

HARIMOHAN GHOSE COLLEGE

DEPARTMENT OF MATHEMATICS

PROGRAMME OUTCOME OF MATHEMATICS HONOURS COURSE

(UNDER CBCS)

PO-1: This course endeavours to acquaint students with the concepts of various papers of mathematics as well as to involve them in critical thinking and scientific analysis.

PO-2: Providing essential foundation in the gross field of Pure and Applied Mathematics for students will help them to develop the ability to apply quantitative tools and techniques for solving various mathematical problems.

PO-3: The deep grasp acquired by the students after completing the course helps them to opt for any interdisciplinary field of science and technology for higher studies and to establish themselves accordingly.

PO-4: This course enables the students to develop a critical approach towards their subject of study and to apply their power of thinking in solving mathematical problems and consequently prepares them to embrace research area.

PO-5: Learning basic programming language makes the students proficient and gives an additional advantage of acquiring software skill in the world of software technology.

PO-6: Upon completion of the study, students will have competence to apply Mathematical Modelling to solve any real-life problems and this itself is conducive to great career opportunities in numerous fields.

HARIMOHAN GHOSE COLLEGE

DEPARTMENT OF MATHEMATICS

PROGRAMME OUTCOME OF B.SC GENERIC ELECTIVE COURSES (UNDER CBCS):

PO-1: This course in Mathematics provides a strong foundation for Basic Sciences and Mathematics as well as helps student to identify, formulate and create mathematical ideas effectively.

PO-2: Understanding and critically analyzing the fundamental concepts in Mathematics are very useful in assisting students apply theoretical knowledge for solving various real-life problems.

PO-3: The basic knowledge of various branches of Mathematics that includes algebra, calculus, geometry makes it possible for the students to develop critical thinking skills and to pursue higher studies in any interdisciplinary field of science.

PO-4: Utilizing the computational techniques and the basic knowledge in programming language, students will be able to build up a successful career in their future.

PO-5: Students are expected to have developed the capability of quantitative reasoning skill which will help them to enhance their employability for different types of jobs.

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DEPARTMENT OF MATHEMATICS

COURSE OUTCOME OF MATHEMATICS (HONOURS) UNDER CBCS

SEMESTER	COURSE CODE	COURSE NAME	COURSE OUTCOMES
1 st Sem	CC1	Calculus, Geometry & Vector Analysis	<ul style="list-style-type: none">* This course is designed to provide students with skills to compute limits, derivatives and integrals of a function and to use applications of vector algebra in real life.* The knowledge of geometry will enable students to solve tangents, normal, chords of a conic in 2D and will provide the concept of 3D to solve 3D related problems.* Students will be able to solve various problems of vector analysis which is applicable to various branches of Mathematics and Physics.
	CC2	Algebra	<ul style="list-style-type: none">*The knowledge of algebra helps to develop students' critical thinking skills that includes problem solving, logic, patterns and reasoning.*Students will be able to understand the concept of relation, mapping, number theory, matrix and determinants.
2 nd Sem	CC3	Real Analysis	<ul style="list-style-type: none">*The students will go through the concept of sequence, convergence of a sequence and its important theorems.*From this course, students will learn the fundamental properties of the real numbers that underpin the formal development of real analysis.
	CC4	Group Theory-I	<ul style="list-style-type: none">*In this course students will be able to understand the concept of cyclic group, finite group, permutation group, co-set and its applications along with Lagrange's theorem and Fermat's theorem.*They will have the capability to gain knowledge of the concept of normal

			subgroup, quotient group, Cayley's Theorem, and First, Second, Third isomorphism theorems.
3 rd Sem	CC5	Theory of Real Functions	<ul style="list-style-type: none"> •Students will learn limit, continuity, uniform continuity, differentiability of a function at a point. •Students will also acquire the concept of maxima minima of a function in an interval.
	CC6	Ring Theory & Linear Algebra-I	<ul style="list-style-type: none"> •This course aims to give students the basic knowledge of rings, subrings, fields, ring homomorphism, isomorphism and related theorems. • This portion plays a key role in the higher study of linear algebra in which students will learn to compute eigenvalues and eigenvectors. They will also learn the Cayley-Hamilton theorem and its use.
	CC7	ODE & Multivariate Calculus-I	<ul style="list-style-type: none"> •This course provides the visualization and manipulation of ODEs in numerical and symbolic form. • Students will be able to understand the concepts of existence and uniqueness of solutions. •Multivariate calculus has useful applications on various branches of Mathematics and Physics.
	SEC-A	C Programming Language	<ul style="list-style-type: none"> •Students can have a good grasp of C language and they will be able to develop logics which helps them to create programs and its applications. •Students will obtain the basic concept of foundation of computer, different generation, hardware and software, algorithm, flowchart.
4 th Sem	CC8	Riemann Integration & Series of Functions	<ul style="list-style-type: none"> • This course offers students the proper idea to learn Riemann integration of bounded real valued functions, integrability of sum, scalar multiple, product, quotient of Riemann integrable functions. •Students will acquire knowledge of sequence of functions, point of convergence, uniform convergence, power series.
	CC9	PDE & Multivariate Calculus-II	<ul style="list-style-type: none"> •In this course students will learn the skill for solving problems of certain

