BARASAT GOVT COLLEGE

UNDER GRADUATE DEPARTMENT OF MATHEMATICS

B.Sc. Mathematics (Hons) CBCS Syllabus

With effect from 2018-19

Programme Specific Outcomes

➢ Bachelor's degree in mathematics is the culmination of in-depth knowledge of algebra, calculus, geometry, differential equations and several other branches of mathematics. This also leads to study of related areas like computer science, Financial Mathematics, statistics and many more. Thus, this programme helps learners in building a solid foundation for higher studies in mathematics.

➢ The skills and knowledge gained has intrinsic beauty, which also leads to proficiency in analytical reasoning. This can be utilised in modelling and solving real life problems. Students undergoing this programme learn to logically question assertions, to recognise patterns and to distinguish between essential and irrelevant aspects of problems.

➢ They also share ideas and insights while seeking and benefitting from knowledge and insight of others. This helps them to learn behave responsibly in a rapidly changing interdependent society.

➢ Students completing this programme will be able to present mathematics clearly and precisely, make vague ideas precise by formulating them in the language of mathematics, describe mathematical ideas from multiple perspectives and explain fundamental concepts of mathematics to non-mathematicians.

➢ Completion of this programme will also enable the learners to join teaching profession in primary and secondary schools. This programme will also help students to enhance their employability for government jobs, jobs in banking, insurance and investment sectors, data analyst jobs and jobs in various other public and private enterprises.

BARASAT GOVERNMENT COLLEGE
Course Outcome or Learning Outcome
Three year B.A. /B.Sc. degree course
Under CBCS semester system
HONOURS COURSE IN MATHEMATICS
With effect from the session: 2018 – 2019

Course Name:	**Core Course-1**
Course Code:	**MTMACOR01T**
Topic Name:	**Calculus, Geometry and Ordinary Differential Equation**

Course Outcome: After successful completion of this course students will be able to:
1) Sketch curves in Cartesian and polar coordinate systems.
2) Learn reduction formulae, derivations and illustrations of reduction formulae for the integration.
3) Solve problem related to arc length, arc length of parametric curves, area of surface of revolution.
4) Understand how to analyze and synthesize given data to solve problems in geometry.
5) Understand the basic ideas of conics and explain the ideas of conics and their various applications.
6) Explain the basics of differential equations and mathematical modelling. They will learn the general, particular, explicit, implicit and singular solutions of a differential equation.

Course Name:	**Core Course-2**
Course Code:	**MTMACOR02T**
Topic Name:	**Algebra**

Course Outcome: After successful completion of this course students will be able to
1. Learn elementary complex numbers and its properties, theory of equations along with solving techniques of cubic & bi-quadratic algebraic equation and inequality with special emphasis on the relation AM, GM & HM.
2. Learn the integers in detail along with the elementary principles such as 'well ordering principle', 'principle of induction', 'division algorithm' etc. and also some important concepts such as congruence, properties of prime numbers, fundamental theorem of arithmetic etc.
3. Learn relations and mapping along with the concept of equipotent sets and cardinality.
4. Learn matrix, its inverse, rank of the matrix, concept of eigen value and eigen vectors.
5. Learn to solve a system of linear equations: homogeneous as well as non-homogeneous and also the consistency in terms of linear independence and dependence.

Course Name:	**Core Course-3**
Course Code:	**MTMACOR03T**
Topic Name:	**Real Analysis**

Course Outcome: This course will enable the students to:
(i) understand the Real number system in detail, e.g., open and closed sets, limit point of a set, concept of Infimum, Supremum, Archimedian properties, etc., and several topological properties.
(ii) gather deep concept of Sequence and Infinite series of real numbers together with graphical interpretations, e.g., convergence and divergence of sequence and series using several Mathematical tools and computation of limits of sequence and series.

Course Name:	**Core Course-4**
Course Code:	**MTMACOR04T**
Topic Name:	**Differential Equation and Vector Calculus**

Course Outcome: After successful completion of this course students will be able to
1. Learn existence and uniqueness of a differential equation.
2. Learn second order differential equations, concept of Wronskian and its solution by the method of variation of parameters as well as operator methods.
3. Learn the power series solution to the differential equation about an ordinary point.
4. Learn dynamical system, concept of phase plane and equilibrium point.
5. Learn vector triple product and some basic vector calculus such as differentiation and integration of vector functions.

Course Name: Core Course-5
Course Code: MTMACOR05T
Topic Name: Theory of Real Functions

Course Outcome: After successful completion of this course students will be able to:
(1) Understand many properties of the real line $\mathbb{R}$ and learn to define sequence in terms of functions from $\mathbb{R}$ to a subset of $\mathbb{R}$.
(2) Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.
(3) Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.
(4) handle fundamental properties of the real numbers that lead to the formal development of real analysis and understand limits and their use in sequences, series, continuity and differentiation. Students will appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems.

