

**Government General Degree College, Singur
District Hooghly, West Bengal**

DEPARTMENT OF MATHEMATICS

PROGRAMME OFFERED: B.Sc.(HONOURS) in MATHEMATICS

UNDER CBCS

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

With effect from 2017-2018

The main components of this syllabus are as follows:

1. Core Course

2. Elective Course

3. Ability Enhancement Course

1. Core Course (CC)

A course that should compulsorily be studied by a candidate as a core requirement is termed as a core course.

2. Elective Course

2.1 Discipline Specific Elective (DSE) Course: A course, which may be offered by the main discipline/subject of study, is referred to as Discipline Specific Elective.

2.2 Generic Elective (GE) Course: An elective course, chosen generally from an unrelated discipline/subject of study with intention to seek an exposure, is called a Generic Elective Course.

3. Ability Enhancement Course (AEC)

The Ability Enhancement Course may be of two kinds:

3.1 Ability Enhancement Compulsory Course (AECC)

3.2 Skill Enhancement Course (SEC)

Details of Courses of B.A./B.Sc. (Honours) under CBCS

Course		Credit		Marks
1.	Core Course (14 papers)	Theory + Practical $14 \times (4+2) = 84$	Theory + Tutorial $14 \times (5+1) = 84$	$14 \times 75 = 1050$
2.	Elective Course (8Papers)			
	A.DSE(4Papers)	$4 \times (4+2) = 24$	$4 \times (5+1) = 24$	$4 \times 75 = 300$
	B.GE(4Papers)	$4 \times (4+2) = 24$	$4 \times (5+1) = 24$	$4 \times 75 = 300$
3.	Ability Enhancement Course			
	A.AECC (2 Papers) AECC1 (ENVS)	$4 \times 1 = 4$	$4 \times 1 = 4$	100
	AECC2(English/MIL)	$2 \times 1 = 2$	$2 \times 1 = 2$	50
	B.SEC(2Papers)	$2 \times 2 = 4$	$2 \times 2 = 4$	$2 \times 50 = 100$
	Total Credit:	142	142	Total Marks=1900

Semester-wise Course Structures

Semester	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total Class hrs./ week	Marks	Credit	
I	CC	BMH1CC01	Calculus, Geometry & Differential Equations	5:1:0	6	75	6	
		BMH1CC02	Algebra	5:1:0	6	75	6	
	AECC		Environmental Studies	4:0:0	4	100	4	
	GE		To be offered by other discipline.				6	
II	CC	BMH2CC03	Real Analysis	5:1:0	6	75	6	
		BMH2CC04	Differential Equations and Vector Calculus	5:1:0	6	75	6	
	AECC		English/Modern Indian Language	2:0:0	2	50	2	
	GE		To be offered by other discipline				6	
III	CC	BMH3CC05	Theory of Real Functions & Introduction to Metric Spaces	5:1:0	6	75	6	
		BMH3CC06	Group Theory-I	5:1:0	6	75	6	
		BMH3CC07	Numerical Methods & Numerical Methods Lab	4:0:2	8	75 (50+25)	6	
		Choose any one from the following courses for Skill Enhancement Courses (SECs).						
	SEC	BMH3SEC11	Logic and Sets	2:0:0	2	50	2	
		BMH3SEC12	Computer Graphics	2:0:0	2	50	2	
		BMH3SEC13	Object Oriented Programming in C++	2:0:0	2	50	2	
	GE		To be offered by other discipline				6	
IV	CC	BMH4CC08	Riemann Integration and Series of Functions	5:1:0	6	75	6	
		BMH4CC09	Multivariate Calculus	5:1:0	6	75	6	
		BMH4CC10	Ring Theory and Linear Algebra-I	5:1:0	6	75	6	
		Choose any one from the following courses for Skill Enhancement Courses (SECs)						
		BMH4SEC21	Graph Theory	2:0:0	2	50	2	

