M.A./M.Sc. (Final) Mathematics

Paper-II : Viscous Fluid Dynamics

Unit 1 : Viscosity, Analysis of stress and rate of strain. Stoke's law of friction. Thermal conductivity and Generalized law of hear conduction. Equations of state and continuity. Navier-Stokes equations of motion. Vorticity and Circulation.

Unit 2 : Dynamical similarity Inspection and dimensional analysis. Buckingham theorem and its application. Non-dimensional parameters and their physical importance. Reynolds number. Froude number. Mach number. Prandtl number. Eckert number. Grashoff number. Brinkmann number, Non-dimensional coefficients; Lift and drag coefficients. Skin friction. Nusselt number, Recovery factor.

Unit 3 : Exact solution of Navier-Stokes equations. Velocity distribution for plane Couette flow, Plane Pioseuille flow, Generalized plane. Couette flow.

Unit 4 : Hagen-Poiseculle flow. Flow in tubes of uniform cross-sections. Flow between two concentric rotating cylinder.

Unit 5 : Stagnation point flows : Hiemenz flow, Flow due to rotating disc.

Unit 6 : Concept of unsteady flow, Flow due to plane wall suddenly set in the motion (Stokes first problem). Flow due to an oscillating plane wall (Stoke's second problem).

Unit 7 : Starting flow in plane Couette motion. Suction/injection through porous wall.

Unit 8 : Equation of energy, Temperature distribution : Between parallel plates, in a pipe, between two concentric rotating cylinders, Temperature distribution of plane Couette flow with transpiration cooling.

Unit 9 : Theory of very slow motion : Stoke's and Oseen's flows past a sphere.

Unit 10 : Concept of boundary layer.

Unit 11 : Derivation of velocity and thermal boundary equations in two-dimensional flow.

Unit 12 : Boundary layer on flat plate (Balsius-Topfer solution). Simple solution of thermal boundary layer equation for $P_r = 1$.