SARAT CENTENARY COLLEGE

Dhaniakhali, District-Hooghly, West Bengal

DEPARTMENT OF MATHEMATICS

PROGRAMME OFFERED B.Sc.(HONOURS) in MATHEMATICS

Under Choice Based Credit System (CBCS)

Model Reference: Syllabus for Mathematics (Honours), University of Burdwan,

Effective from 2017-2018

PROGRAMME OUTCOME (PO)

PO1: Students will cultivate scientific temper.

PO2: Students will acquire fundamental practical skills, technical knowledge, and in-depth domain expertise across different subjects.

PO3: Students will develop effective communication skills

PO4: Students will possess the foundational subject knowledge required for pursuing higher education, professional courses

PO5: Students will be able to formulate model from observation of specific real-world problems

PO6: Students will be prepared for life-long learning

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO1: Students will be familiar with different areas of Mathematics

PSO2: Students will construct abstract models using appropriate mathematical and statistical tools

PSO3: Students will be prepared to use Mathematics, not only in the discipline of Mathematics, but also in other disciplines and in their future endeavors

PSO4: Students will recognize what constitutes mathematical thinking, including the ability to produce and judge the validity of rigorous mathematical arguments

PSO5: Students will identify suitable existing methods of analysis, if any, and assess their strengths and weaknesses in the context of the problem being considered

PSO6: Students will develop the skills necessary to formulate and understand proofs and to provide justification

PSO7: Students will think critically and communicate clearly mathematical concepts and solutions to real-world problems

PSO8: Students will be able to solve problems using a broad range of significant mathematical techniques

PSO9: Students will engage their creativity in the quest for novel or elegant solutions

PSO10: Students will develop an understanding of the precise language of Mathematics

and be able to integrate mathematical arguments with their critical thinking skills

PSO11: Students will be life-long learners who are able to independently expand their mathematical or statistical expertise when needed

COURSE OUTCOME (CO):

SEMESTER-I

BMH1CC01: Calculus, Geometry, Differential Equations

CO1: Help to understand basic of Calculus and it's application such as knowledge about concavity, convexity, asymptotes, envelopes, asymptotes of a curve and tracing a curve

CO2: Derivation of reduction formula in Integral Calculus and gain knowledge to find arc length, area of surface evolution.

CO3: Help to learn the concept of Analytical Geometry as like: Reflection properties of conics, translation and rotation of axes, classification of conics using the discriminant, polar equations of conics , Spheres, Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, Generating lines, classification of quadrics.

CO4: Gain knowledge of solving first order Differential equations, types of solution of a differential equation, special integrating factors and transformations.

CO5: Use of software for studying curves and surfaces and solutions of Differential Equations.

BMH1CC02: Algebra

CO1: Introduction to Classical Algebra, Number Theory and Linear Algebra

CO2: Understanding basics of Algebra of Complex Numbers, solutions of polynomial equations and inequalities each of which is required for future courses.

CO3: Foundational knowledge in Classical Number Theory giving stress on some important results which will be used in future courses.

CO4: Elementary Knowledge in Linear Algebra is developed through problem solving and geometric interpretations of basic ideas.

SEMESTER-II

BMH2CC03: Real Analysis

CO1: Thorough and rigorous study of Real analysis begins with this course.

CO2: Foundation of Real Number System.

CO3: Primary knowledge in sequence of real numbers.

CO4: Introductory knowledge in series of real numbersgiving special attention to convergence tests which arerequiredfor futurecourses

BMH2CC04: Differential Equation and Vector Calculus

CO1: Advancement of the previous course in Ordinary Differential Equations (ODE) through theoretical aspects andapplicationsof them

CO2: Applications of Ordinary Differential equations in designing and solving problems in various branches of science

CO3: Using software to demonstrate the solutions of the equations studied in the course.

CO4: Introductory course in Vector Calculus.

