

## Course guide

### 33106 - AR - Water as a Resource

**Last modified:** 04/05/2023

**Unit in charge:** Manresa School of Engineering  
**Teaching unit:** 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

**Degree:** MASTER'S DEGREE IN NATURAL RESOURCE ENGINEERING (Syllabus 2015). (Compulsory subject).

**Academic year:** 2023    **ECTS Credits:** 5.0    **Languages:** Spanish

#### LECTURER

---

**Coordinating lecturer:** MARIA DOLORS GRAU VILALTA

**Others:**

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

---

**Generical:**

1. The ability to communicate effectively orally and in writing.
2. The ability to summarise and think critically. The ability to adapt to new technologies.

#### TEACHING METHODOLOGY

---

The teaching method consists in the professors presenting the topics using the materials that are available on the ATENEA virtual campus. The materials contain a large number of links to web pages belonging to companies and public administrations on the topics. Students must complete the information given in class with the information on these web pages. Exercises are generally completed in class in small groups and are subject to continuous assessment. Field trips organised to study real cases are also subject to continuous assessment.

#### LEARNING OBJECTIVES OF THE SUBJECT

---

1. To present water, one of the natural resources that is most relevant and most current, from a global perspective.
2. To explain various domestic and industrial forms of water treatment, with an emphasis on optimising its use.
3. To introduce students to the study of groundwater.

#### STUDY LOAD

---

| Type               | Hours | Percentage |
|--------------------|-------|------------|
| Hours large group  | 30,0  | 66.67      |
| Hours medium group | 15,0  | 33.33      |

**Total learning time:** 45 h

## CONTENTS

### DESCRIPTION

#### Description:

1. Water a limited resource - Water on the planet:

Problems of water on the planet and its unequal distribution. The Sustainable Development Goals and water. Virtual water and water footprint.

2. Characteristics and properties of water:

Chemical, physical and biological properties of water. Water anomalies. Water quality indexes. Analytical determinations to define the fluvial state.

3. The water cycle:

Hydrological cycle components. Evaporation and perspiration. Evapotranspiration. Surface and underground runoff. Water balance of a basin.

4. Origin, measurement and management of surface water:

Climate data. Distribution of water in the soil. Methods for calculating evapotranspiration. Surface water. Water capacity. Hydrograms.

5. Groundwater, hydrogeological behavior, hydrogeochemistry, pollution:

Fundamental hydrological parameters. Kinds of aquifers. Hydrogeochemistry, chemical hydrograms. Groundwater pollution. Relationship between groundwater and surface water.

6. Adaptation of water for use: water for human consumption - water for industry:

Collection of water for urban cities. Water use in industry.

7. Drinking Water Treatments, Drinking Water Treatment Station:

Parameters of control and analysis of drinking water, legislation. Origin of the water supplied to the cities. Treatment operations: roughing, pre-disinfection, coagulation-flocculation, sedimentation, filtration, disinfection.

8. Water treatment in the industry: Boiler water - Cooling water - Water / Energy binomial:

Water uses in industry. Energy use. Water / Energy binomial. Kinds of boilers and cooling towers. Water problems: corrosion and inlays. Water treatment of boilers and cooling circuits.

9. Treatments with membranes:

Separation potential of different techniques. Treatments: reverse osmosis, electrodialysis, reversible electrodialysis. Desalination of seawater. Future trends.

10. Techniques for optimizing and saving water use:

Saving water in urban centers. Water saving in industry. Water management in agriculture. Reuse of water in urban centers. Energy use of wastewater. Water reuse in industry.

**Full-or-part-time:** 45h

Theory classes: 30h

Practical classes: 15h

## GRADING SYSTEM

---

Face-to-face assessment system:

- Written test (40%)
- Internet research and oral presentation of detailed information on a chosen topic (30%)
- Exercises (30%)

Blended-learning assessment system:

- Written test (40%)
- Internet research and oral presentation of detailed information on a chosen topic (30%)
- Exercises (30%)

## BIBLIOGRAPHY

---

### Basic:

- Kawamura, Susumu. Integrated design and operation of water treatment facilities. 2nd ed. New York: Wiley, 2000. ISBN 0471350931.
- González Fernández, José A., coord. Teoría y práctica de la lucha contra la corrosión. Madrid: Consejo Superior de Investigaciones Científicas. Centro Nacional de Investigaciones Metalúrgicas, 1984. ISBN 8400056701.
- American Water Works Association. Calidad y tratamiento del agua: manual de suministros de agua comunitaria. Madrid: McGraw-Hill, 2002. ISBN 8448132106.
- American Water Works Association. Tratamiento del agua por procesos de membrana: principios, procesos y aplicaciones. Madrid: McGraw-Hill, 1998. ISBN 8448112067.
- Cheremisinoff, Paul N. Handbook of water and wastewater treatment technology [on line]. New York: Marcel Dekker, 1995 [ Consultation : 10/06/2022 ]. Available on : <https://www.sciencedirect-com.recursos.biblioteca.upc.edu/book/9780750674980/handbook-of-water-and-wastewater-treatment-technologies>. ISBN 0824792777.
- Custodio, E.; Llamas, M. R., eds. Hidrología subterránea. 2ª ed. corr. Barcelona: Omega, 2001. ISBN 8428204462.
- Howd, Robert A.; Fan, Anna M., eds. Risk assessment for chemicals in drinking water [on line]. Hoboken: John Wiley, 2008 [ Consultation : 25/11/2022 ]. Available on : <https://onlinelibrary-wiley-com.recursos.biblioteca.upc.edu/doi/book/10.1002/9780470173381>. ISBN 9780471723448.
- Hidrogeología: conceptos básicos de hidrología subterránea. Barcelona: Fundación Centro Internacional de Hidrología Subterránea, 2009. ISBN 9788492146918.
- Martí Deulofeu, José Mª. Stenco water treatment = Tratamientos de aguas = Tractaments d'aigües. 4ª ed. Barcelona: Stenco, 2007.
- Amjad, Zahid, ed. Reverse osmosis: membrane technology, water chemistry, and industrial applications. New York: Van Nostrand Reinhold, 1993. ISBN 0442239645.
- Metcalf and Eddy. Ingeniería de aguas residuales: tratamiento, vertido y reutilización. 3ª ed. Madrid: McGraw-Hill, 1995. ISBN 8448116070.
- Gray, N. F. Calidad del agua potable: problemas y soluciones. Zaragoza: Acribia, 1996. ISBN 8420008214.
- Water treatment handbook. 7th ed. Malmaison Cedex: Degremont, 2007. ISBN 9782743009700.