Course Outcome of 3 year Mathematics Honours Course:

Upon completion of BMH1CC01: Calculus, Geometry & Differential Equations, students will:

1. Understand and apply hyperbolic functions, higher order derivatives, and Leibnitz rule to solve various types of problems.

2. Analyze concavity, inflection points, envelopes, asymptotes, and perform curve tracing in both Cartesian and polar coordinates.

3. Utilize L'Hospital's rule and its applications in business, economics, and life sciences.

4. Apply reduction formulae and integration techniques for trigonometric and logarithmic functions, parametric equations, and surface area calculations.

5. Demonstrate proficiency in sketching conics, including reflection properties, translation, rotation, and classification using discriminants.

6. Understand and illustrate the properties and graphing of quadrics such as spheres, cylindrical surfaces, central conicoids, paraboloids, and plane sections.

7. Solve differential equations, including general and particular solutions, exact equations, and integrating factors.

8. Apply techniques for separable equations, linear equations, Bernoulli equations, and special transformations.

9. Utilize graphical demonstrations and teaching aids to plot functions, compare graphs and their derivatives, sketch parametric curves, obtain surface of revolution, trace conics, and graph quadric surfaces.

10. Gain a strong foundation in calculus, geometry, and differential equations, with practical applications in various fields.

By the end of the course, students will have acquired the necessary skills to understand, analyze, and solve mathematical problems, and effectively communicate mathematical concepts and results.

Course Outcome of BMH1CC02:

Upon completing the course BMH1CC02, students will be able to:

1. Understand and apply the concepts of polar representation of complex numbers, n-th roots of unity, De Moivre’s theorem, and its applications.

2. Analyze equations, including the relation between roots and coefficients, transformation of equations, Descartes rule of signs, cubic and biquadratic equations, reciprocal equations, separation of roots, and Strum's theorem.

3. Solve inequalities using concepts such as the AM-GM-HM inequality and Cauchy-Schwartz inequality.

4. Comprehend and apply the principles of equivalence relations, partitions, functions, composition of functions, invertible functions, one-to-one correspondence, cardinality of a set, and well-ordering property of positive integers.

5. Utilize the division algorithm, divisibility, and Euclidean algorithm to solve problems. Understand congruence relations between integers and the Fundamental Theorem of Arithmetic.

6. Solve systems of linear equations using row reduction, echelon forms, vector equations, and matrix equations. Understand the concept of linear independence and its applications.

7. Gain knowledge of linear transformations, including the matrix representation of a linear transformation, inverse of a matrix, vector spaces, subspaces, dimension of subspaces, rank of a matrix, eigenvalues, eigenvectors, and the characteristic equation of a matrix.

8. Apply the Cayley-Hamilton theorem to find the inverse of a matrix.

Overall, students will develop a solid foundation in algebra, equation analysis, inequalities, set theory, linear algebra, and matrix theory. They will be equipped with the necessary mathematical tools and techniques to solve complex problems and apply mathematical concepts in various fields.

Course Outcome for Course BMH2CC03: Real Analysis

Upon completion of the course BMH2CC03: Real Analysis, students will:

1. Understand and apply the algebraic and order properties of the real numbers ($\mathbb{R}$) and the concept of ε-neighborhood of a point.

2. Recognize countable and uncountable sets, and understand the uncountability of $\mathbb{R}$.

3. Identify bounded above, bounded below, bounded, and unbounded sets in $\mathbb{R}$. Determine suprema and infima of sets.

4. Comprehend the completeness property of $\mathbb{R}$ and its equivalent properties.

5. Apply the Archimedean property, density of rational (and irrational) numbers in $\mathbb{R}$, and properties of intervals.

6. Analyze limit points, isolated points, open sets, closed sets, and derived sets.

7. Illustrate the Bolzano-Weierstrass theorem and Heine-Borel theorem for sets in $\mathbb{R}$.

8. Understand sequences, bounded sequences, convergent sequences, and the limit of a sequence. Explore liminf and limsup.

9. Apply limit theorems, study monotone sequences, and understand the monotone convergence theorem.

10. Analyze subsequences and identify divergence criteria. Familiarize with the Bolzano-Weierstrass theorem for sequences.

11. Evaluate infinite series for convergence and divergence. Apply the Cauchy criterion and various tests for convergence such as the comparison test, limit comparison test, ratio test, nth root test, integral test, and Leibniz test.

