# COURSE DESCRIPTION

## Integrated management of water resources and wastewater treatment procedures

Academic year 2026 - 2027

**1. Programme-related data**

| | |
|---|---|
| 1.1. Higher Education Institution | BABEŞ-BOLYAI UNIVERSITY |
| 1.2. Faculty | ENVIRONMENTAL SCIENCE AND ENGINEERING |
| 1.3. Department | Environmental Analysis and Engineering |
| 1.4. Field | Environmental Engineering |
| 1.5. Level of study | Master |
| 1.6. Degree programme / Qualification | Sustainable development and environmental management / engineer |
| 1.7. Form of education | Full-time |

**2. Course-related data**

| | | | | | |
|---|---|---|---|---|---|
| 2.1. Course title | **Integrated management of water resources and wastewater treatment procedures** | | | Course code | **NME4212** |
| 2.2. Course coordinator | PhD Lecturer Roba Carmen | | | | |
| 2.3. Seminar coordinator | PhD Lecturer Roba Carmen | | | | |
| 2.4. Year of study | 1 | 2.5. Semester | II | 2.6. Type of assessment | Exam |
| 2.7. Course status | Compulsory | | | 2.8. Course type | Core subject |

**3. Total estimated time** (hours per semester of teaching activities)

| | | | | | |
|---|---|---|---|---|---|
| 3.1. Number of hours per week | **4** | of which: 3.2. course | **2** | 3.3. seminar/ laboratory/ project | **2** |
| 3.4. Total of hours in the curriculum | 56 | of which: 3.5. course | 28 | 3.6. seminar/ laboratory | **28** |
| **Time allocation for individual study (IS) and self-taught activities (ST)** | | | | | **hours** |
| Learning from textbooks, course materials, bibliography, and notes (IS) | | | | | 35 |
| Additional research in the library, on subject-specific electronic platforms, and on-site | | | | | 25 |
| Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays | | | | | 25 |
| Tutoring (professional guidance) | | | | | 0 |
| Examinations | | | | | 4 |
| Other activities | | | | | 5 |
| **3.7. Total hours of individual study (IS) and self-taught activities (ST)** | | | | **90** | |
| **3.8. Total hours per semester** | | | | **150** | |
| **3.9. Number of credits** | | | | **6** | |

**4. Prerequisites** (where applicable)

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|---|---|
| 4.1. curriculum-related | - |
| 4.2 skills-related | - |

**5. Specific conditions** (where applicable)

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|---|---|
| 5.1. course-related | The course is conducted face-to-face in classrooms equipped with a video projector. |
| 5.2. seminar/laboratory-related | •Attendance at a minimum of 80% of laboratory sessions and/or seminars is mandatory and constitutes a prerequisite for admission to the final examination.<br>•Students are required to attend laboratory sessions and/or seminars properly equipped, namely: a lab coat and a laboratory notebook, folder, or an electronic device (tablet/laptop) used for recording and processing experimental data. |

**6.1. Competencies resulting from the completion of the degree programme *(as referred to in the curriculum)*[1]**

| Professional competencies | |
|---|---|
| **Competency code** | **Competency** |
| PC2 | Develop environmental policy |
| PC3 | Assess environmental impact |
| PC6 | Ensure compliance with environmental legislation |
| PC8 | Implement environmental protection measures |
| PC10 | Test samples for pollutants |
| **Transversal competencies** | |
| **Competency code** | **Competency** |
| TC1 | Think analytically |
| TC2 | Work in teams |
| TC3 | Report on environmental issues |

