**III.2.11 DRINKING WATER TREATMENT**

**I. Course description**

**1. Credit points: 3 ECTS**

**2. Time commitment**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Items | Lecture | Tutorial/Exercise | Practice/Assignment | Lab-work | Total |
| No. of hours | 21 | 4 | 5 |  | 30 |

**3. Prerequisites**: General chemistry and physics as well as environmental water chemistry of B1 and B2

**4. Recommended background knowledge:** Students should have background in environmental physic/chemistry and mass transfer

**5. Subject description**

This course covers engineering approaches to treat drinking water with an emphasis on fundamental principles and theory. Analysis (reactor theory, process kinetics, and models) and conceptual design of typical systems for treating drinking water are discussed. Physical and chemical processes including sedimentation, filtration and disinfection are presented. Finally, there are discussions of treatment process combination for drinking water and the economics of drinking water treatment.

**6. Objectives & Outcome**

After completion of the course, the student should be able to:

* Be familiar with the terminology applied to water treatment processes and the key design parameters, units and common flow diagrams
* Apply physical and chemical principles of environmental engineering into drinking water treatment
* Understand the fundamental, scientific basis governing the design and performance of the drinking water treatment technologies
* Design/construct appropriate physical and chemical processes for treatment of municipal drinking water

**7. Assessment/ Evaluation**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Attendance | Exercises | Project | Practicals | Midterm | Final |
| Percentage % |  | 20 | 15 | 15 | 20 | 30 |

**8. Prescribed Textbook(s)**

*[1]* Course Instructor’s Lecture Notes

*[2]* Wastewater Engineering, Treatment and Reuse. Metcalf & Eddy. McGraw-Hill Book Co., 2004 and later editions, ISBN 007-12440-X (Selected Chapters)

*[3]* Water Re-use : Issues, Technologies, and Applications. Metcalf & Eddy, McGraw-Hill Book Co., 2007 or later editions ISBN-13 : 978-0-07-14-5927-3 (Selected Chapters)

**II. Course content**

1. Introduction to Drinking Water:

1.1 Access to Water

1.2 Water and Health

1.3 Economic and Social Effects

1.4 Water Sources

1.5 Challenges

2. Water Quality Parameters and Standards

2.1 Water Quality Parameters

2.2 Water Quality Standards

 3. Reactor Tanks

3.1 Mixed Tanks

3.2 First order Kinetics

3.3 Plug Flow

3.4 Dispersed Flow

3.5 Tanks-In-Series

3.6 Residence Time Distribution

4. Physical Treatment

4.1 Coagulation

4.2 Flocculation

4.3 Sedimentation

4.4 Filtration

4.4.1 Slow Sand Filtration

4.4.2 Rapid Filtration

4.4.3 Others: Pressure Filters; Pre-coat Filters

5. Membrane Processes

5.2 Ultrafiltration

5.2 Reverse Osmosis

5.3 Microfiltration

5.4 Nanofiltration

MIDTERM EXAM

6. Chemical treatment

6.1 Softening

6.2 Adsorption

6.3 Ion exchange

7. Gas transfer and air stripping

8. Disinfection

8.1 Chlorination

8.2 Ozonation

8..3 UV Radiation

9. Class project

FIELD TRIP TO THE WATER TREATMENT PLANT

9. Treatment process combinations

10. Storage and Distribution

11. Course wrap-up and Review

12. Student presentations for class project

**III. Reference Literature**

1 MWH Staff. Water Treatment: Principles and Design. 2nd ed. New York, NY: Wiley, 2005. ISBN: 0471110183

2. D. Fundamentals of Water Treatment Unit Processes. CRC Press / IWA Publishing, 2011