



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Water and Wastewater Chemistry [S2IŚrod2-ZwWOWiG>CH]

### Course

Field of study

Environmental Engineering

Year/Semester

1/1

Area of study (specialization)

Water Supply, Water and Soil Protection

Profile of study

general academic

Level of study

second-cycle

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

### Number of hours

Lecture

30

Laboratory classes

15

Other

0

Tutorials

15

Projects/seminars

0

### Number of credit points

4,00

### Coordinators

dr hab. inż. Izabela Kruszelnicka prof. PP  
izabela.kruszelnicka@put.poznan.pl

### Lecturers

### Prerequisites

1. Knowledge: The scope of scientific knowledge (geography, biology, chemistry, physics) at the level of engineering studies and knowledge of the subject on the basic issues of physical-chemical water treatment and water pollution and waste from literature, databases and other carefully selected sources. 2. Skills: A student identifies and describes the limiting factors in the aquatic environment. He/She is able to distinguish and characterize aquatic ecosystems. He/She is able to identify the causes and effects of various aquatic pollutants and their impact on human health. 3. Social competencies Awareness of the need for the continuous updating and supplementing knowledge and skills

### Course objective

passing thorough knowledge of the chemistry of water and wastewater, chemical and physical processes occurring in aquatic environment, the basis of technical and legal framework for the prevention, formation and reduction of water pollution

### Course-related learning outcomes

Knowledge:

1. A student has knowledge about water as a basic component of the environment. He knows the

natural distribution of inland waters. He/She knows the effect of water constituents on the biochemical processes of the environment.

2. A student has knowledge of the technical methods of pollution prevention and reduction of pollution of both water and wastewater. He/She knows the sources and types of pollution of natural waters and the impact of water pollution on aquatic life.

3. A student knows short and long term processes occurring in the aquatic environment, he/she has knowledge of the biogeochemical cycles in aquatic environments.

4. A student has knowledge of the wastewater and sewage sludge as pollutants. He/She knows the specific organic and mineral substances present in wastewater and their impact on the environment and their effects on living organisms.

5. A student knows how to implement water protection and wastewater treatment policy. He/She knows the legal basis for the protection of the environment and environmental services organization.

Skills:

1. The student is able to obtain information on the degree of water pollution and the load in wastewater from literature, databases and other properly selected sources, conducts experiments, interprets results, draws conclusions.

2. The student is able to make mathematical calculations resulting from the laws of chemistry and physics in relation to the tested water or sewage.

3. The student is able to practically apply norms and standards used to assess the quality of water and sewage.

Social competences:

1. A student understands the need for teamwork in solving theoretical and practical problems.

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture

A written test after the lectures have finished, the test will last for 90 minutes;

Individual discussion possible after the results of a written test.

Tutorials

2 mini-written tests during the semester;

1 written assignment test (final), the test will last for 90 minutes,

Assessment the accuracy of independently solved tasks )

Continuous assessment for each class (rewarded activity)

Laboratory

Each laboratory practice will be preceded by an entrance exam that will check students' readiness to complete an experiment, the test will last for 90 minutes

Written assignment test (final),

The development and defense of individual or team written reports on each exercise

Scale of written evaluations:

50% - 60% sufficient

61% - 70% positive plus

71% - 80% good

81 - 90% good plus

91 - 100% very good

### Programme content

The module program covers the following topics:

The role of water in creating the Earth's climate. Earth's hydrological cycle. Poland's water resources.

Structure of a water molecule, dipole moment, hydrogen bonding. States of water, structure of liquid water, steam and ice. Phase diagram of water, phenomena related to phase transitions.

Physico-chemical analysis of natural components and pollutants contained in water and sewage.

Physical properties of water: dielectric constant, specific heat, thermal conductivity, surface tension, conductivity, absorption of light radiation, solubility of gases and

liquid. Water density and phenomena related to it. Chemical properties of water: dissociation, ion product, reaction, isotopy.

