VICTORIA INSTITUTION (COLLEGE)
UNIVERSITY OF CALCUTTA

Programme Outcome / Programme Specific Outcome / Course Outcome

B.Sc. Mathematics — Four-Year Honours (Major) Programme

(Under Curriculum and Credit Framework — CCF 2022)

Effective from Academic Year 2023–24

Programme Details

Name of Programme	B.Sc. Mathematics (Major) — Four-Year Honours
Programme Type	4-Year Honours (Semesters I to VIII)
Framework	Curriculum and Credit Framework (CCF) 2022 — under NEP 2020
Year of Introduction	2023–24
Total Credits (Sem I–VIII)	Core (DSCC): 100 (Honours, Sem I–VIII) or 80 DSCC + 20 Research (Honours with Research: RM1–RM2 + Internship + Dissertation) | SEC: 12 | IDC: 9 | Minor: 32

Programme Specific Outcomes (PSOs)

The Programme Specific Outcomes below are official, as notified by the University of Calcutta (Ref. No. CUS/183/25, dated 20th June 2025).

PSO	Description
PSO1	The basic objective of studying Mathematics Major/Minor is to develop the mathematical reasoning power of students and provide logical support behind assumptions. Throughout the course, students learn different branches of mathematics and are equipped not only with solutions to various types of problems by framing proper mathematical models, but can also logically justify the models and computational procedures with proper mathematical reasoning.
PSO2	Another objective of the Mathematics Major/Minor course is to enhance the critical thinking power of students by solving a variety of mathematical problems. This programme provides a very strong foundation in mathematical concepts, problem-solving skills and the ability to apply mathematical knowledge in various fields.
PSO3	The undergraduate syllabus is framed so that after successful completion of the three/four-year course, students are able to solve mathematical problems with minimum error. They will be equipped with mathematical skills and techniques applicable in both academic and non-academic work settings, and will be able to translate real-world problems into mathematical models, analyse these models to draw conclusions, and evaluate mathematical arguments through critical thinking.
PSO4	Students will develop a strong understanding of Algebra, Analysis, Metric Spaces, Complex Analysis, Topology, Calculus and its applications, Ordinary and Partial Differential Equations, Mechanics, Probability and Statistics, Mathematical Methods and computational skills using different computer languages. The theory and its applications will motivate students for critical thinking, further specialisation, and pursuit of research in mathematics in India and abroad.

PSO5	Students will get a strong foundation in the subject and develop comprehensive knowledge of all classical and applied fields of mathematics. They will be able to apply mathematical knowledge to problems in engineering sciences, information technology, computer science and social sciences.
PSO6	Students will acquire numerical skill, logical thinking and analytical capability applicable in competitive examinations. Problem-solving skills will be enhanced to resolve day-to-day problems. They will be able to teach in educational and research institutions, and impart their knowledge in different service sectors as erudite consultants.

Programme Outcomes (POs)

Programme Outcomes are the broad, expected outcomes that all students of the B.Sc. Mathematics (Major) programme should demonstrate upon its completion, aligned with NEP 2020 and the University of Calcutta's academic goals.

PO	Description
PO1	In three/four years of study, students will gain thorough knowledge in mathematics by enhancing problem-solving skills to resolve day-to-day problems.
PO2	Graduates will be able to apply their knowledge and skills in a professional setting, communicate effectively and collaborate with others, and engage in lifelong learning and adapt to changing circumstances.
PO3	Students will acquire deep understanding about scientific methods and apply these in solving scientific problems by analysing practical data using qualitative and quantitative methods.
PO4	Students will develop scientific, communicative and numerical skills and be able to pursue rewarding careers in Information Technology, Machine Learning, Industrial Mathematics and AI.
PO5	Students will be able to develop scientific models to solve problems in the fields of Engineering and Social Sciences, and carry out research projects independently or in collaboration with institutions or industries.
PO6	In the course of six semesters students will acquire knowledge of Calculus (single and multiple variables), Geometry, Vector Algebra and Calculus, Modern and Classical Algebra, Real and Complex Analysis, Riemann Integration, Sequences and Series, Probability and Statistics, Metric Spaces, Ordinary and Partial Differential Equations, Mechanics, Numerical Analysis, and two computer languages.
PO7	During the course of study students will learn C and Python — one compiler-based, the other interpreter-based. In Numerical Analysis practicals they apply these languages to run problems and find solutions, enhancing computational and analytical skills and developing proficiency in writing proper algorithms.
PO8	After gaining a flavour of all basic branches of mathematics, students will acquire scientific knowledge and skills in different branches, enabling them to undertake further studies in Mathematics, Statistics or allied areas. They will be able to analyse problems in the light of respective branches, predict solutions of real-life problems with models, and develop logical vision and critical thinking power.