Course Name: Core Course-6
Course Code: MTMACOR06T
Topic Name: Group Theory-I

Course Outcome: This course will enable the students to:
(i) understand the Group of Symmetry, Dihedral Group, Permutation Group via several examples.
(ii) gather knowledge about basic properties of Group, Subgroups, Cyclic Groups, Normal subgroups via a lot of examples.
(iii) understand the deep concept of permutation.
(iv) understand the basic concept of External direct product of Groups with many examples.
(v) understand the Group homomorphisms deeply with a lot of examples and its consequences.

Course Name: Core Course-7
Course Code: MTMACOR07T & MTMACOR07P
Topic Name: Numerical Methods

Course Outcome: After successful completion of this course students will be able to:
1) Obtain numerical solutions of algebraic and transcendental equations.
2) Find numerical solutions of system of linear equations and to check the accuracy of the solutions.
3) Learn about various interpolating and extrapolating methods to find numerical solutions.
4) Solve initial and boundary value problems in differential equations using numerical methods.
5) Apply various numerical methods in real life problems.
6) Obtain numerical solutions of algebraic and transcendental equations in programing language C.
7) Find numerical solutions of system of linear equations and check the accuracy of the solutions in programing language C.
8) Learn about various interpolating and extrapolating methods in programing language C.
9) Solve initial and boundary value problems in differential equations using numerical methods in programing language C.

Course Name: Core Course-8
Course Code: MTMACOR08T
Topic Name: Riemann Integration and Series of Functions

Course Outcome: After successful completion of this course students will be able to:
(1) Demonstrate knowledge of the concepts and theorems of Riemann Integration and to apply them in solving advanced integration problems. They will master basic Calculus concepts, including integration techniques, improper integrals, convergence of integrals and the convergence of sequence and the series of function.
(2) Apply of some simple techniques for testing the convergence of sequences and series of functions, and confidence in applying them.
(3) Apply Calculus concepts to solve physics, geometry and numerical approximation problems.
(4) Students will understand the usage of proper mathematical notation in relation to the above topics and learn some of the applications of the fundamental theorems of integration.

Course Name: **Core Course-9**
Course Code: **MTMACOR09T**
Topic Name: **Multivariate Calculus**

Course Outcome: After successful completion of this course students will be able to
1. Learn the calculus of several variables such as functions, limit, continuity, partial derivatives, directional derivatives, chain rules, differentiation of the functions of two & three variables and extrema.
2. Learn double and triple integrals along with various applications.
3. Learn the vector fields, curl, divergence and line integrals with applications.
4. Learn Green's, Stoke's and Guass divergence theorem with technique to solve various problems.

Course Name: **Core Course-10**
Course Code: **MTMACOR10T**
Topic Name: **Ring Theory and Linear Algebra I**

Course Outcome: After successful completion of this course students will be able to:
(1) Write precise and accurate mathematical objects in ring theory;
(2) Know the fundamental concepts in ring theory such as the concepts of ideals, quotient rings, integral domains, and fields and the concept of ring homomorphism.
(3) Understand the basic ideas of vector algebra: linear dependence and independence and spanning;
(4) Know how to find the row space, column space and null space of a matrix, and be familiar with the concepts of dimension of a subspace and the rank and nullity of a matrix, and to understand the relationship of these concepts to associated systems of linear equations;
(5) Be familiar with the notion of a linear transformation and its matrix.

Course Name: **Core Course-11**
Course Code: **MTMACOR11T**
Topic Name: **Partial Differential Equations, Applications of Ordinary Differential Equations**

Course Outcome: After successful completion of this course students will be able to
1. Learn some important topics such as central force, constrained motion, varying mass, tangent and normal acceleration and planetary motion from the field of particle dynamics and solving technique of various problems as the applications of ordinary differential equations.
2. Learn first order partial differential equations, construction, the canonical forms, solving the quasi linear pde by using the method of characteristics, solution of first order pde by the method of separation of variables.
3. Learn to form heat equation, wave equation and Laplace equation in one and three dimensions and to solve those by the method of separation of variables.
4. Learn to classify of second order linear equations as hyperbolic, parabolic or elliptic and technique of reduction to their canonical forms.
5. Get acquainted with Cauchy problem, its uniqueness and applications to various problems such as infinite & semi-infinite strings (with homogeneous and non-homogeneous initial and boundary conditions).