SEMESTER-III

BMH3CC05: Theory of Real Functions & Introduction to Metric Space

CO1: Determine the limit, continuity and differentiability of functions defined on subsets of the real line.

CO2: Apply the Mean Value Theorem and the Fundamental Theorem of Calculus to problems in the context of real analysis.

CO3: Produce rigorous proofs of results that arise in the context of real analysis.

CO4: Understand and appreciate the concept of a metric space, Open Sets, Closed Sets and be able to recognize standard examples.

CO5: Enrich theoretical understanding of the concept of Derivative and its applications in the study of the geometric properties of curves.

CO6: Elaborate study of Taylor's series and Maclaurine's Series expansions of functions and their applications

CO7: As a beginning, Metric space is defined and examples of various metric spaces are given. Basic ideas in the topology of metric spaces are thoroughly discussed. Separable metric spaces are introduced.

BMH3CC06: Group Theory I

CO1: Introduction to Groups, Subgroups, Cyclic groups, External direct product and Group Homomorphism.

CO2: Special emphasis is given on examples of some important finite groups.

CO3: In depth study of Permutation Groups.

CO4: Proving Number theoretic results using Group Theory.
CO5: The course develops in proving the three Isomorphism Theorems and their applications.

BMH3CC07: Numerical Methods & Numerical Lab

CO1: Starts with the discussion of various approximation techniques

CO2: Using the techniques in interpolations, differentiations, integrations, solutions of system of linear algebraic equations and differential equations.

CO3: Introduction of C programming.

CO4: Development of skills in writing algorithms in C.
CO5: Using the skills in solving numerical problems through writing programmes and running them on computer.

BMH3SEC11: Logic & Sets

CO1: Concept of mathematical reasoning is discussed. As an introductory course in logic, basic concepts like connectives, predicate, and quantifiers etc. are explored.
CO2: All basic concepts of intuitive set theory are covered. Various operations on sets, partition, and various types of relations are discussed.

SEMESTER –IV

BMH4CC08: Riemann Integration and Series of Function

CO1: Introduces Riemann Integration and Series of Functions in this third course in Real Analysis
CO2: Riemann Integration is taught rigorously with special emphasis on Riemann Integrable functions which culminates in the proof of The Fundamental theorem of Integral Calculus.

CO3: Brief exposure to Improper Integration is given

CO5: Thoroughly introduces series of functions

CO6: Uniform convergence is taught in detail.
CO7: Short introductions are given to Fourier Series, Power Series and Weierstrass Approximation theorem

BMH4CC09: Multivariate Calculus

CO1: Analysis of the functions of several variables are rigorously taught.

CO2: Partial Derivatives, total differentiation, directional derivatives, gradient, tangent planes are discussed with geometric interpretations.

CO3: Double Integration and Triple Integration areintroducedandtheirapplicationsinfindingsurfaceareasofplaneregions and volumes of solids are discussed

CO4: Vector Field, Divergence, Curl and Line Integrals are introduced. Applications of line integrals in are

discussed.

CO5: Brief introductions to Green's Theorem, Stoke's Theorem and Divergence theorem are given.

BMH4CC10: Ring Theory and Linear Algebra I

CO1: Basic Ring Theory is introduced rigorously and the concepts of ideal, factor ring, prime ideal and maximal ideals are discussed giving emphasis on examples and problem solving.

CO2: Ring homomorphisms along with three Isomorphism Theorems are discussed in detail.

CO3: The concepts introduce in an informal manner in CC2 course of SEM-I, are discussed in a formal manner with the introduction of Vector Spaces and their properties which are rigorously discussed.

CO4: Linear Transformations and their properties along with their matrix representations are discussed rigorously.

BMH4SEC21: Graph Theory

CO1: The ideas of basic properties of graphs, pseudo-graphs, complete graphs, bi- partite graphs isomorphism of graphs are discussed

CO2:Some concepts of Eulerian circuits, Eulerian graph, semi-Eulerian graph, Hamiltonian cycles, Representation of a graph by a matrix and weighted graph are discussed

CO3 : Preliminary ideas on Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm are given.

