Fluid Dynamics					
Module-No./Abbreviation CE-P06/FD	**Credits** 3 CP	**Workload** 90 h	**Term** 2^{nd} Sem.	**Frequency** Summer term	**Duration** 1 Semester
Courses Fluid Dynamics			**Contact hours** 2 SWS (30 h)	**Self-Study** 60 h	**Group Size:** No Restrictions

Prerequisites

Mathematical Aspects of Differential Equations and Numerical Methods (CE-P01), Mechanical Modeling of Materials (CE-P02), Fluid Mechanics (Bachelor level)

Learning goals / Competences

The students shall acquire consolidated skills of the basic laws of hydraulics, potential theory, flow dynamics and turbulence theory. The students shall be enabled to assess and to solve technical problems related to flow dynamics in hydraulics and in aerodynamics.

After successfully completing the module, the students will be able to

- understand the broad scope of fluid dynamics and the thematic integration of computational fluid dynamics within,
- identify fluid dynamical mechanisms of observed flow phenomena and recognize the governing physical laws,
- choose and apply adequate engineering models to explore and formulate engineering solutions for real flows,
- solve fluid dynamical problems of acceptable complexity tailored to the student’s study status,
- validate and assess these solutions and the achieved results,
- acquire skills in numeracy, media literacy, and digital competence through the completion of supervised and supported self-studies and other activities.

Content

The technical basics of dynamic fluid flows are introduced, studied and recapitulated as well as related problems which are relevant for practical applications and solution procedures with an emphasis put on numerical and computational aspects.

The lectures and exercises contain the following topics:

- Short review of hydrostatics and dynamics of incompressible flows involving friction (conservation of mass, energy and momentum, Navier-Stokes equations)
- Boundary layer theory and introduction to non-isotropic turbulence
- Spectral analysis of turbulent boundary layer flows
- Flow over bluff bodies
- Gaseous transport in the urban environment
- Introduction to engineering applications for CFD method
- Considerations for CFD meshes and numerical domains
- Derivation of the Navier-Stokes equations
- Simulation types and turbulence modeling
- Boundary conditions for external flows
- Discretization methods, focusing on the finite volume method
- Solution algorithms, errors, validation, and verification

The students are guided in the exercises to working out assessment and solution strategies for related,typical technical problems in fluid dynamics.
Teaching methods / Language Lecture (2h / week), Exercises (2h / week) / English
Mode of assessment Written examination (75 min, 100%)
Requirement for the award of credit points Passed final module examination
Module applicability MSc. Computational Engineering
Weight of the mark for the final score 2 %
Module coordinator and lecturer(s) Prof. Dr.-Ing. R. Höffer, Assistants
Further information