# ASANSOL GIRLS' COLLEGE

## Department of Mathematics

## Programme Specific Outcome (PSO) and Course Outcome (CO)

**Programme Specific Outcome (PSO):**

The Programme enables the students

PSO1: to acquire good knowledge and understanding in advanced areas of mathematics.

PSO2: to Formulate and develop mathematical arguments in a logical manner.

PSO3: to prepare themselves for tackling different problems and to understand and correlate them with underlying fundamental mathematical principles.

PSO4: to assimilate the knowledge of mathematics that is applied to any other branch of science in everyday use.

# COURSES OUTCOME
# DEPARTMENT OF MATHEMATICS

| | COURSE NAME | UNIT AND TOPIC | UNIT SPECIFIC CO |
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| SEMESTER-I | MAJOR AND MINOR CLASSICAL ALGEBRA, CALCULUS AND ANALYTICAL GEOMETRY BSCMTMMJ101 | **UNIT-I**: Polar representation of complex numbers, $n^{th}$ roots of unity, De Moivre's theorem for rational indices and its applications, complex functions and their applications | **C1**: Employ De Moivre's theorem in a number of applications to solve numerical problems |
| | | **UNIT-II**: Theory of equations: Relation between roots and coefficients, Transformation of equation, Descartes rule of signs, Cubic and biquadratic equations. Reciprocal equation, separation of the roots of equations, Strum's theorem | **C2**: Understand the importance of roots of real and complex polynomials and learn various methods of obtaining roots |
| | | **UNIT-III**: Inequality: The inequality involving $AM \geq GM \geq HM$, Cauchy-Schwartz inequality, Weierstrass inequality | **C3**: Understand different types of inequality |
| | | **UNIT-IV**: Hyperbolic functions, higher order derivatives, Successive differentiation, Leibnitz rule and its applications to problems of type$(ax + b)^n; e^{ax} \sin(bx + c)$; $e^{ax} \cos(bx + c)$; $log_e(ax + b)$etc. L'Hospital's rule. concavity and inflection points, envelopes, asymptotes, Maxima and Minima, Curvature | **C4**: Understand basics of calculus |
| | | **UNIT-V**: Reduction formulae, derivations and illustrations of reduction formulae for the integration of $sin^n x, cos^n x, tan^n x, sec^n x, (logx)^n, sinnx, sinmx$, etc. parametric equations, parametrizing a curve, arc length, arc length of parametric curves, area of surface of revolution | **C5**: Understand reduction formulae and different techniques of calculus |
| | | **UNIT-VI**: Reflection properties of conics, translation and rotation of axes and second degree equations, classification of conics using the discriminant, Tangent, Normal, pole, polar, Diameter and conjugate diameters, Asymptotes. Polar equations of conics | **C6**: Understand basics of 2D geometry |
| | | **UNIT-VII**: Planes, Straight lines in 3D, Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, Generating lines, classification of quadrics, Tangent plane, Normal | **C7**: Understand basics of 3D geometry |
| | GRAPH THEORY BSCMTMSE101 | **UNIT -I:** Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bipartite graphs isomorphism of graphs | **C1**: Appreciate the definition and basics of graphs along with types and their examples |
| | | **UNIT -II:** Paths and circuits ,Eulerian circuits, Eulerian graph, semi-Eulerian graph and theorems, Hamiltonian cycles and theorems. Representation of a graph by a matrix, the adjacency matrix, incidence matrix, weighted graph, Königsberg bridge problem; Subgraphs | **C2**: Understand the Eulerian circuits, Eulerian graphs, Hamiltonian cycles, representation of a graph by matrix |