Programme Structure — Course List

A. Discipline Specific Core Courses (DSCC)

Semester	Course Code	Course Name
I	MATH-H-DSCC1-1-TH	Calculus, Geometry & Vector Analysis
II	MATH-H-DSCC2-2-TH	Basic Algebra
III	MATH-H-DSCC3-3-TH	Real Analysis
III	MATH-H-DSCC4-3-TH	Ordinary Differential Equations – I & Group Theory – I
IV	MATH-H-DSCC5-4-TH	Theory of Real Functions
IV	MATH-H-DSCC6-4-TH	Mechanics – I
IV	MATH-H-DSCC7-4-TH	Multivariate Calculus – I & Partial Differential Equations – I
IV	MATH-H-DSCC8-4-TH	Group Theory – II & Ring Theory – I
V	MATH-H-DSCC9-5-TH	Probability & Statistics
V	MATH-H-DSCC10-5-TH	Ring Theory – II & Linear Algebra – I
V	MATH-H-DSCC11-5-TH	Riemann Integration & Series of Functions
V	MATH-H-DSCC12-5-TH	Mechanics – II
VI	MATH-H-DSCC13-6-TH	Metric Space & Complex Analysis – I
VI	MATH-H-DSCC14-6-TH	Multivariate Calculus – II & Application of Calculus
VI	MATH-H-DSCC15-6-TH	Numerical Analysis
VII	MATH-H-DSCC16-7-TH	Group Theory – III and Linear Algebra – II
VII	MATH-H-DSCC17-7-TH	Complex Analysis – II and Measure Theory – I
VII	MATH-H-DSCC18-7-TH	Generalised Functions, Integral Transforms and Integral Equations
VII	MATH-H-DSCC19-7-TH	Topology – I
VII	MATH-H-DSCC20-7-TH	Functional Analysis – I
VIII	MATH-H-DSCC21-8-TH	Ordinary Differential Equations – II and Partial Differential Equations – II
VIII	MATH-H-DSCC22-8-TH	Graph Theory
VIII	MATH-H-DSCC23.1-8-TH	Mechanics – III
VIII	MATH-H-DSCC23.2-8-TH	Measure Theory – II
VIII	MATH-H-DSCC24.1-8-TH	Operations Research and Stochastic Process
VIII	MATH-H-DSCC24.2-8-TH	Differential Geometry
VIII	MATH-H-DSCC25.1-8-TH	Fluid Mechanics and Computational Mathematics
VIII	MATH-H-DSCC25.2-8-TH	Functional Analysis – II and Topology – II

VIII	MATH-H-RM1-8-TH	Research Methodology – I
VIII	MATH-H-RM2-8-TH	Research Methodology – II

B. Skill Enhancement Courses (SEC)

Semester	Course Code	Course Name
I	MATH-H-SEC1-1-TH	C Language with Mathematical Applications
II	MATH-H-SEC2-2-TH	Python Programming & Introduction to LaTeX / Artificial Intelligence
III	MATH-H-SEC3-3-TH	Linear Programming & Rectangular Games

C. Interdisciplinary Courses (IDC)

Semester	Course Code	Course Name
I / II / III	MATH-H-IDC-TH	Mathematics in Daily Life

Course Outcomes (COs) with CO–PO and CO–PSO Mapping

For each course below, the Course Outcomes (COs) are listed, followed by two mapping tables: (1) CO–PO Mapping showing which Programme Outcomes each CO addresses, and (2) CO–PSO Mapping showing which Programme Specific Outcomes each CO addresses.

Semester I

MATH-H-DSCC1-1-TH: Calculus, Geometry & Vector Analysis

CO	Course Outcome Statement
CO-1	To understand and compute higher-order derivatives, apply Leibniz's rule and its applications, and use L'Hospital's rule to evaluate limits.
CO-2	To develop proficiency in solving problems involving higher-order derivatives, Leibniz's rule, and L'Hospital's rule.
CO-3	To learn reduction formulae and apply them to determine the arc length of a curve, the area under a curve, and the area and volume of surfaces of revolution.
CO-4	To study the classification of conic sections, reduce them to canonical form, and determine equations of tangents, normals, and polars.
CO-5	To acquire detail knowledge of spheres, cylindrical surfaces, central conicoids, different quadric surfaces.
CO-6	To apply vector equations to problems in geometry and mechanics, and to perform differentiation and integration of vector functions.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓	✓	✓	✓	✓	✓	✓	
CO-2	✓	✓	✓		✓	✓		
CO-3	✓	✓	✓		✓	✓		
CO-4	✓		✓			✓		✓
CO-5	✓		✓			✓		✓
CO-6	✓	✓	✓		✓	✓		

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓		✓	✓
CO-3	✓	✓	✓		✓	✓
CO-4	✓	✓	✓			✓
CO-5	✓	✓	✓			✓
CO-6	✓	✓	✓		✓	✓

MATH-H-SEC1-1-TH: C Language with Mathematical Applications

CO	Course Outcome Statement
CO-1	To learn C language in detail.
CO-2	To learn how to use different types of control statements and arrays.
CO-3	To learn how to write different types of computer programs using C language.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓	✓		✓	✓	✓
CO-2	✓		✓			✓		✓
CO-3	✓		✓	✓		✓	✓	✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓		✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓	✓		✓