SEMESTER –V

BMH5CC11: Partial Differential Equations & Applications

CO1: In this final course on Real Analysis, classification and various techniques of solving Partial Differential Equations are discussed.

CO2: Three widely used PDEs viz. Heat Equation, Wave Equation and Laplace Equation are derived and method for solving them are developed.

CO3: Applications of using PDEs in designing and solving physical problems like central force, constrained motion, Kepler's Law are discussed.

BMH5CC12: Mechanics I

CO1: The concepts of Co-planar forces, Astatic equilibrium, Friction, Equilibrium of a particle on a rough curve, Virtual work, Stable and unstable equilibrium and equilibrium of flexible string have been discussed.

CO2: Simple harmonic motion, Damped and forced vibrations, Motion of a projectile in a resisting medium. Motion of a particle under central force, Keplar's laws of motion, Motion under the inverse square law, Motion of artificial satellites is widely described.

CO3: The ideas about degrees of freedom, Moments and products of inertia, Momental Ellipsoid, Principal axes, D'Alembert's Principle, Motion of a rigid body in two dimensions under finite and impulsive forces, Conservation of momentum and energy are introduced.

BMH5DSE11: Linear Programming

CO1: This is a course on applied mathematics where application of linear algebra in Linear Programming is outlined.

CO2: Simplex method is thoroughly discussed.

CO3: Here students come to know how algorithms are used to solve problems and they see it work in transportation and assignment problems.

CO4: Brief introduction to Game theory is given through formulation and solution of two person zero sum games, games with mixed strategies.

BMH5DSE21: Probability & Statistics

CO1: Ideas on sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, mathematical expectation, moments, moment generating function are discussed.

CO2: The concepts of characteristic function and various distributions like uniform, binomial, Poisson, geometric, negative binomial, normal, exponential are introduced.

CO3: Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, linear regression for two variables are discussed.

CO4: Basic ideas on Chebyshev's inequality, law of large numbers, central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states are well discussed.

SEMESTER –VI

BMH6CC13: Metric Spaces and Complex Analysis

CO1: This second and final course in Metric Spaces, begins with sequences in metric spaces and gives natural introduction to Complete Metric Spaces. Continuity and Uniform continuity are discussed in detail.

CO2: Connectedness and Compactness are introduced. Theorems like Heine-Borel Property and FIP and their implications are discussed.

CO3: Homeomorphisms and Contraction mappings are introduced. Banach Fixed Point theorem is proved and its application in ODE are shown.

CO4: As an introductory course in Complex Analysis, all the basic concepts like limits, continuity, derivatives, integration sequences and series are thoroughly discussed.

BMH6CC14: Ring Theory and Linear Algebra II

CO1: In this second course in Ring Theory, being advanced in nature, polynomial rings are explored extensively and Unique Factorization Domain, Euclidean Domain are briefly discussed.

CO2: In this 2nd course in Linear Algebra, Dual Space and Inner Product Spaces are discussed in detail.

CO3: Basics of Linear Operator theory are developed and short introductions to orthogonal projection and Spectral theory are given.

BMH6DSE33: Group Theory II

CO1: This is an advanced course in Group Theory where students learnt the elementary concepts to select areas in group theory.

CO2: Automorphism Groups, Characteristic Subgroups, Commutator subgroups are introduced. CO3: Classification of finite groups, one of the important fields in group theory, is discussed.

CO4: Group Action, another important concept, is discussed in detail and it is used to Sylow's theorems and leads to determining simple groups with special emphasis on finite groups.

OR

BMH6PW01: Project Work

CO1: Individual Project Work is introduced in the CBCS curriculum and it is very appropriate to the current method of learning.

