UPSC Maths Optional Syllabus PDF

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Complete UPSC Mathematics Optional syllabus for Paper I and Paper II in a
clean, exam-oriented and revision-friendly format.

Ramana Sri IAS

IAS/IFoS Maths Optional | mathsoptional.com | PYQs, Demo Videos, Test Series and Admission Support

Paper I

Linear Algebra, Calculus, Analytical Geometry, ODE, Dynamics & Statics, Vector Analysis

Paper II

Modern Algebra, Real Analysis, Complex Analysis, Linear Programming, PDE, Numerical Analysis, Mechanics & Fluid Dynamics

PYQ Practice

Prepare with topic-wise previous year questions and solution-writing practice

Admission Support

Guidance through WhatsApp, email, or call from the Ramana Sri IAS admission team

Quick Overview | UPSC Maths Optional Syllabus

Mathematics Optional has two papers: Paper I and Paper II. Both papers require concept clarity, theorem understanding, problem-solving speed, calculation accuracy and answer presentation. The subject is static, logical and scoring when prepared with PYQs and regular revision.

Subject
UPSC Mathematics Optional

Exam Stage
Civil Services Mains Examination

Structure
Paper I + Paper II | 250 marks each | 500 optional marks

Preparation Path
Syllabus -> Concepts -> PYQs -> Mock Tests -> Revision

After reading the syllabus, every topic should be connected with previous year questions, solved examples, answer-writing practice and full-length test evaluation.

UPSC Maths Optional Syllabus Paper I

Linear Algebra | Calculus | Analytical Geometry | Ordinary Differential Equations | Dynamics & Statics | Vector Analysis

UPSC Maths Optional Syllabus Paper I

1. Linear Algebra

Vector spaces over R and C, linear dependence and independence, subspaces, bases and dimension. Linear transformations, rank and nullity, matrix of a linear transformation. Algebra of matrices, row and column reduction, echelon form, congruence and similarity, rank of a matrix, inverse of a matrix and solution of a system of linear equations. Eigenvalues, eigenvectors, characteristic polynomial, Cayley-Hamilton theorem, symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal and unitary matrices and their eigenvalues.

2. Calculus

Real numbers, functions of a real variable, limits, continuity, differentiability, mean value theorem, Taylor theorem with remainders, indeterminate forms, maxima and minima, asymptotes and curve tracing. Functions of two or three variables: limits, continuity, partial derivatives, maxima and minima, Lagrange method of multipliers and Jacobian. Riemann definition of definite integrals, indefinite integrals, infinite and improper integrals, double and triple integrals, areas, surface and volumes.

3. Analytical Geometry

Cartesian and polar coordinates in three dimensions, second degree equations in three variables and reduction to canonical forms. Straight lines, shortest distance between two skew lines, plane, sphere, cone, cylinder, paraboloid, ellipsoid, hyperboloid of one and two sheets and their properties.

4. Ordinary Differential Equations

Formulation of differential equations. Equations of first order and first degree, integrating factor and orthogonal trajectory. Equations of first order but not of first degree, Clairaut equation and singular solution. Second and higher order linear equations with constant coefficients, complementary function, particular integral and general solution. Second order linear equations with variable coefficients, Euler-Cauchy equation, homogeneous linear equations and method of variation of parameters. Laplace and inverse Laplace transforms, properties and applications to initial value problems.

UPSC Maths Optional Syllabus Paper I - Continued

5. Dynamics & Statics

Dynamics: Rectilinear motion, simple harmonic motion, motion in a plane, projectiles, constrained motion, work and energy, conservation of energy, Kepler laws and orbits under central forces. Statics: Equilibrium of a system of particles, work and potential energy, friction, common catenary, principle of virtual work, stability of equilibrium and equilibrium of forces in three dimensions.

