2013-2014	**Chemical and Petrochemical Engineering**	*Year 3 - Sem 5.*
4.5.2	**Fluid Mechanics**	Obligatory
Credits*ECTS:* *U.S.* Credits: 2	*Responsible:* *Prof. (s):*	*Language:* French / English
Total Hours students: 48 h	*Period:* September 24 to January 30	

Learning outcomes

By the end of the course the student should be able to :

1. Solve problems related to hydrostatics
2. Apply the equations of conservation of mass, momentum, and energy
3. Apply Reynold transport theorem
4. Express the differential equations for simple fluid and specify the correct boundary conditions and derive the Navier-Stokes equation from basic principles
5. Apply Bernoulli equation for flow in pipes
6. Solve problems related to potential flows
7. Use dimensional analysis and scaling for complex fluid flows
8. Calculate pressure drops across pipes and ducts and learn the difference between laminar and turbulent internal flows.
9. Solve problems related to water hammer
10. Apply basic equations for flow in nozzles
11. Analyze shock waves

Prerequisites

Thermodynamics I

Content

Fluid properties (density, compressibility, viscosity, surface tension, capillarity, vapor pressure and others) – **Hydrostatics** (pressure variation with elevation, manometry, pressure forces on plane and curved surfaces, buoyancy and stability of floating bodies) – **kinematics of fluid motion** (streamlines , streamtubes, flow fields, circulation, vorticity and rotation) – **the conservation of mass** (the continuity equation) - **Reynolds transport theorem** - **flow of incompressible ideal fluid** (Euler and Bernoulli equations, energy and hydraulic grade lines, the work – energy equation, stream function and velocity potential, equipotential lines, flow net, flow over a cylinder/D'Alembert paradox) – the impulse-momentum principle – **flow of real fluid** (laminar and turbulent flows, boundary layers, external and internal flows, Navier-Stokes equations) – **Similitude and dimensional analysis**- **flow in pipes** (pipe friction factor, fiction losses, local losses, Moody diagram, pipe line problems, water hammer),- **flow of compressible fluids** (Euler and energy equations, stagnation point, subsonic and supersonic flows, Mach number, convergent and divergent nozzles, normal and oblique shock waves, real flow in pipes)**.**

Bibliography

Elementary fluid mechanics, Robert L. Street

Evaluation

The evaluation will be done through:

- A partial exam.
- A final exam.
- Homework and assignments