Semester II

MATH-H-DSCC2-2-TH: Basic Algebra

CO	Course Outcome Statement
CO-1	To study exponential, logarithmic, trigonometric, and hyperbolic functions of a complex variable.
CO-2	To develop the ability to solve cubic and biquadratic equations.
CO-3	To acquire knowledge of equivalence relations, partial order relations, linear order relations, and composition of mappings.
CO-4	To understand the well-ordering property of positive integers, the division algorithm, and congruence relations among integers.
CO-5	To learn about the existence and uniqueness of solutions to systems of linear equations, including row reduction and echelon forms.
CO-6	To study the algebraic and geometric properties of vectors in n-dimensional space, including linear independence and its algebraic and geometric characterizations.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓	✓	✓		✓	✓		
CO-3	✓		✓			✓		✓
CO-4	✓		✓	✓		✓	✓	✓
CO-5	✓		✓			✓		✓
CO-6	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓		✓	✓
CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓	✓		✓
CO-5	✓	✓	✓			✓
CO-6	✓	✓	✓			✓

MATH-H-SEC2-2-TH: Python Programming and Introduction to LaTeX / Artificial Intelligence

CO	Course Outcome Statement
CO-1	To learn Python programming language in detail.

CO-2	To write programs using Python language and also plot functions.
CO-3	To learn Latex for typing and formatting scientific documents.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓	✓		✓	✓	✓
CO-2	✓		✓	✓		✓	✓	✓
CO-3	✓		✓	✓		✓	✓	✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓		✓
CO-2	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓		✓

Semester III

MATH-H-DSCC3-3-TH: Real Analysis

CO	Course Outcome Statement
CO-1	To understand the concepts of countable and uncountable sets, as well as bounded and unbounded sets.
CO-2	To learn the concepts of interior points, open sets, limit points, closed sets, dense sets, and related topological ideas.
CO-3	To study real sequences, their convergence, and the concept of subsequences.
CO-4	To study infinite series and apply various tests to determine their convergence.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓
CO-4	✓	✓	✓		✓	✓		

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓		✓	✓

MATH-H-DSCC4-3-TH: Ordinary Differential Equations – I and Group Theory – I

CO	Course Outcome Statement
CO-1	To understand the formation of differential equations and the methods for solving them.
CO-2	To learn techniques for solving first-order, first-degree, and higher-degree differential equations.
CO-3	To study methods for solving higher-order linear and nonlinear differential equations.
CO-4	To study the algebraic structure of groups, including elementary properties, subgroups, order of a group, cyclic groups, alternating groups, and related concepts.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓	✓	✓		✓	✓		
CO-2	✓	✓	✓		✓	✓		

CO-3	✓	✓	✓		✓	✓		
CO-4	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓		✓	✓
CO-2	✓	✓	✓		✓	✓
CO-3	✓	✓	✓		✓	✓
CO-4	✓	✓	✓			✓

MATH-H-SEC3-3-TH: Linear Programming and Rectangular Games

CO	Course Outcome Statement
CO-1	To learn how to formulate real-life problems into mathematical models.
CO-2	To learn simplex method to solve linear programming problems.
CO-3	To understand duality theory and post optimal analysis.
CO-4	To learn how to solve transportation problems and assignment problems.
CO-5	To learn different techniques to solve rectangular games.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓	✓	✓		✓	✓		
CO-2	✓	✓	✓	✓	✓	✓	✓	
CO-3	✓		✓			✓		✓
CO-4	✓	✓	✓		✓	✓		
CO-5	✓	✓	✓		✓	✓		

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓		✓	✓
CO-2	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓		✓	✓
CO-5	✓	✓	✓		✓	✓

Semester IV

MATH-H-DSCC5-4-TH: Theory of Real Functions

CO	Course Outcome Statement
CO-1	To develop a thorough understanding of limits and continuity of functions.
CO-2	To acquire knowledge of bounded functions, types of discontinuities, and uniform continuity.
CO-3	To study Rolle's Theorem, the Mean Value Theorems, and Taylor's Theorem, along with their applications, including the existence of local extrema of a function on an interval.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓	✓	✓		✓	✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓		✓	✓

MATH-H-DSCC6-4-TH: Mechanics – I

CO	Course Outcome Statement
CO-1	To understand the principles of forces, including resultant forces, resultant couples, and coplanar force systems.
CO-2	To study rectilinear motion and simple harmonic motion.
CO-3	To develop the ability to solve problems related to work, power, and energy.
CO-4	To study impulsive forces and the collision of elastic bodies.
CO-5	To develop the ability to solve problems involving the motion of a particle in two dimensions.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓	✓	✓		✓	✓		
CO-4	✓		✓			✓		✓
CO-5	✓	✓	✓		✓	✓		

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓		✓	✓
CO-4	✓	✓	✓			✓
CO-5	✓	✓	✓		✓	✓

MATH-H-DSCC7-4-TH: Multivariate Calculus – I and Partial Differential Equations – I

