HERAMBA CHANDRA COLLEGE
DEPARTMENT OF MATHEMATICS

Programme B.Sc. Mathematics (GENERAL)

Table 1 Programme Outcomes (PO) on completing B.Sc. (General)

Sl. No.	Programme Outcomes
Critical Thinking (PO1)	This outcome involves training students to think critically and independently. Critical thinking skills help graduates make informed decisions and solve problems effectively.
Problem-solving (PO2)	B.Sc programmes should equip students with problem-solving skills. Graduates should be capable of identifying complex issues, analysing root causes, and proposing effective solutions. This skill is valuable in both personal life and professional careers.
Interdisciplinary Knowledge (PO3)	Depending on their chosen major, minor and interdisciplinary subjects within the B.Sc programme, students should develop expertise in their specific area of study, whether it's statistics, computer science, economics, or another field. This specialized knowledge provides depth in their chosen discipline.
Employability (PO4)	On graduating, the students will be eligible for employment in the field of education and other industries like analytics, pharmaceuticals etc. Their skills in comprehension of general social phenomena around them place them in an ideal situation for such jobs. They will also be able to appear for competitive examinations conducted for public sector jobs.

HERAMBA CHANDRA COLLEGE
DEPARTMENT OF MATHEMATICS

Table 2 Programme Specific Objectives (PSO) on completing B.Sc. Mathematics (General)

SL No.	On completing B.Sc. Mathematics, the students will be able to
PSO 1	Students of Mathematics will be acquainted with the concept, factors, methods and historical development of Mathematics.
PSO 2	Students can gather knowledge about Mathematics and explain the application of Mathematics in different fields.
PSO 3	They will understand the importance of Mathematics and their uses in real life.
PSO 4	Develop essential knowledge and skill of planning and management which is an essential part of Mathematics.
PSO 5	They will understand the concept and application of modern technological development and will get acquainted with the curriculum development, inclusiveness and process of evaluation and its implementation in the field of Mathematics.
PSO 6	Understand and apply the concept and will develop skill in analyzing descriptive measures in Mathematics.

///

Course Outcomes (CO) are mapped to the revised Bloom's Taxonomy using the following abbreviations:

R: Remembering

U: Understanding

Ap: Applying

An: Analysing

E: Evaluating

C: Creating

HERAMBA CHANDRA COLLEGE
DEPARTMENT OF MATHEMATICS

Semester- I (July to December)

Programme	B.Sc. Mathematics (General)
paper Code	MG(GE1)101
GE1	Introduction to Mathematics
Year and Semester	1st year 1st semester
Prerequisite Course	Nil
Course Objective	Knowledge of Introduction to Mathematics

Table 3 Course Outcome (CO) on completing Unit-1 to Unit-4

Units as given in syllabus of CU	Course Outcome	On completing the course, the student will be able to:	PSO Addressed	Cognitive level
Unit-1 Algebra 1	CO1	Gain a basic idea of the meaning and understand the nature, scope and aims of Mathematics.	1 and 3	R, U, An, Ap
Unit-2 Diff Calculus 1	CO2	Explain the factors of Mathematics and their interrelationship.	1 and 3	R, U, An, Ap
Unit-3 Diff Equ 1	CO3	Become aware of different aspects of Mathematics that influence Mathematics.	1 and 3	R, U, An, Ap
Unit-4 Coordinate geometry	CO4	Be acquainted with the concept in Mathematics.	1 and 3	R, U, An, Ap

Table 4

	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1					3	3	3	3	2	3
CO2					3	3	3	3	2	3
CO3					3	3	3	3	2	3
CO4					3	3	3	3	2	3
Average										
Correlation level	1-Low (40%<Achievement<50%), 2- Medium (50%<Achievement<60%), 3- High (60%<Achievement)									

HERAMBA CHANDRA COLLEGE
DEPARTMENT OF MATHEMATICS

Mathematics - I
Semester: I
Core Course-1A
Paper Code: MG(GE1)101

Total Marks: 100 [Theory (Th) 65 + Tutorial (Tu) 15 + Internal Assessment 10+Attendance: 10] Total Credits: [5(Th)+1(Tu)]=6 , No. of Lecture hours (Theory): 75, No. of Tutorial contact hours:15

