(3 credits) 001-2-4010

Prerequisite: It is assumed that the student has a background in the calculus of functions of one and several variables, vector calculus and ordinary differential equations and has been introduced to some elementary aspects of partial differential equations (such as, for example, separation of variables). Some knowledge of fluid mechanics is helpful but not essential.

Lectures	Exercise	Laboratory	Field Trip
3		1	

This course provides the environmental physics students with an overview of fluid flow phenomena in the environment, beginning with fundamental fluid dynamics concepts and relations.

- Basic concepts and equation of fluid dynamics: Description of fluid motion: kinematics of flow. Equations of fluid dynamics: continuity equation; momentum equations; the energy equation. Formulation of problems in fluid dynamics: boundary and initial conditions; similarity of fluid flows; dimensional analysis. Irrotational flow. Viscous fluid dynamics: the Navier-Stokes equations; exact solutions of the Navier-Stokes equations; slow viscous flows; (stokes approximation); high Reynolds number flows (boundary layer approximation); jets. Hydrodynamic stability and transition to turbulence. Elements of turbulence theory. Stability of the non-uniformly heated fluid and. free convection.
- Fluid dynamics in environmental applications: Buoyancy forcing of the circulation in the atmosphere and oceans. Environmental manifestations of flow instabilities. Shallow convective circulation in clouds and patterns formation: cloud streets; cellular cloud structures. Stratified flows over topography: blocking; lee waves; severe local storms. Baroclinic instability and the general atmospheric circulation: large-scale eddies (cyclones and anticyclones); frontogenesis; fronts. The concept of vorticity and mesoscale vortex flows; tornadoes. Thermal and salt-driven convection in oceanic flows. Air and water pollution problems.

Lecturers: G.I. Burde, I. Rubinstein

Recommended Reading:

Batchelor, G.K. (1977). *An Introduction to Fluid Dynamics.* Cambridge University Press, Cambridge.
Tritton, D.J. (1988). *Physical Fluid Dynamics. 2nd Edition,* Clarendon Press, Oxford
Gill, A.E. (1982). *Atmosphere-Ocean Dy namics.* Academic Press, New York