Topics

1. Overview, Equations, Ideal Fluids

— OV of phenomenology, especially current research
— Euler Equations — derivation, conservation laws
— Potential flow, induced mass

2. Vorticity and Viscous Flow

— Stress Tensor, Constitutive Relation, Navier–Stokes Equations, Viscous Flow, Stokesian Dynamics and Drag, Clamshell Theorem
— Kelvin's Theorem, Induction Equation, Freezing-in Law, Boundaries
— Stress vs. Strain or Rate-of-Strain?, Relation to Elasticity

3. Instabilities

— Generalized Interchanges: Rayleigh–Bénard convection and extensions
— Rotating Convection; Taylor–Proudman Theorem
— Interfacial Instability: Rayleigh–Taylor, Kelvin–Helmholtz

4. Boundary Layers

— Basics of Drag, Laminar Wake
— Blasius Boundary Layer, Drag
— Drag Crisis

5. Turbulence I — Microscopics

— Basic ideas, K41 Model, Richardson Phenomenology, 4/5 Law
— 2D Turbulence
— Asymptotics, Scaling, and Anomalous Exponents, Implications for Turbulence

6. Turbulence II — Macroscopics

— Pipe Flow Turbulence, Prandtl Law of Wall, Mixing Length Models
— Turbulent Wakes, Wake Structure
— Thermal Boundary Layers

7. Basics of Elasticity
  — Fundamentals: Stress–Strain, Hooke's Law
  — Deformation with Temperature
  — Equilibrium — general theory
  — Plates and Shells, Rods
  — Stability

8. Topics in Elasticity
  — Elastic Waves and Vibration of Rods and Plates
  — Elastic Limit, Plasticity, Strength
  — Visoelasticity — Oldroyd-B