CO2: Each student is given a topic which explores a new idea closely related to what they have learnt so far in this programme under the guidance of a departmental faculty.

CO3: Students learn how to write a mathematical articles systematically. CO4: Students are also encouraged to make Power-Point presentations. CO5: Student’s understanding of the subject is enriched.

BMH6DSE43: Mechanics II

CO1: Mathematical interpretation of Newton’s laws of motion, Galilean transformation and understand limitations of Newton’s laws in solving problems.

CO2: Learn constraints and their classifications, Lagrange’s equation of motion for holonomic system, Gibbs- Appell’s principle of least constraint.

CO3: Understand equilibrium of fluid in a given field of force, equilibrium of floating bodies, pressure of heavy homogeneous liquid.

CO4: Study of convective equilibrium, stress and strain in continuum body.

Department of Mathematics

SARAT CENTENARY COLLEGE

Mapping/Co-relation Program Outcome(PO) & Course Outcome(CO)

(B.Sc. Mathematics Hons. Course)

CO Details	PO Details					
Course Name	PO1: Students will cultivate scientific temper	PO2: Students will acquire fundamental practical skills, technical knowledge, and in-depth domain expertise across different subjects	PO3: Students will develop effective communication skills	PO4: Students will possess the foundational subject knowledge required for pursuing higher education, professional courses	PO5: Students will be able to formulate model from observation of specific real-world problems	PO6: Students will be prepared for life-long learning
Calculus, Geometry & Differential Equations	√	√		√	√	√
Algebra	√	√		√	√	√
Real Analysis	√			√		√
Diff. Equn. and Vector Calculus	√	√		√	√	√
Theory of Real Functions & Introduction to Metric Spaces	√	√		√	√	√
Group Theory I	√			√	√	√
Num. Methods	√	√		√	√	√
Logic and Sets	√	√		√		√
Riemann Integration and Series of Functions	√			√		√
Multivariate Calculus	√	√		√	√	√
Ring Theory and Linear Algebra I	√			√		√
Graph Theory	√	√		√	√	√
Partial Diff.Equn. and Appln.	√	√		√	√	√
Mechanics I	√	√		√	√	√
Linear Programming	√	√		√	√	√
Probability & Statistics	√	√		√	√	√
Metric Spaces and Complex Analysis	√			√		√
Ring Theory and Linear Algebra II	√			√		√
Project Work	√	√	√	√	√	√
Mechanics II	√	√		√	√	√

SARAT CENTENARY COLLEGE

Dhaniakhali, District-Hooghly, West Bengal

DEPARTMENT OF MATHEMATICS

CO-PO for

B.Sc. General Programme (under CBCS)

SEMESTER – 1

BMG1CC1A : Differential Calculus

CO1: Students will be able to work with functions represented in various formats: graphically, numerically, analytically, and verbally, understanding the connections between these representations.

CO2: Students will understand the concept of the derivative as a rate of change and its application in local linear approximations. They will be able to utilize derivatives to solve a diverse range of problems.

CO3: Students will be able to explain the relationship between the derivative of a function as a function and its interpretation as the slope of the tangent line at a specific point.

CO4: Students will be able to identify and determine maxima, minima, critical points, and inflection points of functions, and analyze the concavity of curves.

CO5: Students will be able to apply these calculus techniques to solve and analyze various mathematical models.

SEMESTER – 2

BMG2CC1B Differential Equations

CO1: Solve first-order differential equations using graphical, numerical, and analytical methods.

CO2: Solve and apply linear differential equations of second order (and higher). Determine the complete solution of a non-homogeneous differential equation with constant coefficients using the method of variation of parameters.

CO3: Formulate partial differential equations (PDEs) by eliminating arbitrary constants and functions. Classify and transform PDEs into canonical form.

CO4: Recognize the major classifications of PDEs and understand the qualitative differences between these classes.

