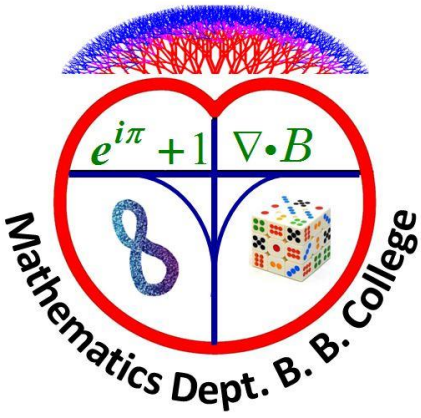
BANWARILAL BHALOTIA COLLEGE ASANSOL

DEPARTMENT OF MATHEMATICS

CRITERIA 2.6.1

PROGRAM OUTCOMES, PROGRAM SPECIFIC OUTCOMES, COURSE OUTCOMES



Program Objectives and Course Outcomes for B.Sc. (Honours) in Mathematics

Program	Program Objectives	Program Specific Objectives
B.Sc. (Honours) in Mathematics	By enrolling into this program, the students become educated in core mathematics, including numerical and computing techniques, thus, enabling them to master both the abstract theoretical aspects as well as problem solving methods under practical situations. They are provided with a high-quality education within an environment committed to excellence in both teaching and research. The programme is oriented in such a way that it helps students to prepare themselves for tackling different problems and to visualize and correlate them with underlying fundamental mathematical principles.	**PSO1:** To make students familiar with the understandings of the basic principles of mathematics.
		PSO2: To develop the ability among students to solve complex problems by critical understanding, analysis and synthesis.
		PSO3: To help students to understand and model real life problems through mathematical equations and learn the requisite tools to solve and analyse them.
		PSO4: To help students to assimilate the knowledge of mathematics that is applied to any other branch of science in everyday use.
		PSO5: To provide a systemic understanding of core physical concepts, principles and theories along with their applications.
		PSO6: To develop proficiency in the analysis of complex analytical as well as numerical problems and to use of appropriate mathematical techniques to solve them.
		PSO7: To grow the ability to use a variety of software packages and techniques to solve analytic and numerical problems and present data in a wide variety of formats.
		PSO8: To provide an intellectually stimulating environment to develop skills and enthusiasms of students to the best of their potential.

Course Outcomes:

Course		Course Outcomes
Semester-I	**Core Course-I** **Course Name: Calculus, Geometry & Differential Equations** **Course Code: BSCHMTMC101**	• Understand various kinds of standard functions and graphs, techniques of integrations and limits. • Understand the concepts on three-dimensional geometry. • Understand the genesis of ordinary differential equations. • Understand the various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.
	Core Course-II **Course Name: Algebra** **Course Code: BSCHMTMC102**	• Understand the importance of roots of real and complex polynomials and learn various methods of obtaining roots. • Employ De Moivre's theorem in a number of applications to solve numerical problems.• Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank. • Find eigen-values and corresponding eigenvectors for a square matrix.
Semester-II	**Core Course-III** **Course Name: Real Analysis** **Course Code: BSCHMTMC201**	• Understand many properties of the real line R and learn to define sequence in terms of functions from R to a subset of R. • Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence. • Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.
	Core Course-IV **Course Name: Differential Equations and Vector Calculus** **Course Code: BSCHMTMC202**	• Learn the Picard's method of obtaining successive approximations of solutions of first order ordinary differential equations. • Know how to solve linear homogeneous and non-homogeneous equations of higher order with constant coefficients. • Understand the system of linear differential equations and the solution techniques. • Understand the theory and applications of vector analysis.
Semester-III	**Core Course-V** **Course Name: Theory of Real Functions & Introduction to Metric Space** **Course Code: BSCHMTMC301**	•Grasp the various aspects of real functions like existence and importance of limits of functions at a certain point of the domain, continuity and differentiability of real functions. • Understand several standard concepts of metric spaces and their properties like openness, closedness, completeness.
	Core Course-VI **Course Name: Group Theory I** **Course Code: BSCHMTMC302**	• Link the fundamental concepts of groups and symmetries of geometrical objects. • Explain the significance of the notions of cosets, normal subgroups, and factor groups. • Analyze consequences of Lagrange's theorem. • Learn about structure preserving maps between groups and their consequences.