**6.2. Learning outcomes relevant to the degree programme** (as referred to in the curriculum)[2]

| Learning outcomes targeted by the subject | | |
|---|---|---|
| **Competency code** | **Knowledge and comprehension** | **Specific academic skills** |
| PC3<br>PC6<br>PC8<br>PC10<br>TC1<br>TC3 | 1. The student/graduate identifies and describes the principles and methods of water quality management, including pollution, depollution and waste recovery processes. | 1. The student/graduate applies methods for the assessment, monitoring and management of environmental quality factors.<br>The student/graduate selects and implements appropriate depollution and treatment procedures for different types of contaminants.<br>The student/graduate identifies and assesses environmental risks associated with contaminated sites. |
| PC2<br>PC6<br>PC8<br>TC1<br>TC2<br>TC3 | 3. The student/graduate identifies and describes the principles of sustainable development, organisational environmental policies and mechanisms for promoting sustainability. | 3. The student/graduate applies sustainable development principles in organisational and environmental contexts. |

**7. Subject-specific learning outcomes**

| Knowledge and comprehension |
|---|
| 1. The student knows and understands the fundamental aspects related to the structure and functioning of watershed systems, including natural processes, anthropogenic pressures, and their role in shaping water quality and ecological status. |

[1] The professional and/or transversal skills targeted by the subject for which the course description is prepared will be copied from the curriculum of the degree programme. For each competency, the complete entry, including the competency code, will be copied with the exact wording that appears in the curriculum, without any changes. If no competency is copied from either of the two categories, the row corresponding to that category is deleted from the table.

[2] The learning outcomes relevant for the degree programme and targeted by the subject for which the course description is prepared will be listed. The entries, copied without any changes from the Curriculum by subject type (Core Subject/Specialisation Subject/Complementary Subject), are listed under the corresponding competency.

| | |
|---|---|
| 2. | The student knows and understands the fundamental principles of Integrated Water Resources Management (IWRM), including policy frameworks, governance mechanisms, and implementation strategies at national and EU levels. |
| 3. | The student knows and understands the principles, mechanisms, and technologies used in wastewater treatment (mechanical, chemical, biological) and their role in pollution control and resource recovery. |
| **4.** | The student knows and understands the role of nature-based and sustainable solutions in water management. |
| 5. | The student knows the fundamental aspects related to environmental risks associated with contaminated sites and aquatic systems, including hazardous pollutants and their impacts on ecosystems and human health. |
| | **Specific academic skills** |
| 1. | The student will be able to apply environmental monitoring and assessment methods for water systems, including sampling, laboratory analysis, and interpretation of physico-chemical and chemical data. |
| 2. | The student will be able to identify the appropriate depollution and treatment procedures for several chemical pollutants present in wastewater. |
| 3. | The student will be able to calculate environmental quality and risk indicators, including pollution indices, ecological status assessments, and human health risk evaluations for contaminated sites. |
| 4. | The student will be able to integrate scientific data with policy and sustainability principles to support decision-making in water resource management, including agricultural reuse, rehabilitation of water bodies, and compliance with environmental regulations. |

**8. Contents**

| **8.1. Course** | **Teaching and learning methods** | **Remarks[3]** |
|---|---|---|
| 1. Watershed dynamics and anthropogenic pressures: tools for environmental impact and risk assessment | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |
| 2. Integrated water resources management: policy development, principles, and implementation strategies | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |
| 3. European water legislation and compliance | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |
| 4. Water quality monitoring and pollutant analysis: methods for environmental assessment and control | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |
| 5. Hazardous pollutants and eutrophication: assessment, testing, and depollution strategies. Case studies. | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |
| 6. Wetlands in environmental protection: nature-based solutions for pollution control and sustainability | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |
| 7. River basin management under climate change: impact assessment and adaptive policy approaches | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |
| 8. Coastal and marine environmental management | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |
| 9. Wastewater treatment technologies – mechanical treatment | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |
| 10. Wastewater treatment technologies – chemical treatment | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |

[3] For example, organisational aspects, recommendations for students, specific aspects relating to the course/seminar, such as inviting experts in the field, etc.