			<p>types of linear and non-linear partial differential equations.</p> <p>* They will also acquire knowledge of certain types of second order partial differential equations and their applications in Mathematical Physics.</p> <ul style="list-style-type: none"> •Students will get an idea for solving problems on multiple integral and centre of gravity, surface and volume of revolution, vector calculus and their applications in Mathematical Physics.
	CC10	Mechanics	<ul style="list-style-type: none"> •Students will get an overview of Analytical Statics related to coplanar forces, friction, virtual work, forces in three dimension, stable and unstable equilibrium and centre of gravity. •They will be able to learn rectilinear and planar motion of a particle in both cartesian and polar system, simple harmonic motion, central orbit, motion under inverse square law and planetary motion. • Students will also have the capability to solve problems on system of many particles, collision of elastic bodies, work-power-energy.
	SEC-B	Scientific computing with Sage Math & R	<ul style="list-style-type: none"> •This course introduces the theory of Scientific Computing which enables students to install and read data files in R/SageMath. •Students will acquire basic knowledge and skill in numerical and symbolic computations using mathematical functions.
5 th Sem	CC11	Probability & Statistics	<ul style="list-style-type: none"> •This course provides the idea of probability theory helping the students to calculate probabilities using conditional probability, rule of total probability and Bayes' theorem. •They will be able to explain the concept of random variable, probability distributions.
	CC12	Group theory-II & Linear Algebra-II	<ul style="list-style-type: none"> •From the course of Group Theory, students will get an idea of automorphisms, direct product and results related to finite abelian groups such as converse of Lagrange's theorem, Cauchy's theorem. •They will also learn about vector spaces that will allow them to appreciate Linear

			<p>Algebra as a tool for learning Geometry of higher dimensional spaces through the language of Algebra.</p> <ul style="list-style-type: none"> •They will also be able to solve problems related to matrix theory up to orthogonalization. •Students will learn Euclidian Space which will help them to understand the mathematical theory behind the Linear Programming problems.
	DSE-A(1)	Bio Mathematics	<ul style="list-style-type: none"> •Students can have an enhanced knowledge and understanding of mathematical modeling and statistical methods in the analysis of biological systems. •Students will acquire knowledge of application of dynamical systems and mathematical modelling of biological problems •They will learn the behavior of discrete and continuous population and their behaviors, which are studied by applying the different tools of linear and non-linear system of ODE and PDE.
	DSE-B(1)	Linear Programming and Game Theory	<ul style="list-style-type: none"> •This course discusses the theory of basic feasible solutions and their properties, convex sets based on the knowledge of linear algebra studied in previous semesters. •They will have the skills in the solution of a Linear Programming Problem by Simplex Method. They will also acquire knowledge on duality, transportation problem, assignment problem and travelling salesman problem. •Students will obtain some knowledge on the basic theory of game problems and their solution by different methods which has many applications in Economics.
6 th Sem	CC13	Metric Space & Complex Analysis	<ul style="list-style-type: none"> •Students will be able to identify curves and regions in the complex plane defined by simple expressions, basic properties of complex integration, analytic functions and to develop the ability to compute such integrals. •This course will make a foundational concept of metric spaces and its important properties, i.e., convergence

			sequence, Cauchy sequence, completeness property, Cantor's intersection theorem, continuous mapping, uniform continuity, sequential compactness, Heine-Borel theorem in \mathbb{R} , connectedness etc.
	CC14	Numerical Methods	<ul style="list-style-type: none"> •Students will go through the concepts in Numerical Analysis and acquire theoretical knowledge that will lay the foundation for solving problems via computer programming. •Students will obtain the basic skill for solving problems via computer programming related to various numerical methods on interpolation, numerical differentiation and integration, differential equations and finding roots of an equation.
	CC14 Practical	Numerical Methods Practical	<ul style="list-style-type: none"> •From this course students will be able to compute the values of any mathematical task with the help of the numerical methods like interpolation, differentiation, integration and they will also be able to find the solution of linear and nonlinear equations with the help of computer software programming.
	DSE-A(2)	Differential Geometry	<ul style="list-style-type: none"> •This course is an introductory course in Tensors, Riemannian space and Einstein space. • Students will be able to learn the theory of space curves and surface.
	DSE-B(2)	Point Set Topology	<ul style="list-style-type: none"> •This course describes the concept of topological spaces, basis and subbasis for a topology, continuity of a function in topological space, finite product topology, homeomorphism, isometry and metric invariants. •Equip the students with the concept of separation axioms of topological spaces, connected and compactness in topological spaces.

