DEPARTMENT OF M.A/M.SC MATHEMATICS

I-SEMESTER

M 101 ALGEBRA -I

(w.e.f. 2021-22 admitted batch)

Course type: Theory
Course Category: Core
Credits: 4
Course objectives/outcomes:

CO 1: To introduce the basic concepts of group theory and study the structure of groups.

CO 2: To introduce the concepts of conjugacy and G sets and prove cayley theorem. To introduce explicitly the properties of permutation groups

CO 3: To determine structure of any abelian groups. To determine structure of finite nonabelian groups through Sylow theorems.

CO 4: To introduce concepts of ring theory. To introduce different types of ideals. To apply Zorn's lemma on the set of ideals.

CO 5: To introduce prime elements and irreducible elements in a commutative integral domain. To study the domains UFD, PID and ED.

M102 REAL ANALYSIS-I
Course type: Theory
Course Category: Core
Credits: 4
Course Objectives/Outcomes:

CO 1: Describe elementary concepts on metric spaces to get the general idea that is relevant to Euclidean spaces.

CO 2: To study the continuity and its properties of real valued functions in metric spaces.

CO 3: Describe the derivatives of real valued functions defined on intervals or segments, and study its properties.

CO 4: Introduce Riemann-Stieltjes integral as a generalization of Riemann integral and discuss the existence of this integral.

CO 5: To study differentiation of integrals and further the extension of integration to vector valued functions.

M103 TOPOLOGY-I
Course type: Theory
Course category: Core
Credits: 4
Course Objectives/ outcomes :
CO 1: To get acquaintance with concepts of sets and functions and their properties which are basic tools to study Mathematics

CO 2: To introduce metric spaces and some elementary concepts in metric spaces

CO 3: To study the concept of continuous functions and their properties, Euclidean and Unitary spaces

CO 4: To understand broader concept of topology and topological spaces, as a generalization of metric spaces and study some basic results in topological spaces

CO 5: To study the concept of compactness and compact spaces . Some important theorems in compact spaces

M104 DIFFERENTIAL EQUATIONS
Course type: Theory
Course category: Core
Credits: 4
Course Objectives/Outcomes:
CO 1: Familiarize with essential concepts of real function theory that help to grasp the theory of ordinary differential equations

CO 2: To introduce basic theorems in theory of ordinary differential equations pertaining to existence, uniqueness, continuation of solutions.

CO 3: To understand dependence of solutions on initial conditions and parameters

CO 4: Transform nth order differential equations in to differential systems and extend the theory to differential systems.

CO 5: To study the qualitative behaviour of solutions of homogeneous and non homogeneous linear equations and systems

M105 LINEAR ALGEBRA
Course type: Theory
Course category: Core
Credits: 4
Course Objective/Outcomes:
CO-1: To introduce the essential concepts of linear transformations on finite dimensional vector spaces.

CO-2: To understand the utilization of ordered basis to represent linear transformations by matrices.

CO-3: To select a single linear operator on finite dimensional vector space and to take it apart to see what makes it tick.
CO-4: To characterise the smallest subspace of a vector space which is invariant under linear operator.

CO-5:To decompose a linear operator on a finite dimensional vector space into a direct sum of operators which are elementary.

II-SEMESTER

M 201 ALGEBRA -II
Course type: Theory
Course category: Core
Credits: 4
Course objectives/outcomes:

CO 1: To understand the concept of extensions of a field, based on the study of irreducible polynomials.

CO 2: To understand the concept of normal extensions and separable extensions based on the study multiplicity of roots of a polynomial

CO 3: To introduce the concept of group of automorphisms on a field. To introduce fixed fields. To prove the fundamental theorem of Galois theory.

CO 4: To apply Galois theory and prove the fundamental theorem of algebra. To study the properties of nth cyclotomic polynomials.

CO 5: To understand Galois theory and study its applications.

M202 REAL ANALYSIS-II
Course type: Theory
Course category: Core
Credits: 4
Course Objectives/Outcomes:

CO 1: Discuss the most important aspects of the problems that arise when limit processes are interchanged.

CO 2: Study the approximation of continuous complex function and its generalization and an introduction of power series.

CO 3: Study of exponential and logarithmic functions, the trigonometric functions and Fourier series and their properties.