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| | | **UNIT -III:** Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Shortest path and Dijkstra's algorithm, Warshall algorithm | **C3**: Relate the graph theory to the real-world problems |
| | BUSINESS MATHEMATICS MDC113 | **UNIT-I**: Algebra | **C1**: Learn the concepts of AP and GP Series, logarithm, Permutation & Combination and Set Theory<br>**C2**: Learn the concepts of Matrix and determinant |
| | | **UNIT-II**: Differential and Integral Calculus | **C3**: Understand the concepts of limit, continuity, differentiability and integration of functions |
| SEMESTER-II | MAJOR AND MINOR<br>LINEAR ALGEBRA I, ORDINARY DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS<br>BSCMTMMJ201 | **UNIT-I:** Systems of linear equations, row reduction and echelon forms, vector equations, matrices and matrix operations, inverse of a matrix, rank of a matrix, determinants and their properties, Cramer's rule, the matrix equation $Ax=b$, solution sets of linear systems and their geometrical interpretation, applications of linear systems, linear independence, eigenvalues and eigenvectors of a matrix. | **C1:** Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using a rank.<br>**C2**: Find eigenvalues and corresponding eigenvectors for a square matrix. |
| | | **UNIT-II:** Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation, linear equation and Bernoulli equations, special integrating factors and transformations, oblique and orthogonal trajectories, equations of first order but not first degree, Clairaut's form, Extraneous loci | **C3:** Understand the genesis of ordinary differential equations<br>**C4**: Understand the various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order |
| | | **UNIT-III:** General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian, method of variation of parameters. Reduction of order of ODE and solution | **C5:** Know how to solve linear homogeneous and non-homogeneous equations of higher order with constant coefficients |
| | | **UNIT-IV:** Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Matrix Method, Solution ofsimultaneous equations of the form dx/P = dy/Q = dz/R. Pfaffian Differential Equation Pdx+Qdy+Rdz = 0, Necessary and sufficient condition for existence ofintegrals of the above (proof not required), Total differential equation | **C6:** Understand the system of linear differential equations and the solution techniques |
| | | **UNIT-V:** Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, vector equations and its simple applications, differentiation and integration of vector functions. Differential operators: gradient, divergence, curl | **C7:** Understand the theory and applications of vector analysis |

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| | MATHEMATICAL SCIENCE BSCMTMMD201 | **UNIT-I:** Introduction to Scilab/Octave and its benefits, the general environment, editor, command window, graphics window, Variables assignments, functions, conditional statements, loops, display of array in terms of matrices and vectors, displaying graphs, plots, output data, datafile. | **C1:** Familiar with open-source mathematical tools |
| | | **UNIT-II:** Plotting of graphs of function exp(ax + b), log(ax + b), 1/(ax + b), sin(ax + b), cos(ax + b), \|ax + b\| and to illustrate the effect of a and b on the graph. Plotting the graphs of polynomials, the derivative graph, the second derivative graph and comparing them. | **C2:** Utilize various mathematical tools for displaying graphs, plots, etc. |
| | | **UNIT-III:** Installation of MikTeX, Basic Syntex, Understanding Latex compilation. Use of templates, using various Classes and Packages, Latex Preamble, Latex commands and debugging errors, formatting text, symbols, indenting, paragraphs, line-spacing, titles and subtitles. | **C3:** Get acquainted with LaTex software<br>**C4**: Prepare resume, question paper, project report, etc. using LaTeX |
| | MATHEMATICAL SCIENCE BSCMTMMD201 | **UNIT-I:** Complex numbers, Algebra of complex numbers, The modulus and the conjugate of a Complex number, Argand plane and polar representation, Cube roots of unity, De Moiver's theorem (statement only) and its elementary applications. | **C1:** Understand the concept of complex number and its algebra |
| | | **UNIT-II:** Sections of a Cone, Circle, Parabola, Ellipse, Hyperbola and basic information of these conic sections, general second degree equation and its Classification. | **C2:** Understand the concept of two-dimension |
| | | **UNIT-III:** Basic definitions, Formation, General, particular and singular solution, solution of first order and first degree differential equations, integrating factors, homogeneous, reducible to homogeneous, exact, linear differential equations. | **C3:** Understand the solution methods of differential equations |
| | | **UNIT-IV:** Vectors and linear combinations, Vectors in three dimensions, Dot products, Lengths and unit vectors, The angle between two vectors, Cross product of vectors, Dependent and independent vectors, collinear and co-planar vectors. | **C4:** Learn the concepts of vector algebra |
| | | **UNIT-V:** Events, Types of events, Sample space, Classical and axiomatic definition of probability, Total and compound probability - theories with examples, Conditional probability, Statistical independence, Baye's theorem, Random variables discrete and continuous probability, Sampling, Sample, Random sample, Frequency distributions, graphical representations of it, Measures of location: Mean, Median, Quartiles, Mode for group and un-grouped frequency distributions. | **C5:** Understand the basic concepts on probability and statistics |