CO	Course Outcome Statement
CO-1	To learn the concepts of limits, continuity, differentiability, and partial derivatives of functions of two or more variables.
CO-2	To learn how to compute directional derivatives, gradients, tangent planes, and higher-order partial derivatives.
CO-3	To study homogeneous functions and implicit functions.
CO-4	To determine extrema of functions of two variables and evaluate multiple and repeated integrals.
CO-5	To understand the classification of partial differential equations (PDEs), and learn methods for solving quasilinear and semilinear equations, including Charpit's general method for nonlinear first-order PDEs.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓		✓	✓		✓	✓	✓
CO-3	✓		✓			✓		✓
CO-4	✓		✓			✓		✓
CO-5	✓	✓	✓		✓	✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓	✓		✓
CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓			✓
CO-5	✓	✓	✓		✓	✓

MATH-H-DSCC8-4-TH: Group Theory – II and Ring Theory – I

CO	Course Outcome Statement
CO-1	To understand normal subgroups, quotient groups, group homomorphisms, and properties of isomorphisms.
CO-2	To learn about automorphisms, external and internal direct products, and Abelian groups.
CO-3	To acquire knowledge of ring theory, including subrings, integral domains, fields, subfields, ideals, ring homomorphisms, and congruence relations on rings.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓			✓

Semester V

MATH-H-DSCC9-5-TH: Probability and Statistics

CO	Course Outcome Statement
CO-1	To understand random experiments, probability axioms, conditional probability, and joint probability.
CO-2	To study distribution functions of random variables, their properties, and probability mass and density functions.
CO-3	To learn about joint distributions of discrete and continuous random variables and their properties.
CO-4	To understand populations and samples, sampling distributions, and sample characteristics.
CO-5	To learn methods for estimating parameters, including the method of maximum likelihood.
CO-6	To acquire knowledge of bivariate frequency distributions and the construction of confidence intervals.
CO-7	To study hypothesis testing, including Type I and Type II errors.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓	✓	✓	✓		✓		✓
CO-2	✓	✓	✓	✓		✓		✓
CO-3	✓	✓	✓	✓		✓		✓
CO-4	✓	✓	✓	✓		✓		✓
CO-5	✓	✓	✓	✓		✓		✓
CO-6	✓	✓	✓	✓		✓		✓
CO-7	✓	✓	✓	✓		✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓		✓
CO-2	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓		✓
CO-4	✓	✓	✓	✓		✓
CO-5	✓	✓	✓	✓		✓
CO-6	✓	✓	✓	✓		✓
CO-7	✓	✓	✓	✓		✓

MATH-H-DSCC10-5-TH: Ring Theory – II and Linear Algebra – I

CO	Course Outcome Statement

CO-1	To understand principal ideal domains, principal ideal rings, and Euclidean domains.
CO-2	To acquire knowledge of polynomial rings, factorization domains, ring embeddings, quotient fields, regular rings, and ideals in regular rings.
CO-3	To study vector spaces, subspaces, quotient spaces, linear span, basis and dimension, full-rank factorization, and rank inequalities.
CO-4	To learn about linear transformations, the algebra of linear transformations, isomorphisms, eigenvalues, and eigenvectors.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓
CO-4	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓			✓

MATH-H-DSCC11-5-TH: Riemann Integration and Series of Functions

CO	Course Outcome Statement
CO-1	To understand Riemann's definition of integrability, necessary and sufficient conditions for Riemann integrability, and the properties of Riemann integrable functions.
CO-2	To study improper integrals, Cauchy's principal value of improper integrals, and convergence tests.
CO-3	To learn about sequences of functions, including pointwise and uniform convergence, and the boundedness, continuity, integrability, and differentiability of the limit function under uniform convergence.
CO-4	To study series of functions, including pointwise and uniform convergence, and the boundedness, continuity, integrability, and differentiability of a series under uniform convergence.
CO-5	To learn power series and Fourier series and their applications.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓

CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓
CO-4	✓		✓			✓		✓
CO-5	✓	✓	✓		✓	✓		

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓			✓
CO-5	✓	✓	✓		✓	✓

MATH-H-DSCC12-5-TH: Mechanics – II

CO	Course Outcome Statement
CO-1	To develop the ability to solve problems related to friction and virtual work.
CO-2	To understand the concepts of stable, unstable, and neutral equilibrium.
CO-3	To learn how to determine the equations of equilibrium for an arbitrary system of forces in three dimensions.
CO-4	To solve problems involving the motion of a particle on a rough curve and the motion of particles with varying mass.
CO-5	To learn the dynamics of systems of particles and rigid bodies in detail.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓	✓	✓		✓	✓		
CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓
CO-4	✓	✓	✓		✓	✓		
CO-5	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓		✓	✓
CO-2	✓	✓	✓			✓

CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓		✓	✓
CO-5	✓	✓	✓			✓

Semester VI

MATH-H-DSCC13-6-TH: Metric Space and Complex Analysis – I

CO	Course Outcome Statement
CO-1	To understand concepts such as open balls, open sets, closed sets, bounded sets, uniform continuity, and isometries.
CO-2	To learn about convergent sequences and completeness of metric spaces.
CO-3	To learn about compactness, connectedness, and the contraction mapping principle.
CO-4	To study limits, continuity, and differentiability of functions of a complex variable.
CO-5	To understand analytic functions and elementary functions of a complex variable.
CO-6	To learn bilinear transformations and their properties.
CO-7	To study power series, including their convergence and representation of analytic functions.
CO-8	To understand properties of harmonic functions and the Milne-Thomson method.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓
CO-4	✓		✓			✓		✓
CO-5	✓		✓			✓		✓
CO-6	✓		✓			✓		✓
CO-7	✓		✓			✓		✓
CO-8	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓			✓
CO-5	✓	✓	✓			✓
CO-6	✓	✓	✓			✓
CO-7	✓	✓	✓			✓
CO-8	✓	✓	✓			✓

MATH-H-DSCC14-6-TH: Multivariate Calculus – II and Application of Calculus

CO	Course Outcome Statement
CO-1	To understand the continuity and differentiability of functions of several variables.
CO-2	To learn how to compute double and triple integrals.
CO-3	To study the divergence and curl of vector fields and apply line integrals.
CO-4	To understand and apply Green's Theorem, Stokes' Theorem, and the Divergence Theorem.
CO-5	To learn curvature, concavity, points of inflection, envelopes, rectilinear asymptotes, curve tracing.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓		✓	✓		✓	✓	✓
CO-3	✓	✓	✓		✓	✓		
CO-4	✓	✓	✓		✓	✓		✓
CO-5	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓	✓		✓
CO-3	✓	✓	✓		✓	✓
CO-4	✓	✓	✓		✓	✓
CO-5	✓	✓	✓			✓

MATH-H-DSCC15-6-TH: Numerical Analysis

CO	Course Outcome Statement
CO-1	To understand polynomial approximation, interpolation, and numerical methods for differentiation and integration.
CO-2	To learn various techniques for solving transcendental and polynomial equations.
CO-3	To study methods for solving systems of linear algebraic equations.
CO-4	To learn techniques for matrix inversion and the Power Method for finding the dominant eigenvalue and eigenvector.
CO-5	To study numerical methods for solving ordinary differential equations.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓	✓		✓	✓	✓
CO-2	✓	✓	✓		✓	✓		
CO-3	✓	✓	✓		✓	✓		
CO-4	✓		✓			✓		✓
CO-5	✓	✓	✓	✓	✓	✓	✓	

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓		✓
CO-2	✓	✓	✓		✓	✓
CO-3	✓	✓	✓		✓	✓
CO-4	✓	✓	✓			✓
CO-5	✓	✓	✓	✓	✓	✓

Semester VII

MATH-H-DSCC16-7-TH: Group Theory – III and Linear Algebra – II

CO	Course Outcome Statement
CO-1	In course of study of Group Theory III, the students learn the deeper concepts of Group theory that will help them in pursuing higher studies.
CO-2	In course of their study they will study in detail finite Abelian Groups , structure of finitely generated free Abelian groups and torsion group that will help them in studying recent research problems.
CO-3	Students will learn Group actions, permutation representation of group action, Applications of group actions, Generalized Cayley's theorem , Index theorem, Burnside theorem, Cauchy's theorem on finite groups, p-group, Centre of pgroups, Sylow's theorems and Simple groups.
CO-4	During study of Linear Algebra II, students will learn about finite dimensional inner product spaces Gram-Schmidt orthonormalisation process, orthogonal complements, Bessel's inequality and linear operator.
CO-5	Students learn Bilinear and quadratic forms, Diagonalisation of symmetric matrices, Hessian matrix, Sylvester's law of inertia (statement only). Fundamental theorem of Linear Algebra Linear functionals, dual space, Annihilators. Eigenspaces of a linear operator, diagonalizability, invariant subspaces and Cayley- Hamilton theorem, the minimal polynomial for a linear operator and canonical forms.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓	✓	✓		✓	✓		✓
CO-3	✓	✓	✓		✓	✓		✓
CO-4	✓		✓			✓		✓
CO-5	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓		✓	✓
CO-3	✓	✓	✓		✓	✓
CO-4	✓	✓	✓			✓
CO-5	✓	✓	✓			✓

MATH-H-DSCC17-7-TH: Complex Analysis – II and Measure Theory – I

CO	Course Outcome Statement

CO-1	After studying Complex Analysis I in semester six the students will be acquainted with the advanced topics of Complex Analysis which will help in their future academics and research.
CO-2	Students will learn curves in the complex plane, complex line integrations, fundamental theorem of calculus, Cauchy-Goursat theorem (statement only), Cauchy's integral formula, Morera's theorem, Liouville's theorem and fundamental theorem of algebra.
CO-3	Students will acquire knowledge about Maximum Modulus theorem (statement only) and its applications, Minimum Modulus Theorem, Taylor's theorem, Laurent's theorem, Various kinds of singularities of complex valued functions, essential singularity, Residue calculus and Residue theorem for the extended complex plane.
CO-4	Students will get an exposure to the basic idea of Measure theory. They will learn the limitations of Riemann Integration and the necessity of theory of Lebesgue integration. They will study the concept of outer measure, inner measure, measurable sets and their properties
CO-5	Students learn about Borel σ-algebra, Borel sets, Definition of Lebesgue measurable set, characterization of Lebesgue measurable sets by open sets, closed sets, Fσ -sets, Gδ -sets; Caratheodory's criterion, non-measurable sets, Cantor set and its properties.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓		✓	✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓	✓	✓		✓	✓		✓
CO-4	✓		✓			✓		✓
CO-5	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓		✓	✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓		✓	✓
CO-4	✓	✓	✓			✓
CO-5	✓	✓	✓			✓