CO 4: Discuss linear transformations on finite-dimensional vector spaces over any field of scalars and derivative of functions of several variables.

CO 5: Study the method of solving implicit functions. Interesting illustration of the general principle that the local behaviour of a continuously differentiable mapping near a point. Further study of derivatives of higher order and differentiation of integrals.

M203: TOPOLOGY-II
Course type: Theory
Course category: Core
Credits: 4
Course Objectives/ outcomes :

CO 1: To study Separation properties of Topological spaces , Urysohn's lemma, Tietze's extension theorem

CO 2: To understand the concept of metrizability of a topological space ,Urysohn's imbedding theorem and one point compactification of a topological space

CO 3: To understand the concept of connected spaces, locally connected spaces, and totally disconnected spaces and their properties

CO 4: To Prove Weierstrass approximation theorem and Stone - Weierstrass theorems

CO 5: To study locally compact spaces and generalise Stone - Weierstrass theorems

M204 COMPLEX ANALYSIS
Course type: Theory
Course category: Core
Credits: 4
Course Objectives/Outcomes:

CO 1: To learn basic properties of power series and utilise this knowledge to construct analytic functions. To understand the relation between the Cauchy - Riemann equations and analytic functions. Study the nature and properties of Mobius transformation

CO 2: To know about Power series expansion of analytic functions, significant properties analytic functions, zeros of analytic functions - gain knowledge pertaining to Liouville theorem, fundamental theorem of algebra, maximum modulus theorem and to know about index of a closed curve

CO 3: To understand the three versions of Cauchy integral formula, Cauchy's theorem and Study Morera's theorem and its significance

CO 4: Be aware of some applications of Cauchy theorem to count zeros of an analytic function and the open mapping theorem as a property of analytic function

CO 5: Recognise and classify singularities of an analytic function - learn about residue theorem

CO 6: Be aware of three versions of maximum modulus theorem and also the Swartz's lemma

M205 DISCRETE MATHEMATICS
Course type: Theory
Course category: Core
Credits: 4
Course Objective/Outcomes:

CO-1: To understand The Four Colour Theorem and applications in chemistry and physics.

CO-2: To familiarize the basic concepts of graphs and different types of graphs.

CO-3: To learn the modelling of Konigsberg Bridge Problem and Hamilton’s Game by graphs.

CO-4: To characterize graphs which are both Eulerain and Hamiltonian.

CO-5: To understand specific difference between modular and distributive lattices.

CO-6: To learn the importance of diamond and pentagon lattices.

III-SEMESTER

M301 FUNCTIONAL ANALYSIS

Course type: Theory

Course category: Core

Credits: 4

Course Objectives/Outcomes:

CO 1: The concept of Banach space through which it helps to consider the combination of algebraic and metric structures opens up the possibility of studying linear transformations of one Banach space into another with the additional property of being continuous.

CO 2: To understand the algebraic and topological aspects of the continuous linear functionals.

CO 3: To study elementary theory of Hilbert spaces and their operators to provide an adequate foundation for the higher studies.

CO 4: To understand a natural correspondence between H and its conjugate space H* , and the adjoint of an operator on a Hilbert space.

CO 5: To study the spectral resolution of an operator T on a Hilbert space H.

M302 CALCULUS OF VARIATIONS

Course type: Theory

Course category: Core

Credits: 4

Course Objectives/Outcomes:

CO 1: To learn about method of variations with fixed boundaries

CO 2: To learn about method of variations with moving boundaries

CO 3: To gain knowledge on some specific variational problems such as those involving extremals with corners and one sided variations

CO 4: To understand sufficient conditions for an extremum for variational problems.

CO 5: To learn about variational problems involving a conditional extremum

M 303 NUMBER THEORY-I
Course type: Theory
Course category: Elective
Credits: 4
Course Objectives /Outcomes:

CO 1: To introduce arithmetical functions and explore their role in the study of distribution of primes.

CO 2: To study the averages of arithmetical functions and some related asymptotic formulas.

CO 3: To introduce the foundations of congruences and study the polynomial congruences.

CO 4: To understand the prime number theorem on distribution of primes and develop some equivalent forms.

CO 5: To introduce the characters of a group and apply to the Dirichlet Theorem on primes in a progression.