Table 5				
Units of the Course	Content	Lecture No	Faculty	Date and sign
Unit-1	**Complex Numbers:** De Moivre's Theorem and its applications. Definition of a^z $(a \neq 0)$. Inverse circular and Hyperbolic functions. **Polynomials:** Polynomials with real coefficients, the n^{th} degree polynomial equation has exactly n roots. **Statements:** (i) If a polynomial $f(x)$ has opposite signs for two real values a and b of x, the equation $f(x) = 0$ has odd number of real roots between a and b. If $f(a)$ and $f(b)$ are of same sign, either no real root or an even number of roots lies between a and b. (ii) Rolle's Theorem and its direct applications. **Rank of a matrix:** Determination of rank either by considering minors or by sweep-out process. Consistency and solution of a system of linear equations with not more than 3 variables by matrix method.	2 2 3 2	SR, AS, AM	
Unit-2	**Number System:** Rational numbers, Geometrical representations, Irrational number, Real number represented as point on a line Linear Continuum. **Real-valued functions:** Limit of a function (Cauchy's definition). Continuity of a function at a point and in an interval. Statement of existence of inverse function of a strictly monotone function and its continuity. **Derivative:** Geometrical and physical interpretation of derivative. Sign of derivative-Monotonic increasing and decreasing functions. Differential application in finding approximation.	3 3 3 4 3 4		

	Successive derivative - Leibnitz's theorem and its application. **Functions of two and three variables:** Their geometrical representations. Limit and Continuity (definitions only) for function of two variables. Partial derivatives. chain Rule. Exact differentials. Functions of two variables - Successive partial Derivatives: Statement of Schwarz's Theorem on Commutative property of mixed derivatives. Euler's Theorem on homogeneous function of two and three variables. **Applications of Differential Calculus:** Curvature of plane curves. Rectilinear Asymptotes (Cartesian only). Envelope of family of straight lines and of curves (problems only). Definitions and examples of singular points (Viz. Node. Cusp, Isolated point).			
Unit -3	**Ordinary differential equation:** Order, degree and solution of an ordinary differential equation (ODE) in presence of arbitrary constants, Formation of ODE. **First order equations:** (i) Exact equations and those reducible to such equation. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations: General and Singular solutions. **Second order linear equations:** Second order linear differential equation with constant coefficients. Euler's Homogeneous equations. **Second order differential equation:** (i) Method of variation of parameters, (ii) Method of undetermined coefficients.	**10** 1 1 1 1 1	AM	
Unit - 4	**Transformations of Rectangular axes:** Translation, Rotation and their combinations. Invariants. **General equation of second degree in x and y:** Reduction to canonical forms. Classification of conic. **Pair of straight lines:** Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax2+2hxy+by2 = 0$. Equation of bisectors. Equation of two lines joining the origin to the points in which a line meets a conic. Equations of pair of tangents from an external point, chord of contact, poles and polars in case of General conic: Particular cases for Parabola, Ellipse, Circle, Hyperbola.	**20** 2 2 4	AS	

HERAMBA CHANDRA COLLEGE
DEPARTMENT OF MATHEMATICS

	Polar equation: Polar eq. of straight lines and circles. Polar equation of a conic referred to a focus as pole. Equation of chord joining two points. Equations of tangent and normal. **Sphere:** Sphere and its tangent plane. Right circular cone.			

	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1							2	2	2			
CO2							2	2	2	2		
CO3					3		2	2	2	2		
CO4					3		2	2	2	2		
Average												
Correlation level					1-Low(40%<Achievement<50%), 2- Medium (50%<Achievement<60%), 3- High (60%<Achievement)							

Semester -II (January- June)
Mathematics - II
Semester : II Credits : 5+1*=6
Core Course-1B Full Marks : 80+20**=100
Paper Code : MG(GE2)201
Minimum number of classes required : 60
*1 Credit for Tutorial
**20 Mark is reserved for Internal Assessment
& Attendance of 10 mark each

Programme	B.Sc. GENERAL
Course Code	MG(GE2)201
Course Name	Mathematics I
Year and Semester	1st year, 2nd Semester
Prerequisite Course	NIL
Course Objective	Developing a critical understanding

