TAM 531 – Inviscid Flow

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Lecture: TR 2:00pm - 3:50pm, 4100 LuMEB

This course outline is flexible; different aspects can be emphasized according to the students' interests.

1. *Introduction*
   Inviscid Flow, its applicability and limitations

2. *Mathematical Tools*
   Vector and tensor algebra, vector and tensor calculus, integral theorems

3. *Kinematics*
   Continuum mechanics, thermodynamics, kinematics, Eulerian and Lagrangian formalisms

4. *Elementary Fluid Mechanics*
   Conservation laws; derivation of the Navier-Stokes equation; specialization to inviscid and other limits; vorticity equation

5. *Irrotational Inviscid Flow*
   Bernoulli's equation, velocity potential and stream function in 2D and 3D, complex variable techniques, conformal mapping, flows induced by moving boundaries

6. *Rotational Inviscid Flow*
   Vortices, flow in rotating systems, vorticity transport, Taylor-Proudman theorem, Kutta-Joukowski

7. *Waves at Interfaces*
   Gravity waves, stability of fluid/fluid interfaces, transport in waves, Stokes drift

8. *Compressible flow*
   Compressible flow effects and equations

9. *Acoustics*
   *A*coustic limit of the compressible flow equations, sound generation

10. *Nonlinear waves*
    Nonlinear acoustics, wave steepening, shocks, Burgers equation

Course evaluation will be by homework (to be assigned and discussed roughly biweekly, with the discussion entering grade consideration), one midterm exam (date TBA) and one final exam (date TBA). For course **prerequisites** please refer to the course listing.

No single **textbook** covers all the material in this class. We will heavily draw from J. S. Marshall, Inviscid Incompressible Flow, Wiley (2001); and also G. B. Whitham, Linear and Nonlinear Waves, Wiley (1974); P. A. Thompson, Compressible Flow Dynamics, Advanced Engineering Series (1988). Please refer to a separate document for further references and details about useful class materials.