प्रो। मूर्ति हरदनहल्ली शं न
विभागाध्यक्ष
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Head of the Department

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Dept. of Aerospace Engineering
IIT Madras, Chennai 600 036

Candidates may choose to attend interviews in one of the three panels given below. They are advised to prepare for the interview on few of the topics listed under the chosen panel. It is presumed that the candidate is knowledgeable with high-school mathematics such as basic geometry, trigonometry, coordinate geometry and algebra. Further, knowledge of basic engineering mathematics including calculus, linear algebra, and differential equations is also expected. Please note that this is only an indicative list.

Panel 1: Aerodynamics, flight dynamics and control

Basic Mathematics:

Linear Algebra: Vector algebra; Matrix – Matrix operations, Determinant, Rank of a matrix, Eigen values and Eigen vectors; System of linear equations.
Calculus: Functions of a single variable and plots; Limit, continuity and differentiability; Mean value theorem; Local / Global maxima and minima; Sequences and Series; Taylor and Maclaurin series; Indefinite and definite integrals; Application of definite integral to find area and volume; Partial and total derivatives. Functions of complex variables – Roots, Analytic functions (Cauchy-Riemann equation).
Differential Equations: First order linear and nonlinear ordinary differential equations (ODE); Higher order linear ODEs with constant coefficients; Cauchy-Euler equation.

Prepare few topics from below. Not expected to know all.

Basics of Fluid Mechanics: Basic equations of motion, Classification of Flows, Flow past bodies, Vortex motion, Lift, Drag, Moments.
Basic Numerical Methods: Convergence, Stability, Finite difference Methods, Complex analysis, Differential Equations, Special functions, Programming Skills.
Basic Gas dynamics: Wave Propagation, Mach Waves, Compressible Flows, Nozzle flows, Shocks, Expansion, Fanno flows, Rayleigh flows.
Experimental Techniques: Measurement of Flow parameters - pressure, temperature, velocity, mass flow, flow visualization.

Flight Dynamics & Control. Laplace transform, response of LTI, transfer functions, feedback systems, open loop and closed loop gains, types of systems, poles and zeros, state space form, stability, controllability, observability.
Free body diagram, point mass model, Airplane performance, rigid body dynamics, trim and stability, static margin, longitudinal and lateral-directional dynamics, longitudinal and lateral modes.

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Panel 2: Structures & Aero-elasticity

Stresses, Strains, Stress-strain behaviour and relations, Stress/ strain transformations.
Trusses, Thin walled cylindrical shells subjected to internal pressure.
Beams (SFD, BMD, bending stresses and deflections - Statically determinate & indeterminate).
Torsional problems. Theories of failure, Column buckling.
Energy methods: conservation of energy, principle of virtual work, Castigliano's theorem.
Elasticity: 3D Hooke's law. equilibrium equations. Plane strain and plane stress problems. Airy's stress function.
Vibrations: Single degree of freedom systems: free and forced oscillations with and without damping; two degrees of freedom systems.
Basics of Composites: Classifications, Stress-strain relations, Material constants, Micro mechanics, Macro mechanics.

Panel 3: Propulsion

Classification of Air Breathing and Rocket Propulsion, Working of turbojet, ramjet, Solid and Liquid Propulsion, Calculation of thrust, Equilibrium Combustion thermodynamics, Elements of Heat Transfer, Gas Turbine Engine Components.
Experimental Techniques: Measurement of Flow parameters - pressure, temperature, velocity, mass flow; flow visualization.
Basic Gas dynamics: Wave Propagation, Mach Waves, Compressible Flows, Nozzle flows, Shocks, Expansion, Fanno flows, Rayleigh flows.

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