Water Chemistry and Hydrobiology - BMEEOVKAI43

I. Subject Specification

1. Basic Data

1.1 Title

Water Chemistry and Hydrobiology

1.2 Code

BMEEOVKAI43

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	2
Lab	1

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	Dr. Laky Dóra
academic rank	Associate professor
email	laky.dora@emk.bme.hu

1.8 Department

Department of Sanitary and Environmental Engineering

1.9 Website

https://epito.bme.hu/BMEEOVKAI43
https://fiek2.mywire.org/course/view.php?id=3526

1.10 Language of instruction

english

1.11 Curriculum requirements

Compulsory in the Specialization in Infrastructure Engineering (BSc) programme

1.12 Prerequisites

Strong prerequisites:

- Basics of environmental engineering (BMEEOVKAT41)

The course cannot be taken if the following course has been already completed:

- Water- and environmental chemistry and hydrobiology (BMEEOVKAI09)

1.13 Effective date

1 September 2022

2. Objectives and learning outcomes

2.1 Objectives

The aim of the course is to introduce the characteristics and operation of the aquatic ecosystems to the students and moreover to teach them how engineering activities affect aquatic ecosystems. During the laboratory exercises, the students gain basic skills in determining certain water quality parameters, and during aquatic biology exercises they can gain insight into the life of natural waters and the diversity of microscopic organisms by using microscopes.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Knows the basic conceptual framework of water chemistry and hydrobiology.
2. Knows the main hydrochemical processes and their role in different types of aquatic ecosystems.
3. Understands the interactions in the water between the living elements of the system.
4. Understands the system of interaction of living and non-living elements in the waters at system level.
5. Knows the difference between the ecosystems of different water types.
6. Knows the main parameters, limit values, relevant standards and regulations for characterizing water quality.
7. Knows the main ecological and environmental problems in the waters, understands their causes and is aware of their treatment options.
8. During the chemical laboratory practice he/she gets acquainted with the methods of measuring the main water quality parameters and is aware of their application.
9. During the biological laboratory practice he/she gets to know the microscopic organisms of aquatic communities and the diversity of macroscopic aquatic organisms.
10. Understands the functioning of aquatic ecosystems and the differences between different water types.

B. Skills

1. Able to make decisions about how to deal with problems in aquatic ecosystems.
2. Is capable of distinguishing larger groups of living organisms.
3. Gets to know the basic knowledge in the field of water chemistry, which is the foundation of water treatment technologies.

C. Attitudes

1. He/she constantly expands his/her knowledge, and in addition to the compulsory curriculum, he/she searches answers from web resources as well.
2. When preparing written documents he/she seeks to produce well-structured and clear documentation as it can be expected by the engineering profession.

D. Autonomy and Responsibility

1. Use of systematic approach in problem solving

2.3 Methods

Theoretical lectures, oral and written communication. Use of IT tools and techniques, laboratory practices.

2.4 Course outline

Week	Topics of lectures and/or exercise classes
1.	Repetition of general chemical bases, updating of previously acquired knowledge, including: atomic structure and properties, isotopes, radioactivity, electronegativity, and major chemical bonds.
2.	Water structure, special properties. Dissociation of water. Characteristics of the solutions. Concentrations. Solubility of gases, liquids and solids in water. Water quality - water quality characterization. Micropollutants. Organic compounds. Laboratory practice: water chemistry I.
3.	Chemical reactions in dilute aqueous solutions. Merging and decomposition. Exchange decomposition. Dissociation. Oxidation and reduction. End products from the decomposition of dead organisms under oxidative or reductive conditions. Precipitation. Gas formation.
4.	Chemical processes leading to equilibrium. The law of mass action. The concept and significance of pH in natural waters. The possibilities of influencing chemical processes. Examples. Rate of chemical reactions in dilute aqueous solutions. Catalytic processes in natural waters. Laboratory practice: water chemistry II.
5.	Behavior of acids, bases and salts in natural waters. Natural buffers, buffer capacity, buffer systems. Forms of carbon dioxide in natural waters. Acid rain. Water hardness and its practical consequences.
6.	Hydrolysis. Hydrolysis of inorganic and organic compounds in dilute aqueous solutions. The relationship between the conductivity of natural waters and salinity. Faraday's laws. Redox potential and ecological significance in natural waters. Adsorption. Laboratory practice: water chemistry III.
7.	Characteristics of the most important hydrochemical components. Sub-summary.
8.	Material and energy flow in aquatic ecosystems. Differences between terrestrial and aquatic environments, their effects on living organisms.