	SEC	BMH3SEC22	Operating System(Linux)	2:0:0	2	50	2
		BMH3SEC23	MATLAB Programming	2:0:0	2	50	2
	GE		To be offered by other discipline				6
V	CC	BMH5CC11	Partial Differential Equations and Applications	5:1:0	6	75	6
		BMH5CC12	Mechanics-I	5:1:0	6	75	6
	Choose any one from the following courses for Discipline Specific Electives						
	DSE	BMH5DSE11	Linear Programming	5:1:0	6	75	6
		BMH5DSE12	Number Theory	5:1:0	6	75	6
		BMH5DSE13	Point Set Topology	5:1:0	6	75	6
	Choose any one from the following courses for Discipline Specific Electives						
	DSE	BMH5DSE21	Probability & Statistics	5:1:0	6	75	6
		BMH5DSE22	Portfolio Optimization	5:1:0	6	75	6
		BMH5DSE23	Boolean Algebra and Automata Theory	5:1:0	6	75	6
VI	CC	BMH5CC13	Metric Spaces and Complex Analysis	5:1:0	6	75	6
		BMH5CC14	Ring Theory and Linear Algebra-II	5:1:0	6	75	6
	Choose any one from the following courses for Discipline Specific Electives						
	DSE	BMH6DSE31	Mathematical Modeling	5:1:0	6	75	6
		BMH6DSE32	Industrial Mathematics	5:1:0	6	75	6
		BMH6DSE33	Group Theory-II	5:1:0	6	75	6
	Choose any one from the following courses for Discipline Specific Electives						
	DSE	BMH6DSE41	Bio Mathematics	5:1:0	6	75	6
		BMH6DSE42	Differential Geometry	5:1:0	6	75	6
		BMH6DSE43	Mechanics-II	5:1:0	6	75	6
Optional Dissertation or project work in place of one Discipline Specific Elective (DSE) Paper							
PW	BMH6PW01	Project Work	0:0:6	6	75	6	

PROGRAMME OUTCOME (PO):

PO1: Choice Based Credit System (CBCS) was introduced in the session 2017-2018

PO2: CBCS has brought a radical change in the undergraduate teaching and learning

PO3: A student gets ample scope to pursue his/her areas of interest

PO4: Besides Mathematics as core subject a student can choose two elective courses of his/her choice as generic courses which help broaden his/her knowledge

PO5: In each semester students have to take 4/5 courses so that they can learn the subjects in a relaxed manner

PO6: Students have to take a compulsory course in Environmental Science so that they become aware of the major environmental issues

PO7: Students' language skills are nurtured in a compulsory language course

PO8: The holistic approach of the programme Enables a student to acquire theoretical as well as practical knowledge in his/her area of interest and also makes him/her a responsible citizen

PROGRAMME SPECIFIC OUTCOME (PSO):

PSO1: Foundation in basic Mathematics namely Algebra, Geometry and Analysis and their applications in various fields of knowledge are the main focus of the programme

PSO2: Instil analytical thinking

PSO3: Appreciation of interconnections among different branches of Mathematics

PSO4: Strengthen theoretical understanding through problem solving

PSO5: Acquire sufficient knowledge for pursuing higher studies in mathematics as well as other branches of science

COURSE OUTCOME(CO):

SEMESTER-I		
Course	Course Name	Course Outcome
CC-1	Calculus, Geometry & Differential Equations	CO1: Mainly recapitulation of what a student learnt in +2 level about each of the topics in this course CO2: Applications of Calculus in studying the properties of plane curves are shown through examples CO3: Study the properties of elementary plane curves in two dimensions and those of surfaces in three dimensions CO4: Introductory knowledge in Ordinary Differential Equations CO5: Use of software for studying curves and surfaces and solutions of Differential Equations
CC-2	Algebra	CO1: Introduction to Classical Algebra, Number Theory and Linear Algebra CO2: Understanding basics of Algebra of Complex Numbers, solutions of polynomial equations and

