

Fluid Dynamics

Exam 1: Ideal fluid

1. Basics of classical mechanics: equations of motion, momentum, energy.
2. Ideal fluid: Continuity and Euler equations.
3. Basics of thermodynamics. A concept of isentropic flow.
4. Momentum and energy conservation for ideal fluid.
5. Eulerian and Lagrangian description of flow. Transport theorem.
6. Bernoulli's theorem
7. Vorticity: definition and interpretation. Euler equations for vorticity (incompressible and compressible).
8. Kelvin circulation theorem. Helmholtz's theorem.
9. Irrotational (potential) flow. Bernoulli equation for unsteady potential flow.
10. Two-dimensional ideal fluid. Uniqueness of incompressible potential flow in simply-connected bounded region. Minimum of kinetic energy.
11. Complex potential. Interpretation of stream function. Blasius theorem.
12. Kutta-Joukowski theorem. D'Alembert's paradox.
13. Flow around a cylinder (with and without circulation). Flow around angles. Kutta's condition for an airfoil (idea).
14. Point vortex. Dynamics of a system of point vortices.
15. Conditions at free surface. Gravity waves.
16. Kelvin-Helmholtz instability.