	Core Course-VII **Course Name: Numerical Methods & Numerical Methods Lab** **Course Code: BSCHMTMC303**	• Understand the problem-solving skills using numerical methods, • Handle large system of equations, non-linearity and that are often impossible to solve analytically, • Solve differential equations by numerical methods, • Develop problem solving skills using computer programming, • Acquire knowledge of computer language, • Solve different numerical problems using C language.
	SEC-I **Course Name: Logic and Sets** **Course Code: BSCHMTMSE301** **Course Name: Programming Language in C** **Course Code: BSCHMTMSE302**	**Logic and Sets:** Understand about truth table, different propositions, predicates and quantifiers, various operations between two sets and logical equivalences. **Programming Language in C:** Acquire knowledge of different computer languages. • Understand basic structures, characters, identifier etc. in C language. • Write flow chart and corresponding C-program for solving numerical and decision-making problems
Semester-IV	**Core Course-VIII** **Course Name: Riemann Integration and Series of Functions** **Course Code: BSCHMTMC401**	• Understand the theory and concepts of Riemann integration. • Understand the applications of the fundamental theorems of integration. • Understand the convergence of series of functions.
	Core Course-IX **Course Name: Multivariate Calculus** **Course Code: BSCHMTMC402**	• Understand the basic concepts and know the basic techniques of differential and integral calculus of functions of several variables. • Solve problems involving maxima and minima, line integral and surface integral, and vector calculus. • Develop mathematical maturity to undertake higher level studies in mathematics and related fields.
	Core Course-X **Course Name: Ring Theory and Linear Algebra I** **Course Code: BSCHMTMC403**	• Know the fundamental concepts in ring theory such as the concepts of ideals, quotient rings, integral domains, and fields. • Understand the concepts of vector spaces, subspaces, bases, dimension and their properties. • Relate matrices and linear transformations, compute eigen values and eigen vectors of linear transformations, isomorphisms.
	SEC-II **Course Name: Graph Theory** **Course Code: BSCHMTMSE401** **Course Name: Object Oriented Programming in C++** **Course Code: BSCHMTMSE402**	**Graph Theory:** Understand the Eulerian circuits, Eulerian graphs, Hamiltonian cycles, representation of a graph by matrix. • Relate the graph theory to the real-world problems **Object Oriented Programming in C++ :** Understand the basic characteristics of object oriented programming languages, different components and structures in C++ programming language. • Understand and apply the programming concepts of C++ which is important for mathematical investigation and problem solving. • Use mathematical libraries for computational objectives. • Represent the outputs of programs visually in terms of well formatted text and plots.

Semester-V	**Core Course-XI** **Course Name: Partial Differential Equations and Applications** **Course Code: BSCHMTMC501**	• Apply a range of techniques to solve first & second order partial differential equations. • Model physical phenomena using partial differential equations such as the heat and wave equations
	Core Course-XII **Course Name: Ring Theory and Linear Algebra II** **Course Code: BSCHMTMC502**	• Understand the polynomial rings, dual spaces, eigen spaces, canonical forms. • Understand the further idea of inner product spaces and linear transformations.
	DSE-I **Course Name: Linear Programming and Game Theory** **Course Code: BSCHMTMDSE501** **Course Name: Group Theory II** **Course Code: BSCHMTMDSE502** **Course Name: Point Set Topology** **Course Code: BSCHMTMDSE503**	**Linear Programming and Game Theory:** Analyse and solve linear programming models of real-life situations. • Provide graphical solution of linear programming problems with two variables, and illustrate the concept of convex set and extreme points. • Solve linear programming problems using simplex method. • Learn techniques to solve transportation and assignment problems. • Solve two-person zero sum game problems. **Group Theory II:** Understand the automorphism, inner automorphism, automorphism groups, automorphism groups. • Understand group action, Sylow's theorems and Cauchy's theorem. **Point Set Topology:** Understand countability of sets, various topological definitions and proofs and it's connection to metric spaces.
	DSE-II **Course Name: Probability and Statistics** **Course Code: BSCHMTMDSE504** **Course Name: Portfolio Optimization** **Course Code: BSCHMTMDSE505**	**Probability and Statistics:** Understand distributions in the study of the joint behaviour of two random variables. • Establish a formulation helping to predict one variable in terms of the other that is correlation and linear regression. • Understand central limit theorem, which establish the remarkable fact that the empirical frequencies of so many natural populations, exhibit a bell-shaped curve **Portfolio Optimization:** Explain technical terminologies essential for the understanding of portfolio optimization including financial markets, investment objectives, types of assets, asset return, risk, short selling, liquidity • Discriminate between different sources of risk and demonstrate the concept of diversification • Demonstrate workings of two asset and multi-asset portfolio optimization and describe how to make optimal capital allocation and portfolio choice decisions on real-data set by hand • Demonstrate measures to evaluate a portfolio's performance • Demonstrate essential concepts of capital asset pricing model