12. Differentiate between absolute and conditional convergence.

13. Utilize graphical demonstrations and teaching aids to plot recursive sequences, study the convergence of sequences, verify the Bolzano-Weierstrass theorem, analyze the convergence/divergence of infinite series, and apply tests such as Cauchy's root test and ratio test through plotting.

By the end of the course, students will have developed a strong foundation in real analysis, including the properties of real numbers, sequences, and infinite series. They will be able to apply these concepts to analyze and solve problems in mathematics and related fields.

Course Outcome for Course BMH2CC04: Differential Equations and Vector Calculus

Upon completion of the course BMH2CC04: Differential Equations and Vector Calculus, students will:

1. Understand the Lipschitz condition and the statement of Picard's theorem.

2. Determine the general solution of homogeneous second-order equations and apply the principle of superposition for homogeneous equations.

3. Apply the Wronskian, its properties, and applications to solve differential equations.

4. Solve linear homogeneous and non-homogeneous equations of higher order with constant coefficients, including Euler's equation. Use methods such as undetermined coefficients and variation of parameters.

5. Analyze systems of linear differential equations, classify linear systems, and apply differential operators and operator methods for linear systems with constant coefficients.

6. Understand the basic theory of linear systems in normal form, specifically for two equations in two unknown functions.

7. Interpret equilibrium points and analyze the phase plane of a system of differential equations.

8. Solve differential equations using power series solutions, both around ordinary points and regular singular points.

9. Work with vector functions, including operations, limits, continuity, differentiation, and integration.

10. Utilize graphical demonstrations and teaching aids to plot families of curves that represent solutions of second and third-order differential equations.

By the end of the course, students will have a solid understanding of differential equations and vector calculus. They will be able to solve various types of differential equations, analyze systems of differential equations, and work with vector functions. These skills will enable them to apply their knowledge to real-world problems in fields such as physics, engineering, and applied mathematics.

Course Outcome for Course BMH3CC05: Theory of Real Functions & Introduction to Metric Space

Upon completion of the course BMH3CC05: Theory of Real Functions & Introduction to Metric Space, students will:

1. Understand the concept of limits of functions using the ε - δ approach and sequential criterion, and be able to determine convergence and divergence of functions.

2. Apply limit theorems and analyze one-sided limits, infinite limits, and limits at infinity.

3. Identify and work with continuous functions, utilizing the sequential criterion for continuity and discontinuity.

4. Explore the algebra of continuous functions and apply the intermediate value theorem, location of roots theorem, and preservation of intervals theorem.

5. Investigate uniform continuity and understand non-uniform continuity criteria, as well as relevant theorems.

6. Analyze differentiability of functions at a point and in an interval, including Caratheodory's theorem, and apply the algebra of differentiable functions.

7. Apply concepts of relative extrema, interior extremum, Rolle's theorem, mean value theorem, and Darboux's theorem.

8. Utilize differential calculus to determine curvature and its applications.

9. Apply Cauchy's mean value theorem and Taylor's theorem with Lagrange's and Cauchy's forms of remainder, and understand their applications to convex functions and relative extrema.

10. Expand functions using Taylor's series and Maclaurin's series, including exponential and trigonometric functions, ln(1 + x), 1/ax+b, and (1 +x)n.

11. Apply Taylor's theorem to inequalities.

12. Understand metric spaces and their definition and examples, including open and closed balls, neighborhoods, open and closed sets, limit points, diameter of sets, subspaces, dense sets, and separable spaces.

By the end of the course, students will have a solid understanding of real functions, including limits, continuity, differentiability, and their applications. They will also have a foundational knowledge of metric spaces and their properties. These skills and concepts will enable them to analyze and work with various types of functions and sets, providing them with a strong basis for further studies in mathematical Course Outcome for BMH3CC06: Group Theory–I

Course Outcome for Course BMH2CC06: Group Theory–I

By the end of this course, students will be able to:

1. Understand and apply the fundamental concepts of group theory: Students will gain knowledge of the symmetries of a square, dihedral groups, and the definition and examples of groups, including permutation groups and quaternion groups through matrices. They will be able to identify and demonstrate elementary properties of groups.

2. Analyze subgroups and their properties: Students will be able to identify and provide examples of subgroups. They will understand the concepts of centralizer, normalizer, and center of a group. Furthermore, they will learn about the product of two subgroups.

