Course Outcome: Choice Based Credit System (CBCS)

Mathematics (H)

Semester	Paper Code	Paper Name	Course Outcome
TDC 1st Semester	**MAT-HC-1016**	**Calculus**	This course will enable the students to: i) Learn first and second derivative tests for relative extrema and apply the knowledge in problems in business, economics and life sciences. ii) Sketch curves in a plane using it mathematical properties in the different coordinate systems of reference. iii) Compute area of surfaces of revolution and the volume of solids by integrating over cross-sectional areas. iv) Understand the calculus of vector functions and its use to develop the basic principles of planetary motion.
TDC 1st Semester	**MAT-HC-1026**	**Algebra**	This course will enable the students to: i) Employ DeMoivre's theorem in a number of applications to solve numerical problems. ii) Learn about equivalent classes and cardinality of a set. iii) Use modular arithmetic and basic properties of congruences. iv) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix. v) Learn about the solution sets of linear systems using matrix method and Cramer's rule
TDC 2nd Semester	**MAT-HC-2016**	**Real Analysis**	This course will enable the students to: i) Understand many properties of the real line R, including completeness and Archimedean properties. ii) Learn to define sequences in terms of

			functions from N to a subset of R. iii) Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence. Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.
TDC 2nd Semester	**MAT-HC-2026**	**Differential Equations**	The course will enable the students to: i) Learn basics of differential equations and mathematical modeling. ii) Formulate differential equations for various mathematical models. iii) Solve first order non-linear differential equations and linear differential equations of higher order using various techniques. iv) Apply these techniques to solve and analyze various mathematical models.
TDC 3rd Semester	**MAT-HC-3016**	**Theory of Real Functions**	This course will enable the students to: i) Have a rigorous understanding of the concept of limit of a function. ii) Learn about continuity and uniform continuity of functions defined on intervals. iii) Understand geometrical properties of continuous functions on closed and bounded intervals. iv) Learn extensively about the concept of differentiability using limits, leading to a better understanding for applications. v) Know about applications of mean value theorems and Taylor's theorem
TDC 3rd Semester	**MAT-HC-3026**	**Group Theory-I**	The course will enable the students to: i) Recognize the mathematical objects that are groups, and classify them as abelian, cyclic and permutation groups, etc.

			ii) Link the fundamental concepts of groups and symmetrical figures. iii) Analyze the subgroups of cyclic groups and classify subgroups of cyclic groups. iv) Explain the significance of the notion of cosets, normal subgroups and factor groups. v) Learn about Lagrange's theorem and Fermat's Little theorem. vi) Know about group homomorphisms and group isomorphisms.
TDC 3rd Semester	**MAT-HC-3036**	**Analytical Geometry**	This course will enable the students to: i) Learn conic sections and transform co-ordinate systems ii) Learn polar equation of a conic, tangent, normal and properties iii) Have a rigorous understanding of the concept of three-dimensional coordinates systems
TDC 3rd Semester	**MAT-SE-3014**	**Computer Algebra Systems and Related Software**	This course will enable the students to: i) Use of software; Mathematica/MATLAB/Maxima/Maple, etc. as a calculator, for plotting functions and animations. ii) Use of CAS for various applications of matrices such as solving system of equations and finding eigenvalues and eigen vectors. iii) Analyze, test, and interpret technical arguments on the basis of geometry
TDC 3rd Semester	**MAT-SE-3024**	**Combinatorics and Graph Theory**	This course will enable the students to: i) Learn about the counting principles, permutations and combinations, Pigeon hole principle ii) Understand the basics of graph theory and learn about social networks, Eulerian and Hamiltonian graphs, diagram tracing puzzles and Knight's tour problem.

TDC 4th Semester	**MAT-HC-4016**	**Multivariate Calculus**	This course will enable the students to: i) Learn the conceptual variations when advancing in calculus from one variable to multivariable discussion. ii) Understand the maximization and minimization of multivariable functions subject to the given constraints on variables. iii) Learn about inter-relationship amongst the line integral, double and triple integral formulations. iv) Familiarize with Green's, Stokes' and Gauss divergence theorems
TDC 4th Semester	**MAT-HC-4026**	**Numerical Methods**	The course will enable the students to: i) Learn some numerical methods to find the zeroes of nonlinear functions of a single variable and solution of a system of linear equations, up to a certain given level of precision. ii) Know about methods to solve system of linear equations, such as False position method, Fixed point iteration method, Newton's method, Secant method, LU decomposition. iii) Interpolation techniques to compute the values for a tabulated function at points not in the table. iv) Applications of numerical differentiation and integration to convert differential equations into difference equations for numerical solutions.
TDC 4th Semester	**MAT-HC-4036**	**Ring Theory**	On completion of this course, the student will be able to: i) Appreciate the significance of unique factorization in rings and integral domains. ii) Learn about the fundamental concept of rings, integral domains and fields. iii) Know about ring homomorphisms and isomorphisms theorems of rings. iv) learn about the polynomial rings over commutative rings, integral domains, Euclidean domains, and UFD

