Lodz University of Technology

Polymeric Materials and Their Processing

Course description

Basic information

Study programme Industrial Process Engineering **Speciality/path** - **Organizational unit** Faculty of Process and Environmental Engineering **Study level** first-cycle programme (inżynier) **Study mode** full-time studies **Education profile** general academic	**Didactic cycle** 2026/27 **Course code** **Language of instruction** polish **Obligatory** Optional **Block** Directional subjects **Course related to scientific research** Yes

Course coordinator	Joanna Marszałek
Course instructor(s)	Joanna Marszałek, Mariola Błaszczyk, Michał Krempski-Smejda

Period Semester 5	**Form of verification** Graded assignment **Classes and hours** • Lecture: 30 • Tutorials: 15 • Laboratory classes: 15	**Total ECTS points** 4

Learning outcomes

Code	Programme outcomes	Detailed outcomes indicators
1IPP2	Has knowledge of key chemical and process engineering processes, including: (1) momentum, heat and mass exchange mechanisms and their application in unit operations and process apparatus; (2) principles of mass, energy and momentum balancing in process engineering processes; (3) product separation, separation and purification processes; (4) fundamentals of chemical and biochemical reaction engineering.	1IPP2.5 Selects and justifies the selection of unit operations and separation methods for a given typical process using process data and stream properties.
1IPP4	Applies analytical and critical thinking to identify, formulate, and solve complex and atypical engineering problems related to industrial processes and process installations, selecting appropriate computational, technological, and organisational methods.	1IPP4.1 Can identify and accurately define a problem occurring in industrial processes or process plants, identifying key technological variables and operational constraints.

Course contents

Fundamentals of polymer materials, including their properties, structure, and classification, as well as industrial polymer processing methods. The course introduces the analysis of polymer processing operations and the selection of technological parameters from a process engineering perspective.

Complementary information

Contents - detailed selection

No.	Contents - detailed selection	Class type
1.	Definitions, classifications, and history of natural and synthetic polymers. Plastic production and waste: environmental aspects. Structure and properties of polymers. Molar mass and methods of determination. Polymer solutions and solubility. Condensed systems. Polymer nucleation and crystallization. Glass transition, pour point, melting point, and degree of crystallinity—research methods. Fundamentals of polymer synthesis and degradation. Biodegradation and biodegradable polymers, biomixtures, and biocomposites. Production of plastics. Polymer additives. Plastics processing: methods, parameters, and apparatus. Simplified extrusion theory. Equations of motion and velocity profiles.	Lecture

No.	Contents - detailed selection	Class type
2.	Solving problems encountered during the extrusion of molten polymers through nozzles and conduits (geometry, flow resistance) in extruders. Determining velocity profiles for non-Newtonian fluid flow (through the gap between barrels, torsional flow – drag flow, and pressure flow). Simple design problems related to multi-hole extruder nozzles, extruder screws with a given output, and extruder nozzle-screw connections.	Tutorials
3.	Wykonanie wymaganej liczby ćwiczeń laboratoryjnych, np. Wytwarzanie kulek biopolimerowych i uwalnianie substancji bioaktywnej z matrycy polimerowej; Identyfikacja próbek polimerowych za pomocą DSC i FTIR (Tg, Tm); Wytwarzanie i badanie właściwości mechanicznych polimerów; Wytwarzanie i badanie właściwości kompozytów gipsowo-polimerowych; Kinetyka wzrostu kryształów polimerów krystalicznych; Degradacja fototermiczna wybranych polimerów; Grawimetryczne badanie kinetyki sorpcji wody w próbkach biopolimerów.	Laboratory classes

Teaching methods and techniques, passing conditions

Class type	Teaching methods and techniques	Passing conditions
Lecture	Lecture	Passing the test. Obtaining at least 60% of the points.
Tutorials	Practice method	Passing a written test based on the tasks completed. Obtaining at least 60% of the points.
Laboratory classes	Laboratory/computer-based exercises	Performing laboratory exercises and preparing reports.

Examination methods, weighed grades

Class type	Examination methods and weighed grades
Lecture	Final test: 40%
Tutorials	Written assignment: 30%
Laboratory classes	Lab report(s): 30%

Verification of learning outcomes

Detailed outcome indicators	Verification criteria	Assesment tool (class type)
1IPP2.5	A positive assessment is given when the student: - recognizes the basic types of polymers and biopolymers, knows their chemical structure and properties, - is able to identify analytical methods for examining the basic parameters (M, Tm, Tf, Tg, X) of polymers, - knows the basic techniques for producing (processing) plastics, - defines the problem occurring in polymer extrusion processes in process installations, identifying key technological variables and operational constraints.	Written assignment (Tutorials), Lab report(s) (Laboratory classes), Final test (Lecture)

Detailed outcome indicators	Verification criteria	Assesment tool (class type)
1IPP4.1	A positive assessment is given when the student: - recognizes the basic types of polymers and biopolymers, knows their chemical structure and properties, - is able to identify analytical methods for examining the basic parameters (M, Tm, Tf, Tg, X) of polymers, - knows the basic techniques for producing (processing) plastics, - defines the problem occurring in polymer extrusion processes in process installations, identifying key technological variables and operational constraints.	Written assignment (Tutorials), Lab report(s) (Laboratory classes), Final test (Lecture)

Literature

Compulsory reading

1. J. F. Rabek, Współczesna wiedza o polimerach, PWN, 2013
2. M. Mucha, Polimery a ekologia, Wydawnictwo Politechniki Łódzkiej, 2002

Other reference materials

1. J. F. Rabek, Polimery - otrzymywanie, metody badawcze, zastosowanie, PWN, 2013
2. W. Przygocki, A. Włochowicz, Fizyka polimerów, PWN, 2001

Research and publications

Knowledge of fluid mechanics, physical chemistry and analytical chemistry required

Student workload

Activity type	Average number of hours* needed to complete an activity
Lecture	30
Tutorials	15
Laboratory classes	15
Preparation for test	15
Preparation for tutorials	15
Preparation for the laboratory	10
Preparation of a report	20
Total student workload	**No. of hours** 120
Workload involving teacher	**No. of hours** 60

Total ECTS points	ECTS 4

* activity hour equals to 45 minutes

Directional learning outcomes

Code	Content
1IPP2.5	Selects and justifies the selection of unit operations and separation methods for a given typical process using process data and stream properties.
1IPP4.1	Can identify and accurately define a problem occurring in industrial processes or process plants, identifying key technological variables and operational constraints.