



Circular Economy in Water Management

Course description sheet

Basic information

<p>Field of study AGH UST International Courses</p> <p>Major All</p> <p>Organisational unit Generic subjects</p> <p>Study level any level</p> <p>Form of study Full-time studies</p> <p>Profile General academic</p>	<p>Didactic cycle 2021/2022</p> <p>Course code POGJOS.A2000000.60378c6311b30.21</p> <p>Lecture languages English</p> <p>Mandatoriness Elective</p> <p>Block General Modules</p> <p>Course related to scientific research Yes</p> <p>USOS code 150-INTCOURSE-xS-197</p>
Course coordinator	Elena Neverova-Dziopak
Lecturer	Elena Neverova-Dziopak, Zbigniew Kowalewski

<p>Period Summer semester</p>	<p>Method of verification of the learning outcomes Exam</p> <p>Activities and hours Lectures: 20 Project classes: 25</p>	<p>Number of ECTS credits 5</p>
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Goals

C1	Transfer of knowledge in the field circular economy as an economic system aimed at eliminating waste and the continual use of resources. Making students aware of the importance and benefits of such regenerative approach.
C2	Presentation of the possibility of applying the principles of circular economy in the water and wastewater economic sector

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge - Student knows and understands:			
W1	problems of water scarcity; role of water resources in life and economy, natural and anthropogenic threats to water quality and the state of water ecosystems; structure of water resources and types of water use. Sources of waste water, its classification, composition and properties, methods of disposal and collection and treatment		Project, Examination
W2	definitions and essence of linear and circular economy in water and wastewater sector and related benefits; the aspects of critical raw materials		Project, Examination
W3	the principles of rational use of water resources and the possibility of water reuse in households, industrial plants and agricultural sector; the possibility of using waste and sewage sludge generated during wastewater treatment and the recovery of valuable substances and energy		Project, Examination
W4	the essence and implementation of the process of transformation of wastewater treatment plants into water and resource production plants		Project, Examination
W5	social, economical and ecological aspects of circular economy in water management		Project, Examination
Skills - Student can:			
U1	evaluate the possibilities of the technological system of wastewater treatment in terms of substance and energy recovery		Participation in a discussion, Project
Social competences - Student is ready to:			
K1	to identify problems related to scarcity of water resources and the impact of sewage treatment plants on the environment; to develop a concept for the implementation of solutions in the field of circular economy in the wastewater section; proposing ways of recovering valuable raw materials and energy from sewage and sewage sludge		Participation in a discussion, Project, Examination
K2	is environmentally conscious and ready to spread the idea of sustainable development and circular economy in society and work environment		Participation in a discussion, Project, Examination

Program content ensuring the achievement of the learning outcomes prescribed to the module

lectures and design classes

Student workload

Activity form	Average amount of hours* needed to complete each activity form

Lectures	20
Project classes	25
Preparation for classes	15
Examination or final test/colloquium	5
Realization of independently performed tasks	25
Contact hours	20
Preparation of project, presentation, essay, report	15
Student workload	Hours 125
Workload involving teacher	Hours 45

* hour means 45 minutes

Program content

No.	Program content	Course's learning outcomes	Activities
1.	Definition and principles of circular economy concept. Critical raw materials	W2, W4, U1, K1, K2	Lectures, Project classes
2.	Problems of water scarcity; global structure of water resources; types of water use water usage structure in different economic sectors	W1, W3, U1, K1, K2	Lectures
3.	Wastewater: classification; qualitative and quantitative characteristics, methods of disposal and treatment; impact of wastewater treatment plants on the environment. Characteristics of sewage sludge: methods of treatment, disposal and utilization; recovery of different substances and energy; wastewater reuse.	W3, W4, U1, K1, K2	Lectures, Project classes
4.	Dirreferent ways of turning wastewater treatment plants into resource recovery facilities. casr studies. Ecological, economical and social aspects of circular economu in water management	W1, W4, W5, U1, K1, K2	Lectures, Project classes

Extended information/Additional elements

Teaching methods and techniques:

Lectures, Discussion, E-learning, Case study, Group work, Project based learning

Activities	Methods of verification	Credit conditions
Lectures	Examination	examination
Project classes	Participation in a discussion, Project	project, participation in the discussion