3. Comprehend the properties and applications of cyclic groups: Students will explore the properties of cyclic groups and learn how to classify subgroups of cyclic groups. They will be able to represent

permutations using cycle notation and understand even and odd permutations. Additionally, students will gain knowledge of the alternating group, properties of cosets, Lagrange's theorem, and its consequences, including Fermat's Little theorem.

4. Understand factor groups and their applications: Students will gain knowledge of the external direct product of a finite number of groups. They will be able to identify normal subgroups and understand factor groups. Moreover, students will learn about Cauchy's theorem for finite abelian groups.

5. Analyze group homomorphisms and isomorphisms: Students will comprehend group homomorphisms and their properties. They will understand Cayley's theorem and the properties of isomorphisms. Furthermore, they will explore the First, Second, and Third isomorphism theorems.

Overall, students completing this course will have a strong foundation in group theory and will be able to apply the concepts and theorems to analyze various mathematical structures and systems.analysis and related fields.

Course Outcome for BMH3CC07: Numerical Methods & Numerical Methods Lab

Upon completion of the course BMH3CC07: Numerical Methods & Numerical Methods Lab, students will be able to:

1. Understand and analyze various numerical algorithms and their convergence properties.

2. Identify and estimate errors in numerical computations, including relative and absolute errors, round-off errors, and truncation errors.

3. Apply different methods for solving transcendental and polynomial equations, such as the Bisection method, Newton's method, Secant method, Regulafalsi method, fixed-point iteration, and Newton-Raphson method. Assess the rate of convergence for these methods.

4. Solve systems of linear algebraic equations using techniques like Gaussian Elimination, Gauss Jordan method, Gauss Jacobi method, Gauss Seidel method, and LU Decomposition. Analyze the convergence properties of these methods.

5. Perform interpolation using Lagrange and Newton's methods, and determine error bounds. Apply finite difference operators for interpolation. Use interpolation-based methods and finite differences for numerical differentiation.

6. Apply numerical integration techniques including Newton-Cotes formulas (such as Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule, Weddle's rule, Boole's rule), midpoint rule, and composite rules. Utilize Gauss quadrature formula for numerical integration.

7. Solve the algebraic eigenvalue problem using the Power method.

8. Solve ordinary differential equations using the method of successive approximations, Euler's method, the modified Euler method, and Runge-Kutta methods of orders two and four.

9. Implement and solve numerical problems using C programming language in the Numerical Methods Lab.

10. Maintain a well-organized lab notebook and effectively communicate the results of numerical experiments during viva voce sessions.

11. Develop programming skills to write programs for solving transcendental and algebraic equations, system of linear equations, interpolation, numerical integration, and ordinary differential equations using C programming language.

12. Analyze and interpret numerical results obtained from programming exercises and assess their accuracy.

13. Apply numerical methods and computational tools to solve mathematical problems encountered in various scientific and engineering disciplines.

By the end of the course, students will have gained a solid foundation in numerical methods, computational techniques, and programming skills, enabling them to apply these methods to real-world problems and perform accurate numerical computations. They will also have developed critical thinking and problem-solving abilities through hands-on experience in the Numerical Methods Lab.

Course Outcome for BMH3SEC11: Logic and Sets

Upon completion of the course BMH3SEC11: Logic and Sets, students will be able to:

1. Understand and analyze logical propositions, including their truth values and logical operators such as negation, conjunction, disjunction, implications, and biconditional propositions.

2. Apply truth tables to evaluate logical equivalences and determine the validity of logical arguments.

3. Comprehend the concepts of predicates and quantifiers, including universal and existential quantifiers, and their use in expressing statements about sets and elements.

4. Apply the laws of set theory and perform set operations such as union, intersection, difference, and symmetric difference.

5. Utilize Venn diagrams to visually represent and analyze sets and their relationships.

6. Apply counting principles to finite sets and understand the concept of infinite sets.

7. Recognize and utilize the properties of the empty set and the power set of a set.

8. Understand the concepts of relations, including composition, types of relations, equivalence relations (with examples of congruence modulo relation), and partial ordering relations.

9. Demonstrate proficiency in applying set identities, generalized union, and intersection operations.

10. Understand and analyze product sets and n-ary relations.

By the end of the course, students will have a solid understanding of logic and set theory, enabling them to reason logically, manipulate sets effectively, and apply these concepts to various mathematical and real-world scenarios. They will also develop critical thinking and problem-solving skills through the application of logical reasoning and set operations.

