



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Recycling

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### Course

Field of study

Management and Production Engineering

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

III/5

Profile of study

general academic

Course offered in

polish

Requirements

compulsory

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### Number of hours

Lecture

15

Tutorials

Laboratory classes

15

Projects/seminars

Other (e.g. online)

### Number of credit points

2

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### Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

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### Prerequisites



Basic knowledge in field of materials technology, chemistry, and management (both metal and non-metal-plastics,).

### Course objective

Learning basic problems related to waste management and their importance for sustainable civilization development.

### Course-related learning outcomes

#### Knowledge

Allowing identification of waste regarding materials for their further processing (recycling). Allowing identification of relations between manufacturing processes and environment (places of forming the waste). Allowing indication of actions limiting quantities of wastes in production processes used in mechanical engineering.

#### Skills

Organization of segregation of industrial waste (metal and plastics). Conducting recycling processes for waste of metals and plastics. Critical evaluation of technical and manufacturing process activities on the environment; can propose actions (processes) reducing quantities of wastes formed during production. Self-education in field of recycling (knowledge of processes and laws).

#### Social competences

Awareness of influence of manufacturing processes in mechanical engineering on natural environment. Awareness of necessity of cooperation between specialists of different fields. Can think and act in an initiative manner. Understands a need of lifetime education.

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Written a test (20 questions), criterion: 3 from 50.1 to 60%, 3.5 from 60.1 to 70%, 4 from 70.1 to 80%, 4.5 from 80.1 to 90.0% and 5 above 90.1% .

Laboratory: Attendance to all classes. Positive assessments from reports and answers for questions asked by a teacher.

### Programme content

Lecture: World consumption of materials and energy. Resources of raw materials. Primary and secondary, renewable and non-renewable raw materials. Waste and environmental protection. Administrative and law conditioning of waste management. Classification of waste. Hazardous waste. After-production and after-use waste. Reclaiming and recycling of materials. Recycling of metal and non-metal materials (plastics, paper). Ecological aspects of recycling. Logistical problems in recycling processes. Techniques of recycling of metals, plastics, rubber, etc. Preparation of materials (waste) for manufacturing processes. Course of processing processes and their effects. Studies of polymer regranulated and metal.



Laboratory: Systems of waste segregation. Classification and segregation of metals waste, alloys and plastics. Examples of processing waste out of selected plastics. Processing complex waste on a selected example. Re-melting of metal scrap and plastics reprocessing.

### Teaching methods

Lecture: multimedia presentation. Laboratory exercises: performing exercises, discussion, team work.

### Bibliography

#### Basic

1. Kozłowski M., Plastics Recycling in Europe, Wyd. Politechniki Wrocławskiej 2006.
2. Tim A. Osswald Natalie Rudolph, Polymer Rheology Fundamentals and Applications, Hanser Publishers, Munich 2015. Book ISBN978-1-56990-517-3.
3. Mark E. Schlesinger, Aluminum Recycling, Second Edition, CRC Press 2013.
4. Ulewicz M., Siwka J., Procesy odzysku i recyklingu wybranych materiałów, Wyd. Wydziału Inż. Proc., Mat. i Fizyki Stosowanej Politechniki Częstochowskiej, Częstochowa 2010.

#### Additional

1. Hong Hocheng, Mital Chakankar, Umesh Jadhav, 1st Edition, Biohydrometallurgical Recycling of Metals from Industrial Wastes, CRC Press 2018.
2. Praca zbiorowa pod red. Jerzego J. Sobczaka, Odlewnictwo Współczesne. Poradnik Odlewnika, Wyd. Stowarzyszenia Technicznego Odlewników Polskich, Tom 1. Materiały, Kraków 2013. ISBN: 878-83-904306-9-0.
3. Brandrup, J., Bittner, M., Menges, G., and Michaeli, W. (1996) Recycling and recovery of plastics, Carl Hanser Verlag, Germany.
4. Letcher T., Plastic Waste and Recycling: Environmental Impact, Societal Issues, Prevention, and Solutions, 1st Edition, Academic Press 2020.
5. Pascoe, R. D. (2000) Sorting of Waste Plastic for Recycling, Rapra Review Reports, 11, 4.

### Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	30	1,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) <sup>1</sup>	20	1,0

<sup>1</sup> delete or add other activities as appropriate