Course Name: **Core Course-12**
Course Code: **MTMACOR12T**
Topic Name: **Group Theory II**

Course Outcome: After successful completion of this course students will be able to:
(1) Apply the concept of Automorphisms for constructing new groups from the given group. The knowledge of automorphism helps them to study more on field theory.
(2) Learn on direct products, group actions , class equations and their applications with proof of all results . This course helps them to opt for more advanced courses in algebra and linear classical groups.
(3) External direct product applies to data security and electric circuits.
(4) Recognize and use the Sylow's theorems to characterize certain finite groups and their applications to check non-simplicity of finite groups.

Course Name: **Core Course-13**
Course Code: **MTMACOR13T**
Topic Name: **Metric spaces and Complex Analysis**

Course Outcome: This course will enable the students to:
(i) understand the concept of Abstract Analysis through Metric Spaces.
(ii) understand the topological properties of metric spaces.
(iii) understand about convergence and divergence of sequences abstractly in Metric spaces.
(iv) Understand the concept of the Fixed Point Theorem (Banach) in metric spaces and its applications.
(v) understand deeply the complex number system and its topological properties in Complex Analysis.
(vi) understand the limit, derivative of complex-valued functions of complex variables and computation of them.
(vii) understand Analytic functions and their properties.
(viii) understand Sequence and series (Laurent series, power series) and their convergence with several examples.
(ix) understand the concept of complex integration, specially Contour integral and their computation and applications.

Course Name: **Core Course-14**
Course Code: **MTMACOR14T**
Topic Name: **Ring Theory and Linear Algebra II**

Course Outcome: After successful completion of this course students will be able to:
(1) Write precise and accurate mathematical objects in ring theory.
(2) Know the fundamental concepts in ring theory such as the concepts of ideals, quotient rings, integral domains, Euclidean domains, unique factorization domains and fields.
(3) Learn in detail about polynomial rings.
(4) Check the irreducibility of higher degree polynomials over rings.
(5) Have an understanding of matrices, and their representation of linear transformations of vector spaces, including change of basis.
(6) Understand the beginnings of the theory of eigenvectors and eigenvalues and appreciate the applications of diagonalizability.
(7) Find canonical form of linear transformations.
(8) Obtain various variants of diagonalization of linear transformations.
(9) Apply Cauchy-Schwarz inequality for deriving metric on inner product spaces and obtain orthonormal basis using Gram-Schmidt orthogonalization.

Course Name: **Discipline Specific Elective-1**
Course Code: **MTMADSE01T**
Topic Name: **Linear Programming Problem**

Course Outcome: After successful completion of this course students will be able to:
1) Analyze and solve linear programming models of real life situations.
2) Provide graphical solutions of linear programming problems with two variables, and illustrate the concept of convex set and extreme points.
3) Understand the theory of the simplex method.
4) Know about the relationships between the primal and dual problems, and to understand sensitivity analysis.
5) Learn about the applications to transportation, assignment and two-person zero-sum game problems.

Course Name: **Discipline Specific Elective-2**
Course Code: **MTMADSE03T**
Topic Name: **Probability & Statistics**

Course Outcome: This course will enable the students to:
1) Understand distributions in the study of the joint behaviour of two random variables.
2) Establish a formulation helping to predict one variable in terms of the other that is, correlation and linear regression.
3) Understand central limit theorem, which establish the remarkable fact that the empirical frequencies of so many natural populations, exhibit a bell shaped curve.
4) Know about Markov Chains, Chapman-Kolmogorov equations and classification of states.
5) Perceive the characteristics of sample data using various methods of statistical measurements.

Course Name: **Discipline Specific Elective-3**
Course Code: **MTMADSE04T**
Topic Name: **Theory of Equations**

Course Outcome: After successful completion of this course students will be able to:
(1) Describe the relation between roots and coefficients
(2) Find the sum of the power of the roots of an equation using Newton's Method.
(3) Transform the equation through roots multiplied by a given number, increase the roots, decrease the roots, removal of terms
(4) Solve the reciprocal equations.
(5) Analyze the location and describe the nature of the roots of an equation.

Course Name: **Discipline Specific Elective-4**
Course Code: **MTMADSE06T**
Topic Name: **Mechanics**

Course Outcome: After successful completion of this course students will be able to
1. Learn problem solving technique in the field of Analytical Statics with topics: Co-planar forces, Astatic equilibrium, friction, equilibrium of a particle on a rough curve, virtual work, forces in three dimensions, general conditions of equilibrium, centre of gravity for different bodies, stable and unstable equilibrium.
2. Learn rotating axes, motion of a projectile in a resisting medium, stability of nearly circular orbits, motion under the inverse square law, various cases on slightly disturbed orbits, motion of artificial satellites, particle in three dimensions, motion on a smooth sphere, cone, and on any surface of revolution.
3. Learn Rigid Dynamics with special emphasis on problem solving on the following topics: degrees of freedom, moments and products of inertia, principal axes, D'Alembert's principle, motion about a fixed axis, compound pendulum, motion of a rigid body in two dimensions under impulsive forces, conservation of momentum and energy.