| | | |
|---|---|---|
| 11. Wastewater treatment technologies – biological treatment | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |
| 12. Environmentally friendly technologies used for the removal of chemical pollutants from wastewaters. Case studies. | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |
| 13. Economical aspects of wastewater treatment: cost analysis, efficiency, and sustainability | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |
| 14. Agricultural reuse of appropriately treated wastewater: principles, practices, and sustainability implications | PowerPoint presentation, interactive discussions, and group-based learning activities | 2 hours |

Bibliography:


1. Edzwald JK. (2011), *Water Quality & Treatment. A Handbook on Drinking Water*, Sixth Edition, ISBN: 978-0-07-163010-8, McGraw-Hill
2. Loucks DP, Van Beek E. (2005), *Water Resources Systems Planning and Management An Introduction to Methods, Models and Applications*, ISBN 92-3-103998-9, UNESCO.
3. Mihăiescu R. (2018), Integrated management of water resources and procedures for wastewater treatment, lecture notes.
4. Davis Mackenzie L. (2010), *Water and wastewater engineering: design principles and practice*. Mackenzie L. Davis. professional edition: New York : McGraw-Hill.
5. Robescu D, Szabolcs L, Robescu D, Verestoy A. (2004), *Wastewater treatment technologies, installations and equipments*. Ed. Tehnică, Bucureşti.
6. Pietrareanu IG. (2018), *Conventional and Advanced Wastewater Treatment*, Matrix Rom Publishing House, Bucharest.
7. Robescu LD, Stroe F, Presura A, Robescu DN (2011), *Wastewater Treatment Techniques*, Technical Publishing House.
8. Ianculescu O, Ionescu G, Racovițeanu R. (2001), *Wastewater Treatment*, Matrix Rom Publishing House, Bucharest.
9. Ionescu GC, Ionescu GL, Sâmbeţeanu A. (2013), *Modern Technologies for Wastewater Treatment*, Matrix Rom Publishing House, Bucharest.
10. Dima M. (2005), *Urban Wastewater Treatment*, Tehnopress Publishing House, Iaşi.
11. Cheremisinoff NP (2002), *Handbook of Water and Wastewater Treatment Technologies*, Elsevier Science.


| **8.2. Seminar/ laboratory** | **Teaching and learning methods** | **Remarks** |
|---|---|---|
| 1. Organization of laboratory/seminar activities. Presentation of laboratory/seminar topics and individual assignments. Laboratory safety rules. | discussion | 2 hours |
| 2. Watershed management planning: case studies from Romania. | Problem-based learning, experimental method, mathematical models, guided discussion, discovery-based learning | 2 hours |
| 3. Surface water sampling methodology. Measurement of general physico-chemical parameters (pH, redox potential, turbidity, total dissolved solids, suspended solids, dissolved oxygen, COD-Mn). Data interpretation. | Problem-based learning, experimental method, mathematical models, guided discussion, discovery-based learning | 2 hours |
| 4. Surface water sample processing and analysis of specific chemical parameters (major dissolved ions and heavy metals). Ecological status assessment. | Problem-based learning, experimental method, mathematical models, guided discussion, discovery-based learning | 2 hours |
| 5. Analysis of heavy metals and sulphates ions in acid mine wastewaters sampled from former mining areas from Romania. Part I - Sample processing, analysis. | Problem-based learning, experimental method, mathematical models, guided discussion, discovery-based learning | 2 hours |
| 6. Analysis of heavy metals and sulphates ions in acid mine wastewaters sampled | Problem-based learning, experimental method, mathematical | 2 hours |

