

# STUDY GUIDE

## *NEW MICROPOLLUTANTS IN THE ENVIRONMENT: OCCURRENCE, DETECTION, AND REMOVAL*

Organised by

Poznan University of Technology

| 1. IDENTIFYING DATA.             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
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| • Course Name.                   | New micropollutants in the environment: occurrence, detection, and removal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| • Coordinating University.       | Poznan University of Technology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| • Partner Universities Involved. | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| • Course Field(s).               | Environmental sciences, analytical chemistry, biotechnology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| • Related Study Programme.       | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| • ISCED Code.                    | 0521 Environmental Sciences, 0531 Chemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| • SDG.                           | SDG3, SDG6, SDG11, SDG13, SDG14, SDG15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| • Study Level.                   | B/M/D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| • EUNICE Key Competencies        | <p>[Indicate the Key Competencies offered by the course.]</p> <ul style="list-style-type: none"> <li>• Green – strongly</li> <li>• Orange - moderately</li> <li>• Red – partially</li> <li>• Blank cell - not at all</li> </ul> <table border="1"> <tbody> <tr> <td>Problem solving</td> <td></td> </tr> <tr> <td>Teamworking</td> <td></td> </tr> <tr> <td>Communication</td> <td></td> </tr> <tr> <td>Self-management</td> <td></td> </tr> <tr> <td>Cognitive flexibility</td> <td></td> </tr> <tr> <td>Digital competence</td> <td></td> </tr> <tr> <td>Technical competence</td> <td></td> </tr> </tbody> </table> | Problem solving |  | Teamworking |  | Communication |  | Self-management |  | Cognitive flexibility |  | Digital competence |  | Technical competence |  |
| Problem solving                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| Teamworking                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| Communication                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| Self-management                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| Cognitive flexibility            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| Digital competence               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |
| Technical competence             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |  |             |  |               |  |                 |  |                       |  |                    |  |                      |  |

|  |                                 |  |
|--|---------------------------------|--|
|  | Global intercultural competence |  |
|--|---------------------------------|--|

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| • Number of ECTS credits allocated. | 3                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| • Mode of Delivery.                 | Online classes and self-study                                                                                                                                                                                                                                                                                                                                                                                                       |
| • Language of Instruction.          | English                                                                                                                                                                                                                                                                                                                                                                                                                             |
| • Course Dates.                     | 01.03.2027 r. - 20.06.2027 r.                                                                                                                                                                                                                                                                                                                                                                                                       |
| • Precise Schedule of the Lectures. | <ul style="list-style-type: none"> <li>• Lectures: 15 h, once a week, 8 meetings, duration approx.1,5h, according to the topics specified in 6. COURSE ORGANISATION</li> <li>• Group work / problem-solving sessions, case study analysis (guided work): 15 h, once a week, 8 meetings, duration approx.1,5h</li> <li>• Independent study (reading, preparation): 25 h</li> <li>• Preparation of case study report: 15 h</li> </ul> |
| • Key Words.                        | Emerging micropollutants, Environment, Micropollutants detection, Micropollutants removal                                                                                                                                                                                                                                                                                                                                           |
| • Catchy Phrase.                    | Discover how tiny pollutants create big challenges—and the science designed to stop them                                                                                                                                                                                                                                                                                                                                            |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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| • Prerequisites and co-requisites. | <p>Students should successfully complete courses that provide fundamental knowledge in chemistry and environmental processes, such as:</p> <p>General Chemistry – basic chemical principles, reactions, equilibrium, and thermodynamics.</p> <p>Organic Chemistry – structure and behaviour of organic compounds, important for understanding pharmaceutical and industrial micropollutants.</p> <p>Environmental Chemistry – chemical processes occurring in air, water, and soil systems.</p> <p>Analytical Chemistry – fundamentals of chemical analysis, sampling, and instrumental methods.</p> <p>Environmental Science / Introduction to Environmental Engineering – overview of environmental systems and pollution sources.</p> |
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|                                                                        | <p>Basic Statistics or Data Analysis – for the interpretation of environmental monitoring data.</p> <p>These prerequisites ensure students understand chemical transformations, pollutant transport, and environmental monitoring techniques.</p> <p>This course is available for B/M/D.</p> <p>The course will be led in English; good written and communication skills are required to enable group work and final report preparation.</p> <p>Co-requisites</p> <p>Courses that may be taken concurrently to support the learning outcomes include:</p> <ul style="list-style-type: none"> <li>• Instrumental Analysis – techniques such as chromatography and mass spectrometry are used to detect trace pollutants.</li> <li>• Water and Wastewater Treatment – processes relevant to removing micropollutants.</li> <li>• Environmental Toxicology / Ecotoxicology – impacts of contaminants on ecosystems and human health.</li> <li>• Environmental Monitoring and Sampling Techniques – field and laboratory methods for pollutant assessment.</li> </ul> |
| • Number of EUNICE students that can attend the Course.                | 45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| • Number of EUNICE students that can attend the course per institution | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| • Course inscription procedure(s).                                     | No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

## 2. CONTACT DETAILS.

|                     |                                                |
|---------------------|------------------------------------------------|
| • Department.       | Department of Organic and Bioorganic Chemistry |
| • Name of Lecturer. | Agata Zdarta                                   |
| • E-mail.           | agata.zdarta@put.poznan.pl                     |
| • Other Lecturers.  | -                                              |

## 3. COURSE CONTENT.

This course provides an overview of emerging micropollutants in environmental systems, focusing on their sources, occurrence, environmental fate, detection methods, and removal technologies.