Course Outcome for BMH4CC08: Riemann Integration and Series of Functions

Upon completion of the course BMH4CC08: Riemann Integration and Series of Functions, students will be able to:

1. Understand and apply the concepts of Riemann integration, including upper and lower sums, Darboux integration, and the Riemann conditions of integrability.

2. Define the Riemann integral using Riemann sums and understand the equivalence of different definitions.

3. Determine the integrability of monotone and continuous functions using Riemann integration and analyze the properties of the Riemann integral.

4. Apply the Intermediate Value theorem for integrals and understand the Fundamental theorem of Integral Calculus.

5. Analyze improper integrals and understand the convergence of Beta and Gamma functions.

6. Comprehend the concepts of pointwise and uniform convergence of sequences of functions and apply the theorems on continuity, differentiability, and integrability of the limit function.

7. Understand the properties and convergence criteria for series of functions, including the Cauchy criterion for uniform convergence and the Weierstrass M-Test.

8. Apply Fourier series to analyze periodic functions, including the determination of Fourier coefficients and the sum function of a series.

9. Analyze the properties of Fourier series, such as the Riemann-Lebesgue lemma, Bessel's inequality, Parseval's identity, and Dirichlet's condition.

10. Understand power series, including the radius of convergence, and apply Cauchy-Hadamard theorem.

11. Perform differentiation and integration of power series and apply Abel's theorem and Weierstrass Approximation theorem.

By the end of the course, students will have a solid understanding of Riemann integration and series of functions, enabling them to analyze and integrate various types of functions and series. They will develop proficiency in applying these concepts to solve mathematical problems and gain insights into the properties and behavior of functions and series.

Course Outcome for BMH4CC09: Multivariate Calculus

Upon completion of the course BMH4CC09: Multivariate Calculus, students will be able to:

1. Understand and apply the concepts of functions of several variables, including limit and continuity, partial differentiation, total differentiability, and differentiability.

2. Apply the chain rule for functions with one and two independent parameters, compute directional derivatives, and analyze the properties of the gradient and Jacobian.

3. Determine extrema of functions of several variables using necessary and sufficient conditions, including the method of Lagrange multipliers.

4. Perform double integration over rectangular and non-rectangular regions, evaluate double integrals in polar coordinates, and compute triple integrals.

5. Calculate volumes using triple integrals, understand cylindrical and spherical coordinates, and apply the concept of change of variables in double and triple integrals.

6. Define vector operators, including the gradient of a scalar function, and understand directional derivatives and vector fields.

7. Comprehend divergence and curl, and apply line integrals using the fundamental theorem for line integrals and conservative vector fields.

8. Apply line integrals to calculate work done in vector fields.

9. Understand and apply Green's theorem, surface integrals, and integrals over parametrically defined surfaces.

10. Apply Stokes' theorem and the Divergence theorem in the evaluation of line and surface integrals.

By the end of the course, students will have a strong understanding of multivariate calculus, enabling them to analyze functions of multiple variables, compute integrals in various coordinate systems, and apply vector operators in the context of line and surface integrals. They will develop proficiency in solving mathematical problems involving multivariable functions and gain insights into the geometrical and physical interpretations of these concepts.

Course Outcome for BMH4CC10: Ring Theory and Linear Algebra I

Upon completion of the course BMH4CC10: Ring Theory and Linear Algebra I, students will be able to:

1. Define and identify examples of rings, understand the properties of rings, and recognize subrings, integral domains, and fields.

2. Determine the characteristic of a ring and comprehend the concepts of ideals, including ideals generated by subsets of a ring.

3. Perform operations on ideals, analyze factor rings, and identify prime and maximal ideals.

4. Understand ring homomorphisms and their properties, and apply the isomorphism theorems I, II, and III.

5. Explore the field of quotients and its significance in ring theory.

6. Define vector spaces and subspaces, analyze the algebra of subspaces, and comprehend quotient spaces.

7. Apply concepts of linear combination, linear span, linear independence, basis, and dimension in the context of vector spaces.

8. Determine the dimension of subspaces and utilize extension, deletion, and replacement theorems.

9. Explore linear transformations and their properties, including null space, range, rank, and nullity.

10. Represent linear transformations using matrices and comprehend the algebra of linear transformations.

11. Apply isomorphisms and theorems related to isomorphisms in the context of linear transformations.

12. Understand the concept of invertibility and isomorphisms, and analyze the change of coordinate matrix.

By the end of the course, students will have a solid foundation in ring theory and linear algebra, enabling them to analyze structures of rings, understand the properties and operations of ideals, and explore the fundamental concepts of vector spaces and linear transformations. They will develop proficiency in solving problems related to these topics and be equipped with the necessary knowledge for further studies in advanced algebra and linear algebra.