HERAMBA CHANDRA COLLEGE
DEPARTMENT OF MATHEMATICS

Group, Section and Unit as given in syllabus of CU	Course Outcome	On completing the course, the student will be able to:	PSO Addressed	Cognitive level
Unit 1 Differential calculus-II	CO1	Develop a critical understanding & application of calculus	All	All
Unit 2 Differential Equation-II	CO2	Develop a critical understanding of skill of problem solving	All	All
Unit 3 Vector Algebra	CO3	Develop a critical understanding of solving real life problems.	All	All
Unit 4 Discrete Mathematics	CO4	Knowledge of number system & their applications.	All	All

	PO1	PO2	PO3	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1				3	3	3	3	3	3	
CO2				2	2	2	2	2	2	
CO3				2	2	2	2	2	2	
Average										
Correlation level				1-Low(40%<Achievement<50%), 2- Medium (50%<Achievement<60%), 3- High (60%<Achievement)						

Total Marks: 100 [Theory (Th) 65 + Tutorial (Tu) 15 + Internal Assessment 10+Attendance: 10]
Total Credits: [5(Th)+1(Tu)] = 6, No. of Lecture hours: 75, No. of Tutorial contact hours: 15

HERAMBA CHANDRA COLLEGE
DEPARTMENT OF MATHEMATICS

Section/ Unit of the Course	Content	Lecture No	Faculty	Date and sign
Unit 1	**Sequence of real numbers :** Bounds of a sequence and monotone sequence. Limit of a sequence.Statements of limit theorems. Convergence and divergence of monotone sequences-applications of the theorems, definition of *e*. Cauchy's general principle of convergence and its application. • **Infinite series:** Convergence and Divergence (definitions). Cauchy's principle as applied to infinite series (application only). Series of positive terms :comparison test. D.AIembert's Ratio test. Cauchy's nth root test and Raabe's test Applications. Alternating series. Statement of Leibnitz test and its applications. • **Real-Valued functions defined on an interval:** Statement of Rolle's Theorem and its geometrical interpretation. Mean value theorems of Lagrange and Cauchy. Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's from of remainders. Taylor's and Maclaurin's Infinite series of functions like ex, $\sin x$, $\cos x$, $(1+x)n$, $\log(1+x)$ with restrictions wherever necessary. • **Indeterminate Forms :** L'Hospital's Rule : Statement and Problems only. • **Maxima and Minima** :Application of maxima and minima for a function of single variable not more than three variables, Lagrange's Method of undetermined multiplier - Problems only.	**15**	**AM, SR**	
Unit 2	Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Simple eigenvalue problem. **Order and degree of partial differential equations:** Concept of linear and non-linear partial differential equations, Formation of first order partial	**10**		

	differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.			
Unit 3	**Vector Algebra:** Addition of Vectors, Multiplication of a Vector by a Scalar. Collinear and Coplanar Vectors. Scalar and Vector products of two and three vectors. Simple applications to problems of Geometry. Vector equation of plane and straight line. Volume of Tetrahedron. Applications to problems of Mechanics (Work done and Moment).	**10**	**SR**	
Unint 4	**Integers** : Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbitrary base. Prime Integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Euclid's Theorem. Linear Diophantine equations. h Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Representation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers ˆa“ Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid's Theorem. To show how to find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear Diophantine equation ˆa“ when such an equation has solution, some applications. i • **Congruences :** Congruence relation on integers, Basic properties of this relation. Linear congruences, Chinese Remainder Theorem. System of Linear congruences.	**25**	**MD**	

	h Definition of Congruence ˆa“ to show it is an equivalence relation, to prove the following : $a \_ b$ (mod m) implies (i) $(a + c) \_ (b + c)$ (mod m) (ii) $ac \_ bc$ (mod m) (iii) $an \_ bn$ (mod m), for any polynomial $f(x)$ with integral coefficients $f(a) \_ f(b)$ (mod m) etc. Linear Congruence, to show how to solve these congruences, Chinese remainder theorem ˆa“ Statement and proof and some applications. System of linear congruences, when solution exists ˆa“ some applications. i • **Application of Congruences** : Divisibility tests. Check-digit and an ISBN, in Universal product Code, in major credit cards. Error detecting capability. h Using Congruence, develop divisibility tests for integers based on their expansions with respect to different bases, if d divides $(b - 1)$ then $n = (akak-1a1b)$ is divisible by d if and only if the sum of the digits is divisible by d etc. Show that congruence can be used to schedule Round-Robin tournaments. Check digits for different identification numbers ˆa“ International standard book number, universal product code etc. Theorem regarding error detecting capability. i • **Congruence Classes** : Congruence classes, addition and multiplication of congruence classes. Fermat’s little theorem. Euler’s theorem. Wilson’s theorem. Some simple applications. h Definition of Congruence Classes, properties of Congruence classes, addition and multiplication, existence of inverse. Fermat’s little theorem. Euler’s theorem. Wilson’s theorem - Statement, proof and some applications. i • **Boolean algebra** : Boolean Algebra, Boolean functions, Logic gates, Minimization of circuits.			

