UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Laboratory of Understanding Sustainable Management of Industrial Water

2526-1-F7603Q022

Aims

The objective of the laboratory course is to enable students to understand the principles and methods that allow sustainable management of water resources in industry. Special attention is given to a quantitative assessment of the sustainability of water use by industry using various indicators and indices. The sustainability of industrial water is assessed at various levels: from processes and water use within the boundaries of the company/facility to the impact of the company/facility on the environment as a whole.

Knowledge and understanding
At the end of the course the student will have a fundamental understanding of:
• key principles and limitations for assessing the sustainable use of water resources in industry.
• main environmental impacts of water abstractions and wastewater discharges.
• key practices for optimizing water use in industrial processes.
• main indicators of sustainability of industrial water.

Applying knowledge and understanding
At the end of the course the student will be able to:
• assess the sustainability of water use and management in a company;
• minimize environmental impacts;
• reduce operational costs;
• ensure long-term availability of water resources.

Making judgements
At the end of the course the student will be able to:
• assess whether a form of water usage is sustainable or not;
• decide on the most sustainable use of water resources;
• analyse economically the impact of a more sustainable water use.

Communication skills

At the end of the course the student should be able to
• analyse problems in the ares covered by the course in a clear and concise way.
• explain orally with a suitable language the objectives, the procedures and the results of the elaborations carried out.

Learning skills
At the end of the course the student should be able to different from those presented during the course, and to understand the topics covered in the scientific literature concerning the sustainability issue.

Contents

• Anthropogenic and urban water cycle, water balance.
• Groundwater recharge and discharge, groundwater renewability and sustainability.
• Surface water environmental flow, surface water/groundwater interactions, groundwater-dependent ecosystems.
• Hydro-biogeochemical processes affecting the quality of freshwater resources.
• Wastewater treatment and environmental impacts.
• Implementation and monitoring of Key Performance Indicators.
• Sustainability reporting and certification.
• Socially Responsible Investment Indices and Environmental Accounting.
• Sustainability in industrial water management.

Detailed program

• Alteration of the natural water cycle by anthropogenic and urban activities, water supply and sewerage networks.
• Major sources of freshwater to meet industrial needs.
• Groundwater recharge and discharge, groundwater balance, groundwater recharge rates and renewal time.
• Groundwater renewability, sustainability of groundwater abstractions, managed aquifer recharge.
• Problems related to groundwater over-exploitation in a changing climate.
• Interactions between groundwater and surface water, base flow and environmental flow, groundwater-dependent ecosystems.
• Hydro-biogeochemical processes, pollution and contamination of water resources.
• Wastewater treatment technologies, environmental impacts of wastewater discharge.
• Sustainable Water Management in industry.
• Service Management Fundamentals and integration with Water Management in industry.
• Water Management and Sustainability Reporting: ESG Reporting on water use in industry.
• Water treatment as a service: Key Performance Indicators for Sustainable Water Management.
• Sustainability Reporting and certifications: ISO 14001, GRI and ESRS.
• Sustainability Assessment and reporting: water footprint of industrial operations, ensuring transparency in water use and management practices.
• Sustainable supply chain management for water.

Prerequisites

• Basic knowledge of hydrochemistry.
• Basic knowledge of hydrogeology.
• Basic knowledge of service management.

Teaching form

6 CFUs of mixed theoretical and practical lessons in the classroom (60 hours):
• 20 two-hour lectures, in person, Delivered Didactics;
• 10 two-hour lectures, in person, reading and discussing case studies, Interactive Teaching.

Attendance to lectures and interactive exercises is highly recommended.

Textbook and teaching resource

• Mace R. (2022). Groundwater Sustainability - Conception, Development, and Application. Springer Nature, Berlin. DOI: https://doi.org/10.1007/978-3-031-13516-3.
• Lens P., Hulshoff Pol L., Wilderer P., Asano T. (2005). Water Recycling and Resource Recovery in Industry - Analysis, Technologies and Implementation. IWA Publishing, London. DOI: https://doi.org/10.2166/9781780402802.
• Slides.
• Selected scientific papers made available on the e-learning website of the course.

Semester

II semester (March - June)

Assessment method

The final examination will take the form of an oral interview. There will be a single oral interview for both modules due to their close interconnection. The oral interview is structured in two parts:
• a first part in which the student will expose, by means of presentation with slides, the results of an assignment involving the critical analysis of a case study (duration of the presentation 10-15 min); in this part, the ability to critically understand, expose and communicate a scientific text will be evaluated;
• a second part of discussion, with 2-4 questions, on the topics covered by the two modules of the course (duration of 20-30 min); in this part the degree of knowledge acquired and the ability to apply the interpretative tools acquired will be evaluated.

The final score will be between 18/30 and 30/30 *cum laude*, based on the overall assessment considering the following criteria:
(1) knowledge and understanding;
(2) ability to connect different concepts;
(3) autonomy of analysis and judgment;
(4) ability to correctly use scientific language.

Office hours

Students are asked to refer to the indications provided in the syllabi of the modules.

Sustainable Development Goals

QUALITY EDUCATION | CLEAN WATER AND SANITATION | INDUSTRY, INNOVATION AND INFRASTRUCTURE | SUSTAINABLE CITIES AND COMMUNITIES | RESPONSIBLE CONSUMPTION AND PRODUCTION