Prerequisites and additional requirements

Basic knowledge on environmental sciences

Literature

Obligatory

1. Arena, M., Ciceri, N. D., Terzi, S., Bengo, I., Azzone, G. & Garetti, M. 2009. A state-of-the-art of industrial sustainability: definitions, tools and metrics. *International Journal of Product Lifecycle Management*, 4, 207-251
2. Egle, L.; Rechberger, H.; Krampe, J.; Zessner, M. Phosphorus recovery from municipal wastewater: An integrated comparative technological, environmental and economic assessment of P recovery technologies. *Sci. Total Environ.* 2016, 571, 522-542
3. Frijns, J.; Hofman, J.; Nederlof, M. The potential of (waste)water as energy carrier. *Energy Convers. Manag.* 2013, 65, 357-363
4. Neczaj E., Grosser A., *Circular Economy in Wastewater Treatment Plant-Challenges and Barriers*, Proceedings vol. 2, pp. 614, 2018

Optional

1. Mulchandani A., Westerhoff R., Recovery opportunities for metals and energy from sewage sludge, *Bioresource Technology*, vol. 2015, pp. 2015-226, 2016
2. Raheem A., Singh V., He J., Dastyar W., Dionysiou D. D., Opportunities and challenges in sustainable treatment and resource reuse of sewage sludge: A review, *Chemical Engineering Journal*, vol. 337, no. October 2017, pp. 616-641, 2018
3. Rossi, L.; Reuna, S.; Fred, T.; Heinonen, M. RAVITA Technology - new innovation for combined phosphorus and nitrogen recovery. *Water Sci. Technol.* 2018, 78, 2511-2517

Scientific research and publications

Research

1. Optimization of Wastewater Treatment facilities operation. The evaluation of potential of substances and energy recovering.
2. Rational use of water resources and ecosystems protection. Mitigation of anthropogenic negative impact on water environment. Close cycles of water.

Publications

1. Analysis of eutrophication potential of municipal wastewater / M. Preisner, E. NEVEROVA-DZIOPAK, Z. KOWALEWSKI // *Water Science and Technology* ; ISSN 0273-1223. — 2020 vol. 81 iss. 9, s. 1994-2003. — Bibliogr. s. 2001-2003, Abstr.. — Publikacja dostępna online od: 2020-05-26. — tekst: <https://iwaponline.com/wst/article/81/9/1994/74435/Analysis-of-eutrophication-potential-of-municipal>
2. An analytical review of different approaches to wastewater discharge standards with particular emphasis on nutrients / Michał Preisner, Elena NEVEROVA-DZIOPAK, Zbigniew KOWALEWSKI // *Environmental Management* ; ISSN 0364-152X. — 2020 vol. 66 iss. 4, s. 694-708. — Bibliogr. s. 706-708, Abstr.. — Publikacja dostępna online od: 2020-08-12. — tekst: <https://link.springer.com/content/pdf/10.1007/s00267-020-01344-y.pdf>
3. Application of activated sludge model (ASM) for phosphorus (P) recovery potential simulation / Michał Preisner, Marzena Smol, Elena NEVEROVA-DZIOPAK, Zbigniew KOWALEWSKI // W: 1st international conference Strategies toward Green Deal Implementation - water and raw materials [Dokument elektroniczny] : 14-16 December 2020, online : conference proceedings / scientific ed. Marzena Smol ; Mineral and Energy Economy Research Institute. Polish Academy of Sciences. — Wersja do Windows. — Dane tekstowe. — Cracow : Publishing House. Mineral and Energy Economy Research Institute. Polish Academy of Sciences, 2020. — e-ISBN: 978-83-959215-5-1. — S. 114. — Wymagania systemowe: Adobe Reader. — Tryb dostępu: https://greendeal2020.pl/wp-content/uploads/2021/01/Conference-proceedings_GreenDeal2020-1.pdf [2021-01-08]
4. Mitigation of eutrophication caused by wastewater discharge: a simulation-based approach / Michał Preisner, Elena NEVEROVA-DZIOPAK, Zbigniew KOWALEWSKI // *Ambio* ; ISSN 0044-7447. — 2021 vol. 50 iss. 2, s. 413-424. — Bibliogr. s. 421-424, Abstr.. — Publikacja dostępna online od: 2020-05-25. — tekst: <https://link.springer.com/content/pdf/10.1007/s13280-020-01346-4.pdf>
5. Surface water eutrophication in Poland: assessment and prevention / Elena NEVEROVA-DZIOPAK // W: *Quality of water resources in Poland* / eds. Martina Zeleňáková, Katarzyna Kubiak-Wójcicka, Abdelazim M. Negm. — Cham : Springer Nature Switzerland AG, cop. 2021. — (Springer Water ; ISSN 2364-6934). — ISBN: 978-3-030-64891-6 ; e-ISBN:

