COURSE DESCRIPTION CARD - SYLLABUS

Course name
Manufacturing and recycling of polymer packaging [S2TOZ1>TWiROP]

Course

Field of study
Circular System Technologies

Year/Semester
1/2

Area of study (specialization)
Renewable raw material technologies

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

The student has the necessary engineering knowledge to understand phenomena and processes in circular system technologies. The student has knowledge in the field of circular system technologies, chemical engineering, mechanical engineering and chemical industry equipment.

Course objective

Transfer of knowledge in the field of manufacturing techniques and recycling of polymer packaging. Development of skills in acquiring technological knowledge in the field of manufacturing and recycling of polymer packaging and familiarization with the principles of operation of modern processing plants.

Course-related learning outcomes

Knowledge:
1. The student has advanced, structured and theoretically based knowledge of the principles of the circular economy and the reasons for its implementation. [K_W02]
2. The student has advanced, detailed knowledge covering issues in the field of sustainable production, rules of conduct and development trends in the circular economy. [K_W03]
3. The student has expanded knowledge about material recycling methods, raw material and energy

recovery from waste materials necessary to design, optimize and implement innovative technological processes. [K_W12]

Skills:
1. The student is able to define and critically evaluate technical solutions for waste recycling in accordance with the principles of a circular economy. [K_U04]
2. The student is able to interact with other people and take a leading role in a team to solve engineering problems regarding methods and devices used in technologies, including those related to the circular economy. [K_U09]
3. The student is able to analyze and critically evaluate new areas in circular technologies and related fields, assess their innovation and technical feasibility. [K_U19]

Social competences:
1. The student is aware of personal responsibility resulting from his/her professional role and the emergence of moral and ethical problems in the context of professional activities. [K_K01]
2. The student critically assesses his/her knowledge, understands the need to further education and improve his/her professional, personal and social competences. [K_K03]
3. The student is able to think and act in an entrepreneurial way, while being aware of his social role and public interest. [K_K04]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Stationary: written exam (open or closed questions). Online: final test using the test module on the eKursy platform (20-30 questions). Student obtains a pass by achieving at least 51% of points.
Laboratory classes: Stationary form - oral answer or written test from the material contained in the exercises and the given theoretical issues; presence and realization of all laboratory exercises provided in the study program; grade from reports prepared after each exercise. A final grade will be given based on the average grades of the oral/written answers and reports for each exercise, divided by the number of exercises performed. Online form - oral answer and/or written test from the material contained in the exercises, tutorial videos and the theoretical issues provided, conducted in the "live view" mode with the webcam turned on via eMeeting or Zoom platform during a direct conversation with the teacher and/or using the test module on the eKursy platform; online presence and completion of all laboratory exercises provided in the study program; grade from the reports prepared after each exercise and sent via the eKursy platform or by e-mail using the university's e-mail system. A final grade will be given based on the average grade of the oral/written answers and reports for each exercise, divided by the number of exercises performed.

Programme content

Issues in the field of manufacturing techniques and recycling of polymer packaging including circular system technologies.

Course topics

The course content includes the following topics:
1. The importance of polymers and polymer processing in the packaging industry
2 Packaging and the environment
3. Modification of polymer materials with particular emphasis on processing modification
4. Methods for preparing plastics for processing - used in the packaging production
5. Indices of processability of polymer materials.
6. Manufacturing techniques and recycling of polymer packaging, including biodegradable packaging:
- extrusion: basics of the extrusion process with a discussion of technological lines and techniques used in the packaging production: film extrusion (blow film extrusion, flat film extrusion), multilayer film extrusion, films and layered films extrusion from recycled materials blowing;
- Circular system technologies in the extrusion process;
- basics of the conventional injection molding process with a discussion of special injection techniques used in the packaging production: foaming injection, water assisted injection molding, gas assisted injection molding, micro injection molding, large injection molding, precision injection molding, blow molding, etc.;

- Circular system technologies in the injection molding process;
- rotational molding;
7. Methods of secondary processing of plastics:
- thermoforming;
- combining (welding, sealing, gluing, riveting);
- machining, plastic forming, surface treatment.
8. Packaging recycling
The laboratory exercises include:
- Blow film extrusion.
- Injection molding process in the circular technologies.
- Thermoforming.
- Recycling of polymer packagings.
- Packaging production using an form blowing extrusion.

Teaching methods

1. Lecture: multimedia presentation, illustrated with examples on the board.
2. Laboratories - practical classes.

Bibliography

Basic:
1. 1. H. Żakowska: "Opakowania a środowisko", PWN W-wa 2017.
2. K. Wilczyński: „Reologia w Przetwórstwie Tworzyw Sztucznych”, WNT W-wa 2001.
3. R. Sikora: „Przetwórstwo tworzyw wielkocząsteczkowych”, PWN W-wa 1987.
4. R. Sikora: „Podstawy przetwórstwa tworzyw polimerowych”, WPL Lublin 1992.
5. K. Wilczyński: „Przetwórstwo tworzyw sztucznych”, WPW W-wa 2000.
6. A. Smorawiński: „Technologia wtrysku”, WNT W-wa 1984.
7. K. Wilczyński: „Przetwórstwo Tworzyw Polimerowych”, WPW, Warszawa 2018.
8. A. K. Błęcki: „Recykling materiałów polimerowych”, WNT W-wa 1997.
9. J. Kijeński, A.K. Błędzki, R. Jeziórksa: „Odzysk i recykling materiałów polimerowych”, PWN W-wa 2011;

Additional:
1. H. Saechtling: „Tworzywa sztuczne. Poradnik”, WNT Warszawa 2000.
3. R. Sikora i in., „Przetwórstwo tworzyw polimerowych. Podstawy logiczne, formalne i terminologiczne”, WPL Lublin 2006.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	64	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	61	2,50