TDC 4th Semester	**MAT-SE-4014**	**R Programming**	This course will enable the students to: i) Be familiar with **R** syntax and use **R** as a calculator. ii) Understand the concepts of objects, vectors and data types. iii) Know about summary commands and summary table in **R**. iv) Visualize distribution of data in **R** and learn about normality test. v) Plot various graphs and charts using R.
TDC 4th Semester	**MAT-SE-4024**	**LaTeX and HTML**	After studying this course the student will be able to: i) Create and typeset a LaTeX document. ii) Typeset a mathematical document using LaTex. iii) Learn about pictures and graphics in LaTex. iv) Create beamer presentations. v) Create web page using HTML.
TDC 4th Semester	**MAT-SE-4034**	**Boolean Algebra**	After studying this course the student will be able to: i) learn about the order isomorphism, Hasse diagrams, building new ordered set. ii) learn about the algebraic structure lattices, properties of modular and distributive lattices. iii) get ideas about the Boolean algebra, Switching circuits and applications of switching circuits.
TDC 5th Semester	**MAT-HC-5016**	**Complex Analysis**	The completion of the course will enable the students to: i) Learn the significance of differentiability of complex functions leading to the understanding of Cauchy−Riemann equations. ii) Learn some elementary functions and valuate the contour integrals. iii) Understand the role of

			Cauchy−Goursat theorem and the Cauchy integral formula. iv) Expand some simple functions as their Taylor and Laurent series, classify the nature of singularities, find residues and apply Cauchy Residue theorem to evaluate integrals.
TDC 5th Semester	**MAT-HC-5026**	**Linear Algebra**	The course will enable the students to: i) Learn about the concept of linear independence of vectors over a field, and the dimension of a vector space. ii) Basic concepts of linear transformations, dimension theorem, matrix representation of a linear transformation, and the change of coordinate matrix. iii) Compute the characteristic polynomial, eigenvalues, eigenvectors, and eigenspaces, as well as the geometric and the algebraic multiplicities of an eigenvalue and apply the basic diagonalization result. iv) Compute inner products and determine orthogonality on vector spaces, including Gram−Schmidt orthogonalization to obtain orthonormal basis. v) Find the adjoint, normal, unitary and orthogonal operators.
TDC 5th Semester	**MAT-HE-5016**	**Number Theory**	This course will enable the students to: i) Learn about some fascinating discoveries related to the properties of prime numbers, and some of the open problems in number theory, viz., Goldbach conjecture etc. ii) Know about number theoretic functions and modular arithmetic. iii) Solve linear, quadratic and system of linear congruence equations.
TDC 5th Semester	**MAT-HE-5026**	**Mechanics**	The course will enable the students to: i) Know about the concepts in statics such as moments, couples, equilibrium in both two and three dimensions. ii) Understand the theory behind friction and center of gravity.

			iii) Know about conservation of mechanical energy and work-energy equations. iv) Learn about translational and rotational motion of rigid bodies.
TDC 5th Semester	**MAT-HE-5036**	**Probability and Statistics**	This course will enable the students to: i) Learn about probability density and moment generating functions. ii) Know about various univariate distributions such as Bernoulli, Binomial, Poisson, gamma and exponential distributions. iii) Learn about distributions to study the joint behavior of two random variables. iv) Measure the scale of association between two variables, and to establish a formulation helping to predict one variable in terms of the other, i.e., correlation and linear regression.
TDC 5th Semester	**MAT-HE-5046**	**Linear Programming**	This course will enable the students to: i) Learn about the graphical solution of linear programming problem with two variables. ii) Learn about the relation between basic feasible solutions and extreme points. iii) Understand the theory of the simplex method used to solve linear programming problems. iv) Learn about two-phase and big-M methods to deal with problems involving artificial variables. v) Learn about the relationships between the primal and dual problems. vi) Solve transportation and assignment problems. vii) Apply linear programming method to solve two-person zero-sum game problems.