| | COURSE NAME | UNITS AND TOPICS | UNIT SPECIFIC CO |
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| SEMESTER III | MULTIVARIABLE CALCULUS (BSCHMTMC301) | **UNIT-I**: Limit, Continuity and Partial Differentiation | This course will enable the students to<br>**C1**: Learn conceptual differences while advancing from one variable to several variables in calculus |
| | | **UNIT-II:** Differentiability and Total Differentiation | **C2**: Visualise the structure of curves and surfaces in plane and space etc |
| | | **UNIT-III**: Extrema of Functions and Vector Field | **C3**: Apply multivariable calculus in various optimization problems<br>**C4**: Learn the applications of multivariable calculus in different fields like Physics, Economics,Medical Sciences, Animation & Computer Graphics etc |
| | | **UNIT-IV**: Double and Triple Integrals | **C5**: Understand inter-relationships amongst the line integral, double and triple integral formulations. |
| | | **UNIT-V:** Green's, Stoke's and Gauss's Divergence Theorem | **C6**: Realize the importance of Green, Gauss, and Stokes' theorems in other branches of Mathematics |
| | GROUP THEORY (BSCHMTMC302) | **UNIT-I**: Groups, Finite groups, | **C1**: Recognize the mathematical objects called groups<br>**C2**: Link the fundamental concepts of groups and symmetries of geometrical objects |
| | | **UNIT-II**: Subgroups, Cyclic groups | **C3**: Explain the significance of the notions of subgroups, and cyclic groups |
| | | **UNIT-III**: Normal Subgroups and their properties, Quotient group | **C4**: Explain the significance of the notions of cosets, normal subgroups, and factor groups<br>**C5**: Analyze the consequences of Lagrange's theorem |
| | | **UNIT-IV**: Homomorphisms | **C6**: Learn about structure-preserving maps between groups and their consequences |
| | PROBABILITY AND STATISTICS (BSCHMTMC303) | **UNIT-I**: Basic notions of probability, Conditional probability, Mathematical expectation, Characteristic function | **C1**: Understand Basix concepts of Probability |
| | | **UNIT-II**: Discrete distributions, Continuous distributions | **C2**: Understand distributions in the study of random variables |
| | | **UNIT-III**: Joint cumulative distribution function and its properties, Joint probability density function, Conditional distributions and expectations | **C3**: Understand distributions in the study of the joint behaviour of two random variables |
| | | **UNIT-IV**: The Correlation coefficient, Covariance, Calculation of covariance, Linear regression for two variables, The method ofleast squares, Chebyshev's theorem, Strong law of large numbers, Centrallimit theorem and weak law of large numbers | **C4**: Establish a formulation helping to predict one variable in terms of the other that is correlationand linear regression<br>**C5**: Understand central limit theorem, which establish the remarkable fact that the |

