Hydraulic turbomachines

Vagnoni Elena

<table>
<thead>
<tr>
<th>Cursus</th>
<th>Sem.</th>
<th>Type</th>
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<tr>
<td>Energy Science and Technology</td>
<td>MA1, MA3 Obl.</td>
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<td>Mechanical engineering minor</td>
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<td>Mechanical engineering</td>
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<td>Nuclear engineering</td>
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Language of teaching: English
Credits: 4
Session: Winter
Semester: Fall
Exam: Written
Workload: 120h
Weeks: 14
Hours: 4 weekly
Lecture: 3 weekly
Exercises: 1 weekly

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
Franc, Avellan et al., Cavitation, EDP Grenoble, 1994
Handout and Scientific Literature from LMH, Industry, International Association

Ressources en bibliothèque
• Cavitation / Franc
• Turbomachines hydrauliques / Henry

Notes/Handbook
slides handout Handbook

Moodle Link
• https://go.epfl.ch/ME-453

Prerequisite for
Cavitation, Hydroacoustic, Master Project