		<p>inequalities each of which is required for future courses</p> <p>CO3: Foundational knowledge in Classical Number Theory giving stress on some important results which will be used in future courses</p> <p>CO4: Elementary Knowledge in Linear Algebra is developed through problem solving and geometric interpretations of basic ideas</p>
SEMESTER-II		
Course	Course Name	Course Outcome
CC-3	Real Analysis	<p>CO1: Thorough and rigorous study of Real analysis begins with this course</p> <p>CO2: Foundation of Real Number System</p> <p>CO3: Introductory knowledge in sequence of real numbers</p> <p>CO4: Introductory knowledge in series of real numbers giving special attention to convergence tests which are required for future courses</p>
CC-4	Differential equations & Vector Calculus	<p>CO1: Advancement of the previous course in Ordinary Differential Equations through theoretical aspects and applications of them</p> <p>CO2: Applications of Ordinary Differential equations in designing and solving problems in various branches of science</p> <p>CO3: Using software to demonstrate the solutions of the equations studied in the course</p> <p>CO4: Introductory course in Vector Calculus</p>
SEMESTER-III		
Course	Course Name	Course Outcome
CC-5	Theory of Real Functions & Introduction to Metric Spaces	<p>CO1: This, being a second course in Real Analysis, introduces Continuity, Differentiability and applications along with Taylor's Series</p> <p>CO2: Limits and Continuity are thoroughly studied giving sufficient knowledge of theoretical aspects and use them in problem solving</p> <p>CO3: Introduction to Uniform Continuity</p> <p>CO4: Enrich theoretical understanding of the concept of Derivative and its applications in the study of the</p>

		<p>geometric properties of curves</p> <p>CO5: Elaborate study of Taylor's series and Maclaurine's Series expansions of functions and their applications</p> <p>CO6: 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.</p>
CC-6	Group Theory-I	<p>CO1: Introduction to Groups, Subgroups, Cyclic groups, External direct product and Group Homomorphism.</p> <p>CO2: Special emphasis is given on examples of some important finite groups</p> <p>CO3: In depth study of Permutation Groups</p> <p>CO4 Proving Number theoretic results using Group Theory</p> <p>CO5: The course culminates in proving the three Isomorphism Theorems and their applications</p>
CC-7	Numerical Methods & Numerical Methods Lab	<p>CO1: Discussion of various approximation techniques</p> <p>CO2: Using the techniques in interpolations, differentiations, integrations, solutions of system of linear algebraic equations and differential equations</p> <p>CO3: Introduction of C programming</p> <p>CO4: Development of skills in writing algorithms in C</p> <p>CO5: Using the skills in solving numerical problems through writing programmes and running them on computer</p>
SEC-1	Logic and Sets	<p>CO1: Concept of mathematical reasoning is discussed. As an introductory course in logic, basic concepts like connectives, predicate, and quantifiers etc. are explored.</p> <p>CO2: All basic concepts of intuitive set theory are covered. Various operations on sets, partition, and various types of relations are discussed.</p>
SEMESTER-IV		
Course	Course Name	Course Outcome
CC-8	Riemann Integration & Series of Functions	<p>CO1: Introduces Riemann Integration and Series of Functions in this third course in Real Analysis</p> <p>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</p>

