INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

DPT GENIE ENERGETIQUE ET ENVIRONNEMENT
ENERGETICS AND ENVIRONMENTAL ENGINEERING
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Fluid Mechanics

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IDENTIFICATION

CODE : GEN-3-S1-EC-MFLU
ECTS : 3.0

HOURS

Lectures :	22.0 h
Seminars :	20.0 h
Laboratory :	4.0 h
Project :	0.0 h
Teacher-student contact :	46.0 h
Personal work :	25.0 h
Total :	71.0 h

ASSESSMENT METHOD

1 test of 3h
Pratical works evaluation

TEACHING AIDS

Lecture slides, polycop, form and supervised work subjects

TEACHING LANGUAGE

French

CONTACT

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AIMS

This course falls under the Energy - Processes 1 [GEN-3-ue-NRJ1] teaching unit [CE] and contributes to the following general competences:

A1 Analyse a real or virtual system [or problem] [level 2]
A2 Use a model of a real or virtual system [level 2]
A3 Implement an experimental approach [level 2]
A5 Process data [level 2]
A6 Communicate an analysis or a scientific approach with scenarios adapted to their speciality [level 2]
C1 Design, size, manage and optimise energy systems in complex and varied contexts [city, industry, transport] [level 1]
C2 Design, size and optimise process engineering installations [level 1]

This course is designed to enable the student to work on and be assessed on the following knowledge

- Notion of imbalance and transport
- Descriptions of fluid motion, different flow regimes
- Laws describing fluid motion [pressure, gravity, inertia, viscosity]
- Dimensionless numbers in fluid mechanics
- Principle of lift and drag on objects placed in a flow
- Notions of boundary layers

By allowing the student to work on and be assessed on the following skills:
- Conduct mass, momentum and kinetic energy balances
- Study, model and dimension static and dynamic hydraulic and aeraulic flows in perfect and real fluids
- Choose a control volume for the study and dimensioning of hydraulic and aeraulic installations
- Perform dimensional analysis and apply similarities to hydraulic and airflow systems
- Use laminar and turbulent boundary layer assumptions for flow modelling

CONTENT

- Fluid Characteristics: viscosity, newtonian fluid, compressibility,....
- Fluid Statics: basic law of hydrostatic, Archimede theorem, force on a plane surface
- Ideal Fluid - Bernoulli Equation - Applications [Pitot tube, Venturi Flowmeter, ...]
- Fluid Kinematics: Lagrangian and Eulerian descriptions; material derivative; system and control volume; Reynolds transport theorem
- Finite Control Volume Analysis: conservation of mass; momentum, kinetic energy and energy budgets
- Differential analysis of flows: continuity equations; stress-deformation relationships; Euler and Navier-Stokes equations; elementary solutions
- Dimensional Analysis and Similitude: Vaschy-Buckingham theorem, some important dimensionless numbers in fluid mechanics, physical sigbnificance and relationship with Navier-Stokes equations, similitude laws for models
- External Flows: laminar and turbulent boundary layer; flow separation; force around an immersed body; drag and lift

BIBLIOGRAPHY

S. CANDEL - Mécanique des Fluides - Dunod 2001
P. CHASSAING - Mécanique des Fluides, Eléments d'un premier parcours - Cepadues 2000
R. COMOLET - Mécanique expérimentale des Fluides tomes 1 et 2 - Dunod 2002
B.R. MUNSON, D.F. YOUNG, T.H. OKISHII - Fundamentals of Fluid Mechanics- 5th Edition, John Wiley Sons 2006

PRE-REQUISITE

Mechanics of material point and solid body
Resolution of ordinary differential equations
Calculation of partial derivatives
Tensorial calculus and classical operators (gradient, divergence, curl)

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