The course introduces major groups of contaminants, including pharmaceuticals, personal care products, endocrine-disrupting compounds, PFAS, pesticides, and microplastics.

Students will learn how these substances enter environmental compartments such as water, soil, and sediments, how they are monitored using modern analytical techniques, and how advanced treatment technologies can remove them from the environment. The course also addresses ecological risks, regulatory challenges, and future perspectives in environmental monitoring and pollution control.

The course will be organised into seven main topics, including an introduction to environmental micropollutants, their occurrence and fate, as well as sampling, monitoring, detection, and remediation strategies, concluding with innovative solutions and future perspectives.

#### 4. LEARNING OUTCOMES.

Knowledge:

Explain the concept and classification of emerging micropollutants.

Identify major sources, pathways, and environmental distribution of micropollutants.

Describe environmental fate, transformation processes, and ecological impacts.

Understand modern analytical techniques used for micropollutant detection and monitoring.

Describe conventional and advanced technologies used for micropollutant removal.

Skills:

Interpret environmental monitoring data related to micropollutants.

Evaluate scientific literature on emerging contaminants.

Assess the efficiency of different treatment technologies for micropollutant removal.

Competences:

Critically discuss the environmental risks associated with emerging micropollutants.

Propose appropriate strategies for monitoring and mitigation of micropollutant contamination.

#### 5. OBJECTIVES.

Students will gain knowledge of how emerging micropollutants enter the environment, how scientists detect them, and which technologies can effectively remove them from water and other environmental matrices.

Students will apply scientific methods to design monitoring or research studies on micropollutants; use analytical data and modelling tools to evaluate contamination scenarios; and communicate findings effectively through reports, presentations, and scientific discussions.

#### 6. COURSE ORGANISATION.

##### UNITS

- |    |                                               |
|----|-----------------------------------------------|
| 1. | Introduction to Environmental Micropollutants |
| 2. | Types of Emerging Micropollutants             |

|                                                                   |                                            |
|-------------------------------------------------------------------|--------------------------------------------|
| 3.                                                                | Occurrence and Environmental Fate          |
| 4.                                                                | Sampling and Monitoring Strategies         |
| 5.                                                                | Analytical Detection Methods               |
| 6.                                                                | Removal and Treatment Technologies         |
| 7.                                                                | Emerging Solutions and Future Perspectives |
| <b>LEARNING RESOURCES AND TOOLS.</b>                              |                                            |
| Scientific journals and databases.                                |                                            |
| <b>PLANNED LEARNING ACTIVITIES AND TEACHING METHODS.</b>          |                                            |
| Lectures, discussions, group work (problem solving), case studies |                                            |

|                                                    |
|----------------------------------------------------|
| <b>7. ASSESSMENT METHODS, CRITERIA AND PERIOD.</b> |
| Case study analysis with a report, non-graded      |
| <b>OBSERVATIONS.</b>                               |
|                                                    |

|                                                                                                                                                                                                                                                             |
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| <b>8. BIBLIOGRAPHY AND TEACHING MATERIALS.</b>                                                                                                                                                                                                              |
| Emerging Pollutants: Protecting Water Quality for the Health of People and the Environment, ed: Sarantuyaa Zandaryaa, Ali Fares, Gabriel Eckstein, ISBN: 978-92-3-100750-7, UNESCO & Springer Nature, 2025, DOI: 10.1007/978-3-031-71758-1.                 |
| Emerging Contaminants, ed: Nuro, Aurel, ISBN: 978-1-83962-419-3, IntechOpen, 2021, DOI: 10.5772/intechopen.87857.                                                                                                                                           |
| Li Y, Li Y, Zhang S, Gao T, Gao Z, Lai CW, Xiang P, Yang F. Global Distribution, Ecotoxicity, and Treatment Technologies of Emerging Contaminants in Aquatic Environments: A Recent Five-Year Review. Toxics. 2025; 13(8):616. DOI: 10.3390/toxics13080616. |
| Ojija F. Emerging environmental contaminants: Sources, effects on biodiversity and humans, remediation, and conservation implications. Sci Prog. 2024; 107(2):368504241253720. DOI: 10.1177/00368504241253720.                                              |
| Boahen, E., Owusu, L. & Adjei-Anim, S.O. A comprehensive review of emerging environmental contaminants of global concern. Discov Environ 3, 144 (2025). DOI: 10.1007/s44274-025-00259-x.                                                                    |