Course Outcome for BMH4SEC21: Graph Theory

Upon completion of the course BMH4SEC21: Graph Theory, students will be able to:

1. Define graphs, pseudo graphs, complete graphs, and bi-partite graphs, and identify their basic properties.

2. Understand the concept of graph isomorphism and determine whether two graphs are isomorphic.

3. Analyze Eulerian circuits, Eulerian graphs, semi-Eulerian graphs, and comprehend the associated theorems.

4. Explore Hamiltonian cycles and theorems related to Hamiltonian graphs.

5. Represent graphs using matrices, such as the adjacency matrix and incidence matrix.

6. Analyze weighted graphs and understand the implications of assigning weights to edges.

7. Solve the traveling salesman's problem and determine the shortest path in a graph.

8. Understand the concept of trees and their properties, including spanning trees.

9. Apply Dijkstra's algorithm and the Warshall algorithm in solving graph-related problems.

By the end of the course, students will have a solid understanding of graph theory and its applications. They will be able to analyze and interpret different types of graphs, determine graph isomorphism, and solve problems related to Eulerian circuits, Hamiltonian cycles, and tree structures. They will also develop proficiency in utilizing matrices to represent graphs and applying algorithms like Dijkstra's algorithm and the Warshall algorithm to solve graph-based optimization problems. These skills will provide a strong foundation for further studies in graph theory and its applications in various fields such as computer science, operations research, and network analysis.

Course Outcome for BMH5CC11: Partial Differential Equations and Applications

Upon completion of the course BMH5CC11: Partial Differential Equations and Applications, students will be able to:

1. Understand the basic concepts, definitions, and classifications of partial differential equations (PDEs).

2. Apply the method of characteristics to obtain the general solution of quasi-linear equations.

3. Solve first-order partial differential equations using the method of separation of variables.

4. Derive and classify second-order linear PDEs as hyperbolic, parabolic, or elliptic.

5. Transform second-order linear PDEs into canonical forms for further analysis.

6. Solve the Cauchy problem for second-order PDEs, including the Cauchy-Kowalewskaya theorem.

7. Solve initial and boundary value problems for PDEs, including problems with non-homogeneous boundary conditions.

8. Apply the method of separation of variables to solve specific PDE problems, such as the vibrating string problem and heat conduction problem.

9. Utilize graphical demonstrations as teaching aids to illustrate the solutions and characteristics of PDEs.

By the end of the course, students will have a solid understanding of partial differential equations and their applications. They will be able to classify and solve various types of PDEs, including first-order and second-order equations. They will also gain proficiency in using the method of separation of variables and the method of characteristics to obtain solutions for PDEs. Additionally, students will develop the ability to apply their knowledge to real-world problems, such as modeling heat conduction and vibrations in strings. These skills will equip them to pursue further studies or research in the field of partial differential equations and their applications in physics, engineering, and other scientific disciplines.

Course Outcome for BMH5CC12: Mechanics I

Upon completion of the course BMH5CC12: Mechanics I, students will be able to:

1. Understand and analyze co-planar forces, including astatic equilibrium, friction, and the equilibrium of particles on rough curves.

2. Apply the concept of virtual work in the analysis of forces and equilibrium.

3. Solve problems related to forces in three dimensions and apply the general conditions of equilibrium.

4. Determine the center of gravity for different bodies and analyze stable and unstable equilibrium situations.

5. Analyze the equilibrium of flexible strings.

6. Understand and analyze simple harmonic motion, damped and forced vibrations.

7. Apply the principles of motion referred to a set of rotating axes and analyze the motion of projectiles in a resisting medium.

8. Analyze the motion of particles under central forces, including the application of Kepler's laws of motion.

9. Understand and analyze the motion of particles in three dimensions and on surfaces of revolution.

10. Understand and apply the concepts of degrees of freedom, moments and products of inertia, and the principal axes.

11. Apply D'Alembert's principle and analyze motion about a fixed axis, including the motion of compound pendulums and systems of particles.

12. Analyze the motion of rigid bodies in two dimensions under finite and impulsive forces, and apply the principles of conservation of momentum and energy.

