JF 207 Introductory Course Instructor: Ganesh S Credits: 3:0 Fluid Mechanics

Fluid kinematics: Continuum hypothesis, Flow description and visualization, Decomposition of relative motion.

Conservation laws: Conservation of mass, momentum and energy, Constitutive equations. Elementary kinetic theory: molecular perspective of thermodynamics, probabilistic picture of molecular motion, expression for transport coefficients.

Cartesian vectors and tensors.

Solutions to the Navier-Stokes equations: Hydrostatics, Uni-directional flows, Low Reynolds number flows, Lubrication theory.

Vorticity dynamics: Kelvin's Circulation Theorem, Sources of vorticity production, Canonical vortex structures, Dynamics of rotating fluids.

Hydrodynamic stability: the Kelvin-Helmholtz and Rayleigh-Taylor mechanisms.

A brief introduction to turbulence.

Potential flows: Bernoulli's theorem, complex-variable formulation for plane potential flows. Boundary layer theory: Introduction to singular perturbation theory, Boundary layer on a flat plate, Falkner-Skan solutions, Separation.

Compressible flows: Sound waves, Flow in a converging-diverging nozzle, Shocks, The Riemann problem.

An introduction to non-Newtonian fluid mechanics.

Books:

1. Fluid mechanics - Kundu, Cohen and Hu.

- 2. Advanced transport phenomena Leal
- 3. Introduction to fluid dynamics Batchelor
- 4. Fluid mechanics Landau and Lifschitz
- 5. Rotating fluids Greenspan
- 6. Waves in fluids Lighthill
- 7. Vectors, tensors and basic equations of fluid mechanics Aris, Rutherford