CIVIL-466

Water resources engineering and management

Bieri Martin Peter, Leite Ribeiro Marcelo, Perona Paolo

Cursus	Sem.	Type
Civil Engineering	MA2, MA4	Opt.
Civil engineering minor	E	Opt.
Energy Science and Technology	MA2, MA4	Opt.
Environmental Sciences and Engineering	MA2, MA4	Opt.

Language of teaching	English
Credits	5
Session	Summer
Semester	Spring
Exam	Written
Workload	150h
Weeks	14
Hours	**5 weekly**
Courses	3 weekly
Exercises	1 weekly
TP	1 weekly
Number of positions	

Summary

The course focuses on designing and managing water systems to ensure sustainable use for both human and environmental needs. Engineering aspects:water quantity, quality, timing, distribution. Management: economic evaluation of water systems in the context of global changes and financial constraints.

Content

- Introduction and definitions: water availability, security and scarcity, river basins, riparian states, etc.;
- Water uses, supply and withdrawals: traditional vs non-traditional, consumptive vs non-consumptive uses, etc.;
- Time series analysis and modelling: water resources & climate change;
- Multipurpose water reservoir design and management (irrigation, domestic and industrial use, flood control, energy production);
- Review of pipe flow hydraulics: water distribution networks;
- Pumps and turbines: characteristics and operating points;
- Hydropower production;
- Drought analysis and flood control;
- Instream flow protection: environmental flows, static vs dynamic flow releases;
- Engineering economics: economic indexes, and marginal analysis
- Water allocation: multicriteria optimization, game theory, conflict and cooperation;
- Integrated Water Management:
- Advanced topics in water resources engineering: water footprint, virtual water network, etc.;
- WRM in action: balancing demand and supply;
- WRM in action: transboundary river basins and the Environmental, Social and Governance (ESG) concept;
- WRM in action: water economics and financing; investment and cash flow;
- WRM in action: decision making and risk assessment;

Keywords

Water resources, hydrological modelling, water uses, water allocation, optimization, decision making, management, sustainability, conclict and cooperation, water footprint

Learning Prerequisites

Required courses

Hydrology, elementary fluid mechanics or hydraulics related courses

Learning Outcomes

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

- Assess / Evaluate and model water resources a vailabity at different scales.
- Assess / Evaluate Calculate different water needs.
- Formulate an integrated and sustainable water management concept.
- Design distribution networks and systems involving hydraulic machines.
- Perform a basic economic analysis and assess the economic value of water projects.
- Distinguish between project development with or without profitability goal.
- Assess / Evaluate water issues in the current economic context using engineering economics tools.
- Optimize the regulation of a watercourse with respect to human and environmental needs.
- Implement time series analysis and modeling concepts to hydrologic data.

Transversal skills

- Take responsibility for environmental impacts of her/ his actions and decisions.
- Take account of the social and human dimensions of the engineering profession.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Use both general and domain specific IT resources and tools

Teaching methods

Ex-cathedra teaching, exercise and small project

Expected student activities

- Attendance at lectures and exercise sessions
- Commitment to exercises and project
- Ability to basic use of common data analysis and programming softwares (e.g., Matlab, R, Python, Excel, etc.)

Assessment methods

20% Exercise assignments
10% small project
70% Written exam

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

Moodle

Notes/Handbook
Moodle

Moodle Link
- https://go.epfl.ch/CIVIL-466

Prerequisite for
Future water engineering and hydraulic courses, e.g. Irrigation and drainage engineering; ecohydrology, fluvial ecomorphology, dam engineering, etc. Because of the engineering economics, the optimization and the time series analysis acquired concepts, this course is however propedeutical to many non-directly related hydraulic courses proper of SIE and GC.