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| | | | empirical frequencies of so many natural populations, exhibit a bell shaped curve |
| | MATHEMATICAL LOGIC (BSCHMTMSE301) | **UNIT-I**: First-order languages, Terms of language, Formulas of language, First order theory | **C1**: Understand basic notions of logic |
| | | **UNIT-II**: Structures of first-order languages, Truth in a structure, Model of a theory, Embeddings and isomorphism | **C2**: Understand structures of first order languages, embeddings, and isomorphisms |
| | | **UNIT-III**: Introduction, propositions, truth table, negation, conjunction and disjunction. Propositional equivalence, Predicates and quantifiers | **C3**: Understand about truth table, different propositions, predicates and quantifiers, basic Theorems like the Compactness Theorem, Meta Theorem and Post Tautology Theorem |
| | | **UNIT-IV**: Proof in first-order logic, Meta theorems in first-order logic, Some meta theorem in arithmetic, Consistency and completeness | **C4**: Understand the syntax of first-order logic and semantics of first-order languages |
| | | **UNIT-V**: Completeness theorem, Interpretation in a theory, Extension by definitions, Compactness theorem and applications, Complete theories, Applications in algebra | **C5**: Grasp the concept of completeness interpretations and their applications with special stress on applications in Algebra |
| | PROGRAMMING LANGUAGE IN C (BSCHMTMSE302) | **UNIT-I**: Basics of computer programming language | **C1**: Acquire knowledge of different computer languages |
| | | **UNIT-II**: Constants, Variables, Operation and Expressions | **C2**: Understand basic structure, characters, keywords, identifiers, data types, operators,expressions, etc. in C language |
| | | **UNIT-III**: Decision Making and Branching, Control Statements | **C3**: Write flow chart and corresponding C-program for solving problems requiring decision making, branching, looping and other control statements |
| | | **UNIT-IV**: Arrays and Functions, Two Dimensional Arrays | **C4**: Learn to implement in C programming |
| | | **UNIT-V**: Functions, Function Calls, | **C5**: Learn to implement functions in C programming |
| | | **UNIT-VI**: Structures, Unions and Pointers | **C6**: Familiarise with the concepts of structure, union and pointers |
| SEMESTER IV | MECHANICS BSCHMTMC401 | **UNIT-I**: Statics | **C1**: Understand necessary conditions for the equilibrium of particles acted upon by various forces and learn the principle of virtual work for a system of coplanar forces acting on a rigid body |
| | | **UNIT-II**: Centres of Gravity and Common Catenary | **C2**: Determine the centre of gravity of some materialistic systems and discuss the equilibrium of a uniform cable hanging freely under its own weight |
| | | **UNIT-III**: Rectilinear Motion | **C3**: Deal with the kinematics and kinetics of the rectilinear motions of a |

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| | | | particle including the constrained oscillatory motions of particles |
| | | **UNIT-IV**: Motion in a Plane | **C4**: Deal with the kinematics and kinetics of the planar motions of a particle including the constrained oscillatory motions of particles |
| | | **UNIT-V**: Central Orbits | **C5**: Learn that a particle moving under a central force describes a plane curve and know the Kepler's laws of the planetary motions, which were deduced by him long before the mathematical theory given by Newton |
| | LINEAR ALGEBRA BSCHMTMC402 | **UNIT-I**: Vector Spaces | **C1**: Understand the concepts of vector spaces, subspaces, bases, dimension and their properties |
| | | **UNIT-II**: Linear Transformations | **C2**: Relate matrices and linear transformations |
| | | **UNIT-III**: Further Properties of Linear Transformations | **C3**: Compute eigen values and eigen vectors of linear transformations |
| | | **UNIT-IV**: Inner Product Spaces | **C4**: Learn properties of inner product spaces and determine orthogonality in inner product spaces |
| | | **UNIT-V**: Adjoint of a Linear Transformation and Canonical Forms | **C5**: Realise the importance of adjoint of a linear transformation and its canonical form |
| | PARTIAL DIFFERENTIAL EQUATIONS AND CALCULUS OF VARIATIONS (BSCHMTMC403) | **UNIT-I**: Basics of partial differential equations | **C1**: Understand problems, methods and techniques of PDE |
| | | **UNIT-II**: Geometric Interpretation of First order non-linear PDEs and Cauchy's Method of Characteristics, Method of Separation of Variables for solving first order PDEs | **C2**: Understand the geometric and physical nature of Partial Differential Equations and classify them accordingly |
| | | **UNIT-III**: Basics of second and higher order PDE | **C3**: Apply a range of techniques to solve first & second order partial differential equations |
| | | **UNIT-IV**: Derivation of Wave Equation and Heat Equation in One-dimension. Method of separation of variables | **C4**: Model physical phenomena using partial differential equations such as the heat and waveequations |
| | | **UNIT-5**: Calculus of Variations-Variational Problems with Fixed Boundaries | **C5**: Understand problems, methods and techniques of calculus of variations |
| | | **UNIT-6**: Calculus of Variations-Variational Problems with Moving Boundaries | **C6**: Understand Variational Problems with Moving Boundaries |
| | GRAPH THEORY BSCHMTMSE401 | **UNIT-I**: Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bipartite graphs isomorphism of graphs | **C1**: Appreciate the definition and basics of graphs along with types and their examples |
| | | **UNIT-II**: Eulerian circuits, Eulerian graph, semi–Eulerian graph and theorems, Hamiltonian cycles and theorems. Representation of a graph by a matrix, the adjacency matrix, incidence matrix, weighted graph | **C2**: Understand the Eulerian circuits, Eulerian graphs, Hamiltonian cycles, and representation of a graph by matrix |