	Course Name: Boolean Algebra and Automata Theory **Course Code: BSCHMTMDSE506**	**Boolean Algebra and Automata Theory:** Understand Boolean algebra and Boolean functions, logic gates, switching circuits and their applications. • Apply a number of proof techniques to theorems in language design. • Develop a clear understanding of undesirability. • Understand the equivalence between Non-deterministic Finite State Automata and Deterministic Finite State Automata.
Semester-VI	**Core Course-XIII** **Course Name: Metric Spaces and Complex Analysis** **Course Code: BSCHMTMC601**	• Understand several standard concepts of metric spaces and their properties like openness, closedness, completeness, Bolzano-Weierstrass property, compactness, and connectedness. • Identify the continuity of a function defined on metric spaces and homeomorphisms. • Visualize complex numbers as points of R and stereographic projection of complex plane on the Riemann sphere. • Understand the significance of differentiability and analyticity of complex functions leading to the Cauchy-Riemann equations. • Learn the role of Cauchy-Goursat theorem and Cauchy integral formula in evaluation of contour integrals. • Apply Liouville's theorem in fundamental theorem of algebra. • Understand the convergence, term by term integration and differentiation of a power series • Learn Taylor and Laurent series expansions of analytic functions, classify the nature of singularity, poles and residues and application of Cauchy Residue theorem.
	Core Course-XIV **Course Name: Mechanics** **Course Code: BSCHMTMC602**	• Familiarize with subject matter, which has been the single centre, to which were drawn mathematicians, physicists, astronomers, and engineers together. • 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. • Determine the centre of gravity of some materialistic systems and discuss the equilibrium of a uniform cable hanging freely under its own weight. • 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.
	DSE-III **Course Name: Number Theory** **Course Code: BSCHMTMDSE601**	**Number Theory:** Learn about some important results in the theory of numbers including the prime number theorem, Chinese remainder theorem, Wilson's theorem and their consequences. • Learn about number theoretic functions, modular arithmetic and their applications. • Familiarise with modular arithmetic and find primitive roots of prime and composite numbers. • Know about open problems in number theory, namely, the Goldbach conjecture and twin-prime conjecture. • Apply public crypto systems, in particular, RSA.

	Course Name: Industrial Mathematics **Course Code: BSCHMTMDSE602** **Course Name: Mathematical Modelling** **Course Code: BSCHMTMDSE603**	**Industrial Mathematics:** Understand the applications of mathematics in the field of industrial manufacturing. • Understand the theories behind the industrial inventions. • Understand the theories of the inverse problem, X-Rays and CT Scan **Mathematical Modelling:** Assess and articulate what type of modeling techniques are appropriate for a given physical system, • Construct a mathematical model of a given physical system and analyze it, • Make predictions of the behavior of a given physical system based on the analysis of its mathematical model.
	DSE-IV **Course Name: Differential Geometry** **Course Code: BSCHMTMDSE604** **Course Name: Bio Mathematics** **Course Code: BSCHMTMDSE605** **Course Name: Astronomy** **Course Code: BSCHMTMDSE606**	**Differential Geometry:** Explain the basic concepts of tensors. • Understand role of tensors in differential geometry. • Learn various properties of curves including Frenet-Serret formulae and their applications. • Know the Interpretation of the curvature tensor, Geodesic curvature, Gauss and Weingarten formulae. • Understand the role of Gauss's Theorema Egregium and its consequences. • Apply problem-solving with differential geometry to diverse situations in physics, engineering and in other mathematical contexts. **Bio Mathematics:** Grasp the idea of various bio-mathematical models and techniques which will help them to tackle physical world problems **Astronomy:** Ability to comprehend astronomical scales and understand basic concepts of positional, astronomy like astronomical coordinate system and measurement of distances, time and temperature and radius of star. • Understand basic parameters of stars like brightness, radiant flux, luminosity, magnitude, orbits, spectral classification. H-R diagram, • Understand astronomical techniques, various types of optical telescopes and telescope mountings. Various types of detectors and their use with telescopes. • Understanding Physics of sun and solar system: photosphere, chromosphere, corona, solar activity. Solar MHD, helioseismology, solar system and its origin.

