



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Recycling [S1IMat1>Rec]

Course

Field of study

Materials Engineering

Year/Semester

3/5

Area of study (specialization)

–

Profile of study

general academic

Level of study

first-cycle

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

15

Laboratory classes

15

Other (e.g. online)

0

Tutorials

0

Projects/seminars

0

Number of credit points

2,00

Coordinators

dr inż. Łukasz Bernat

lukasz.bernat@put.poznan.pl

Lecturers

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:

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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 renewable and non-renewable raw materials.
- Legal and administrative conditions of waste management in Poland and the EU.
- Definitions and classification of waste (post-production and post-consumer waste).
- Ecological aspects of recycling polymer and metal materials.
- Organizational preparation of waste for processing (shredding, classification, sorting, thickening, etc.).
- The course of secondary processing processes and their effects.
- Techniques for recycling metals, plastics, rubber, ceramics, etc. supported by examples.
- Assessment of the quality of secondary polymer materials.

Lab

- Systems for classification and segregation of polymer and metal waste and their alloys.
- Melting and refining of aluminum scrap.
- Grinding and testing of the granulometric characteristics of polymer recyclates
- Secondary processing (recirculation) of plastic waste.

Course topics

Lecture

Metals:

- Definitions regarding metal waste and recycling,
- Metal waste management,
- Characteristics of the waste catalog,
- The flow of metal waste in the part manufacturing process,
- Metal waste collection methods,
- Methods of processing metal waste (shredding, classification, sorting, thickening),
- Recycling of cast steel and cast iron (classification of steel and cast iron scrap, process of producing steel from scrap),
- Recycling of aluminum and its alloys (classification of aluminum alloys, sorting, thermal removal of paint coatings, furnaces for melting fine and coarse scrap, refining, integrated melting plant, can recycling, can melting line),
- Recycling of copper and its alloys (classification of copper alloys, copper-bearing materials, processing of waste electronic and electrical equipment, cable recycling),

Plastics:

- Characteristics of plastics in terms of recycling
- Circular economy of plastics
- Analysis of recovery and recycling processes of polymer materials (chemical, mechanical recycling, energy recovery)

- Sorting and separation techniques for polymeric materials
- Examples of lines for mechanical recycling of plastic waste
- Industrial technologies for improving the quality of regranulates

Lab

Metals:

- Classification of scrap due to dimensions, origin, chemical composition, etc.,
- Scrap sorting methods used in purchases of secondary metal raw materials,
- Melting of thin-walled scrap,
- Refining of aluminum alloys,
- Assessment of the metallurgical quality of samples cast from aluminum scrap.

Plastics:

- Assessment of the granulometric characteristics of secondary raw materials
- Assessment of the processing properties of mechanical recycling products
- Plastics identification technologies in terms of waste sorting

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	45	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	15	0,50