

ME-453

**Hydraulic turbomachines**

Avellan François, Vagnoni Elena

Cursus	Sem.	Type
Energy Management and Sustainability	MA1, MA3	Opt.
Energy Science and Technology	MA1	Obl.
Mechanical engineering	MA1, MA3	Opt.
Mechanics		Obl.
Nuclear engineering	MA1	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Courses	3 weekly
Exercises	1 weekly
<b>Number of positions</b>	

**Summary**

Master lecture on Hydraulic Turbomachines: impulse and reaction turbines, pumps and pump-turbines.

**Content**

- Turbomachine equations, mechanical power balance in a hydraulic machines, moment of momentum balance applied to the runner/impeller, generalized Euler equation.
- Hydraulic characteristic of a reaction turbine, a Pelton turbine and a pump, losses and efficiencies of a turbomachine, real hydraulic characteristics.
- Similitude laws, non dimensional coefficients, reduced scale model testing, scale effects.
- Cavitation, hydraulic machine setting, operating range, adaptation to the piping system, operating stability, start stop transient operation, runaway.
- Reaction turbine design: general procedure, general project layout, design of a Francis runner, design of the spiral casing and the distributor, draft tube role, CFD validation of the design, design fix, reduced scale model experimental validation.
- Pelton turbine design: general procedure, project layout, injector design, bucket design, mechanical problems.
- Centrifugal pump design: general architecture, energetic loss model in the diffuser and/or the volute, volute design, operating stability.

**Learning Prerequisites****Recommended courses**

Incompressible Fluids Mechanics  
Introduction to turbomachines

**Learning Outcomes**

By the end of the course, the student must be able to:

- Formulate the operating point of a hydraulic turbomachine
- Specify a type of hydraulic turbine
- Sketch the layout of a hydraulic turbomachine
- Select appropriately the dimensions of a hydraulic turbomachine

**Transversal skills**

- Use a work methodology appropriate to the task.
- Communicate effectively with professionals from other disciplines.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.

**Teaching methods**

ex cathedra lectures with working case studies

**Expected student activities**

attendance at lectures completing exercises and reading written material

**Assessment methods**

written exam

**Resources****Bibliography**

P. HENRY: Turbomachines hydrauliques - Choix illustré de réalisation marquantes, PPUR, Lausanne, 1992.

Franc, Avellan et al., Cavitation, EDP Grenoble, 1994

Handout and Scientific Literature from LMH, Industry, International Association

**Ressources en bibliothèque**

- [Turbomachines hydrauliques / Henry](#)
- [Cavitation / Franc](#)

**Notes/Handbook**

slides handout Handbook

**Websites**

- <http://lmh.epfl.ch/teaching>

**Prerequisite for**

Cavitation, Hydroacoustic, Master Project