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| | | **UNIT-III**: Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm | **C3**: Relate the graph theory to the real-world problems |
| SEMESTER-V | SET THEORY &METRIC SPACES (BSCHMTMC501) | **UNIT-I**: Theory of Sets | **C1**: Learn basic facts about the cardinality of a set |
| | | **UNIT-II**: Concepts in Metric Spaces | **C2**: Learn abstract formulation of the notion "distance" on an arbitrary set and learn how known concepts like continuity, convergence of sequences etc behave in such abstract setting |
| | | **UNIT-III**: Complete Metric Spaces and Continuous Functions | **C3**: Understand different properties of Complete Metric Spaces and Continuous Functions |
| | | **UNIT-IV**: Compactness | **C4**: Understand different properties of complete Metric Spaces |
| | | **UNIT-V**: Connectedness | **C5**: Understand different properties of Connected Metric Spaces |
| | ADVANCED ALGEBRA (BSCHMTMC502) | **UNIT-I**: Automorphism, inner automorphism, Characteristic subgroups, Applications of group actions. Generalized Cayley's theorem. Index theorem | **C1**: Understand the automorphism, inner automorphism |
| | | **UNIT-II**: Groups acting on themselves by conjugation, class equation and consequences, conjugacy in $S_n$, p-groups, Sylow's theorems and consequences, Cauchy's theorem, Finite Simple Groups, Simplicity of $An$ for $n \geq 5$, non-simplicity tests | **C2**: The fundamental concepts of Group Actions and their applications |
| | | **UNIT-III**: Definition, examples and elementary properties of rings, Commutative rings, Integral domain, Division rings and fields, Prime, principal and maximal ideals, Relation between integral domain and field | **C3**: Be acquainted with the basic concepts of Ring Theory such as the concepts of ideals, quotient rings, Integral domains and Fields |
| | | **UNIT-IV**: Euclidean domain, principal ideal domain, and unique factorization domain | **C4**: Understand basic properties of Euclidean domain, principal ideal domain, and unique factorization domain |
| | | **UNIT-V**: Extension of a field, Algebraic element of a field, Algebraic and transcendental numbers, Perfect field, Classification of finite fields | **C5**: Know in detail about Polynomial Rings, Fundamental properties of Finite Field extensions and classification of Finite Fields |

