ME-453

Hydraulic turbomachines

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

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

Summary

Master lectures on Hydraulic Turbomachines: operating principles, design and innovation of impulse and reaction turbines, industrial pumps and pump-turbines.

Content

- Fundamental equations for turbomachines operation: mass conservation and specific energy equation for turbulent flows, 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.
- Similtude 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, 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.
- Innovations in hydruaic machinery.
- Sustainability in turbomachines manufacturing and operation.

Learning Prerequisites

Recommended courses

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
- Design the layout of a hydraulic turbomachine
- Specify types and components of hydraulic turbine
- Describe The flow phenomena and instabilities in turbomachines

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 Scientifc Litterature from LMH, Industry, International Association

Ressources en bibliothèque

- Find the references at the Library

Notes/Handbook

slides handout Handbook

Moodle Link

- https://go.epfl.ch/ME-453

Prerequisite for

Cavitation, Hydroacoustic, Master Project