MATHEMATICS

Programme Specific Outcomes

Programme offered by the Department	Outcomes
B.Sc Honours Programme	On completion of the Programme, the students would be able to : PSO1. Recall basic facts about mathematics and acquire knowledge of mathematics helping him to develop mathematical mind. PSO2. Think analytically to apply his knowledge in several branches of sciences. PSO3. Going through the mathematical theorems rigorously, students should be able to develop the skill to solve different mathematical problems effectively. PSO4. It is expected that the knowledge and the skill acquired during this curriculum will translate them to a different sphere of mental health and they will easily cope up with higher studies. PSO5. Going through this course, students should be bold enough mentally to face any competitive examination in future.
B.Sc Programme Course (General)	On completion of the Programme, the students would be able to PSO1. Recall basic facts about mathematics and should be able to display knowledge of conventions such as notations, terminology. PSO2. Students should be apply their skills and knowledge to daily life problems. PSO3. Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study. PSO4. It is expected that the knowledge and the skill acquired during this curriculum will translate them to a different sphere of mental health and they will easily cope up with higher studies. PSO5. Going through this course, students should be bold enough mentally to face any competitive examination in future.

MATHEMATICS

Course Outcomes

B.Sc Honours Programme

Semester	Course Code	Course Title	Outcomes
I	CC1	**Calculus, Geometry and Differential Equation**	Understand the concept of two and three dimensions and transient behaviors of some known curves and surfaces such as straight line, plane, spheres, conicoid. Students will be able to solve first order and first degree differential equations, understand the notion of singular and general solution. Enable students to sketch curves in Cartesian and polar coordinate systems. Learn the applications of differential and integral calculus such as finding asymptotes, envelopes, inflexion points, reduction formulae, finding arc length, area and volume of revolution.
	CC2	**Algebra**	Enable to study the existence of some basic properties of functions, existence of its inverse, composition of different functions, one-to-one correspondence and the cardinality of set. Understand the properties of integers, gcd, lcm of numbers and also the congruence relationship between integers. Row reduced form and row reduced echelon form of a matrix will help to find the rank of a matrix, rank of a null space, row space and column space of a matrix. Congruence will help to find the normal form of a square matrix and find the signature and index of a matrix. To learn to find Eigen values and eigen functions of a matrix which is used in the study of vibrations, chemical reactions and geometry.

			Eigen values and eigen vectors helps to find whether the matrix is diagonalized or not. Students will be acquainted with some new areas of algebra. They will learn to solve beyond quadratic equation.
II	CC3	**Real Analysis**	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 $\mathbb{R}$. Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior and limit of a bounded sequence. Enable the students to assimilate the notions of limit of a sequence and convergence of a series of real numbers. Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.
	CC4	**Differential equation and Vector algebra:**	Many real world practical problems can be converted into differential Equation. So it is one of the most important section in the context of Applied Mathematics. The specific outcomes are to know about the existence and uniqueness of solution, Particular integral, Complementary function etc. Also In this topic several practical problems are formed by the Differential Equation and solved. Lipschitz conditions and Picards theorem will definitely struck a students mind about existence of a solution of differential equation. They will learn higher order linear differential equations. They will learn variation of parameters and method of undetermined coefficients. The notion of equilibrium points and phase plane will really make them agile mined.

			Students will learn the concept of vector products like triple product and four vector product. They will know what is vector functions, learn about the concept of limit, continuity, differentiability and integration of a vector valued functions. It will help to study about any physical object and its orientation in space(3-D).
III	CC5	**Theory of real functions and Introduction to Metric Space**	Understand the notions of continuity, uniform continuity, differentiability of a function of a single variable. Understand the consequence of various mean value theorems for differentiable functions. To equip students with basic mathematical notions such as open and closed sets, sub spaces, separable spaces, complete metric spaces which can be used to study general topology and real and complex analysis.
	CC6	**Group Theory I**	Students will be acquainted with new area of mathematics viz. Group Theory. They will learn to think about symmetries, various properties of groups and subgroups. Idea of cosets will help them to learn how a group can be partitioned and how Lagrange utilised this concept to make his remarkable theory. Idea of normal subgroups, quotient groups, product of subgroups and external direct product will definitely help them to enhance their mental ability. They will also learn the concepts of isomorphism and the isomporphism theorem will astonish them and will help them to think isomorphism between different groups.
	CC7	**Riemann Integration and series of functions**	To learn Riemann Integral and its properties in detail, leading to fundamental theorem of calculus and Mean value theorem. To study different tests for solving

