

- The basics
 - Velocity field, Euler and Lagrangian descriptions
 - Pressure
 - Viscous force (microscopic and macroscopic descriptions)
 - Stress tensor
 - Stream lines/streak lines/path lines
- Derivation of the governing equations
 - Conservation of mass
 - Conservation of momentum
 - Conservation of energy
- Boundary Conditions
- Reynolds number and dynamic similarity
- Bernoulli's law in different forms
- Vorticity, Circulation, and Vorticity Equation, Kelvin's theorem
- Exact solutions
 - 1D pipe and channel flow
 - Taylor Couette Flow
 - Flow down an inclined plane
 - Planar shear flow (shear flow between two parallel plates, unsteady flow next to an impulsively started plane)
 - Spinning down of a line vortex
- Self-Similarity and Dimensional Analysis
- Aerodynamics
 - General discussion on forces on a moving object in Stokes flow and in flow at finite Reynolds numbers
 - Newton's particle theory
 - Kutta-Joukowski theory of aerodynamic lift
 - Potential flow (irrotational flow), Laplace equation, and complex variable analysis
 - Blasius theorem
 - Joukowski Transformation (a circle to a plate, to an ellipse, to an airfoil)
 - Kutta condition

- Signature of thrust, thrust generated by reciprocal motions
- Low Reynolds number flow phenomena (Stokes flow)
 - History independent (no memory)
 - Time reversibility
 - Linear in U
 - Drag on a moving sphere
 - Scallop theorem
- Thin Film Theory
 - Flow in a Hele-Shaw cell
 - Lubrication theory
 - Flow through porous media
 - Adhesion between two plates with a thin film gap
- Boundary Layer equation and Boundary Separation
 - Derivation of the equation
 - Self-similar solution, scaling arguments
 - Physical picture of the vorticity generation, and the subsequent diffusion and advection
 - Boundary layer separation condition
- Jets
 - Self-similar solution
 - Mass flux and entrainment
- Computational Methods
 - Finite Difference Scheme
 - Wave equation (FTCS scheme, Lax Scheme)
 - Diffusion equation (FTCS scheme, Implicit Scheme, Crank-Nicholson Scheme)
 - Diffusion equation with non-constant coefficients
 - Von Neumann Stability Analysis
 - Courant Friedrich Levy (CFL) conditions
- Relevant Math
 - Vector Calculus, Divergence/Stokes Theorems
 - Reynolds transport theorem
 - Partial Differential Equations
 - Self-Similarity Solutions
 - Complex Variable Analysis
 - Taylor Series
 - Finite Difference Schemes