Processes of enriching water with minerals: chemical composition and structure of minerals,

physicochemical composition of soils, weathering processes.

The role of ion exchange in shaping the composition of natural waters. Water dispersion systems.

Formation of the composition of water from rainwater to groundwater.

Classification of natural waters according to ionic composition and degree of mineralization.

Carbonate-calcium balance. Basic indicators of the ionic composition of water.

Water eutrophication. Nitrogen compounds as indicators of water pollution. Heavy metals in water and their toxic effects in water. Natural organic compounds in water.

Water pollution with urban and industrial sewage. Water pollution with crude oil and its derivatives. Water pollution with synthetic organic compounds: phenols, surfactants, plant protection products, buffer solutions, determination of buffer properties of soils, adsorption of pollutants on coal.

Water disinfection by-products. Radioactive water pollution. Estimating health risk. Water and sewage quality standards.

## Course topics

The lecture program covers the following topics:

The role of water in creating the Earth's climate. Earth's hydrological cycle. Poland's water resources.

Structure of a water molecule, dipole moment, hydrogen bonding. States of water, structure of water liquid, vapor and ice. Phase diagram of water, phenomena related to phase transitions.

Physico-chemical analysis of natural components and pollutants contained in water and sewage.

Physical properties of water: dielectric constant, specific heat, thermal conductivity, voltage surface, conductivity, absorption of light radiation, melting. Water density and phenomena related to it.

Chemical properties of water: dissociation, ionic product, reaction, isotopy.

Processes of enriching water with minerals: chemical composition and structure of minerals, composition physicochemical soil, weathering processes.

The role of ion exchange in shaping the composition of natural waters. Water dispersion systems.

Formation of the composition of water from rainwater to groundwater.

Classification of natural waters according to ionic composition and degree of mineralization. Carbon dioxide.

Carbonate-calcium balance. Basic indicators of the ionic composition of water.

Water eutrophication. Nitrogen compounds as indicators of water pollution. Heavy metals in water and their toxic effects in water. Natural organic compounds in water.

Water pollution with urban and industrial sewage. Water pollution with crude oil and its derivatives. Water pollution with synthetic organic compounds: phenols, surfactants, plant protection products, polycyclic aromatic hydrocarbons.

Water disinfection by-products. Radioactive water pollution. Risk estimation health. Water and sewage quality standards.

The exercise program covers the following topics:

basic chemical laws, concentrations of solutions, laws of the gas state, stoichiometry, oxidation and reduction, volumetric analysis

The laboratory program covers the following topics:

buffer solutions, determination of buffer properties of soils, adsorption on carbon.

## Teaching methods

Learning methods: information lecture, lecture with multimedia presentation, problem lecture;

tutorials: accounting exercises;

laboratory: laboratory experience

## Bibliography

Basic:

1. Dojlido J.R.: Chemia wód powierzchniowych, Wydawnictwo Ekonomia i Środowisko, Białystok, (1995).
2. Hermanowicz W. i inni, Fizyko-chemiczne badanie wody i ścieków, Arkady, Warszawa, (1998)
3. Hermanowicz W., Dojlido J., Dożańska W., Koziorowski B., Zerbe J., Fizyko-chemiczne badanie wody i ścieków, Arkady, Warszawa, (1999)
4. Gomółka E., Szaynok A., Chemia wody i powietrza, Wrocław 1997

Additional:

1. Anielak A.M., Chemiczne i fizykochemiczne oczyszczanie ścieków, PWN, Warszawa, 2002
2. Atkins P.W., Chemia fizyczna, Wyd. Naukowe PWN, Warszawa 2001

3. Wyrwas B., Kruszelnicka I. , Ginter- Kramarczyk D., Wpływ wybranych anionowych i niejonowych ZPC na pracę osadu czynnego, Przemysł chemiczny 90/4 2011

4. Ginter - Kramarczyk i in. Taraźniejszość i przyszłość produktów leczniczych w społeczeństwie i środowisku Przemysł chemiczny 92/5 2013

#### Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50