Course Name: **Skill Enhancement Course-1**
Course Code: **MTMSSEC01M**
Topic Name: **C- Programming**

Course Outcome: 1) Theoretical study of C Language
2) HLL VS C Similarity
3) History of H.L. Language Revolution
4) Problem based C Coding
5) Practical Problem solving

Course Name: **Skill Enhancement Course-2**
Course Code: **MTMSSEC02M**
Topic Name: **Logic and Sets**

Course Outcome: 1) Definition for Logic
2) Study Materials supplied
3) Study Videos are supplied
4) Class test Performance are good
5) Lsst session the full class was online and successful.

BARASAT GOVERNMENT COLLEGE
Course Outcome or Learning Outcome
Three year B.A. /B.Sc. degree course
Under CBCS semester system
GENERAL COURSE IN MATHEMATICS
With effect from the session: 2018 – 2019

Course Name: **Generic Elective/Department Specific Core Course-1**
Course Code: **MTMHGEC01T / MTMGCOR01T**
Topic Name: **Differential Calculus**

Course Outcome: This course will enable the students to:
1) Calculate the limit and examine the continuity and understand the geometrical interpretation of differentiability.
2) Understand the consequences of various mean value theorems and compute maxima-minima and indeterminate forms.
3) Draw curves in Cartesian and polar coordinate systems.
4) Understand the concept of successive differentiation, partial differentiation and homogeneous functions.
5) Understand and compute the Tangents and Normals, Curvature, Asymptotes, Singular points.

Course Name: **Generic Elective/Department Specific Core Course-2**
Course Code: **MTMHGEC02T / MTMGCOR02T**
Topic Name: **Differential Equation**

Course Outcome: 1) Understand the genesis of ordinary as well as partial differential equations.
2) Learn various techniques of getting exact solutions of certain solvable first order differential equations and linear differential equations of second order.
3) Understand Wronskian, and its properties. Learn about the method of variation of parameters, the Cauchy-Euler equation, Simultaneous differential equations and Total differential equations.
4) Learn about solution of first order linear partial differential equations using Lagrange's method and non-linear partial differential equations using Charpit's method.
5) Know how to classify second order partial differential equations into elliptic, parabolic and hyperbolic.
6) (i) study Materials supplied in online mode (ii) Video lectures are also supplied (iii) Problem's Origin has been described (iv) Problem based lectures are given in online mode (v) Different Problem has been understood by the students.

Course Name: **Generic Elective/Department Specific Core Course-3**
Course Code: **MTMHGEC03T / MTMGCOR03T**
Topic Name: **Real Analysis**

Course Outcome: This course will enable the students to:
(i) understand the Real number system, e.g., open and closed sets, limit point of a set, concept of Infimum, Supremum, Archimedian properties, etc., and some topological properties.
(ii) gather concept of Sequence and Infinite series of real numbers, e.g., convergence and divergence of sequence and series using several Mathematical tools and computation of limits of sequence and series.
(iii) gather concepts of sequence and series of functions, e.g., pointwise and uniform convergence of sequence and series of functions using several mathematical tools and computation of limits of sequence and series of functions.

Course Name: **Generic Elective/Department Specific Core Course-4**
Course Code: **MTMHGEC04T / MTMGCOR04T**
Topic Name: **Algebra**

Course Outcome: This course will enable the students to:
(i) understand Binary relations and functions sufficiently.
(ii) understand the concept of Group, Cyclic group, General Linear group, Group of symmetries, permutation group, subgroup together with basic properties and examples.
(iii) understand the concept of Ring, Subring, Ideal, Integral Domain, Field together with their basic properties and examples.

Course Name: **Department Specific Elective-1**
Course Code: **MTMGDSE01T**
Topic Name: **Matrices**

Course Outcome: After successful completion of this course students will be able to

1. Learn vector spaces over R, standard basis and concept of Linear Independence and dependence.

2. Learn various properties of matrices including inverse, rank, concept of eigen values and eigen vectors and diagonalization of a matrix.

3. Learn to solve a system of linear equations by the matrix method.

Course Name: **Department Specific Elective-2**
Course Code: **MTMGDSE04T**
Topic Name: **Linear Programming**

Course Outcome: This course will enable the students to:

1) Analyze and solve linear programming models of real life situations.

2) Provide graphical solutions of linear programming problems with two variables, and illustrate the concept of convex set and extreme points.

3) Understand the theory of the simplex method, two-phase method, Big-M method and their comparison.

4) Know about the relationships between the primal and dual problems, and to understand economic interpretation of the dual and sensitivity analysis.