HERAMBA CHANDRA COLLEGE
DEPARTMENT OF MATHEMATICS

	PO1	PO2	PO3	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1				3	3	3	3	3	3	
CO2				3	3	3	3	3	3	
CO3				3	3	3	3	3	3	
Average										
Correlation level				1-Low(40%<Achievement<50%), 2- Medium (50%<Achievement<60%), 3- High (60%<Achievement)						

Semester –III (July to December)
Core Course -1C
Paper Code: MG(GE3)301

Programme	B.SC. GENERAL Mathematics
Course Code	MG(GE3)301
Course Name	Mathematics III
Year and Semester	2nd year 3rd semester
Prerequisite Course	Nil
Course Objective	To develop an understanding of calculus and l.P.P

Group, Section and Unit as given in syllabus of CU	Course outcome	On completing the course, the student will be able to:	PSO Addressed	Cognitive level
Unit 1 Integral Calculus	CO1	Develop knowledge of calculus & its applications	All	All
Unit 2	CO2	Develop a critical understanding of different	All	All

HERAMBA CHANDRA COLLEGE
DEPARTMENT OF MATHEMATICS

Numerical Methods		numerical methods.		
Unit 3 Linear Programming	CO3	Develop knowledge of problem solving in real life issues	All	All

	PO1	PO2	PO3	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1				3	3	3	3	3	3	
CO2				3	3	3	3	3	3	
CO3				3	3	3	3	3	3	
Average										
Correlation level				1-Low(40%<Achievement<50%), 2- Medium (50%<Achievement<60%), 3- High (60%<Achievement)						

Core Course III:
Total Marks: 100 [Theory(Th) 65 + Tutorial(Tu) 15 + Internal Assessment 10+Attendance: 10] Total Credits: [5(Th)+1(Tu)]=6 , No. of Lecture hours: 75, No. of Tutorial contact hours:15

Section/ Unit of the Course	Content	Lecture No	Faculty	Date and sign
Unit 1	**Integtal Calculus:** Evaluation of definite integrals. • Integration as the limit of a sum (with equally spaced as well as unequal intervals). • Reduction formulae of Z sin$n$ x cos$m$ xdx, Z sin$m$ x cos$n$ x dx, Z tan$n$ xdx and associated problems (m and n are non-negative integers). • Definition of Improper Integrals : Statements of (i) μ-test (ii) Comparison test (Limit from excluded) -	**10**	**SR,AS**	

	Simple problems only. Use of Beta and Gamma functions (convergence and important relations being assumed). • Working knowledge of double integral. • Applications : Rectification, Quadrature, volume and surface areas of solids formed by revolution of plane curve and areas problems only. ////			
Unit 2	**Numerical Methods (30 Marks)** [25 classes] • Approximate numbers, Significant figures, Rounding off numbers. Error : Absolute, Relative and percentage. • Operators - _,r and *E* (Definitions and some relations among them). • Interpolation : The problem of interpolation Equispaced arguments Difference Tables, Deduction of Newton's Forward Interpolation Formula, remainder term (expression only). Newton's Backward interpolation Formula (Statement only) with remainder term. Unequally- spaced arguments Lagrange's Interpolation Formula (Statement only). Numerical problems on Interpolation with both equally and unequally spaced arguments. • Numerical Integration : Trapezoidal and Simpson's 13-rd formula (statement only). Problems on Numerical Integration. • Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Location of root (tabular method), Bisection method, Newton-Raphson method with geometrical significance, Numerical Problems. (Note : Emphasis should be given on problems)	**25** **2** **3** **3** **3** **4** **4** **4** **2**	**DH**	
Unit-3 :	**Linear Programming (30 Marks)** • Motivation of Linear Programming problem.	**25**	**SR**	

	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. • The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme print of the convex set of feasible solutions, A.B.F.S. to an L.P.P. corresponds to an extreme point of the convex set of feasible solutions. 8 • 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), by simplex method and method of penalty. Concept of Duality. Duality Theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions.			