MATH-H-DSCC18-7-TH: Generalised Functions, Integral Transforms and Integral Equations

CO	Course Outcome Statement
CO-1	The students will conceive the idea of generalized functions, regular generalized functions, test function, support function, singular generalized function, Dirac Delta function and Dirac Delta sequence.
CO-2	In course of studying this paper the students will learn different integral transforms which will be immensely helpful in their future studies. They will learn Fourier Transform and its properties, Convolution, Transform of derivatives and derivatives of transform, Perseval formula, Inversion theorem and its application in solving ordinary differential equations.

CO-3	Students will also learn Laplace transform and its properties, Transform of derivatives and derivatives of transform, Convolution, The inversion theorem and Application in solving ordinary differential equations.
CO-4	Students will be acquainted with the basic idea of Integral equations. They will study Fredholm equation and its solution by the method of successive approximation, Neumann series, equations with degenerate kernel, Volterra equation and its solution by the method of iterated kernel.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓		✓	✓		✓
CO-2	✓	✓	✓		✓	✓		✓
CO-3	✓	✓	✓		✓	✓		✓
CO-4	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓		✓	✓
CO-2	✓	✓	✓		✓	✓
CO-3	✓	✓	✓		✓	✓
CO-4	✓	✓	✓			✓

MATH-H-DSCC19-7-TH: Topology – I

CO	Course Outcome Statement
CO-1	In this course the students will get an exposure to the study of Topology starting the basic idea from Metric space. In course of time they will learn the idea of accumulation point, derived set, base and subbases, finite product topology and other basic concepts.
CO-2	Students will study first and second countability axioms, separability and Lindelöf property. T1 property, Equivalence of second countability, separability and Lindelöf property in metric spaces and continuous functions in details including Heine's continuity criterion for first countable topological spaces.
CO-3	Students will also learn different separation axioms (T1 , T2 , T3 , T4 , T5 etc) which will help them to understand the spirit of the subject.
CO-4	Finally the students will learn compactness, Compactness and continuous functions, Product of two compact spaces, Countably compact, sequentially compact and Frechet compact spaces.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓

CO-4	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓			✓

MATH-H-DSCC20-7-TH: Functional Analysis – I

CO	Course Outcome Statement
CO-1	In this course, students will gain a basic understanding of fundamental concepts that will help them study various topics in pure and applied mathematics. They will learn the concept of Cardinal numbers and the order relations among them, along with the Schröder–Bernstein theorem. The course will also introduce the concept of an infinite basis of a Vector space (or linear space) and the notion of Dimension of a vector space, defined as the cardinal number of a basis of the vector space.
CO-2	Students will learn normed liner spaces and its different properties in detail.
CO-3	Students will learn about Bounded linear operators between Normed vector spaces, properties of finite-dimensional spaces, the equivalence of norms, the topological isomorphism between n-dimensional normed spaces and Euclidean space, and the Riesz's lemma.
CO-4	In this course the students will also learn about Bounded linear functional and its example, construction of unbounded linear functional on every infinite dimensional linear space, Hahn-Banach theorem (extension form only) and its consequences and dual space of normed linear space.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓
CO-4	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓			✓

Semester VIII

MATH-H-DSCC21-8-TH: Ordinary Differential Equations – II and Partial Differential Equations – II

CO	Course Outcome Statement
CO-1	Students will learn the analytical and application aspects of ordinary differential equations, which will help them pursue higher studies.
CO-2	They will learn Qualitative Analysis of One-dimensional Continuous Systems, Saddlle-node, Transcritical and Pitchfork bifurcations, Systems of Differential Equations, Planar linear autonomous systems, phase plane and phase portraits and Planar Nonlinear systems.
CO-3	The students will be acquainted with the ideas of ordinary point and singular points, Types of singularity, Series solution of a second order differential equation, Legendre equation and Legendre function, Bessel equation and Bessel functions.
CO-4	Students will become familiar with Sturm–Liouville problems and eigenfunction expansions, and will also be introduced to Green's functions.
CO-5	Students will learn various types of partial differential equations and their solution methods, enabling them to address different research problems.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓	✓	✓		✓	✓		
CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓
CO-4	✓	✓	✓		✓	✓		
CO-5	✓	✓	✓		✓	✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓		✓	✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓		✓	✓
CO-5	✓	✓	✓		✓	✓

MATH-H-DSCC22-8-TH: Graph Theory

CO	Course Outcome Statement
CO-1	In this course, students will become familiar with an important branch of mathematics in which they will study the origin and applications of graph theory. They will also learn the definitions of the basic terms of graph theory.

