

KERALA PUBLIC SERVICE COMMISSION

SYLLABUS FOR THE POST OF RANGE FOREST OFFICER IN KERALA FOREST & WILDLIFE DEPARTMENT

Optional subject- Mathematics

Module 1 Sets, Relations, Functions and Number Theory :- Basic relations between sets, Boolean Operations on sets, Relations, Operations on relations, Equivalence relations and partitions, Functions, Operations on functions, Types of functions, Use of functions to compare size.

The division algorithm, The Euclidean algorithm, Linear Diophantine equations, The Fundamental Theorem of Arithmetic, Linear congruences, Residue classes, Fermat's theorem, Euler's theorem, Wilson's theorem, Euler's phi-function, Mobius function.

(20 Marks)

Module 2 Algebra :- Polynomials, Equality of two polynomials, Roots of an equation, Fundamental Theorem of Algebra, Multiplication of roots, Diminishing and increasing the roots of an equation, Removal of terms of an equation, Reciprocal equations, sum of the integral powers of the roots and symmetric functions of the roots, Descartes's rule of signs.

Groups, subgroups, Cyclic groups, Permutations, Groups of cosets, Normal subgroups and Factor groups, Homomorphism and isomorphism in groups, Rings, Fields and Integral domains, Quotient rings and ideals, Homomorphism of rings.

(20 Marks)

Module 3 Linear Algebra :- Matrices, Types of matrices, Matrix addition, matrix multiplication and their properties, Transpose of a matrix, Determinants and its properties, Inverse of a matrix, Cramer's rule, Rank of a matrix, Elementary transformations, Solution of a system of linear transformations, Characteristic equation, Eigen values and eigen vectors of a matrix, Cayley Hamilton Theorem.

Vector Spaces, Subspaces, Linearly independent and linearly dependent vectors, Basis and dimension of a vector Space, Linear transformations, Representation of linear transformation by matrix, Kernel and image of a linear transformation.

(20 Marks)

Module 4 The real number system, Sequences and Series of Real Numbers:- Countable sets, Uncountable sets and bounded subsets of the set of all real numbers, sequences of real numbers, limit of a sequence, convergent sequences and divergent sequences, Bounded sequences, monotonic sequences, Operations on convergent sequences, Cauchy sequences.

Convergence and divergence of an infinite series, Series with non-negative terms, Alternating series, Absolute convergence and conditional convergence, Rearrangement of series, Tests for convergence – Comparison test, Cauchy's root test, D'Alembert's Ratio Test, Raabe's Test, Logarithmic Test. **(20 Marks)**

Module 5 Real Valued Functions, Differentiable Functions and Applications of the Derivative
:- Bounded functions, Limits of functions, Monotonic functions, Continuous functions, Uniformly Continuous functions, Sequences of functions, Differentiable functions, Rolle's theorem and Mean-value theorem for derivatives.

Increasing and Decreasing functions, Relative maxima and minima, First derivative test, Second derivative test, Absolute maxima and minima, Rectilinear motion - velocity and acceleration. **(20 Marks)**

Module 6 The Riemann Integral and Application of the Definite integral in geometry :- Definition of the Riemann Integral, Existence of Riemann integral, Properties of the Riemann integral, Fundamental theorem of Calculus, Improper Integrals

Area between two curves, Volumes by slicing, Volumes by cylindrical shells, Length of a plane curve, Area of a surface of Revolution, Work and Moments. **(20 Marks)**

Module 7 Analytical Solid Geometry and Vector Algebra :- Direction cosines and Direction ratios of a line, Angle between two lines, The Plane, Angle between two planes, Plane through the intersection of two given planes, Planes bisecting the angle between two planes, projection on a plane, The Straight line- General form and symmetrical form -, Point of intersection of a line and a plane, Angle between a line and a plane, Shortest distance between two lines, Intersection of three planes, The sphere, Equation of a sphere in different forms, Tangent planes, Angle of intersection of two spheres.

Scalar product of two vectors and properties of scalar product of two vectors, Vector product of two vectors and properties of vector product of two vectors, Scalar triple product and properties of scalar triple product, Vector triple product. **(20 Marks)**

Module 8 Multiple Integrals and Vector Calculus :- Double Integrals, Double Integrals over nonrectangular regions, Double Integrals in Polar Coordinates, Surface Area- Parametric Surfaces, Triple Integrals, Triple Integrals in Cylindrical and Spherical Coordinates, Change of variable in Multiple Integrals

Vector Fields, Line Integrals, Independence of Path, Conservative Vector Fields, Green's Theorem, Surface Integrals, Applications of Surface Integrals, Flux, The Divergence Theorem, Stokes' Theorem. **(20 Marks)**

Module 9 Differential Equations and Linear Programming:: - Differential Equations of first order and first degree- Variable Separable, Homogeneous Differential Equations, Linear Differential Equations, Equations reducible to Linear Equations-, Linear Differential Equations of nth Order with constant coefficients, Homogeneous Linear Equations, Exact Differential equations – Conditions of exactness, Integrating factors-, Orthogonal Trajectories

Convex sets and hyperplanes , Slack and surplus variables, Basic feasible solution of a linear programming problem, The simplex method, Artificial variables, The two phase method for artificial variables, The revised simplex method, Transportation problems.

(20 Marks)

Module 10 Complex Analysis :- Basic properties of Complex numbers, Vectors and Moduli, Complex conjugates, Exponential form, Products and Powers in exponential form, Arguments of Products and Quotients, Roots of Complex Numbers, Functions of a complex variable, Limits and theorems on limits, Continuity, Derivatives, Cauchy-Riemann Equations, Sufficient conditions for Differentiability, Analytic functions and Harmonic functions.

Contour Integrals, Upper Bounds for moduli of Contour Integrals, Simply Connected Domains, Cauchy Integral Formula and its Extensions, Liouville's Theorem and the Fundamental Theorem of Algebra, Maximum Modulus Principle, Taylor Series and Laurent's Series, Isolated Singular Points, Residues, Cauchy's Residue Theorem, The three Types of Isolated Singular points, Residues at Poles.

(20 Marks)

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.