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| | INTEGRAL TRANSFORMS AND FOURIER ANALYSIS BSCHMTMDSE502 | **UNIT-I**: Fourier Series | **C1**: Learn Fourier series, Bessel's inequality, term by term differentiation and integrationof Fourier series |
| | | **UNIT-II**: Fourier Transforms | **C2**: Know about Fourier Transform and its relation with Fourier Series and the sufficient conditions for its existence |
| | | **UNIT-III**: Laplace Transforms | **C3**: Laplace Transform and its relation with Fourier Transform and the sufficient conditions for its existence |
| | | **UNIT-IV**: Applications of Integral Transforms and Fourier Analysis | **C4**: Familiarise with the properties of Fourier and Laplace Transforms<br>**C5**: Learn to apply Fourier and Laplace Transforms to well-known functions<br>**C6**: Learn to find inverse Laplace Transform and inverse Fourier Transform<br>**C7**: To be able to solve real world initial value, boundary value and initial-boundary problems using Integral Transforms or Fourier Series |
| | LINEAR PROGRAMMING AND GAME THEORY (BSCHMTMDSE503) | **UNIT-I**: Introduction to linear programming problem. Theory of simplex method, graphical solution | **C1**: Analyze and solve linear programming models of real life situations<br>**C2**: Provide graphical solution of linear programming problems with two variables, and illustratethe concept of convex set and extreme points |
| | | **UNIT-II**: Duality, formulation of the dual problem, primal–dual relationships, economic interpretation of the dual, Dual Simplex method | **C3**: Solve linear programming problems using dual simplex method |
| | | **UNIT-III**: Transportation problem and its mathematical formulation, Travelling salesman problem | **C4**: Learn techniques to solve transportation and assignment problems |
| | | **UNIT-IV**: Game theory | **C5**: Solve two-person zero sum game problems |
| SEMESTER-VI | COMPLEX ANALYSIS BSCHMTMC601 | **UNIT-I**: Complex Plane and functions | **C1**: Visualize complex numbers as points of $\mathbb{R}^2$ and stereographic projection of complex plane on the Riemann sphere |
| | | **UNIT-II**: Analytic functions and Cauchy-Riemann equations | **C2**: Understand the significance of differentiability and analyticity of complex functions leading to the Cauchy-Riemann equations |
| | | **UNIT-III**: Power Series | **C3**: Understand the convergence, term by term integration and differentiation of a power series |
| | | **UNIT-IV**: Conformal and Bilinear Transformations | **C4**: Understand basic properties of Conformal and Bilinear Transformations |

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| | | **UNIT-V**: Cauchy's theorem | **C5**: Understand basic properties of Cauchy's theorem |
| | | **UNIT-VI**: Singularities and Contour integration | **C6**: Learn Taylor and Laurent series expansions of analytic functions, classify the natureof singularity, poles and residues and application of Cauchy Residue theorem |
| | NUMERICAL METHODS & NUMERICAL LAB BSCHMTMC602 | **UNIT-I**: Algorithms, Convergence, Errors: Relative, Absolute. Round off, Truncation | **C1**: Understand the problem solving skills using numerical methods |
| | | **UNIT-II**: Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Error and Rate of convergence of these methods | **C2**: To solve the equations which are impossible to solve analytically |
| | | **UNIT-III**: System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. GaussJacobi method, Gauss Seidel method and their convergence analysis, LU Decomposition | **C3**: Handle large system of equations, non-linearity and and that are often impossible to solve analytically |
| | | **UNIT-IV**: Interpolation, Numerical differentiation | **C4**: Understand basic notions of interpolation |
| | | **UNIT-V**: Numerical Integration, The algebraic eigen value problem | **C5**: To solve integration and eigen value problem which are impossible to solve analytically |
| | | **UNIT-VI**: Numerical solution of Ordinary Differential Equations | **C6**: Solve differential equations by numerical methods |
| | NUMBER THEORY BSCHMTMDSE602 | **UNIT-I**: Distribution of Primes and Theory of Congruencies | **C1**: Learn about some important results in the theory of numbers including the prime number theorem, Chinese remainder theorem, Euler's theorem, Wilson's theorem and their consequences |
| | | **UNIT-II**: Number Theoretic Functions | **C2**: Learn about number theoretic functions, modular arithmetic and their applications |
| | | **UNIT-III**: Primitive Roots | **C3**: Familiarise with modular arithmetic and find primitive roots of prime and composite numbers |
| | | **UNIT-IV**: Quadratic Reciprocity Law | **C4**: Know about open problems in number theory, namely, the Goldbach conjecture andTwin-prime conjecture |
| | | **UNIT-V**: Applications | **C5**: Apply public crypto systems, in particular, RSA |