	Producer, reducing and consumer organisms, autotrophic and heterotrophic organisms, food chains and food webs in waters. Habitats and major groups of organisms in lakes and rivers.
9.	Effects of environmental effects on living organisms. Relationship between environment and populations in waters, limitation and limiting factors. Possibilities for regulation. Description and comparison of aerobic and anaerobic degradation. Examples of practical application.
10.	The principle and main characteristics of water classification according to the Hungarian standard MSZ 12749. The ecological rating system in the Water Framework Directive. Comparison of current standard and WFD certification. Laboratory practice: Hydrobiology I. (microscopic examination of eutrophic and oligotrophic surface water and wastewater).
11.	The water cycle in nature. Elements of water management, the order of importance of material circulation. Human effects on elements of water management. Water use, land cover, changes in runoff, effects on evapotranspiration, etc. The carbon cycle in the aquatic ecosystem. Effects of human activity on the carbon cycle.
12.	Phosphorus cycle in the aquatic ecosystem. The biological significance of phosphorus. The most important phosphorus forms in the waters. Effects of human activity on nitrogen circulation. Mechanism of human effects in phosphorus circulation (eg mining, fertilizer production, eutrophication). Laboratory practice: Hydrobiology II.
13.	The oxygen, sulfur, and nitrogen cycles in the aquatic ecosystem. Biological significance of oxygen, sulfur and nitrogen. Elements of photosynthesis, respiration, diffusion, oxygen balance. Major forms of nitrogen in waters. Elements of the nitrogen balance and the oxygen balance. The effects of human activity on the circulation of these three elements.
14.	Summary

The above programme is tentative and subject to changes due to calendar variations and other reasons specific to the actual semester. Consult the effective detailed course schedule of the course on the subject website.

2.5 Study materials

1. Chemistry Libre Texts (https://chem.libretexts.org/)
2. Britannica.com Water Chemistry (https://www.britannica.com/)
3. Journal of Enviromental Protection
4. Slides of lectures

2.6 Other information

1. It is compulsory to attend the laboratory practices. Those students, who miss these practices, cannot get the credits of the course.
2. Those students, who miss more than 30% of the lectures, cannot get the credits of the course.

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website. Special appointments can be requested via e-mail from the lecturers: (musa.ildiko@emk.bme.hu)

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The assessment of the learning outcomes specified in clause 2.2. above and the evaluation of student performance occurs via two written tests and the written exam.
Final grade for the course is offered based on the two midterms. If the student accepts this grade, this will be his/her final grade, he/she does not need to take the written exam. If the student wants to change the offered grade (based on the two midterms), it is possible by taking written exam.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
1st midterm test	MT1	A.1, A.2, A.4, A.6, A.8; B.1, B.3; C.1, C.2; D.1
2nd midterm test	MT2	A.3, A.5, A.7, A.9, A.10; B.2; C.1, C.2; D.1
Exam	E	A.1-A.9; B.3; C.2; D.1

The dates of deadlines of assignments/homework can be found in the detailed course schedule on the subject's website.

3.3 Evaluation system

Abbreviation	Score
MT1	12.5%
MT2	12.5%
Total (During the teaching period)	25%
E	75%
Total	100%

3.4 Requirements and validity of signature

Signature can be obtained if the student has attended at least 70% of the lectures, both mid-term tests have been successfully completed (minimum grade: 2) and the laboratory exercises have been succesfully completed.

3.5 Grading system

Grade	Points (P)
Excellent (5)	>= 80
Good (4)	>= 70
Satisfactory (3)	>= 60
Passed (2)	>= 50
Failed (1)	< 50

3.6 Retake and repeat

The midterm test can be repeated – once without paying a fee – at a previously determined date given in the course schedule. If the first repetition is also unsatisfactory (failed), one of the tests can be repeated once more,

during the repetition week, by paying a fee.

3.7 Estimated workload

Activity	**Hours/semester**
Attendance at the lectures, practices	14×3=42
Preparation for mid-term evaluations	30
Preparation for the exam	18
Sum	**90**

3.8 Effective date

1 September 2022

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