Module 7.

- മലയാളവ്യാകരണപഠനത്തിന്റെ ചരിത്രം – വർണ്ണം – വർണ്ണവികാരം – അക്ഷരം – അക്ഷരമാലയുടെ സവിശേഷപഠനം – പദം – ലീലാതിലകത്തിലെയും കേരളപാണിനീയത്തിലെയും സന്ധിനിയമങ്ങൾ.

Module 8.

- നാമം – നാമവിഭാഗങ്ങൾ – ലിംഗം – വചനം – വിഭക്തി – കാരകം – തദ്ധിതം.

Module 9.

- { കിയ – നിർവചനം – വർഗ്ഗീകരണം – കാലപ്രത്യയങ്ങൾ – പ്രകാരം പ്രയോഗം – നിഷേധം – കൃത്ത്.

Module 10.

- വാക്യഘടന – പദക്രമം – പൊരുത്തം – വാക്യവിഭാഗങ്ങൾ – സമാസം

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21. Mathematics

Unit I
Fundamental Concepts

Module 1. Sets and functions

- General ideas of sets, sets of numbers and operations on sets. Countable and uncountable sets. Properties of relations and functions. Domain, codomain and range of functions. Injective and surjective functions, bijections and inverses. Graphs of polynomials, trigonometric functions and other elementary real valued functions. Composition of functions. Polynomials and polynomial equations - remainder and factor theorems. Relation between ro ots and coe cients of a polynomial of degree up to three.

Module 2. Analytic geometry

- Coordinates of points in plane and space. Distance in terms of co ordinates. Determination of coordinates of points on a line in terms of two points. Slope of a line. Representation of curves in a plane as equations - straight lines, circles and conics. Geometric and algebraic properties of their equations. Direction cosines and direction ratios of a line in space. Coplanar and non-coplanar lines. Equations of lines, planes and spheres in both cartesian and vector forms.

Module 3. Elementary calculus

- Limits of functions, di erentiability, and derivative as slope. Derivatives of polynomial functions, exponential function and trigonometric functions. Derivatives of sums, products, composite and inverse functions. Increasing and decreasing functions, local extrema, and simple appli-cations. Integration as anti-di erentiation, integral as sum. Length of curves, area under curves and volume of solids of revolution using integration.

Module 4. Probability

- Basic Combinatorics - Pigeonhole principle, permutations and combinations. Random experiment, sample space, events, probability, discrete Probability, conditional probability and independent events.

Unit II
Real and Complex Analysis

Module 1. Basic concepts in Real Analysis

- Convergence and limits of sequences and series of real numbers. Geometric and harmonic series. Sequences and series of real functions, point-wise and uniform convergence. The exponential series. Limits, continuity, directional and total derivatives of functions of several variables.

Module 2. Integration and basic Measure Theory

- Functions of bounded variations. Riemann integrals and Riemann Stieltjes integrals of real valued functions. The concepts of Lebesgue measure and Lebesgue integral of real valued functions. Lebesgue measurable sets, measurable functions and simple func- tions.

Module 3. Basic concepts in Complex Analysis

- Basic properties of complex numbers. Absolute value. Polar form of a complex number. De Moivres theorem and nth roots of unity and nth roots of complex numbers. Properties of complex analytic functions-Cauchy Reimann equations, infinite di erentia-bility, Harmonic conjugates. Conformal mappings. Mobius transformations and cross ratio.

Module 4. Complex Integration

- Power series of functions, Radius of convergence of power series. Zeroes, poles and singularities of functions. Liouvilles Theorem. Open Mapping Theorem. Maximum Modulus Theorem. Line integrals of complex valued functions, Cauchys Theorem and Cauchys integral formula for complex functions. Contour integration and residue theorem

Unit III
Abstract Algebra

Module 1. Groups

- Groups and subgroups, Groups of permutations. Abelian and non-abelian groups. Cyclic groups. Finite and infinite groups. Normal subgroups and quotients. Homomorphisms and isomor- phisms. Homomorphic images and quotients. Lagranges theorem. Order of an element. Groups of prime order and prime-square order. Direct products and direct sums of groups. Sylows theorem.

Module 2. Rings

- Ring of integers and ring of polynomials. Ring of integers modulo n. Finite rings. Com-mutative and non-commutative rings. Ideals, maximal ideals and prime ideals. Quotient Rings. Homomorphisms and isomorphisms. Homomorphic images and quotients. Zero divisors. Integral domains. Euclidean domains. Units, associates and primes in a ring. Groups of units of rings.