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| | BIO MATHEMATICS BSCHMTMDSE604 | **UNIT-I**: Mathematical Biology and the modelling process | **C1**: Understand basic notions of Bio-Mathematics |
| | | **UNIT-II**: Activator-Inhibitor system, Insect Outbreak Model, Qualitative analysis of continuous models, bifurcations and limit cycles with examples in the context of biological scenario Spatial Models | **C2**: Grasp the idea of various bio-mathematical models and techniques which will help them to tacklephysical world problems |
| | | **UNIT-III**: Discrete Models, Case Studies: Optimal Exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models | **C3**: Understand different discrete models |

## GENERIC COURSES OUTCOME
## DEPARTMENT OF MATHEMATICS

| | COURSE NAME | UNIT AND TOPIC | UNIT SPECIFIC CO |
|---|---|---|---|
| **SEMESTER-III** | **LINEAR AND MODERN ALGEBRA BSCHMTMGE301** | **UNIT-I**: Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn of integers under addition modulo n, and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, Normal subgroups: their definition, examples, and characterizations, Quotient groups. Divisor of zeros, Rings, Integral domain, fields. | **C1**: Understand the concepts of different types of groups, rings, and field. |
| | | **UNIT-II**: Solution of non-homogeneous system of three linear equations by matrix inversion method. Elementary row and column operations, rank of a matrix, row reduced echelon form and fully reduced normal form. | **C2:** Understand the basic concepts of group actions and their applications. |
| | | **UNIT-III:** Vector spaces over reals, simple examples, linear dependence and independence of a finite set of vectors, sub-spaces, definition and examples. | **C3:** Understand the concepts of vector spaces, sub-spaces, linear dependence and linearindependence of a finite set of vectors. |
| **SEMESTER-IV** | **BASICS IN REALANALYSIS BSCHMTMGE401** | **UNIT-I:** Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem. | **C1:** Understand about sets in R, sequences, series of functions and infinite series. |
| | | **UNIT-II:** Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence. | **C2:** Understand about sequence of real numbers. |
| | | **UNIT-III:** Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence. | **C3:** Understand about series of real numbers. |

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| | | **UNIT-IV:** Sequences and series of functions, Pointwise and uniform convergence. Mn-test, M-test, Statementsof the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence. | **C4:** Understand about sequences and series of functions. |

## PROGRAM COURSES OUTCOME
## DEPARTMENT OF MATHEMATICS

| | COURSE NAME | UNIT AND TOPIC | UNIT SPECIFIC CO |
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| SEMESTER-III | BASICS IN ALGEBRA BSCPMTMC301 | **UNIT-I**: Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn of integers under addition modulo n, and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, Normal subgroups: their definition, examples, and characterizations, Quotient groups. Divisor of zeros, Rings, Integral domain, fields. | **C1**: Understand the concepts of different types of groups, rings, and field. |
| | | **UNIT-II**: Solution of non-homogeneous system of three linear equations by matrix inversion method. Elementary row and column operations, rank of a matrix, row reduced echelon form and fully reduced normal form. | **C2:** Understand the basic concepts of group actions and their applications. |
| | | **UNIT-III:** Vector spaces over reals, simple examples, linear dependence and independence of a finite set of vectors, sub-spaces, definition and examples. | **C3:** Understand the concepts of vector spaces, sub-spaces, linear dependence and linearindependence of a finite set of vectors. |
| | SETS AND MATHEMATICAL LOGIC BSCPMTMSE301 | **UNIT-I:** Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations | **C1:** Understand about different propositions of logic. |
| | | **UNIT-II:** Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinitesets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set. | **C2:** Understand about truth table, logical operators. |

