



Module name: Sustainable development and circular economy

Academic year: 2019/2020 Code: ZSDA-3-0024-s ECTS credits: 5

Faculty of: Szkoła Doktorska AGH

Field of study: Szkoła Doktorska AGH Specialty: —

Study level: Third-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 0

Course homepage: —

Responsible teacher: dr hab. inż, prof. AGH Grzesik Katarzyna (grzesikk@agh.edu.pl)

### Module summary

Developing knowledge of the circular economy concept, models and principles as well as strategies towards implementing circular economy. Developing the ability to prepare case studies on a closed loop value chain for a chosen product or an industrial symbiosis.

### Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence: is able to			
M_K001	critical evaluation of his/her current knowledge in the field of circular economy and recognition of the importance of knowledge in solving modern problems of economic development and management of natural resources	SDA3A_K01	Participation in a discussion, Execution of a project, Case study, Activity during classes
M_K002	fulfilling the social obligations of a researcher of technical university and providing the public with information and opinions on the opportunities of a circular economy	SDA3A_K02	Participation in a discussion, Execution of a project, Activity during classes
Skills: he can			
M_U001	write a detailed report on a case study of industrial symbiosis or closed loop value chain as well as prepare and shown a brief presentation on the developed case study	SDA3A_U03, SDA3A_U05, SDA3A_U01	Presentation, Participation in a discussion, Execution of a project, Activity during classes

M_U002	search and present examples of industrial symbiosis or closed loop value chain and develop a case study of industrial symbiosis or closed loop value chain	SDA3A_U02, SDA3A_U05, SDA3A_U01, SDA3A_U04	Presentation, Participation in a discussion, Execution of a project, Activity during classes
Knowledge: he knows and understands			
M_W001	concept goals and principles of circular economy, describe the initiatives, strategies towards circular economy and opportunities of circular economy	SDA3A_W02, SDA3A_W05, SDA3A_W01	Presentation, Participation in a discussion, Execution of a project, Activity during classes
M_W002	limits to growth, world mega trends and problems of current economic development; concept, principles and goals of sustainable development	SDA3A_W02, SDA3A_W05, SDA3A_W01	Presentation, Participation in a discussion, Execution of a project, Activity during classes

## Number of hours for each form of classes

Suma	Form of classes										
	Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
45	15	0	0	30	0	0	0	0	0	0	0

## FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
Social competence: is able to												
M_K001	critical evaluation of his/her current knowledge in the field of circular economy and recognition of the importance of knowledge in solving modern problems of economic development and management of natural resources	-	-	-	+	-	-	-	-	-	-	-
M_K002	fulfilling the social obligations of a researcher of technical university and providing the public with information and opinions on the opportunities of a circular economy	-	-	-	+	-	-	-	-	-	-	-
Skills: he can												

M_U001	write a detailed report on a case study of industrial symbiosis or closed loop value chain as well as prepare and shown a brief presentation on the developed case study	-	-	-	+	-	-	-	-	-	-	-
M_U002	search and present examples of industrial symbiosis or closed loop value chain and develop a case study of industrial symbiosis or closed loop value chain	-	-	-	+	-	-	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	concept goals and principles of circular economy, describe the initiatives, strategies towards circular economy and opportunities of circular economy	+	-	-	-	-	-	-	-	-	-	-
M_W002	limits to growth, world mega trends and problems of current economic development; concept, principles and goals of sustainable development	+	-	-	-	-	-	-	-	-	-	-

## Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	45 h
Preparation for classes	6 h
przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania	36 h
Realization of independently performed tasks	24 h
Contact hours	1 h
Summary student workload	112 h
Module ECTS credits	5 ECTS

## Additional information

### Module content

#### Lectures

##### Sustainability

Ancient civilisations collapse and climate change, what is sustainability, nature principles of sustainability, three pillars of sustainable development, sustainable development goals,

##### Limits to growth

Exponential world population and consumption, modern lifestyles - are they sustainable?, resources availability and depletion.

Limits to linear economy, material and value losses, Linear vs circular economy.

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Exponential world population and consumption, modern lifestyles - are they sustainable?, resources availability and depletion.

Limits to linear economy, material and value losses, Linear vs circular economy.

#### Concepts and models of circular economy (CE)

Key principles of circular economy, inspirations from nature - fundamental characteristics of CE, ReSolve and multi R framework, building blocks of CE.