6. Vector Analysis

Scalar and vector fields, differentiation of vector field of a scalar variable, gradient, divergence and curl in Cartesian and cylindrical coordinates, higher order derivatives, vector identities and vector equations. Applications to geometry: curves in space, curvature and torsion, Serret-Frenet formulae, Gauss and Stokes theorems and Green identities.

UPSC Maths Optional Syllabus Paper II

Modern Algebra | Real Analysis | Complex Analysis | Linear Programming | PDE | Numerical Analysis & Computer Programming | Mechanics & Fluid Dynamics

1. Modern Algebra

Groups, subgroups, cyclic groups, cosets, Lagrange theorem, normal subgroups, quotient groups, homomorphism of groups, basic isomorphism theorems, permutation groups and Cayley theorem. Rings, subrings and ideals, homomorphisms of rings, integral domains, principal ideal domains, Euclidean domains, unique factorization domains, fields and quotient fields.

UPSC Maths Optional Syllabus Paper II - Continued

2. Real Analysis

Real number system as an ordered field with least upper bound property. Sequences, limit of a sequence, Cauchy sequence and completeness of real line. Series and convergence, absolute and conditional convergence of series of real and complex terms, rearrangement of series. Continuity and uniform continuity, properties of continuous functions on compact sets, Riemann integral, improper integrals and fundamental theorems of integral calculus. Uniform convergence, continuity, differentiability and integrability for sequences and series of functions, partial derivatives of functions of several variables, maxima and minima.

3. Complex Analysis

Analytic functions, Cauchy-Riemann equations, Cauchy theorem, Cauchy integral formula, power series representation of an analytic function, Taylor series, singularities, Laurent series, Cauchy residue theorem and contour integration.

4. Linear Programming

Linear programming problems, basic solution, basic feasible solution and optimal solution, graphical method and simplex method of solutions, duality, transportation and assignment problems.

5. Partial Differential Equations

Family of surfaces in three dimensions and formulation of partial differential equations. Solution of quasi-linear partial differential equations of the first order, Cauchy method of characteristics, linear partial differential equations of the second order with constant coefficients, canonical form, equation of a vibrating string, heat equation, Laplace equation and their solutions.

UPSC Maths Optional Syllabus Paper II - Continued

6. Numerical Analysis & Computer Programming

Numerical methods: solution of algebraic and transcendental equations of one variable by bisection, Regula-Falsi and Newton-Raphson methods. Solution of systems of linear equations by Gaussian elimination, Gauss-Jordan and Gauss-Seidel methods. Newton forward and backward interpolation, Lagrange interpolation, numerical integration by trapezoidal rule, Simpson rules and Gaussian quadrature formula. Numerical solution of ordinary differential equations by Euler and Runge-Kutta methods. Computer programming: binary, octal and hexadecimal systems, conversions, arithmetic and logical operations, Boolean algebra, logic gates, truth tables, normal forms, representation of numbers, algorithms and flow charts for numerical analysis problems.

7. Mechanics & Fluid Dynamics

Mechanics: Generalized coordinates, D Alembert principle and Lagrange equations, Hamilton equations, moment of inertia and motion of rigid bodies in two dimensions. Fluid Dynamics: Equation of continuity, Euler equation of motion for inviscid flow, streamlines, path of a particle, potential flow, two-dimensional and axisymmetric motion, sources and sinks, vortex motion and Navier-Stokes equation for a viscous fluid.

How to continue after the syllabus?

- Divide Paper I and Paper II topics into smaller modules.
- Solve UPSC Maths Optional previous year questions topic-wise.
- Maintain a separate formula, theorem and standard method revision notebook.
- Write full-length mock tests to improve speed, accuracy and answer presentation.
- Prepare an error notebook and revise mistakes every week.

Ramana Sri IAS Guidance

For UPSC Maths Optional syllabus guidance, PYQ practice, demo videos, test series, answer evaluation and admission support, our Ramana Sri IAS admission team will guide you through WhatsApp, email, or call.

Prepared for Ramana Sri IAS. Clean syllabus reference for UPSC Maths Optional study planning.