			improper integrals of first and second kind. To study pointwise and uniform convergence of sequences and series of functions. Learn Fourier Series and its importance, Power series, Cauchy Hadamard theorem and Weistrass approximation theorem.
	SEC1	**Logic and Sets**	Set theory is the base of Abstract Algebra. So to gather knowledge about Abstract Algebra, the concept of Set theory should be required. On the other hand Mathematical logic is the very interesting and applicable topic in Mathematics. Students will learn about some basic connectives in logical sentence, the validity of an argument, predicate logic, Quantifiers etc.
IV	CC8	**Multivariable Calculus:**	In this section functions are defined in 'n' dimensional space. The existence of limit, continuity, differentiation are discussed in detail. This topic provides the concept of partial derivatives which is the most applicable topic in the field of Applied Mathematics. Learn conceptual variations while advancing from one variable to several variable in calculus. Apply multivariable calculus in optimization problems Inter-relationship amongst the line integral, double and triple integral formulations. Realize importance of Green, Gauss and Stoke's theorems in other branches of mathematics.
	CC9	**Ring Theory and Linear Algebra I**	Students will be acquainted with Ring theory. Concepts of integral domain, fields and ideals will help them to move for higher mathematics. Ring homomorphism and isomorphism theorems will make them exicited and creative. The idea of basis and dimension will be introduced here. They will also

			learn the notion of rank and nullity. Linear transformation and change of coordinate matrix will throw a beam of light into their minds and will help them to develop mathematical mind.
	CC10	**Metric spaces and Complex Analysis**	Enable to study connected, compact spaces and contraction mappings and their applications to ordinary differential equations. Understand the significance of differentiability and analyticity of complex functions leading to the Cauchy Riemann equations. Learn the role of Cauchy Goursat theorem and Cauchy integral formula in evaluation of contour integrals. Apply Liouville's theorem in fundamental theorem of algebra. Learn Taylor and Laurent series expansions of analytic functions.
	SEC2	**Graph Theory**	Graph theory is an important tool for mathematical modelling. Students will study different types of graphs, operations on graphs, tree, path, circuit in details and algorithms to find special spanning trees. Learn the concept of Adjacency matrix, Incidence matrix and the relation between this matrices and the graphs. They will also learn about hamiltonian circuit, Eulerian circuit, weighted graph. They will learn to solve travelling salesman problems using graph.
V	CC11	**Group Theory II**	The idea of automorphism and its various properties will be taught here. Students will also learn the concept of characteristic subgroups and commutator subgroups. The idea of group action and its properties will be a milestone to the students and will definitely throw a glimpse of light to their mind. The concept of Sylow theorems will make them speechless and will definitely help them to think critically. They

			will also learn about the simplicity of A_n for $n \geq 5$.
	CC12	**Numerical Methods**	This course will enable the students to obtain numerical solutions of algebraic and transcendental equations, find numerical solutions of system of linear equations and check the accuracy of the solutions. Learn about various interpolating methods and solve initial and boundary value problems to differential equations using numerical methods Learn about several numerical differentiation and integration techniques and understand C programming and its utility in writing numerical programmes.
	DSE1	**Probability and Statistics**	Understand the notion of probability mass functions, various types of distributions and their applications to real life problems. Learn about expectations, covariance and linear regression, Markov chains and Chapman-Kolmogorov equations. Understand the role of statistics as applied science and its utility in predicting phenomenon and pattern.
	DSE2	**Number Theory:**	The specific outcomes of this topic is to discuss about the behaviors and some basic properties of integers. Linear congruence between different numbers are carefully discussed in this present section and the importance of various theorem and their application in number theory are described. This topic also executes about the Pythagorian triplet, Legendere symbol, Fermat's Two-square theorem etc.
VI	CC13	**Ring Theory and Linear Algebra II**	The idea of polynomial rings and its various consequences will be taught here. Students wil be acquainted with the concept of factorization of polynomials, reducibility test, unique factorization domains etc. They will also learn dual spaces, dual basis and anihilators.

			Inner product spaces and the concept of minimal solution to a system of linear equations will be very attractive to students as they will learn the concept of generalized inverse of a matrix. While going through orthogonal projection and spectral theorem, students will surely get struck. In a nutshell, this curriculum will transform the students to a higher dimension of mathematical ability.
	CC14	**Partial differential Equation:**	The most important topic in the field Applied Mathematics is the Partial Differential Equation. Many physical, chemical and biological problems may be formed by using partial differential equation. In this topic students would gather knowledge about the formation and solution of partial differential equation. Also in this topic, three important Equations like Parabolic, Hyperbolic and Elliptic are described in details. By using this one can study several interesting topic like Bio-Mathematics, Mathematical Physics, Mathematical Statistics etc.
	DSE3	**Boolean Algebra and Automata Theory**	Learn about partially ordered sets, lattices and their types. Understand Boolean algebra and Boolean functions, logic gates, switching cirecuits and thair applications Understand the concept of finite state machines, regular languages, grammars and their relationship with machines. Realize Turing machine as a model of computation and its variants and their equivalence.
	DSE4	**Theory of Equations**	Familiar with properties of polynomials, Descarte's rule of signs. Understand the concept of symmetric functions and their applications. Application of Newton's and Sturm's