Business models in circular economy

#### Strategies towards circular economy

European Union Action plan towards Circular economy, EU new targets for waste recycling, Strategy for plastics, Ecodesign and EU product policy, Monitoring framework for CE

#### Opportunities for circular economy

Economic and Environmental, Opportunities for companies, Opportunities for citizens

#### Closed loop chain

Reverse logistics, closed loop supply chain

#### Life cycle thinking

Life cycle thinking and Life Cycle Assessment

#### Implementation of circular economy

Examples of implemented circular economy model

### **Project classes**

Students are required to develop and deliver a case study of an industrial symbiosis or a closed loop value chain, based on literature, report, studies or based on their own knowledge and observations. It is necessary to prepare a detailed report on the case study and brief presentation, which needs to be shown to all students.

### **Teaching methods and techniques:**

Lectures: The content of the lecture is presented in the form of a multimedia presentation enriched with shows related to the issues presented.

Project classes: Students work on their own with the assignments on a case study.

### **Warunki i sposób zaliczenia poszczególnych form zajęć, w tym zasady zaliczeń poprawkowych, a także warunki dopuszczenia do egzaminu:**

For passing the project classes it is required:

- execution and passing a project report for a positive grade
- performance and passing a presentation or poster for a positive grade
- presence at least 80% of project classes

If a project report and a presentation/poster are not passed till the last day of the project classes (the end of a semester) the grade is failed in the first run. A student who failed, has two more chances to pass in the second and third run.

### **Zasady udziału w poszczególnych zajęciach, ze wskazaniem, czy obecność studenta na zajęciach jest obowiązkowa:**

Lectures:

- Attendance is mandatory: No
  - Participation rules in classes: Students participate in lectures learning the teaching content according to the course syllabus. Students should keep asking questions and clarifying doubts.
- Audiovisual registration of the lecture requires the teacher's consent.

Project classes:

- Attendance is mandatory: Yes
- Participation rules in classes: Students carry out practical work aimed at obtaining competences assumed by the syllabus. The method of project implementation and the final result are assessed.

### **Method of calculating the final grade**

The final grade FG is calculating according to the following formula:

$$FG = 0,7 \cdot R + 0,3 \cdot Pres$$

where:

R - report grade

Pres - presentation grade

### **Sposób i tryb wyrównywania zaległości powstałych wskutek nieobecności studenta na zajęciach:**

In the case of absence from the project classes the student makes up the scope of material in consultation with the teacher and supplements the relevant content in the project.

### **Prerequisites and additional requirements**

Prerequisites and additional requirements not specified

### **Recommended literature and teaching resources**

1. European Circular Economy Stakeholder Platform <http://circulareconomy.europa.eu/platform/>
2. European Commission. Sustainability and circular economy Webpage [https://ec.europa.eu/growth/industry/sustainability\\_en](https://ec.europa.eu/growth/industry/sustainability_en)
3. United Nations. Sustainable development goals webpage. <http://www.un.org/sustainabledevelopment/>
4. Ellen MacArthur Foundation Web page <https://www.ellenmacarthurfoundation.org/>  
Environmental Science webpage. <https://www.environmentalscience.org/sustainability>
5. Ellen MacArthur Foundation Growth within: a circular economy vision for a competitive Europe. 2015
6. Ellen MacArthur Foundation. Towards the circular economy: business rationale for an accelerated transition. 2015
7. Ellen MacArthur Foundation. Towards the circular economy: Accelerating the scale-up across global supply chains. 2014
8. Ellen MacArthur Foundation. Towards the circular economy: Economic and business rationale for an accelerated transition. 2013
9. Material Economics 2018. The circular economy - a powerful force for climate mitigation (2018)
10. European Investment Bank, 2018. Circular Economy Guide. Supporting the circular transition
11. Working Group FINANCE, 2016. Money makes the world go round
12. European Environment Agency, 2017. Circular by design. Products in the circular economy. EEA report No 6/2017
13. European Environment Agency, 2016. Circular economy in Europe Developing the knowledge base. EEA report No 2/2016
14. European Environmental Bureau Towards an EU product policy framework contributing to the circular economy 2018.
15. Journal of Cleaner Production
16. Sustainability Science Journal
17. Journal of Industrial Ecology

### **Scientific publications of module course instructors related to the topic of the module**

1. Grzesik K., 2005. The waste management plans - tools of sustainable development. Polish Journal of Environmental Studies. vol. 14, No. 5, 2005
2. Grzesik K., 2008. The realization of the commune waste management plans - a step towards sustainable development. Polish Journal of Environmental Studies. Vol 17, No. 3A, 2008
3. Grzesik K., Guca K., 2011. Screening study of Life Cycle Assessment (LCA) of the electric kettle with SimaPro software. Geomatics and Environmental Engineering; vol. 5 no. 3 pp. 57-68.

