Solve problems involving relation between the roots and the coefficients of equations. 3. define symmetric functions, Transformation of equations Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic (Cardan's method) and biquadratic (Ferrari's method). 4. Separate the roots of equations, Strums theorem. Conditions for reality of the roots of an equation. Solution of numerical equations.
	Mechanics (DSE 06T)	After taking this course, the student should be able to 1.Understand some basic terminology of Mechanics Co-planar forces. Astatic equilibrium. Friction. Virtual work. 2.find out centre of gravity for different bodies. Stable and unstable equilibrium. **3.**Equations of motion referred to a set of rotating axes. 4. solve problem on motion of a projectile in a resisting medium. 5. solve problem related with motion under the inverse square law, motion of artificial satellites. Motion of a particle in three dimensions. Motion on a smooth sphere, cone, and on any surface of revolution. **5.**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.

Course outcomes B.Sc General Mathematics

Semester	Course	Course Outcomes
SEM I	**Differential Calculus GEC01T**	After successful completion of the course, Students will be able to: 1. Interpret a function from an algebraic, numerical, graphical and verbal perspective and extractinformation relevant to the phenomenon modelled by the function. 2. verify the value of the limit of a function at a point using the definition of the limit 3. understand the consequences of the intermediate value theorem for continuous functions and types of discontinuities 4. derive the expression for the derivative of elementary functions from the (limit) definition

		5. be able to show whether a function is differentiable at a point. 6. formulate Successive differentiation, use Leibnitz's theorem, 7. can perform Partial differentiation of functions more than two variables, use of Euler's theorem on homogeneous functions. 8. idea of Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, ex, log(l+x), (l+x)n, Maxima and minima , indeterminate forms 9. acquire knowledge about Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves.
SEM II	**Differential Equations GEC02T**	After successful completion of the course, students are 1.familiar with concepts of order, degree of a differential equation and able to distinguish betweenlinear, nonlinear, ordinary and partial differential equations. 2. Get idea of integrating factor and learn rules for finding integrating factors. 3. Acquainted with various methods for solving differential equations of first order and first degree 4. Solve differential equations of first order but not of first order. 5. Acquainted with concepts of complementary function and particular integrals and hence can solve linear differential equations with constant coefficients. 6. Solve linear homogeneous differential equations by Cauchy-Euler method. 7.Get idea of Wronskian and its properties and can solve equations by method of variations of parameters. 8.Can solve equations by reducing its order 9. Recognize and solve total differential equations. 10. Can solve simultaneous differential equations 11. Formulate partial differential equations and solve them using Lagrange's and Charpit's method. 12. Can classify second order partial differential equations into elliptic, parabolic and hyperbolic .
SEM III	**Real Analysis GEC03T**	After completion of this course students will acquire 1.Basic concepts of sets , bounded sets, suprema andinfima, completeness property of R, Archimedean property of R, intervals. 2.Concept of cluster points and statement of Bolzano-Weierstrass theorem. 3. to understand real sequence and its convergence and divergence . 4. working knowledge of convergence and divergence infinite series. 5. definition and examples of absolute and conditional convergence.

		6.Idea of Sequences and series of functions, Pointwise and uniform convergence. M_n-test, M-test, 7. capacity to find out radius of convergence of a power series
SEM IV	**Algebra GEC04T**	After completing the course, students will able to 1.Define equivalence relations and partitions 2.Define functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set. 3.Identify the various algebraic structures with their corresponding binary operations. 4. generalize the groups on the basis of their orders, elements, order of elements and group relations 5. Compare two groups of same orders on the basis of isomorphism Criteria. 6. Compute the possible subgroups of given group of specific orders and will recognize them. 7.Lagrange's theorem and uses of it 8. acquire knowledge of rings ,Subrings and ideals, Integral domains and fields, examples of fields: Z_p, Q, R, and C.
SEM V	**Matrices DSE 01T**	After completing this course student will be able to 1. Study of $\mathbb{R}$, $\mathbb{R}^2$,$\mathbb{R}^3$ as vector spaces over $\mathbb{R}$. Standard basis for each of them. Concept of Linear Independence and examples of different bases. Subspaces of$\mathbb{R}^2$, $\mathbb{R}^3$. 2. Accumulate concept of Translation, Dilation, Rotation, Reflection in a point, line and plane. 3.ConvertMatrix form of basic geometric transformations. Interpret eigen values and eigen vectors for such transformations and eigen spaces as invariant subspaces. 4 Find out Rank of a matrix. Invariance of rank under elementary transformations. Reduction tonormal form, 5.Find Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four. 6.To Reducediagonal form upto matrices of order 3. 7.Compute matrixinverses using elementary row operations. Rank of matrix. 8.Find Solutions of a system of linear equations usingmatrices. 9.Illustrate examples of above concepts from Geometry, Physics, Chemistry, Combinatorics andStatistics
SEM VI	**Numerical Methods DSE 03T**	After taking this course, the student should be able to 1.Define term Algorithms, Convergence, 2. Familiar with Bisection method, False position method, Fixed point iteration method,Newton's method, Secant method, LU decomposition, Gauss-Jacobi, Gauss-Siedel and SOR iterative methods. 3. learnfinite difference operators.Lagrange and Newton interpolation

		4. learn how to Solve the Ordinary differential equation by various methods 5. to find the Integration & derivative by various methods
SEM IV and VI	**Logic and Sets SEC01T**	**After completion students will be able to** 1. Simplify and evaluate basic logic statements including compound statements, implications,inverses, converses, and contrapositives using truth tables and the properties of logic. 2.Express a logic sentence in terms of predicates, quantifiers, and logical connectives **3.**concept of sets and operations, subsets, Set operations and the laws of set theory and Venn diagrams. 4.concept of Relation as Product set. Composition of relations, Types of relations, Partitions 5.acquire knowledge of equivalence relations with exampleof congruence modulo relation. Partial ordering relations, n- ary relations.
SEM III and V	**C-Programming Language SEC02T**	On completion of the course, students are able to: 1. Understand What is Computer and Basic concepts of computer. 2. Prepare Algorithm and Flowchart of Program. 3. declaration of data type ,printf(), scanf(), compilation etc. 4. Understand operators, expressions and preprocessors. 5. Understand arrays , it's declaration and uses. 6. use of if-else statement,for loop, while loop and do-while loop; controlling loop execution: breakand continue, nested loop 7. use of one dimensional array to finding maximum,minimum, simple sorting and searching. 8. use of multi-dimensional arrays memory allocation and deallocation: *malloc()* and *free()* functions 9. use of Functions, Pointers, arrays as function parameters, *return* statement, Header files and their role. 10. Illustrate different examples like swapping values, compute n!, nCr, find max/min from a list of elements, sort a set of numbers, matrix addition/multiplication etc