| | | |
|---|---|---|
| from former mining areas from Romania. Part II - Data interpretation. | models, guided discussion, discovery-based learning | |
| 7. Water contamination indices: calculation and case studies | Problem-based learning, experimental method, mathematical models, guided discussion, discovery-based learning | 2 hours |
| 8. Carcinogenic and non-carcinogenic human health risk indices: Calculation and Case Studies | Problem-based learning, experimental method, mathematical models, guided discussion, discovery-based learning | 2 hours |
| 9. Nature-based solutions for wastewater treatment: case studies and best practices from EU countries | Problem-based learning, experimental method, mathematical models, guided discussion, discovery-based learning | 2 hours |
| 10. Eco-friendly methods used for the removal of heavy metals from wastewater. Practical activity. | Problem-based learning, experimental method, mathematical models, guided discussion, discovery-based learning | 2 hours |
| 11. Assessment of water suitability for agricultural use based on major ion quality indices | Problem-based learning, experimental method, mathematical models, guided discussion, discovery-based learning | 2 hours |
| 12. Rehabilitation of watercourses. Case studies from EU courtiers. | Problem-based learning, experimental method, mathematical models, guided discussion, discovery-based learning | 2 hours |
| 13. Review and recovery of laboratory activities. | Problem-based learning, experimental method, mathematical models, guided discussion, discovery-based learning | 2 hours |
| 14. Assessment of acquired knowledge and experimental results. | guided discussion, examination | 2 hours |

Bibliography:


1. Loucks DP, Van Beek E. (2005), *Water Resources Systems Planning and Management An Introduction to Methods, Models and Applications*, ISBN 92-3-103998-9, UNESCO.
2. Mihăiescu R. (2018), Integrated management of water resources and procedures for wastewater treatment, lecture notes.
3. Robescu D, Szabolcs L, Robescu D, Verestoy A. (2004), *Wastewater treatment technologies, installations and equipments*. Ed. Tehnică, Bucureşti.
4. Pietrareanu IG. (2018), *Conventional and Advanced Wastewater Treatment*, Matrix Rom Publishing House, Bucharest.
5. Ionescu GC, Ionescu GL, Sâmbeţeanu A. (2013), *Modern Technologies for Wastewater Treatment*, Matrix Rom Publishing House, Bucharest.
6. Dima M. (2005), *Urban Wastewater Treatment*, Tehnopress Publishing House, Iaşi.
7. Cheremisinoff NP (2002), *Handbook of Water and Wastewater Treatment Technologies*, Elsevier Science.

**9. Evaluation**

| Type of activity | 9.1 Evaluation criteria[4] | 9.2 Evaluation methods[5] | 9.3 Percentage in the final grade |
|---|---|---|---|
| 9.4. Course | Degree of understanding the fundamental concepts | Oral exam | 50% |
| | Ability to analyze and synthesize information | | |
| | Quality of argumentation | | |
| 9.5. Seminar/ laboratory | Application of knowledge in practical contexts | Seminar activity, project presentation | 25% |
| | Ability to rigorously follow and apply an experimental laboratory protocol | Laboratory reports | 25% |
| 9.6 Minimum standard for passing | | | |
| Obtaining a minimum grade of 5 for each laboratory report and project presentation<br>Obtaining a minimum grade of 5 in the oral examination.<br>Acquiring fundamental theoretical knowledge regarding the water resources management and the ability to correctly apply fundamental concepts related to wastewater treatment technologies<br>Compliance with the minimum requirements for participation in teaching activities. | | | |

**10. SDG labels (Sustainable Development Goals)[6]**

| | | |
|---|---|---|
|  | ● | Sustainable Development Generic Label |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  |  |
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
|  |  |  |  |  |  |  |  | No label applies |
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

[4] The evaluation criteria must directly reflect the learning outcomes targeted at the level of the degree programme respectively at the level of the subject. More specifically, the learning outcomes set out in the expected learning outcomes are assessed.

[5] Both final evaluation methods and ongoing evaluation strategies should be established.

[6] Select a single label which, according to the *Implementation of SDG labels in the academic process*, best matches the subject. If the subject addresses sustainable development in a generic manner (i.e. by presenting/introducing the general framework of sustainable development, etc.), then the Sustainable Development generic label may be applied. If none of the labels describe the subject, select the last option: *"No label applies."*

Date of entry:
30.04.2026

Signature of course coordinator

Signature of seminar coordinator

Date of approval in the department:
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Signature of the head of department

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