By the end of the course, students will have a solid understanding of mechanics, including the analysis of forces, equilibrium, and motion of particles and rigid bodies. They will be able to apply their knowledge to solve problems related to equilibrium, oscillations, projectile motion, central forces, and rigid body motion. These skills will provide a strong foundation for further studies or research in mechanics and related fields such as physics and engineering.

Course Outcome for BMH5DSE11: Linear Programming

Upon completion of the course BMH5DSE11: Linear Programming, students will be able to:

1. Understand the concepts and principles of linear programming and its applications.

2. Apply the simplex method and graphical solutions to solve linear programming problems, including determining optimality and unboundedness.

3. Formulate and solve linear programming problems using the simplex algorithm and tableau format.

4. Understand the concepts of artificial variables, two-phase method, and the Big-M method in linear programming.

5. Analyze the duality of linear programming problems, including formulating and solving the dual problem.

6. Interpret the economic implications of the dual problem.

7. Apply the Dual Simplex method to solve linear programming problems.

8. Formulate and solve transportation problems using methods such as northwest-corner, least cost, and Vogel's approximation.

9. Formulate and solve assignment problems using the Hungarian method.

10. Understand the formulation of two-person zero-sum games in game theory.

11. Solve two-person zero-sum games and analyze games with mixed strategies.

12. Apply graphical solution procedures and linear programming techniques to solve games.

By the end of the course, students will have a solid understanding of linear programming techniques and their applications. They will be able to formulate and solve linear programming problems using the simplex method, dual simplex method, and graphical solutions. They will also have the skills to solve transportation problems, assignment problems, and two-person zero-sum games using linear programming approaches. These skills will enable students to analyze and optimize various real-world problems involving resource allocation, transportation, and decision-making.

Course Outcome for BMH5DSE21: Probability and Statistics

Upon completion of the course BMH5DSE21: Probability and Statistics, students will be able to:

1. Understand the fundamental concepts of probability theory, including sample space, probability axioms, and random variables (discrete and continuous).

2. Define and analyze cumulative distribution functions, probability mass/density functions, mathematical expectation, moments, moment generating functions, and characteristic functions.

3. Apply discrete distributions such as uniform, binomial, Poisson, geometric, and negative binomial, as well as continuous distributions such as uniform, normal, and exponential.

4. Analyze joint cumulative distribution functions, joint probability density functions, and properties of random variables, including marginal and conditional distributions.

5. Calculate expectations of functions of two random variables and conditional expectations.

6. Understand the concepts of independent random variables, bivariate normal distribution, correlation coefficient, and joint moment generating functions.

7. Calculate covariance using joint moment generating functions.

8. Apply linear regression for two variables in statistical analysis.

9. Interpret Chebyshev's inequality, weak and strong laws of large numbers, and the central limit theorem.

10. Analyze Markov Chains, Chapman-Kolmogorov equations, and the classification of states.

11. Understand the concepts of random samples, sampling distributions, and estimation of parameters.

12. Perform hypothesis testing in statistical analysis.

By the end of the course, students will have a solid understanding of probability theory and statistical concepts. They will be able to analyze and apply various probability distributions, calculate expectations and conditional probabilities, and perform statistical inference tasks such as estimation and hypothesis testing. These skills will enable students to interpret and analyze data, make informed decisions based on statistical analysis, and apply probability and statistical concepts in real-world scenarios.

Course Outcome for BMH6CC13: Metric Spaces and Complex Analysis

Upon completion of the course BMH6CC13: Metric Spaces and Complex Analysis, students will be able to:

1. Understand the fundamental concepts of metric spaces, including sequences, Cauchy sequences, and complete metric spaces.

2. Apply Cantor's theorem to analyze complete metric spaces.

3. Define and analyze continuous mappings, uniform continuity, connectedness, and compactness in metric spaces.

4. Apply sequential compactness, Heine-Borel property, and totally bounded spaces in the context of compact sets and continuous functions.

5. Understand homeomorphism, contraction mappings, and the Banach Fixed point Theorem, and apply them to ordinary differential equations.

6. Analyze limits and continuity in complex analysis, including limits involving the point at infinity.

7. Understand the properties of complex numbers, regions in the complex plane, and functions of complex variables.

8. Apply differentiation formulas, including the Cauchy-Riemann equations, and identify sufficient conditions for differentiability.