TDC 5th Semester	**MAT-HE-5056**	**Spherical Trigonometry and Astronomy**	This course will enable the students to: i) Learn about the properties of spherical and polar triangles ii) Know about fundamental formulae of spherical triangles iii) Learn about the celestial sphere, circumpolar star, rate of change of zenith distance and azimuth iv) Learn about Kepler's law of planetary motion, Cassini's hypothesis, differential equations or fraction.
TDC 5th Semester	**MAT-HE-5066**	**Programming in C**	After completion of this paper, student will be able to: i) Understand and apply the programming concepts of C which is important to mathematical investigation and problem solving. ii) Learn about structured data-types in C and learn about applications in factorization of an integer and understanding Cartesian geometry and Pythagorean triples. iii) Use of containers and templates in various applications in algebra. iv) Use mathematical libraries for computational objectives. v) Represent the outputs of programs visually in terms of well formatted text and plots. vi) In practical students learn about the roots of a quadratic equation, solution of an equation using N-R algorithm, sin(x), cos(x) with the help of functions
TDC 6th Semester	**MAT-HC-6016**	**Riemann Integration and Metric spaces**	The course will enable the students to: i) Learn about some of the classes and properties of Riemann integrable functions, and the applications of the Fundamental theorems of integration. ii) Know about improper integrals including, beta and gamma functions.

			iii) Learn various natural and abstract formulations of distance on the sets of usual or unusual entities. Become aware one such formulations leading to metric spaces. iv) Analyse how a theory advances from a particular frame to a general frame. v) Appreciate the mathematical understanding of various geometrical concepts, viz. Balls or connected sets etc. in an abstract setting. vi) Know about Banach fixed point theorem, whose far-reaching consequences have resulted into an independent branch of study in analysis, known as fixed point theory. vii) Learn about the two important topological properties, namely connectedness and compactness of metric spaces.
TDC 6th Semester	**MAT-HC-6026**	**Partial Differential Equations**	The course will enable the students to: i) Formulate, classify and transform first order PDEs into canonical form. ii) Learn about method of characteristics and separation of variables to solve first order PDE's. iii) Classify and solve second order linear PDEs. iv) Learn about Cauchy problem for second order PDE and homogeneous and non-homogeneous wave equations. v) Apply the method of separation of variables for solving many well-known second order PDEs.
TDC 6th Semester	**MAT-HE-6016**	**Boolean Algebra and Automata Theory**	The course will enable the students to: i) learn about the order isomorphism, Hasse diagrams, building new ordered set. ii) learn about the algebraic structure lattices, properties of modular and distributive lattices. iii) get ideas about the Boolean algebra, Switching circuits and applications of switching circuits.

			iv) Appreciate the theory of automata and its applications
TDC 6th Semester	**MAT-HE-6026**	**Bio Mathematics**	Towards the end of the course the student would be able to i) Learn the development, analysis and interpretation of bio-mathematical models. ii) Learn about the mathematics behind different bio-mathematical models iii) Solve basic application-oriented mathematical problems in real life situation. Students also would be able to develop problem solving skills useful in future study.
TDC 6th Semester	**MAT-HE-6036**	**Mathematical Modelling**	The course will enable the students to: i) Know about power series solution of a differential equation and learn about Legendre's and Bessel's equations. ii) Use of Laplace transform and inverse transform for solving initial value problems. iii) Learn about various models such as Monte Carlo simulation models, queuing models, and linear programming models.
TDC 6th Semester	**MAT-HE-6046**	**Hydromechanics**	The course will enable the students to: i) Know about Pressure equation, rotating fluids. ii) learn about Fluid pressure on plane surfaces, resultant pressure on curved surfaces, Gas law, mixture of gases iii) learn about the Eulerian and Lagrangian method. iv) learn about equation of continuity, examples, acceleration of a fluid at a point
TDC 6th Semester	**MAT-HE-6056**	**Rigid Dynamics**	The course will enable the students to: i) Know about find the moments and products of inertia. ii) learn about the motion of the center of inertia. iii) learn about the D'Alembert's principle and Lagrange's equations. iv) learn about motion of a body in 2-dimension.

TDC 6th Semester	**MAT-HE-6066**	**Group Theory II**	The course shall enable students to: i) Learn about automorphisms for constructing new groups from the given group. ii) Learn about the fact that external direct product applies to data security and electric circuits. iii) Understand fundamental theorem of finite abelian groups. iv) Be familiar with group actions and conjugacy in Sn. v) Understand Sylow's theorems and their applications.
TDC 6th Semester	**MAT-HE-6076**	**Mathematical Finance**	On completion of this course, the student will be able to: i) Know the basics of financial markets and derivatives including options and futures. ii) Learn about pricing and hedging of options, as well as interest rate swaps. iii) Learn about no-arbitrage pricing concept and types of options. iv) Learn stochastic analysis (Ito formula, Ito integration) and the Black−Scholes model. v) Understand the concepts of trading strategies and valuation of currency swaps.