

SIDI Phd Admission - Visvesvaraya 2026 Written Test – Syllabus

The written test consists of two parts (A & B)

Part-A will have questions related to the following topics:

1. Engineering Mathematics:- Linear Algebra: Vector algebra, matrix algebra, systems of linear equations, rank of a matrix; Eigenvalues and eigenvectors; Calculus: Functions of single variable, limits, continuity and differentiability, chain rule, maxima and minima, Integration; Functions of several variables, partial derivatives, gradient, divergence and curl, directional derivatives; Line, surface and volume integrals. Theorems of Stokes, Gauss and Green.; Differential Equations: First order linear ordinary differential equations; Higher order linear ODEs with constant coefficients; Classification of partial differential equations; solution to: wave equation, Laplace equation, heat equation using separation of variables methods; Numerical Methods: Numerical solutions for linear and nonlinear algebraic equations by bisection, Newton-Raphson method; basic numerical differentiation; numerical integration by trapezoidal and Simpson's rules; linear regression and least squares method; linear interpolation; Basics of probability and statistics: Bayes theorem, mean, median, & mode; variance; binomial, normal and Poisson distribution.
2. Flight Mechanics & Space Dynamics:- Atmosphere: Properties of standard atmosphere; Classification of aircraft. Airplane (fixed wing aircraft) configuration and various parts; Pressure altitude; equivalent, calibrated, indicated air speeds; Primary flight instruments: Altimeter, air speed indicator, vertical speed indicator, turn-bank indicator. Aerodynamic forces and moments; angle of attack; sideslip; High-lift devices; roll, pitch & yaw controls; Airplane performance: CL-alpha curve, drag polar; take-off and landing; steady climb and descent; absolute and service ceiling; range and endurance, load factor, turning flight, V-n diagram. Winds: head, tail and cross winds; Static stability: stability and control derivatives; longitudinal stick fixed and free stability; horizontal tail position and size; directional stability, vertical tail position and size; lateral stability; wing dihedral, sweep & position; hinge moments, stick forces; Linear momentum and angular momentum balance for rigid bodies; Space Dynamics: central force motion, Keplerian orbits, Kepler's laws; escape velocity.

3. Aerodynamics:- Basic fluid mechanics: fluid kinematics, streamline, streakline, pathline; conservation laws: mass, linear momentum and energy (integral and differential form); dimensional analysis and dynamic similarity; incompressibility conditions; Newtonian fluids; Elementary ideas of viscous flows: Hagen-Poiseuille flow, Couette flow, basic concepts in boundary layers, boundary layer thickness; Two-dimensional potential flow theory: sources, sinks, doublets, point vortex and their superposition, Bernoulli's equation; Airfoils and wings: airfoil nomenclature; aerodynamic coefficients: lift, drag, and moment; Kutta-Joukowski theorem; thin airfoil theory, Kutta condition, starting vortex; finite wing theory: induced drag, Prandtl lifting line theory; critical and drag divergence Mach numbers. Compressible flows: basic concepts of compressibility, one-dimensional compressible flows, isentropic flows, normal and oblique shocks, Prandtl-Meyer flow, flow through nozzles and diffusers.
4. Structures:- Strength of materials: Stress and strain, stress-strain curves of steel and Aluminium; stresses and deflections in statically determinate and indeterminate linear elastic trusses, bars, beams, and shafts; two-dimensional transformations of stresses and strains, Mohr's circle, principal stresses and strains; combined loading, failure criteria: maximum stress, Tresca, von Mises; strain energy; Castigliano's principles; three-dimensional Hooke's law; plane stress and strain; Euler buckling of columns; Flight vehicle structures: torsion, bending and shear of open and closed thin-walled sections: symmetric and unsymmetric cross-sections; loads on aircraft; Structural Dynamics: free and forced vibrations of undamped and damped SDOF systems; free vibrations of undamped 2-DOF systems.
5. Visualization and spatial ability:- Pictorial and diagrammatic questions to test the understanding of transformation and/or manipulation of 2D shapes and 3D objects and their spatial relationships; Analytical and logical reasoning: Ability to analyse given information logically and select the most appropriate solutions; ability to weigh opinions, arguments or solutions against appropriate criteria; ability to use logic and structured thinking to deduce from a short passage, which of a number of statements is the most accurate response to a posed question; Design thinking and problem solving: Ability to understand the context, the users and the constraints and select the most appropriate solution for a given design problem; Observation and design sensitivity: Ability to discern subtle differences in visual properties and aesthetic outcomes.

Part-B will have questions related to the following topics:

1. Robotics and automation:
 - a. Basic concepts: Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.
 - b. Power sources and sensors: Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.
 - c. Manipulators, actuators and grippers: Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – u various types of grippers – design considerations.
 - d. Kinematics and path planning: Solution of inverse kinematics problem – multiple solution Jacobian work envelope – hill climbing techniques – robot programming languages.
2. Additive manufacturing technologies and its applications: Fused Deposition Modeling (FDM), Selective Laser Sintering(SLS), Stereolithography (SLA), Selection Laser Melting (SLM), Jetting, 3D Printing, Laser Engineering Net Shaping (LENS), Laminated Object Manufacturing (LOM), Electron Beam Melting (EBM) Capabilities, materials, costs, advantages and limitations of different systems. AM applications in Battery thermal management, Desalination, Defense, Bio-reactors, Aerospace, Automobile, Medical implants
3. Electronics and Instrumentation: Analog and digital electronics, operational amplifiers, filters, oscillators, microcontrollers and embedded systems, sensors and transducers, signal conditioning and data acquisition, measurement principles and calibration, control systems and automation, error analysis, PLC and SCADA, IoT-based instrumentation, and AI applications in sensor data.
4. Materials selection & Lightweighting: Sustainable design, Finite Element Analysis, Computer Aided Engineering in product design, Impact and Crash Worthiness. Fundamental understanding of metals, non-metals, alloys, and composites; basic concepts of material properties, their testing, and validation including mechanical, magnetic, thermal, electrical, and optical properties, along with corresponding testing methodologies.