9. Analyze analytic functions, exponential functions, logarithmic functions, and trigonometric functions.

10. Evaluate derivatives and definite integrals of functions in complex analysis.

11. Understand contours, contour integrals, and upper bounds for the moduli of contour integrals.

12. Apply the Cauchy-Goursat theorem and the Cauchy integral formula in complex analysis.

13. Understand Liouville's theorem and the fundamental theorem of algebra.

14. Analyze convergence of sequences and series, including Taylor series and Laurent series.

15. Understand absolute and uniform convergence of power series.

By the end of the course, students will have a solid understanding of metric spaces and complex analysis. They will be able to analyze and apply concepts such as continuity, compactness, and differentiability in metric spaces. In complex analysis, students will be able to evaluate limits, derivatives, and contour integrals, and apply important theorems such as the Cauchy-Goursat theorem. These skills will enable students to analyze and solve problems in various areas of mathematics and apply complex analysis techniques to real-world scenarios.

Course Outcome for BMH6CC14: Ring Theory and Linear Algebra II

Upon completion of the course BMH6CC14: Ring Theory and Linear Algebra II, students will be able to:

1. Understand polynomial rings over commutative rings, including the division algorithm, principal ideal domains, and factorization of polynomials.

2. Apply reducibility tests, irreducibility tests, and the Eisenstein criterion in determining the factorization of polynomials.

3. Analyze divisibility, irreducible elements, primes, and unique factorization domains in integral domains.

4. Understand dual spaces, dual basis, double dual, transpose of a linear transformation, and the matrix representation in the dual basis.

5. Apply annihilators and eigen spaces of a linear operator, and analyze diagonalizability, invariant subspaces, and the Cayley-Hamilton theorem.

6. Determine the minimal polynomial for a linear operator and identify canonical forms.

7. Understand inner product spaces, norms, and the Gram-Schmidt orthogonalization process.

8. Analyze orthogonal complements, Bessel's inequality, the adjoint of a linear operator, and least squares approximation.

9. Solve systems of linear equations using minimal solutions.

10. Analyze normal and self-adjoint operators, orthogonal projections, and the spectral theorem.

By the end of the course, students will have a strong understanding of advanced topics in ring theory and linear algebra. They will be able to analyze polynomial rings, factorize polynomials, and identify properties of integral domains. In linear algebra, students will be proficient in dual spaces, eigen spaces, diagonalization, and canonical forms. They will also have a solid understanding of inner product spaces, orthogonalization processes, and spectral theorems. These skills will equip students with the necessary tools to solve complex problems in abstract algebra and linear algebra, and to apply these concepts in various mathematical and practical contexts.

Course Outcome: BMH6DSE33 - Group Theory II

Upon completing the course on Group Theory II, students will achieve the following outcomes:

1. Understanding of Automorphism: Students will comprehend the concept of automorphisms in groups, including inner automorphisms and automorphism groups. They will be able to analyze automorphism groups of both finite and infinite cyclic groups and explore the applications of factor groups to automorphism groups.

2. Knowledge of Characteristic Subgroups and Commutator Subgroup: Students will acquire knowledge about characteristic subgroups and the properties of the commutator subgroup. They will understand the significance of these subgroups in the study of group theory.

3. Proficiency in Direct Products: Students will gain proficiency in understanding the properties of external direct products, including the group of units modulo n as an external direct product. They will also learn about internal direct products and the Fundamental Theorem of finite abelian groups.

4. Understanding Group Actions: Students will grasp the concept of group actions, including stabilizers and kernels. They will learn to associate permutation representations with given group actions and explore applications of group actions. They will also learn about the Generalized Cayley's theorem and the Index theorem.

5. Knowledge of Conjugacy and Sylow's Theorems: Students will understand groups acting on themselves by conjugation and the implications of the class equation. They will study conjugacy in Sn, p-groups, Sylow's theorems, and consequences. They will also learn Cauchy's theorem and non-simplicity tests, including the simplicity of An for $n \geq 5$.

Overall, students will develop a solid understanding of advanced topics in group theory, enabling them to analyze and apply the concepts of automorphism, direct products, group actions, and conjugacy in various mathematical and theoretical contexts.

Course Outcome: BMH6DSE43 - Mechanics II

Upon completing the course on Mechanics II, students will achieve the following outcomes:

1. Interpretation of Newton's Laws: Students will develop an understanding of the interpretation of Newton's laws of motion and the concept of Galilean transformation. They will explore the limitations of Newton's laws in solving certain problems and gain insight into the concept of absolute length and time.