**COURSE OUTCOME OF MATHEMATICS (GENERAL) UNDER
CBCS**

SEMESTER	COURSE CODE	COURSE NAME	COURSE OUTCOMES
1 st Sem	CC1/GE1	Algebra-I, Differential Calculus-I, Differential Equation-I, Coordinate Geometry	<ul style="list-style-type: none"> •From this course, students will acquire the concept of complex number, polynomial and matrix theory. •They will be able to learn real number, limit, continuity and differentiability of a real valued function and partial derivatives. • Students will obtain the knowledge of ordinary differential equation and the existence and uniqueness of solution of ODE. •This portion helps the students in solving the problems on pair of straight lines, classification of conics and reduction of their standard forms, tangents, normal, chords of a conic in two-dimensional and three dimensional analytical geometry.
2 nd Sem	CC2 / GE2	Differential Calculus-II, Differential Equation-II, Vector Algebra, Discrete Math.	<ul style="list-style-type: none"> •Students will be able to learn about convergence and divergence of infinite series of constant terms, mean value theorem, application of principle of maxima and minima for a function in single variable in geometrical and physical problems. •They will also learn about solution of linear homogeneous and non-homogeneous equations with constant coefficients. •Students will acquire knowledge on vector operations and its applications.
3 rd Sem	CC3 / GE3	Integral Calculus, Numerical Methods, Linear Programming	<ul style="list-style-type: none"> •Students will be able to comprehend the concept of improper integration, Beta and Gamma functions, convergence of improper integration and its applications. •They will learn the concept of numerical methods, interpolation, differentiation, integration and numerical solution of transcendental equations. •Students will obtain the knowledge on linear programming and basic idea of linear algebra, different methods of LPP .
	SEC-A	C Programming Language	<ul style="list-style-type: none"> •From this course students will acquire knowledge on foundation of computer,

			<p>different generation, hardware and software, algorithm, flowchart.</p> <ul style="list-style-type: none"> •Students will be able to solve various problems with C-programming which may/may not be solved analytically.
4 th Sem	CC4 / GE4	Algebra-II, Computer Science & Programming Probability & Statistics	<ul style="list-style-type: none"> •From this course, students will acquire knowledge on groups, rings, fields, vector space over a field, eigenvalues & eigenvectors etc. •The main objective of the programming language is to provide the students the basic concept of computer generations and computer anatomy, number systems, concepts on different programming languages and algorithms & flow charts. •Students will be able to learn the rule of probability , Bayes' Theorem and to calculate probabilities using conditional probability. •They will also be able to explain the concept of random variable, the probability distributions and to analyze statistical data.
	SEC-B	Mathematical Logic	<ul style="list-style-type: none"> •After completion of the course students are expected to be able to analyze logical propositions via truth tables.
5 th Sem	SEC-A	Object Oriented Programming in C++	<ul style="list-style-type: none"> •Students will be able to demonstrate an understanding of algorithms in the problem-solving process, to identify the necessary properties of good problem-solving techniques and to create and analyze algorithms for solving simple problems.
	DSE-A	Graph Theory	<ul style="list-style-type: none"> •This course describes the theory of graphs, pseudographs, complete graphs, isomorphism of graphs. •Students will learn the concept of path and circuit and related theorems. •Students will be able to know about the Kuratowski's graphs.
6 th Sem	SEC-B	Boolean Algebra	<ul style="list-style-type: none"> •This course offers students to learn how to use truth tables and laws of identity, distributive, commutative and domination. •Equip the students with the skill to compute sum of products and product of sum expansions and convert boolean expressions to logic gates and vice-versa.
	DSE-B	Advanced Calculus	<ul style="list-style-type: none"> •Students will be able to know about the concept of uniform convergence and point wise convergence of sequence and series of functions.

			<ul style="list-style-type: none">•Students will learn about power series and Fourier series and its properties.*They will get the idea of Laplace Transform and their properties which can be used to solve ODE.
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