CO5: Solve linear and non-linear PDEs using various methods and apply these methods to solve relevant physical problems.

CO6: Develop the ability to apply differential equations to significant applied and/or theoretical problems.

SEMESTER – 3

BMG3CC1C Real Analysis

CO1: Students will understand the algebraic and order properties of real numbers, explore the concepts of countable and uncountable sets, including the uncountability of real numbers, and apply these concepts to other areas of higher mathematics.

CO2: Students will gain a solid understanding of bounded and unbounded sets, suprema and infima, the Completeness Axiom and its equivalent properties, the Archimedean Property, and the density property of real numbers, and apply these concepts to other areas of higher mathematics.

CO3: Students will investigate the properties of subsets of real numbers, including intervals, neighborhoods, interior points, limit points, isolated points, open sets, closed sets, derived sets, and compact sets in $\mathbb{R}$. They will prove the Bolzano-Weierstrass Theorem for sets and the Heine-Borel Theorem and be prepared to utilize these concepts in postgraduate studies.

CO4: Students will explore the properties of sequences of real numbers, including the concepts of limit of a sequence, limit inferior, limit superior, limit theorems, monotone convergence theorem, subsequences, the Monotone Subsequence Theorem, the Bolzano-Weierstrass Theorem for sequences, Cauchy sequences, and Cauchy's Convergence Criterion.

CO5: Students will understand the concepts of pointwise and uniform convergence of sequences and series of real-valued functions.

CO6: Students will understand and analyze power series, including their radius of convergence and the Cauchy-Hadamard theorem.

SEMESTER – 4

BMG4CC1D Algebra

CO1: Students will analyze and justify whether a given mathematical structure forms a group. They will understand the general properties of groups and their applications.

CO2: Students will understand and recognize the properties of various groups, including Dihedral groups, Quaternion groups, and permutation groups.

CO3: Students will understand the concepts of subgroups, cyclic subgroups, normal subgroups, quotient groups, and their examples. They will also be able to understand cosets, Lagrange's theorem, and its applications.

CO4: Students will understand the concept of the external direct product of a finite number of groups. They will be able to analyze Cauchy's theorem for finite abelian groups and its consequences.

CO5: Students will understand the concepts and properties of Normal Subgroups. They will prove Cayley's theorems for non-abelian groups and study their applicability.

CO6: Students will understand the structure and properties of different Rings. They will establish a conceptual connection between Rings and Groups.

CO7: Students will understand the concepts and properties of Subrings, Integral domains, and Fields, and the interconnections between them. They will understand the importance of the characteristic of a Ring and its usefulness for fields.

SEMESTER – 5

BMG5DSE1A1 Matrices

CO1: Transform a matrix into row-reduced echelon form, determine the rank of a matrix, and use these concepts to investigate the consistency and solutions of systems of linear equations.

CO2: Compute the inverse of a matrix and investigate the characterizations of invertible matrices.

CO3: Determine the Characteristic Equation of a matrix, prove the Cayley-Hamilton theorem, and apply this theorem to find the inverse of a matrix.

CO4: Acquire a thorough understanding of eigenvalues and eigenvectors of a matrix and apply these concepts in other branches of Mathematics and Mathematical Sciences.

CO5: Apply these techniques to solve and analyze various mathematical problems in Geometry, Physics, Chemistry, Combinatorics, and Statistics.

SEMESTER – 6

BMG6DSE1B3 Linear Programming

CO1: Students will be introduced to linear programming problems and their graphical solutions.

CO2: Students will gain knowledge about convex sets, basic and non-basic solutions, and the reduction of basic solutions from basic feasible solutions.

CO3: Students will analyze optimality conditions and unboundedness in linear programming.

CO4: Students will understand the Simplex method, Two-Phase method, Big-M method, and their comparative advantages.

CO5: Students will learn about duality in linear programming, including the formulation of the dual problem, primal-dual relationships, and the economic interpretation of the dual.