2. Equilibrium of Fluids and Stress Analysis: Students will learn about the equilibrium of fluids in a given field of force and the pressure in a heavy homogeneous liquid. They will understand the equilibrium of floating bodies and the concepts of isothermal and adiabatic changes in gases. Additionally, they will gain knowledge about convective equilibrium, stress in continuum bodies, and stress quadric.

3. Constraints and Lagrange's Equations: Students will acquire knowledge about constraints and their classifications. They will understand Lagrange's equation of motion for holonomic systems and explore the application of Gibbs-Appell's principle of least constraint. They will also learn about the work-energy relation for constraint forces, including shielding friction.

Overall, students will develop a strong foundation in advanced mechanics, allowing them to interpret Newton's laws, analyze equilibrium in fluids, and understand the dynamics of systems with constraints. This knowledge will enable them to solve complex problems and apply theoretical principles to real-world scenarios in mechanics.

Course Outcome: BMH6PW01 - Project Work

Upon completing the course on Project Work, students will achieve the following outcomes:

1. Research and Exploration: Students will demonstrate the ability to independently choose a topic on Mathematics and its Applications for their project work. They will engage in extensive research and exploration of the chosen topic, gaining a deeper understanding of its theoretical and practical aspects.

2. Effective Written Communication: Students will develop skills in written communication by preparing a comprehensive written submission for their project work. They will effectively organize and present their findings, demonstrating clarity, coherence, and logical reasoning in their written work.

3. Presentation Skills: Students will enhance their presentation skills through the seminar presentation component of the project work. They will effectively communicate their research findings, using visual aids and engaging techniques to captivate the audience and convey their knowledge effectively.

4. Critical Thinking and Analysis: Students will demonstrate critical thinking skills by analyzing the topic and its applications in Mathematics. They will evaluate and interpret the data collected during their research, drawing meaningful conclusions and making logical connections to relevant mathematical concepts.

5. Oral Communication and Defense: Students will showcase their oral communication skills during the viva voce component of the project work. They will articulate their understanding of the topic,

respond to questions, and defend their research findings, displaying depth of knowledge and the ability to think on their feet.

Overall, students will develop research, communication, and analytical skills through their project work. They will apply mathematical concepts to real-world applications, fostering a deeper appreciation for the subject and honing their abilities to undertake independent study and present their findings effectively.

Program Outcome of 3-Year Mathematics Honours Course

Semester I:

1. Understand the fundamental concepts of calculus, geometry, and differential equations.
2. Apply algebraic techniques to solve mathematical problems.
3. Demonstrate knowledge of environmental studies .

Semester II:

1. Gain a deeper understanding of real analysis and its applications.
2. Apply differential equations and vector calculus in solving mathematical problems.
3. Develop proficiency in English or a modern Indian language.

Semester III:

1. Acquire a solid understanding of the theory of real functions and introduction to metric spaces.
2. Comprehend the principles of group theory and its applications.
3. Apply numerical methods and demonstrate proficiency in numerical methods lab.
4. Choose and develop skills in logic and sets, computer graphics, or object-oriented programming in C++.

Semester IV:

1. Understand the concepts of Riemann integration and series of functions.
2. Apply multivariate calculus to solve mathematical problems.
3. Gain a deeper understanding of ring theory and linear algebra.
4. Choose and develop skills in graph theory, operating systems (Linux), or MATLAB programming.

Semester V:

1. Gain proficiency in solving partial differential equations and their applications.

2. Apply mechanics principles to solve mathematical problems.

3. Choose and specialize in linear programming, number theory, or point set topology.

4. Choose and specialize in probability and statistics, portfolio optimization, or Boolean algebra and automata theory.

Semester VI:

1. Demonstrate proficiency in metric spaces and complex analysis.

2. Advance understanding of ring theory and linear algebra.

3. Choose and specialize in mathematical modeling, industrial mathematics, or group theory.

4. Choose and specialize in bio mathematics, differential geometry, or mechanics.

5. Optional dissertation or project work in place of one Discipline Specific Elective (DSE) Paper.

Overall Program Outcome:

1. Develop a strong foundation in calculus, algebra, and analysis.

2. Apply mathematical techniques and principles to solve complex problems.

3. Develop analytical and critical thinking skills.

4. Gain proficiency in using numerical methods and computer programming for mathematical applications.

5. Develop effective communication skills through language courses.

6. Choose and specialize in specific areas of mathematics based on personal interests and career goals.

7. Demonstrate the ability to conduct independent research through optional dissertation or project work.

8. Prepare for further studies or careers in various fields such as academia, research, finance, data analysis, and more.