			theorem
I / III	GE Paper 1	**Calculus, Geometry and Differential Equation**	Understand the concept of two and three dimensions and transient behaviors of some known curves and surfaces such as straight line, plane, spheres, conicoid. Students will be able to solve first order and first degree differential equations, understand the notion of singular and general solution. Enable students to sketch curves in Cartesian and polar coordinate systems. Learn the applications of differential and integral calculus such as finding asymptotes, envelopes, inflexion points, reduction formulae, finding arc length, area and volume of revolution.
II / IV	GE Paper 2	**Algebra**	Row reduced form and row reduced echelon form of a matrix will help to find the rank of a matrix, null space, row space and column space of a matrix. Enable students to solve n number of equation with m number of variables. Study the concept of linearly independent, linearly dependent vectors and help them to find basis in vector spaces. Understand the concept of subspaces of R^n and the dimension of R^n. To learn to find Eigen values and eigen functions of a matrix which is used in the study of vibrations, chemical reactions and geometry. Eigen values and eigen vectors helps to find whether the matrix is diagonalized or not. Students will learn the concept of Linear Transformation which will help them to define a linear mapping from a vector space to a vector space.

B.Sc Programme (General)

Semester	Course Code	Course Title	Outcomes
I	DSC1	**Calculus and Geometry**	Understand the concept of two and three dimensions and transient behaviors of some known curves and surfaces such as straight line, plane, spheres, conicoid. Enable students to sketch curves in Cartesian and polar coordinate systems. Learn the applications of differential and integral calculus such as finding asymptotes, envelopes, inflexion points, reduction formulae, finding arc length, area and volume of revolution.
II	DSC2	**Algebra**	Row reduced form and row reduced echelon form of a matrix will help to find the rank of a matrix, null space, row space and column space of a matrix. Enable students to solve n number of equation with m number of variables. Study the concept of linearly independent, linearly dependent vectors and help them to find basis in vector spaces. Understand the concept of subspaces of R^n and the dimension of R^n. To learn to find Eigen values and eigen functions of a matrix which is used in the study of vibrations, chemical reactions and geometry. Eigen values and eigen vectors helps to find whether the matrix is diagonalized or not. Students will learn the concept of Linear Transformation which will help them to define a linear mapping from a vector space to a vector space.
III	DSC3	**Real Analysis**	Understand many properties of the real line R like algebraic property, ordered property, completeness property, dense property. Learn the concept of finite set, countable set and uncountable sets. Recognize interior point,open set,limit point, closed set, adherent point and their properties.Understand the Bolzano Weistress

			property. Understand which sets are compact set and which are not, learn Heine-Borel theorem. Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate limit of a bounded sequence. Enable the students to assimilate the notions of limit of a sequence and convergence of a series of real numbers. Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.
IV	DSC4	**Differential Equation and Vector Calculus**	Study linear and non linear differential equations, understand Euler's method, variation of parameters and method of undetermined coefficients. Finding power series solution about an ordinary point and singular point. Students will learn the concept of vector products like triple product and four vector product. Understand the concept of vector functions and limit, continuity, differentiability and integration of vector valued functions. It will help to study about any physical object and its orientation in space(3-D).
V	DSE1	**Group Theory and Linear Algebra**	Recognize dihedral, permutation, quaternion groups. Learn the concept of Subgroups, centralizer, normalizer and product of two subgroups. Study Lagrange's theorem and its consequences. Learn the concept of vector spaces, subspaces, linearly independent and dependent vectors, basis, dimension and their properties. Learn the concept of linear transformation and its properties, learn relationship between matrix and linear transformation. Learn the concept of kernel and image set of a linear transformation and properties and the Rank nullity theorem will help them to find the properties like one one , onto, dimension of image set and dimension

			of kernel of linear transformation.
VI	DSE2	**Linear Programming**	Analyze and solve linear programming models of real life situations. Provide graphical solution of LPP with two variables Learn the theory of simplex method and about the applications to transportation, assignment and two-person zero-sum game problems.
III / V	SECP1	**Logic and sets**	Set theory is the base of Abstract Algebra. So to gather knowledge about Abstract algebra, the concept of Set theory should be required. On the other hand Mathematical logic is the very interesting and applicable topic in Mathematics. Students will learn about some basic connectives in logical sentence, the validity of an argument, predicate logic, Quantifiers etc.
IV / VI	SECP2	**Number Theory**	The specific outcomes of this topic is to discuss about the behaviors and some basic properties of integers. Linear congruence between different numbers are carefully discussed in this section and the importance of various theorem and their application in number theory are described. This topic also executes about the Pythagorian triplet, Legendere symbol, Fermat's Two-square theorem etc. Understand the concept of Linear congruence and Chinese remainder theorem.