CO-2	Students will also learn about Eulerian graphs, Hamiltonian paths and cycles, and Hamiltonian graphs. They will study applications such as the Traveling Salesman Problem (TSP), route planning, and DNA sequencing.
CO-3	Students will acquire knowledge of the definition and properties of trees, minimal spanning trees in weighted graphs, Kruskal's algorithm and Prim's algorithm. They will also study binary trees and their properties, Dijkstra's algorithm for finding the shortest path in a graph, and decision trees used in artificial intelligence.
CO-4	Students will study planar graphs, Kuratowski's two graphs, Euler's polyhedron formula, Kuratowski's theorem, homeomorphic graphs, and the dual of a graph.
CO-5	The course will introduce the concept of directed graphs (digraphs), the matrix representation of graphs, and the adjacency and incidence matrices of graphs and digraphs. Students will also learn about the chromatic number of graphs and its elementary properties, as well as map-coloring problems and the Four Color Problem.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓	✓	✓		✓	✓		
CO-2	✓	✓	✓		✓	✓		
CO-3	✓		✓	✓		✓	✓	✓
CO-4	✓		✓			✓		✓
CO-5	✓	✓	✓		✓	✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓		✓	✓
CO-2	✓	✓	✓		✓	✓
CO-3	✓	✓	✓	✓		✓
CO-4	✓	✓	✓			✓
CO-5	✓	✓	✓		✓	✓

MATH-H-DSCC23.1-8-TH: Mechanics – III

CO	Course Outcome Statement
CO-1	In this paper the idea of degrees of freedom, generalized coordinates, different constraints and forces of constraints are introduced. The students will learn Lagrange's equations of motion of first and second kind, cyclic coordinates, Routhian equation of motion, Action integral, Hamiltonian, Hamilton's equations of motion and Noether's theorem.
CO-2	The students will learn to find Hamilton's equations from variational principles, principle of stationary action, Liouville's theorem and canonical transformation.
CO-3	The course will introduce the fundamentals of solid mechanics, providing a foundation for higher studies. Students will become acquainted with the continuum hypothesis, Lagrangian and Eulerian descriptions, and the material derivative. They will gain knowledge of deformation tensors, finite strain tensors, strain invariants, body forces, and surface forces. Additionally,

	students will study the continuity equation, the first law of thermodynamics, classical elasticity, the generalized Hooke's law, and the strain energy function.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓		✓	✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓	✓	✓	✓	✓	✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓		✓	✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓	✓	✓	✓

MATH-H-DSCC23.2-8-TH: Measure Theory – II

CO	Course Outcome Statement
CO-1	In this course, a deeper understanding of measure theory will be developed. Students will study Lebesgue measurable functions, the characterization of Lebesgue measurable functions, the concept of "almost everywhere," the algebra of measurable functions, and Borel measurable functions with examples. They will also learn about the approximation of Lebesgue measurable functions by continuous functions.
CO-2	The students will learn in detail the Lebesgue integral of non-negative measurable function.
CO-3	During the course of study, students will be introduced to the Lebesgue integral of measurable functions taking values in the set of nonzero real numbers. They will also learn the Dominated Convergence Theorem and the relationship between the Lebesgue and Riemann integrals.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓			✓

MATH-H-DSCC24.1-8-TH: Operations Research and Stochastic Process

CO	Course Outcome Statement
CO-1	In this paper the students will be conversant with Integer programming and network optimization which are fundamental in present day research in any scientific field.
CO-2	The students will learn queuing theory with Poisson arrival and exponential distribution. They will study in particular M/M/1/∞/ FIFO model and its steady solutions which are helpful in different applied fields. They will also learn Monte Carlo simulation and inventory models which are very much necessary in any industrial research.
CO-3	The idea of stochastic will be introduced which will help them in pursuing Higher studies. The students will be acquainted with the idea of Markov Chain, Stochastic matrices, Chapman-Kolmogorov equation, Equilibrium distributions and Stochastic process in continuous time.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓		✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓		✓

MATH-H-DSCC24.2-8-TH: Differential Geometry

CO	Course Outcome Statement
CO-1	This course will introduce the concepts and basic terminology of tensors. Students will learn about tensor transformation laws, properties of tensors, Riemannian tensors, and Einstein spaces.
CO-2	The students will learn in detail the theory of curves where they will learn Serret- Frenet formulae.
CO-3	During the course, students will gain a detailed understanding of the theory and geometry of surfaces, which will help them comprehend geodesics and surface curvature. They will study level surfaces, quadric surfaces, ruled surfaces, and surfaces of revolution, as well as Gauss and Weingarten maps and their properties. Additionally, students will learn about normal and geodesic curvatures, Gaussian and mean curvature, and the principal curvatures of a surface.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓

CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓			✓

MATH-H-DSCC25.1-8-TH: Fluid Mechanics and Computational Mathematics

CO	Course Outcome Statement
CO-1	In this paper the idea of Fluid mechanics will be introduced which will help them in pursuing Higher studies. The students will learn Lagrangian and Eulerian formulation, Fluid Kinematics, Material derivative and Equation of continuity.
CO-2	The students will learn basic concepts of fluid at rest, fluid in motion, viscous, non-viscous, Newtonian, perfect, compressible and incompressible fluids. Stress analysis and strain analysis, and constitutive equations for ideal / perfect fluid.
CO-3	The students will study Euler's equation for perfect fluids, Navier-Stokes' equation, equation of equilibrium for perfect fluids, Bernoulli's equation, Conservative field of force and equation of energy for perfect fluid. Irrotational motion will also be considered in course of study and students will learn some exact solutions of Navier-Stokes' equation.
CO-4	In computational mathematics students will learn Numerical Integration, Numerical Solution of System of Linear Equations, Numerical Solution of Ordinary Differential Equations (ODE), The Finite Difference Method and Numerical Solution of Boundary Value Problems for ODE and Numerical Solution of Partial Differential Equations (PDE).
CO-5	In tutorial component students will solve the practical problems using PYTHON which will help in their higher education and pursuing research.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓
CO-4	✓	✓	✓	✓	✓	✓	✓	
CO-5	✓	✓	✓		✓	✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓

CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓		✓	✓

MATH-H-DSCC25.2-8-TH: Functional Analysis – II and Topology – II

CO	Course Outcome Statement
CO-1	In this course, students will study functional analysis and topology in depth, providing a strong foundation for higher studies. They will learn the Open Mapping Theorem, the Closed Graph Theorem, the Uniform Boundedness Principle, and some applications of these theorems.
CO-2	Students will study inner product spaces and Hilbert spaces in detail, where they will learn about Bessel's inequality and Parseval's equation for separable Hilbert spaces, the Gram–Schmidt orthonormalization process, and the Riesz representation theorem.
CO-3	In this course, students will study connectedness, local connectedness, quotient spaces, as well as the concepts of nets and filters.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓	✓	✓		✓	✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓		✓	✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓			✓

MATH-H-RM1-8-TH: Research Methodology – I

CO	Course Outcome Statement
CO-1	Students will understand the meaning and objectives of research, learn to identify and formulate research problems within their area of interest, and develop basic skills in mathematical writing with clarity and logical presentation.
CO-2	Students will become familiar with professional mathematical organizations such as the American Mathematical Society, Mathematical Association of America, and Society for Industrial and Applied Mathematics. They will also learn about journal metrics, research databases, indexing services, and ethical practices in scientific research.
CO-3	As a mathematical modeling tool the students will learn different types of elliptic, parabolic and hyperbolic Partial Differential Equations (PDE) with examples. They will also learn analytical solution techniques and numerical solution techniques of PDE that will be helpful for pursuing research.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓	✓	✓		✓	✓		✓
CO-2	✓	✓	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓		✓	✓
CO-2	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓

MATH-H-RM2-8-TH: Research Methodology – II

CO	Course Outcome Statement
CO-1	After studying Scientific Communication and Publishing, students will understand the structure of a research paper, the methods of effective scientific communication, and the techniques involved in publishing research work. They will also learn how to write a review of research articles.
CO-2	After acquiring knowledge of Thesis Writing and Presentation Tools, students will learn the fundamentals of thesis and project report writing. They will also develop the ability to write scholarly papers and present their ideas effectively using LaTeX.
CO-3	As a mathematical modelling tool the students will learn either Machine Learning in Mathematical Research or Graph Theory in Mathematical Research. In the Machine learning course, the students will learn the basics of graph theory, introduction to machine learning, supervised and unsupervised learning and support vector machines which will help them in pursuing research of present day need. In laboratory assignment the students will use python to deal problems involving machine learning. In the Graph theory course, students will study fundamental concepts of Graph Theory, including definitions and properties of graphs, Hamiltonian graphs, the Travelling Salesman Problem, route planning, and DNA sequencing. The course also covers algorithms such as Joseph Kruskal's algorithm, Robert C. Prim's algorithm, and Edsger W. Dijkstra's shortest path algorithm, along with topics such as Binary trees, Decision trees, Planar graphs, Kuratowski's theorem, adjacency and incidence matrices, the Chromatic number of graphs, map colouring problems, and the Four color theorem.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓		✓	✓		✓
CO-2	✓		✓	✓		✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6

CO-1	✓	✓	✓		✓	✓
CO-2	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓	✓	✓

Semester I / II / III (Interdisciplinary Course)

MATH-H-IDC-TH: Mathematics in Daily Life

CO	Course Outcome Statement
CO-1	To learn basic ideas of set theory.
CO-2	To learn mathematics of integers behind ISBN, UPC, VISA, MASTER card nos.
CO-3	To get an idea of propositional logic, logical connectives.
CO-4	To learn basics of linear programming problems.
CO-5	To learn financial mathematics at elementary level.

CO–PO Mapping

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8
CO-1	✓		✓			✓		✓
CO-2	✓		✓			✓		✓
CO-3	✓		✓			✓		✓
CO-4	✓	✓	✓	✓	✓	✓	✓	
CO-5	✓		✓			✓		✓

CO–PSO Mapping

CO/PSO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	✓	✓	✓			✓
CO-2	✓	✓	✓			✓
CO-3	✓	✓	✓			✓
CO-4	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓			✓