Module 3. Fields

- Field of rational numbers, real numbers and complex numbers. Integers modulo a prime number. Finite fields. Finite integral domains. Polynomials over fields, reducibility and irre-ducibility. Algebraic and transcendental extensions of fields. Degree of extension and irreducible polynomial of an element, Splitting fields, groups of automorphisms and fixed fields.

Unit IV
Linear Algebra and Matrix Theory

Module 1. Matrix Theory

- Algebra of matrices - Types of matrices, nilpotent matrices, invertible matrices. Determinants of square matrices. Echelon matrices and rank of a matrix. Systems of linear equations and solutions and matrix methods for checking consistency.

Module 2. Vector spaces

- Vector spaces over an arbitrary field, real numbers and complex numbers. Linear independence and dependence. Basis and dimension. subspaces and quotients. Direct sums of vector spaces. Geometry of points, lines and planes in R2 and R3 in terms of subspaces.

Module 3. Linear Transformation

- Linear maps. Di erentiation and integration as linear maps Range, null space and dimensional relations. Invertible transformations. Representation of linear maps between finite dimensional vector spaces as matrices and vice-versa. Dependence of matrix of a linear trans- formation on the basis and relation with change of basis. Linear functional and dual basis. Linear functionals on R2. Eigenvalues and eigenvectors. Minimal polynomial, characteristic polynomial and Cayley Hamilton theorem, Diagonalization.

Unit V
Number Theory and Differential Equations

Module 1. Number theory

- Principle of Mathematical Induction. Prime factorization. Properties of divisibility. Coprime numbers. G C D and L C M of numbers. Eulers totient function and its multiplicative property. Congurences. Chinese remainder theorem. Fermats little theorem. Wilsons theorem.

Module 2. Ordinary Di erential Equations

- Order and degree of di erential equations. Formation of di er-ential equation and di erent types of di erential equations of first order. Representation of family of curves by di erential equations. Orthogonal trajectories. Existence and uniqueness of solutions of initial value problems for first order ordinary di erential equations, Method of variationof parameters, Wronskian. Power series solutions of di erential equations. Bessel and Legendre polynomials.

Module 3. Partial Di erential Equations

- Solution of the equation of the form Pdx+Qdy+Rdz=0. Charpits and Jacobis method for solving first order PDEs, Classification of higher order PDEs (parabolic, elliptic and hyperbolic types). General solution of higher order PDEs with constant co e cients. Metho d of separation of variables. Wave equation, Heat equation and Laplace equation.

Unit VI
Topology and Functional Analysis

Module 1. Metric Topology

- Metric spaces. Discrete metric. Euclidean metric on Rn and Cn. Supremum metric on the set of real valued functions and complex valued functions on a closed interval. Limit points and convergence of sequences in a metric space. Cauchy sequences. C omplete metric spaces. Completion of a metric space. Cantors intersection theorem and Baires category theorem. Compact subsets and connected subsets of R and C. Heine-Borel theorem for Rn

Module 2. General Topology

- Topological spaces, open sets and closed sets. Usual topology on R and C. Base and subbase for a topology. Closure, interior and boundary of subsets. Compactness and connectedness. Convergence of sequences in a topological space. Non-uniqueness of limits. Hausdor Spaces and separation axioms. Continuity of functions between topological spaces. Preservation of compactness and connectedness under continuous functions. Homeomorphisms. Product topology.

Module 3. Normed linear spaces

- Norm on linear spaces. Euclidean norm on Rn and Cn. Finite and infinite dimensional p spaces. Lp spaces. Closed and non-closed linear subspaces. Closure and interior of linear subspaces. Continuous linear maps between normed linear spaces. Bounded operators and operator norm. Banach spaces. Open mapping theorem and closed graph theorem.

Module 4. Inner product spaces

- Inner products. Examples of norms arising from inner products and not arising from any inner product. Parallelogram law. Orthogonality in inner product spaces. Orthonor-mal bases. Fourier Expansion. Bessels inequality. Hilbert spaces. Parsevals identity. Continuous linear maps between Hilbert spaces. Pro jection map, Riesz representation theorem.

22. Music

Unit I

Module 1. History of music

- Period I – Natya Sastra to Sangita Ratnakara
- Period II – Chaturdandi prakasika onwards