		<p>CO3: Brief exposure to Improper Integration is given</p> <p>CO5: Thoroughly introduces series of functions</p> <p>CO6: Uniform convergence is taught in detail</p> <p>CO7: Short introductions are given to Fourier Series, Power Series and Weierstrass Approximation theorem</p>
CC-9	Multivariable Calculus	<p>CO1: Analysis of the functions of several variables are rigorously taught</p> <p>CO2: Partial Derivatives, total differentiation, directional derivatives, gradient, tangent planes are discussed with geometric interpretations</p> <p>CO3: Double Integration and Triple Integration are introduced and their applications in finding surface areas of plane regions and volumes of solids are discussed</p> <p>CO4: Vector Field, Divergence, Curl and Line Integrals are introduced. Applications of line integrals in finding mass and work are discussed</p> <p>CO5: Brief introductions to Green's Theorem, Stoke's Theorem and Divergence theorem are given</p>
CC-10	Ring Theory & Linear Algebra-I	<p>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</p> <p>CO2: Ring homomorphisms along with three Isomorphism Theorems are discussed in detail</p> <p>CO3: The concepts introduced in an informal way in CC2, are discussed in a formal manner with the introduction of Vector Spaces and their properties which are rigorously discussed</p> <p>CO4: Linear Transformations and their properties along with their matrix representations are discussed rigorously</p>
SEC-2	Graph Theory	<p>CO1: The ideas of basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs isomorphism of graphs are discussed</p> <p>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</p> <p>CO3 : Preliminary ideas on Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, arshall algorithm are given</p>
SEMESTER-V		
Course	Course Name	Course Outcome

CC-11	Partial Differential Equations and Applications	<p>CO1: In this final course on Real Analysis, classification and various techniques of solving Partial Differential Equations are discussed</p> <p>CO2: Three widely used PDEs viz. Heat Equation, Wave Equation and Laplace Equation are derived and method for solving them are developed</p> <p>CO3: Applications of using PDEs in designing and solving physical problems like central force, constrained motion, Kepler's Law are discussed</p>
CC-12	Mechanics I	<p>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.</p> <p>CO2: Simple harmonic motion, Damped and forced vibrations, Motion of a projectile in a resisting medium. Motion of a particle under central force, Kepler's laws of motion, Motion under the inverse square law, Motion of artificial satellites is widely described.</p> <p>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.</p>
DSE-1	Linear Programming	<p>CO1: This is a course on applied mathematics where application of linear algebra in Linear Programming is outlined.</p> <p>CO2: Simplex method is thoroughly discussed.</p> <p>CO3: Here students come to know how algorithms are used to solve problems and they see it work in transportation and assignment problems</p> <p>CO3: Brief introduction to Game theory is given through formulation and solution of two person zero sum games, games with mixed strategies</p>
DSE-2	Probability and Statistics	<p>CO1 : Ideas on sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, mathematical expectation, moments, moment generating function are discussed</p> <p>CO2: The concepts of characteristic function and various distributions like uniform, binomial, Poisson, geometric, negative binomial, normal, exponential are introduced</p> <p>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</p>

		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		
Course	Course Name	Course Outcome
CC-13	Metric Spaces & Complex Analysis	<p>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.</p> <p>CO2: Connectedness and Compactness are introduced. theorems like Heine-Borel Property and FIP and their implications are discussed</p> <p>CO3: Homeomorphisms and Contraction mappings are introduced. Banach Fixed Point theorem is proved and its application in ODE are shown</p> <p>CO4: As an introductory course in Complex Analysis, all the basic concepts like limits, continuity, derivatives, integration sequences and series are thoroughly discussed.</p>
CC-14	Ring Theory and Linear Algebra-II	<p>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</p> <p>CO2: In this second course in Linear Algebra, Dual Space and Inner Product Spaces are discussed in detail</p> <p>CO3: Basics of Linear Operator theory are developed and short introductions to orthogonal projection and Spectral theory are given</p>
DSE-3	Group Theory II	<p>CO1: This is an advanced course in Group Theory where students learn to use the elementary concepts to select areas in group theory.</p> <p>CO2: Automorphism Groups, Characteristic Subgroups, Commutator subgroups are introduced</p> <p>CO3: Classification of finite groups, one of the important fields in group theory, is discussed.</p> <p>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</p>
DSE-4	Project Work	CO1: Project Work is introduced in the CBCS and it is

very pertinent 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 supervisor

CO3: Students learn how to write a mathematical article systematically

CO4: Students are also encouraged to make Power Point presentations

CO5: Student's understanding of the subject is enriched