

ME-443

Hydroacoustic for hydropower plants

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Cursus	Sem.	Type
Energy Science and Technology	MA2, MA4	Opt.
Mechanical engineering minor	E	Opt.
Mechanical engineering	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Oral
Workload	90h
Weeks	14
Hours	3 weekly
Lecture	2 weekly
Project	1 weekly
Number of positions	

Summary

Introduction to pressure wave propagation phenomena in hydraulic circuits, water hammer calculations, transient behaviour of hydroelectric plants, 1D numerical simulation of the dynamic behaviour of Francis, Pelton and Kaplan turbines, and study of the stability of these systems.

Content**The course aims to:**

1. to present transient flows phenomena in hydraulic circuits,
2. to present the modelling, numerical simulation and analysis of the dynamic behaviour of hydraulic systems including hydraulic turbomachinery,
3. to analyse hydroelectric power plants transient behavior.

The course will cover the following aspects:

- Presentation of the different types of transient flow phenomena in hydraulic circuits such as water hammer in pipes, mass oscillations in surge tanks and transient regime of hydraulic machines.
- Introduction of the fundamental equations needed to model transient phenomena in hydraulic circuits (mass and momentum conservation).
- Analytical, graphical and numerical resolution of problems relating to the calculation of transient behaviour in hydraulic circuits.
- 1D numerical modelling of hydroelectric power plants, taking into account the main components such as: pressurised pipe, surge tanks, pressurised air vessels, cavitation, pumps, Francis, Pelton and Kaplan turbines and reversible Francis pump-turbines.
- Study of the stability of hydraulic systems.
- Introduction to the SIMSEN simulation software and case studies: water hammer in pipe, mass oscillation in surge tank, unit startup, emergency shutdown of turbines and pumps.
- Application of the course concepts in the context of a mini-project to study a pumped storage power station transient behavior.

Keywords

- pressure wave propagation in pressurised pipes
- water hammer
- hydraulic transient phenomena
- 1D modelling of dynamic behaviour of hydraulic systems
- 1D numerical simulation of hydraulic systems
- hydraulic turbine dynamics

Learning Prerequisites

Required courses

- Fluid mechanics
- Introduction to turbomachinery

Recommended courses

- Hydraulic turbomachinery

Learning Outcomes

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

Transversal skills

- Use a work methodology appropriate to the task.
- Communicate effectively, being understood, including across different languages and cultures.
- Use both general and domain specific IT resources and tools
- Write a scientific or technical report.

Teaching methods

Ex cathedra teaching, case study, mini-project with analytical approach, graphics and numerical simulation with SIMSEN software.

Expected student activities

Mini-project in groups of 3 to 4 students aiming to apply the concepts covered in the course to a real industrial case and using the SIMSEN simulation software, writing two mini-project reports.

Assessment methods

Mini-project report in two parts (part I analytical and graphical approach and part II numerical simulation using SIMSEN software) (50%) and individual oral exam (50%).

Resources

Virtual desktop infrastructure (VDI)

No

Notes/Handbook

Slides and polycopié