



# WATER POLLUTION AND ITS CONTROL TECHNOLOGIES

## SYLLABUS

### INTRODUCTION

This course provides an overview of engineering approaches to protecting water quality with an emphasis on water treatment unit operations. It covers a wide range of topics, including water characterization parameters and designing systems to treat municipal and industrial wastewater, as well as the legislative framework. As the course is intended for engineering students, special focus is placed on control technologies and future trends regarding preventing water pollution.

### OBJECTIVES

The main aim of the course is to provide students with a scientific and technical background in water quality monitoring, pollution control technologies and environmental management. This OCW course focuses on unit operations for municipal and industrial wastewater treatment. Students will also be introduced to the European legislative framework on water quality.

Specific objectives are listed below.

1. Provide information on the basic concepts of water pollution and its effects on human and ecosystem health
2. Demonstrate how to interpret laboratory analysis to establish whether the water fulfils the quality requirements for different uses.
3. Show how to look at the major water pollutants, their sources, physical, chemical and biological transformations and impacts.
4. Assist with exploring how natural ecosystems respond to changes in water characteristics, including the self-purification capacity of oxygen-demanding materials and filtration of solid components.
5. Facilitate the learning of strategies to control common water pollutants in municipal and industrial wastewater.



6. Present detailed information about the design characteristics of unit operations for wastewater control, including pre-treatment, primary treatment and secondary treatment.
7. Help to provide an insight into the fundamentals of some of the most widely used advanced treatments

## SKILLS/ COMPETENCIES / LEARNING OUTCOMES

Upon completion of this OCW course, students should be able to:

1. List the main water pollutants and their effects on human health and the environment
2. Discuss several types of water pollution problems and the chemistry and physics affecting them
3. Interpret the results of laboratory analysis for water characterization
4. Develop a broad overview understanding of the strategies, regulations and policies to manage water pollution in the European context.
5. Describe unit operations used for wastewater treatment
6. Select methods to control and prevent water pollution to meet effluent requirements within realistic constraints, such as economic, environmental and social aspects, health and safety, manufacturability, and sustainability
7. Design and optimize various unit operations and unit processes used in water treatment and configure processes in a treatment plant. This includes obtaining and applying appropriate design values and making appropriate assumptions when needed

## PREREQUISITES

This course is intended for undergraduates and first year graduate students. It is a science-based course that the students to be comfortable with mathematical calculations, physics and chemistry. Students who do not feel comfortable with these prerequisites will need to do outside self-study to progress satisfactorily through the course.

## COURSE DESCRIPTION

This course provides an introduction to major aspects of water quality science and its control technology, including an overview of the main pollutants and their effects, typical wastewater characteristics (both municipal and industrial wastewater) and how those



characteristics may affect relevant unit operations (physical, chemical and biological). It also focuses on how to combine these operations to control water pollution and to meet effluent requirements. The complex regulatory and institutional framework controlling water quality management in Europe is also covered.

## **COURSE PROGRAMME AND CONTENT**

The course is structured in three modules: Introduction to Water Pollution, Municipal Wastewater Treatment Technologies and Industrial Wastewater Treatment Technologies. Each module will focus on the following content:

### 1. Introduction to Water Pollution

- Water pollutants and sources
- Water quality assessment
- Effects of oxygen demanding wastewaters
- Dissolved oxygen and self-purification

### 2. Municipal Wastewater Treatment Technologies

- Municipal wastewater treatment
- Pre-treatment
- Primary treatment
- Secondary treatment
- Advanced treatments

### 3. Industrial Wastewater Treatment Technologies

- Classification of industrial effluents
- Specific treatment processes

## **METHODOLOGY**

Participants will be given reading material and a collection of problems to practice various aspects of water pollution and its control technologies. At the end of each lesson, they will be required to complete a self-assessment quiz in order to evaluate their level of knowledge and understanding in key areas (formative assessment).

All materials (lectures notes, exercises, self-assessment quizzes, bibliography and other resources) will be delivered at the beginning of the course. Hence, participants can complete the activities at times convenient to them. However, it is recommended to do so progressively according to the schedule in the next section.



### COURSE TIMELINE

Students should plan to spend 4-5 hours each week over 6 weeks to complete this course. It requires 24-30 working hours which means 1 ECTS credit

The aforementioned three modules and the associated tasks should be completed according to the schedule shown in Figure 1.

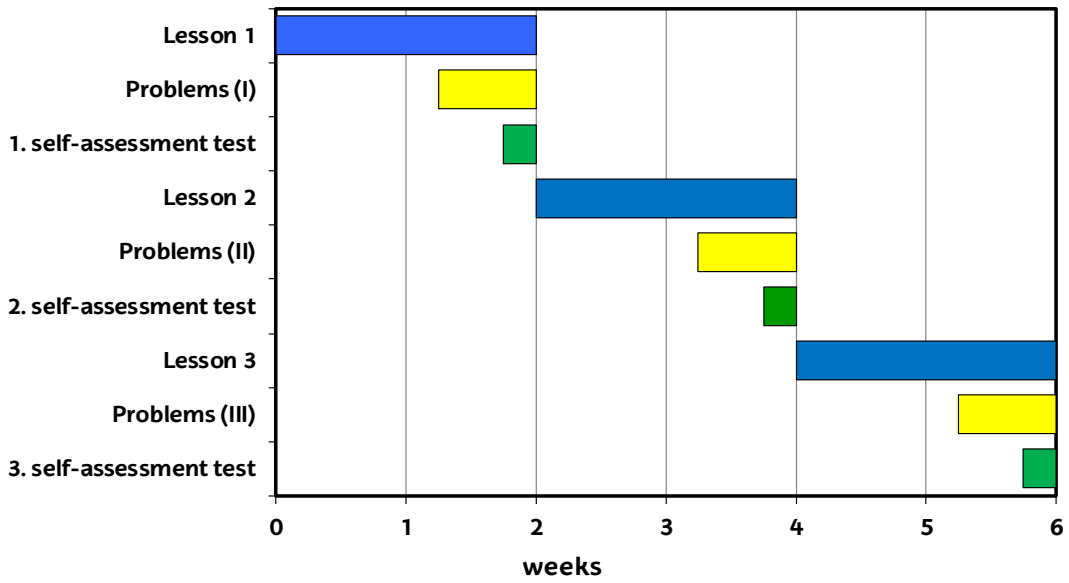


Figure 1. Gantt chart for the 'Water pollution and its control technologies' course