Program Objectives and Course Outcomes for B.Sc. (Program) in Mathematics

Program	Program Objectives	Program Specific Objectives
B.Sc. (Program) in Mathematics	By enrolling into this program, the students become educated in mathematical basics, including numerical and computing techniques, thus, enabling them to be capable modelling real world problems in mathematics and solving them. The programme is oriented in such a way that it helps students to explore mathematical concepts, and enrich their knowledge in mathematics for application in other subjects.	**PSO1:** To make students familiar with the understandings of the basic principles of mathematics.
		PSO2: To help students to understand and model real life problems through mathematical equations and learn the requisite tools to solve and analyse them.
		PSO4: To help students to assimilate the knowledge of mathematics that is applied to any other branch of science in everyday use.
		PSO5: To provide an intellectually stimulating environment to develop skills and enthusiasms of students to the best of their potential.

Course Outcomes:

Course		Course Outcomes
Semester-I	**Core Course-I (1)** **Course Name: Differential Calculus Course** **Code: BSCPMTMC101**	• Understand limit, continuity, differentiability and partial differentiation. • Learn Rolle ’s Theorem, mean value theorems, maxima and minima, indeterminate forms and different applications of calculus.
Semester-II	**Core Course-I (2)** **Course Name: Differential Equations and Vector Calculus** **Course Code: BSCPMTMC201**	• Learn various methods to find the solutions of ordinary differential equations. • Understand the central concepts in vector calculus; vector-valued functions; gradient, divergence and curl.
Semester-III	**Core Course-I (3)** **Course Name: Algebra Course** **Code: BSCPMTMC301**	• Understand the concepts of different types of groups, rings and field. • Solve a system of non-homogeneous linear equations. • Understand the concepts of real vector space, sub-space and linear dependence and independence of a finite set of vectors.
	SEC-1 **Course Name: Mathematical Logic and Sets** **Course Code: BSCPMTMSE301**	• Understand about different propositions of logic, truth table, logical operators, various operations and relations related to sets
Semester-IV	**Core Course-I (4)** **Course Name: Real Analysis** **Course Code: BSCPMTMC401**	• Understand the basic concepts of mechanics with examples and applications of real world problems
	SEC-2 **Course Name: Boolean Algebra** **Course Code: BSCPMTMSE401**	• Understand Boolean algebra and Boolean functions, logic gates, switching circuits and their applications. • Apply a number of proof techniques to theorems in language design.

Semester-V	**DSE-I (1)** **Course Name: Mechanics** **Course Code: BSCPMTMDSE501** **Course Name: Numerical Analysis** **Course Code: BSCPMTMDSE502**	**Mechanics:** Apply a range of techniques to solve first & second order partial differential equations. • Model physical phenomena using partial differential equations such as the heat and wave equations **Numerical Analysis:** Understand the problem-solving skills using numerical methods, • Handle large system of equations, non-linearity and that are often impossible to solve analytically, • Solve differential equations by numerical methods.
	SEC-3 **Course Name: Number Theory Course Code: BSCPMTMSE501**	• Learn Lame's theorem, linear Diophantine equation, congruences, Goldbach conjecture, Euler's phi-function.
Semester-VI	**DSE-I (2)** **Course Name: Linear Programming Problems** **Course Code: BSCPMTMDSE601** **Course Name: Probability & Statistics** **Course Code: BSCPMTMDSE602**	**Linear Programming Problems:** Analyze and solve linear programming models of real-life situations. • Provide graphical solution of linear programming problems with two variables, and illustrate the concept of convex set and extreme points. • Solve linear programming problems using simplex method. • Learn techniques to solve transportation and assignment problems. **Probability & Statistics:** Understand the basic concepts on probability and statistics. • Understand the various probability distributions and their applications, mathematical expectation, moments.
	SEC-4 **Course Name: Graph Theory** **Course Code: BSCPMTMSE601**	• Appreciate the definition and basics of graphs along with types and their examples. • Understand the Eulerian circuits, Eulerian graphs, Hamiltonian cycles, representation of a graph by matrix. • Relate the graph theory to the real-world problems.