M305 LATTICE THEORY-I
Course type: Theory
Course category: Elective
Credits: 4
Course Objective/Outcomes:

CO-1: To familiarize the concepts of poset, chain conditions.

CO-2: To learn the lattice theoretic duality principle.

CO-3: To study complements, relative complements and semi-complements of elements of a bounded lattices.

CO-4: To learn the properties of compact elements and compactly generated lattices.

CO-5: To study the posets as topological spaces.

M306 COMMUTATIVE ALGEBRA- I
Course type: Theory
Course category: Elective
Credits: 4
Course Objective/Outcomes:
CO-1: To familiarize the essential concepts of ideals, quotient rings and homomorphisms.

CO-2: To understand the difference between zero divisors, nilpotent elements and units.

CO-3: To study the properties of finitely generated modulus.

CO-4: To introduce tensor product of modulus and its exactness properties.

CO-5: To learn the concepts of extended and contracted ideals in the ring of fractions.

IV-SEMESTER

M401 MEASURE AND INTEGRATION
Course type: Theory
Course category: Core
Credits: 4
Course Objectives/Outcomes:
CO 1: Introduce a special theory on sets, called outer measure of a set and measurable sets, which are useful to get an idea on real number system.

CO 2: To understand measurable functions through the certain construction of measurable sets and their properties.

CO 3: To introduce and understand the Lebesgue integral of various measurable functions and their properties.

CO 4: To study differentiation of Lebesgue integral and convex functions.

CO 5: To study some spaces of functions of a real variable, the Lp spaces.

M402 PARTIAL DIFFERENTIAL EQUATIONS
Course type: Theory
Course category: Core
Credits: 4
Course Objectives/Outcomes:
CO 1: To be introduced to categorization of partial differential equations such as linear, quasi linear and nonlinear equations.

CO 2: To learn a few methods of solving linear, semi linear and quasi linear equations and construction of Cauchy problem for first order partial differential equations

CO 3: To understand the classification pertaining to second order equation and learn the p rocedure of reducing equations to their canonical forms.

CO 4: To understand the structure of hyperbolic equation, know its properties and solve related problems

CO 5: To understand the structure of elliptic equation, know its properties and solve related problems

CO 6: To understand the structure of parabolic equation, know its properties and solve related problems

M 403 NUMBER THEORY-II (PREREQUISITE: NUMBER THEORY I)
Course type: Theory
Course category: Elective
Credits: 4
Course Objectives/Outcomes:
CO 1: To introduce the concept of Quadratic residues. To define Legendre symbol and evaluate Quadratic residue. To generalize Legendre symbol to Jacobi symbol and to study applications of Quadratic residues

CO 2: To introduce the concept of primitive roots. To understand the study on existence of primitive roots.

CO 3: To define Dirichlet Series and identify the plane of absolute convergence and convergence of Dirichlet series. To establish Euler products to Dirichlet series.

CO 4: To derive some analytic properties of Dirichlet series. To develop some expressions as exponential and integral form for Dirichlet series.

CO 5: To understand the analytic proof of prime number theorem based on the analytic properties of the particular Dirichlet series, Riemann Zeta function.

M405 LATTICE THEORY-II (PREREQUISITE: LATTICE THEORY-I)
Course type: Theory
Course category: Elective
Credits: 4
Course Objective/Outcomes:
CO-1: To study equivalent conditions for a lattice to become modular and distributive.

CO-2: To learn meet-representations of modular and distributive lattices.

CO-3: To understand the equivalent conditions for a complete Boolean algebra to become atomic.

CO-4: To study the properties of valuations of Boolean algebras.

CO-5: To learn the properties of rings of sets

M406 COMMUTATIVE ALGEBRA-II (PREREQUISITE: COMMUTATIVE ALGEBRA-I)
Course type: Theory
Course category: Elective
Credits: 4
Course Objective/Outcomes:
CO-1: To learn the decomposition of ideals into primary ideals.

CO-2: To learn Going-Up and Going-Down theorems concerning prime ideals in an integral extensions.

CO-3: To study valuation rings of a given field of fractions.

CO-4: To characterise Noetherian rings and Artin rings.

CO-5: To study primary decomposition in Noetherian rings and to learn The Structure Theorem for Artin rings.