

Pandit Deendayal Upadhyaya Adarsha Mahavidyalaya
Department of Mathematics
Dalgaon, Darrang, Assam-784116

Mathematics (Honours)

Programme Specific Outcomes: After completion of B.Sc.(H) programme in mathematics a student shall enable to:

- i) Communicate mathematics effectively by oral, written, computational and graphic means.
- ii) Create mathematical ideas from basic axioms.
- iii) Gauge the hypothesis, theories, techniques and proofs provisionally.
- iv) Utilize mathematics to solve theoretical and applied problems by critical understanding, analysis and synthesis.
- v) Identify applications of mathematics in other disciplines and in the real world, leading to enhancement of career prospects in a plethora of fields.
- vi) Appreciate the requirement of lifelong learning through continued education and research.

Semester-I

MAT-HC-1016: Calculus (Including Practical)

Course Outcomes:

This course will enable the students to:

- i) Learn first and second derivative tests for relative extremum and apply the knowledge in problems in business, economics and life sciences.
- ii) Sketch curves in a plane using its mathematical properties in different coordinate systems.
- 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.

MAT-HC-1026: Algebra

Course Outcomes:

This course will enable the students to:

- i) Employ De Moivre'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.

GENERIC ELECTIVE

MAT-HG-1016/ MAT-RC-1016: Calculus

Course Outcomes:

This course will enable the students to:

- i) Understand continuity and differentiability in terms of limits.
- ii) Describe asymptotic behavior in terms of limits involving infinity.
- iii) Use derivatives to explore the behavior of a given function, locating and classifying its extrema, and graphing the function.
- iv) Understand the importance of mean value theorems.

MAT-HG-1026: Analytical Geometry

Course Outcomes:

This course will enable the students to:

- i) Transform coordinate systems, conic sections
- ii) Learn polar equation of a conic, tangent, normal and related properties
- iii) Have a rigorous understanding of the concept of three-dimensional coordinate systems
- iv) Understand geometrical properties of dot product, cross product of vectors

Semester-II

MAT-HC-2016: Real Analysis

Course Outcomes:

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.
- iv) Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.

MAT-HC-2026: Differential Equations (including practical)

Course Outcomes:

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.

GENERIC ELECTIVE

MAT-HG-2016/MAT-RC-2016: Algebra

Course Outcomes:

This course will enable the students to:

- i) Learn how to solve the cubic and biquadratic equations, also learn about symmetric functions of the roots for cubic and biquadratic.
- ii) Employ De Moivre's theorem in a number of applications to solve numerical problems.
- iii) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix. Finding inverse of a matrix.
- iv) Recognize the mathematical objects that are groups, and classify them as abelian, cyclic and permutation groups, ring etc.

MAT-HG-2026: Discrete Mathematics

Course outcomes:

After the course, the student will be able to:

- i) Understand the notion of ordered sets and maps between ordered sets.
- ii) Learn about lattices, modular and distributive lattices, sub lattices and homeomorphisms between lattices.
- iii) Become familiar with Boolean algebra, Boolean homomorphism, Karnaugh diagrams, switching circuits and their applications.

Semester-III

MAT-HC-3016: Theory of Real Functions

Course Outcomes:

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

MAT-HC-3026: Group Theory – I

Course Outcomes:

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.

MAT-HC-3036: Analytical Geometry

Course Outcomes:

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

SKILL ENHANCEMENT COURSES

SEC-1

MAT-SE-3014: Computer Algebra Systems and Related Software

Course Outcomes:

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) Understand the use of the statistical software **R** as calculator and learn to read and get data into **R**.
- iv) Learn the use of **R** in summary calculation, pictorial representation of data and exploring relationship between data.
- v) Analyze, test, and interpret technical arguments on the basis of geometry

MAT-SE-3024: Combinatorics and Graph Theory

Course Outcomes:

This course will enable the students to:

- i) Learn about the counting principles, permutations and combinations, Pigeonhole 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.

GENERIC ELECTIVE PAPERS

MAT-HG-3016/MAT-RC-3016: Differential Equations

Course Outcomes:

The course will enable the students to:

- i) Learn basics of differential equations and mathematical modelling.
- ii) Solve first order non-linear differential equations and linear differential equations of higher order using various techniques.

MAT-HG-3026: Linear Programming

Course Outcomes:

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.

SEMESTER-IV

MAT-HC-4016: Multivariate Calculus

Course Outcomes:

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

- iii) Learn about inter-relationship amongst the line integral, double and triple integral formulations.
- iv) Familiarize with Green's, Stokes' and Gauss divergence theorems

MAT-HC-4026: Numerical Methods (including practical)

Course Outcomes:

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 and 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.

MAT-HC-4036: Ring Theory

Course Outcomes:

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 homomorphism and isomorphism theorems of rings.
- iv) Learn about the polynomial rings over commutative rings, integral domains, Euclidean domains, and UFD

SKILL ENHANCEMENT COURSES

SEC-2

MAT-SE-4014: R Programming

Course Outcomes:

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**.

MAT-SE-4024: LaTeX and HTML (practical)

Course Outcomes:

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.

MAT-SE-4034: Boolean Algebra

Course Outcomes:

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.

GENERIC ELECTIVE PAPERS

MAT-HG-4016/ MAT-RC-4016: Real Analysis

Course Outcomes:

This course will enable the students to:

- i) Understand many properties of the real line \mathbb{R} , including completeness and Archimedean properties.
- ii) Learn to define sequences in terms of functions from \mathbb{R} to a subset of \mathbb{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.

- iv) Apply the ratio, root and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.

MAT-HG-4026: Numerical Analysis

Course Outcomes:

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 Gauss–Jacobi, Gauss–Seidel and SOR methods.
- 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.

SEMESTER-V

MAT-HC-5016: Complex Analysis (including practical)

Course Outcomes:

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 can evaluate 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.

MAT-HC-5026: Linear Algebra

Course Outcomes:

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.

DISCIPLINE SPECIFIC ELECTIVE PAPERS
DSE-1

MAT-HE-5016: Number Theory

Course Outcomes:

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.

MAT-HE-5026: Mechanics

Course Outcomes:

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.

MAT-HE-5036: Probability and Statistics

Course Outcomes:

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.
- v) Understand central limit theorem, which helps to understand the remarkable fact that: the empirical frequencies of so many natural populations, exhibit a bell-shaped curve, i.e., a normal distribution

DSE-2

MAT-HE-5046: Linear Programming

Course Outcomes:

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.

MAT-HE-5056: Spherical Trigonometry and Astronomy

Course Outcomes:

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

MAT-HE-5066: Programming in C (including practical)

Course Outcomes:

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.

SEMESTER-VI

MAT-HC-6016: Riemann Integration and Metric spaces

Course Outcomes:

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) Analyze 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.

MAT-HC-6026: Partial Differential Equations (including practical)

Course Outcomes:

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 as well as non-homogeneous wave equations.
- v) Apply the method of separation of variables for solving second order PDEs.

DSE-3

MAT-HE-6016: Boolean Algebra and Automata Theory

Course Outcomes:

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

MAT-HE-6026: Bio-Mathematics

Course outcomes:

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.

MAT-HE-6036: Mathematical Modeling (including practical)

Course Outcomes:

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.

MAT-HE-6046: Hydromechanics

Course Outcomes:

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

DSE-4

MAT-HE-6056: Rigid Dynamics

Course Outcomes:

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.

MAT-HE-6066: Group Theory II

Course Outcomes:

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 S_n .
- v) Understand Sylow theorems and their applications in checking non-simplicity.

MAT-HE-6076: Mathematical Finance

Course outcomes:

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.