	PO1	PO2	PO3	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1				2	2	2	3	2	2	
CO2				2		2	3	2	2	
CO3				2		2	3	2	2	
Avera										

HERAMBA CHANDRA COLLEGE
DEPARTMENT OF MATHEMATICS

ge										
Correlation level				1-Low(40%<Achievement<50%), 2- Medium (50%<Achievement<60%), 3- High (60%<Achievement)						

Semester –IV (July to December)
Core Course -1D
Paper Code: MG(GE4)401

Total Marks: 100 [Theory(Th) 65 + Tutorial(Tu) 15 + Internal Assessment 10+Attendance: 10] Total Credits: [5(Th)+1(Tu)]=6 , No. of Lecture hours: 75, No. of Tutorial contact hours: 15

Section/ Unit of the Course	Content	Lecture No	Faculty	Date and sign
Unit 1	**Algebra-II** • **Group Theory:** Definition and examples taken from various branches (example from number system, roots of Unity, 2×2 real matrices, non singular real matrices of a fixed order). Elementary properties using definition of Group. Definition and examples of sub- group - Statement of necessary and sufficient condition and its applications. • Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field. • **Concept of Vector space over a Field :** Examples, Concepts of Linear combinations, Linear dependence and independence of a finite number of vectors, Sub- space, Concepts of generators and basis of a finitedimensional vector space. Problems on formation of basis of a vector space (No proof required). • Real Quadratic Form involving not more than three variables (problems only). • **Characteristic equation** of square matrix of order not more than three determination of Eigen Values and Eigen Vectors (problems only). Statement and illustration of Cayley-Hamilton Theorem.	10	AS	
Unit 2	Computer Science & Programming (30 Marks):	25	AM	

	• **Computer Science and Programming :** Historical Development, Computer Generation, Computer Anatomy Different Components of a computer system. Operating System, hardware and Software. • Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer - BIT, BYTE, WORD etc. Coding of a data- ASCII, etc. • Programming Language : Machine language, Assembly language and High level language, Compiler and interpreter. Object Programme and source Programme. Ideas about some HLL– e.g. BASIC, FORTRAN, C, C++, COBOL, PASCAL, etc. • Algorithms and Flow Charts– their utilities and important features, Ideas about the complexities of an algorithm. Application in simple problems. FORTRAN 77/90: Introduction, Data Type– Keywords, Constants and Variables - Integer, Real, Complex, Logical, character, subscripted variables, Fortran Expressions.			
Unit 3	**Probability & Statistics (30 Marks):** • Elements of probability Theory : Random experiment, Outcome, Event, Mutually Exclusive Events, Equally likely and Exhaustive. Classical definition of probability, Theorems of Total Probability, Conditional probability and Statistical Independence. Baye's Theorem. Problems, Shortcoming of the classical definition. Axiomatic approach problems, Random Variable and its Expectation, Theorems on mathematical expectation. Joint distribution of two random variables. • Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties. Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey.	25	SR	

	Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency distribution. Histogram, Frequency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis. • Sampling Theory : Meaning and objects of sampling. Some ideas about the methods of selecting samples, Statistic and parameter, Sampling Proportion. Four fundamental distributions, derived from the normal: (i) standard Normal Distribution, (ii) Chi-square distribution (iii) Student's distribution (iv) Snedecor's F-distribution. Estimation and Test of Significance. Statistical Inference. Theory of estimation Point estimation and Interval estimation. Confidence Interval / Confidence Limit. Statistical Hypothesis - Null Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and II error. Problems. • Bivariate Frequency Distribution. Scatter Diagram, Co-relation co-efficient Definition and properties. Regression lines.			

	PO1	PO2	PO3	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1					2	3	3	2	2	
CO2					2	3	3	2	2	
CO3					2	3	3	2	2	
Average										

HERAMBA CHANDRA COLLEGE
DEPARTMENT OF MATHEMATICS

Correlation level	1-Low(40%<Achievement<50%), 2- Medium (50%<Achievement<60%), 3- High (60%<Achievement)