- 978-3-030-64892-3. — S. 321–346. — Bibliogr., Abstr.
6. Technical progress in the drainage infrastructure of modern cities / Daniel Słyś, Józef Dziopak, Elena NEVEROVA-DZIOPAK // W: *Evropejskie innovacionnye tehnologii vodosnabżeniâ i vodootvedeniâ v usloviâh Űžnogo Kavkaza* [Dokument elektorniczny] : monografia / pod nauč. red. A. Prangišvili, [et al.] ; Gruzinskij Tehničeskij Universitet, Belostokskij Tehničeskij Universitet. — Wersja do Windows. — Dane tekstowe. — Tbilisi : Gruzinskij Tehničeskij Universitet, 2019. — (Ekologiâ Okrużaûšej Sredy ; t. 1). — eISBN dla wszystkich tomów: 978-9941-28-425-0. — e-ISBN: 978-9941-28-485-4. — S. 13–31. — Wymagania systemowe: Adobe Reader. — Tryb dostępu: https://drive.google.com/file/d/10U4ao4i4_iNwYJgsu_1FSEWz-gHQQooo/view [2019-09-05]. — Bibliogr. s. 28–31
 7. computer simulation of wastewater eutrophication potential as the base for proper selection of treatment technologies / Elena NEVEROVA-DZIOPAK, Zbigniew KOWALEWSKI, Michał Preisner // W: *11th International Conference on Contemporary Problems of Architecture and Construction* [Dokument elektroniczny] : Architecture, Construction, Construction Mechanics, Environmental Engineering, Engineering Maintenance of Buildings and Structures, Geodesy : 14-16 October 2019, Yerevan, Republic of Armenia / ed. Narine Pirumyan. — Wersja do Windows. — Dane tekstowe. — Yerevan : National University of Architecture & Construction of Armenia, [2019]. — S. 393–399. — Wymagania systemowe: Adobe Reader. — Tryb dostępu: <https://nuaca.am/wp-content/themes/nuaca/images/Proceedings.pdf> [2019-10-24]. — Bibliogr. s. 399, Abstr.
 8. Analysis of Mariupol metallurgical enterprises influence on ecological state of surface waters — Analiza wpływu zakładów metalurgicznych w Mariupolu na stan ekologii wód powierzchniowych / Olena Dan, Elena NEVEROVA-DZIOPAK, Eleonora Butenko, Alexey Kapustin // *Geomatics and Environmental Engineering* ; ISSN 1898-1135. — Tytuł poprz.: Geodezja oraz Inżynieria Środowiska. — 2017 vol. 11 no. 1, s. 25–31. — Bibliogr. s. 31, Streszcz., Summ.. — tekst: <http://journals.bg.agh.edu.pl/GEOMATICS/2017.11.1/geom.2017.11.1.25.pdf>
 9. Dobór optymalnych warunków chemicznego strącania fosforu w ściekach w oparciu o symulację komputerową — [The selection of optimum conditions for the chemical removal of phosphorus in the wastewater based on a computer simulation] / Elena NEVEROVA-DZIOPAK, Zbigniew KOWALEWSKI // W: *Technologie informatyczne w ochronie i kształtowaniu środowiska* [Dokument elektroniczny] : I konferencja naukowo-techniczna : Warszawa, 17 stycznia 2017 roku / Polskie Stowarzyszenie Informatyki Środowiska. — Wersja do Windows. — Dane tekstowe. — [Warszawa] : [PSIS], [2017]. — Slajdy [1–27]. — Wymagania systemowe: Adobe Reader. — Tryb dostępu: <https://goo.gl/NtWY9t> [2017-04-04]. — Streszcz.. — Tekst streszcz.: <https://goo.gl/2Gu3mK>