UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Laboratory of Understanding Sustainable Management of Industrial Water

2627-1-F7603Q022

Aims

The objective of the 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
It is expected that students 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;
• analyze economically the impact of a more sustainable water use.

Communication skills

At the end of the course the student should be able to:
• analyze problems in the areas 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 understand concepts that are different from those presented during the course, and to understand the topics covered in the scientific literature on sustainability issues.

Contents

• Implementation and monitoring of Key Performance Indicators.
• Sustainability reporting and certification.
• Socially Responsible Investment Indices and Environmental Accounting.
• Sustainability in industrial water management.
• Urban and industrial water cycle, water balance, water sources.
• Environmental sustainability of water abstraction.
• Environmental sustainability of wastewater discharge.
• Water footprint
• Water stewardship

Detailed program

• Sustainable 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, ISO 14046, AWS Standard
• Sustainability Assessment and reporting: water footprint of industrial operations, ensuring transparency in water use and management practices.
• Water Stewardship and business value. Case studies.
• Alteration of the natural water cycle by anthropogenic activities; surface-water/groundwater interactions; supply systems, sewerage networks and key stages of urban and industrial water cycle.
• Water balance; global freshwater abstraction, global distribution of water, major sources of freshwater to meet industrial needs.
• Sustainability & renewability of water use; groundwater balance, renewability of groundwater abstraction, environmental flow requirement
• Main hydrochemical processes in aquatic systems; main pollution of groundwater and surface water; case studies.
• Blue, green and grey water footprint, water footprint accounting, water footprint sustainability assessment, case studies.
• Water stewardship, water accounting, water risk assessment, water replenishment, international water stewardship standard, case studies.

Prerequisites

• Basic knowledge of hydrochemistry.

• Basic knowledge of hydrogeology.
• Basic knowledge of general management.

Teaching form

6 CFUs (60 hours) of mixed delivered (38 hours) and interactive (22 hours) didactics in the classroom:
-> 4 two-hour lectures (8 hours), in-presence delivered didactics by presenting slides;
-> 10 four-hour lectures (40 hours), in-presence mixed delivered (30 hours) and interactive (10 hours) didactics: the first part of delivered didactics by presenting slides is aimed at involving students in the second interactive part by making practical exercises with free online tools and reading and discussing case studies.
-> 3 four-hour lectures (12 hours), in-presence interactive didactics by reading, analyzing and discussing scientific papers.

Textbook and teaching resource

• Davis C., Rpsenblum E. (2021). Sustainable industrial water use: perspectives, incentives, and tools, London: IWA Publishing, 2021, DOI: https://doi.org/10.2166/9781789060676
• Mace R. (2022). Groundwater Sustainability - Conception, Development, and Application. Springer Nature, Berlin. DOI: https://doi.org/10.1007/978-3-031-13516-3
• Cuthbert, M. O., Gleeson, T., Bierkens, M. F. P., Ferguson, G., & Taylor, R. G. (2023). Defining renewable groundwater use and its relevance to sustainable groundwater management. Water Resources Research, 59, e2022WR032831. https://doi.org/10.1029/2022WR032831
• Hoekstra, A.Y., Chapagain, A.K., Aldaya, M.M., & Mekonnen, M.M. (2011). The Water Footprint Assessment Manual: Setting the Global Standard (1st ed.). Routledge. https://doi.org/10.4324/9781849775526
• Slides, reports, book chapters and selected scientific papers made available on the e-learning website of the course.

Semester

II semester (March - June)

Assessment method

The final examination consists of a single oral interview with a score in the range 18-30/30 cum laude. There will be a single oral interview for both modules of the course which comprises the discussion of various topics covered in the course, with an emphasis also on the connections between concepts and processes, such as to arrive at a critical evaluation of work from the point of view of sustainability of industrial water use as a whole.

The oral interview is structured in:
• 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 evaluation will award a maximum total score of 30/30: a maximum of 10/30 for the first part of presentation and 20/30 for the second part of program questions, the latter is subdivided into 10/30 for questions related to the first module and 10/30 for questions related to the second module.

Students with Specific Learning Disorders should refer to the Student Guide and the DSA Service at the University (https://en.unimib.it/services/offices-and-facilities/disability-sld-binclusion-space).

Grade < 18
Knowledge and Understanding: The student only partially identifies the characteristics of the concepts. The connections between the concepts are fragmented and poorly supported by theoretical knowledge.
Ability to apply knowledge and understanding: The student identifies only a few relevant elements in a phenomenon, unable to integrate them into a coherent analysis.
Communication and Argumentation Skills: In the oral exam, the student develops a basic argument, lacking logical structure and characterized by numerous expository inaccuracies.
Learning, self-assessment, and self-regulation skills: The student is able to reconstruct only some aspects of their learning and professional development journey.

Grade 18-22
Knowledge and Understanding: The student recognizes and explains most of the conceptual features and is able to provide a relatively coherent explanation, albeit with some inaccuracies. Theoretical references are present but not always rigorously.
Ability to apply knowledge and understanding: The student is able to recognize a significant number of elements and provide a partial explanation, while highlighting some gaps in the analysis.
Communication and argumentation skills: In the oral exam, the student constructs a basic argument, with a minimal structure but with some inaccuracies.
Learning, self-assessment, and self-regulation skills: The student demonstrates a basic awareness of their learning path, managing to draw essential connections between learning experiences, albeit with some inaccuracies.

Grade 23-27
Knowledge and Understanding: The student demonstrates a thorough understanding of conceptual characteristics. In the oral exam, explanations are well-articulated and supported by an appropriate use of theoretical references.
Ability to apply knowledge and understanding: The student accurately identifies the essential elements of a phenomenon. The application of knowledge occurs with methodological rigor that is not always solid.
Communication and argumentation skills: In the oral exam, the student develops a coherent and well-organized argument, demonstrating good command of language and a solid logical-argumentative structure. Communication is clear and effective.
Learning, self-assessment, and self-regulation skills: The student analyzes his or her learning journey in a clear and structured manner, highlighting significant relationships between the various developmental stages and demonstrating a good capacity for critical reflection.

Grade 28-30
Knowledge and Understanding: The student demonstrates a thorough mastery of concepts, articulating complex connections and providing comprehensive explanations. Theoretical references are used with relevance and rigor.
Ability to apply knowledge and understanding: The student demonstrates an advanced ability to analyze a phenomenon, comprehensively identifying and interpreting all salient elements. Knowledge is applied with methodological rigor, supported by solid and detailed argumentation.
Communication and argumentation skills: In the oral exam, the student develops a solid and detailed argument, with a rigorous logical structure and a high level of textual coherence. The presentation is fluent and well-structured.
Learning, self-assessment, and self-regulation skills: The student demonstrates an advanced capacity for self-reflection, developing a detailed and in-depth analysis of their learning and professional development journey. The connections between learning experiences and theoretical concepts are clear, coherent, and rigorous.

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