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| | | **UNIT-III:** 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 | **C3:** Understand about various operations and relations related to sets. |
| **SEMESTER-IV** | **INTRODUCTION TO REAL ANALYSIS BSCPMTMC401** | **UNIT-I:** Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem. | **C1:** Understand about sets in R, sequences, series of functions and infinite series. |
| | | **UNIT-II:** Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence. | **C2:** Understand about sequence of real numbers. |
| | | **UNIT-III:** Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence. | **C3:** Understand about series of real numbers. |
| | | **UNIT-IV:** Sequences and series of functions, Pointwise and uniform convergence. Mn-test, M-test, Statementsof the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence. | **C4:** Understand about sequences and series of functions. |
| | **BOOLEAN ALGEBRA BSCPMTMSE401** | **UNIT-I:** 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 | **C1:** Understand Boolean algebra and Boolean functions, logic gates, switching circuitsand their applications. |
| | | **UNIT-II:** Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and minimization of switching circuits using Boolean algebra | **C2:** Apply a number of proof techniques to theorems in language design. |
| **SEMESTER-V** | **MECHANICS BSCPMTMDSE501** | **UNIT-I:** Rectilinear motion, Motion under repulsive force (i) proportional to distance (ii) inversely proportional to square of the distance, Motion under attractive force inversely proportional to square of the distance, Motion under gravitational acceleration. | **C1:** Understand motion in a straight line. |
| | | **UNIT-II:** Simple harmonic motion, Damped oscillation, Forced and Damped oscillation,Elastic string and spiral string, Hook's law, Particle attached to a horizontal elastic string, Particle attached to a vertical elastic string. | **C2:** Understand SHM |
| | | **UNIT-III:** Projectiles motion in vacuum and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point. | **C3:** Understand motion in a resisting medium. |

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| | | **UNIT-IV:** Central orbit. Kepler's laws of motion. Motion under inverse square law. | **C4:** Understand Kepler's law of motion and central orbit. |
| | **NUMBER THEORY BSCPMTMSE501** | **UNIT-I:** Division algorithm, Lame'e theorem, Linear Diophantine equation, fundamental theorem of arithmetic, prime counting function, statement of prime number theorem, Goldbach conjecture, binary and decimal representation of integers, linear congruences, complete set of residues | **C1:** Learn Lame's theorem, linear Diophantine equation, congruences. |
| | | **UNIT-II:** Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobious inversion formula, the greatest integer function, Euler's phi-function | **C2:** Learn Goldbach conjecture, Euler's phi-function. |
| **SEMESTER-VI** | **LINEAR PROGRAMMING PROBLEMS BSCPMTMDSE601** | **UNIT-I:** Motivation of Linear Programming problem. Statement of L.P.P., Formulation of L.P.P., Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.). Degenerate and Non-degenerate B.F.S. | **C1:** Analyze and solve linear programming models of real life situations |
| | | **UNIT-II:** Fundamental Theorem of L.P.P. (Statement only) Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables). Simplex method, Simplex algorithm, Artificial variable technique (Big M method). | **C2:** Provide graphical solution of linear programming problems with two variables, and illustrate the concept of convex set and extreme points |
| | | **UNIT-III:** Duality in L.P.P.: Concept of duality, Fundamental properties of duality, Fundamental theorems of duality, Duality & Simplex method | **C3:** Solve linear programming problems using simplex method |
| | | **UNIT-IV:** Transportation Problem (T.P.): Mathematical formulation, Existence of feasible solution, Loops and their properties, Initial basic feasible solutions (different methods, like North West corner, Row minima, Column minima, Matrix minima & Vogel's Approximation method), Optimal solutions, Degeneracy in T.P., Unbalanced T.P | **C4:** Learn techniques to solve transportation and assignment problems |
| | **GRAPH THEORY BSCPMTMSE601** | **UNIT-I:** Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bipartite graphs isomorphism of graphs | **C1:** Appreciate the definition and basics of graphs along with types and their examples |
| | | **UNIT-II:** Eulerian circuits, Eulerian graph, semi-Eulerian graph and theorems, Hamiltonian cycles and theorems.Representation of a graph by a matrix, the adjacency matrix, incidence matrix, weighted graph | **C2:** Understand the Eulerian circuits, Eulerian graphs, Hamiltonian cycles, representation of a graph by matrix |
| | | **UNIT-III:** Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm | **C3:** Relate the graph theory to the real-world problems |