4. Grzesik K., Terefeńko T., 2012. Life Cycle Assessment of an Inkjet Printer. Polish Journal of Environmental Studies. Vol. 21, No. 5A, pp. 95-105
5. Grzesik-Wojtysiak K., Kukliński G., 2013 Screening life cycle assessment of a laptop used in Poland. Environment Protection Engineering, Vol. 39, 2013, No. 3, pp. 43-55
6. Grzesik K., Kozakiewicz R., Bieda B., 2014. Life cycle assessment for landfilling, incineration and mechanical-biological treatment of residual waste for Krakow city (Poland). SGEM2014 : GeoConference on Energy and clean technologies: International multidisciplinary scientific geoconference : 17-26, June, 2014, Albena, Bulgaria, conference proceedings. Vol. 2, Nuclear technologies, recycling, air pollution and climate change.
7. Bieda B., Grzesik K., Sala D., Gaweł B., 2015. Life cycle inventory processes of the integrated steel plant (ISP) in Krakow, Poland – coke production, a case study, International Journal of Life Cycle Assessment; vol. 20 iss. 8, pp. 1089-1101.
8. Grzesik K., Usarz M., 2016. A life cycle assessment of the municipal waste management system in Tarnów, Geomatics and Environmental Engineering, vol. 10 no. 2, pp. 29-38.
9. Grzesik, K., Malinowski M., 2016. Life cycle assessment of refuse-derived fuel production from mixed municipal waste, Energy Sources. Part A, Recovery, utilization, and environmental effects, vol. 38 no. 21, pp. 3150-3157
10. Bieda B., Skalna I, Gaweł B., Grzesik K., Henclik A., Sala D., 2017. Life cycle inventory processes of the integrated steel plant (ISP) in Krakow, Poland-continuous casting of steel (CCS): a case study. International Journal of Life Cycle Assessment DOI 10.1007/s11367-017-1365-0.
11. Grzesik K., Bieda B., Kozakiewicz R., Kossakowska K., 2017. Prospects of rare earth elements (REEs) recovery from tailings and mining waste. International Conference on Raw Materials and Energy in a Circular and Low-Carbon Economy, Kraków 14-15 September, 2017.
12. Grzesik K., Bieda B., Kozakiewicz R. Kossakowska K. 2017. Goal and scope and its evolution for Life Cycle Assessment of Rare Earth Elements recovery from secondary sources. SGEM 2017 SGEM 2017 - 17th international multidisciplinary scientific geoconference, 29 June-5 July, 2017, Albena, Bulgaria conference proceedings. Vol. 17 iss. 41, Nuclear technologies recycling air pollution and climate change. pp. 107-114
13. Kossakowska K., Grzesik K., 2017 A review of Life Cycle Assessment studies of Rare Earth Elements industry SGEM 2017 - 17th international multidisciplinary scientific geoconference, 29 June-5 July, 2017, Albena, Bulgaria conference proceedings. Vol. 17 iss. 52, Ecology and environmental protection pp. 19-25
14. Bieda B., Grzesik K., 2017. Uncertainty analysis of the life cycle inventory of rare earth elements from secondary flotation of rare earth elements in beneficiation rare earth waste from the gold processing: case study. SGEM 2017 - 17th international multidisciplinary scientific geoconference, 29 June-5 July, 2017, Albena, Bulgaria conference proceedings. Vol. 17 iss. 41, Nuclear technologies recycling air pollution and climate change. pp. 269-275
15. Grzesik K., Malinowski M., 2017. Life Cycle Assessment of Mechanical -Biological Treatment of Mixed Municipal Waste, Environmental Engineering Science vol 34 no 2 pp. 207-220

## **Additional information**

None