Lodz University of Technology

Food Industry Process Engineering

Course description

Basic information

Study programme Industrial Process Engineering **Speciality/path** - **Organizational unit** Faculty of Process and Environmental Engineering **Study level** second-cycle programme (magister 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	Jacek Stelmach
Course instructor(s)	Jacek Stelmach, Remigiusz Modrzewski, Anna Rył

Period Semester 2	**Form of verification** Graded assignment **Classes and hours** • Lecture: 20 • Laboratory classes: 20 • Project work: 30	**Total ECTS points** 5

Prerequisites

1. Knowledge of basic chemical and process engineering processes, including comminution, extraction, and destilation.
2. Basic knowledge of chemical industry equipment.

Learning outcomes

Code	Programme outcomes	Detailed outcomes indicators
2IPP2	Possesses advanced, including specialised, knowledge in material and energy balances, fluid mechanics, momentum transfer, heat and mass transfer, reaction kinetics, separation processes, process dynamics and control, equipment design, and product manufacturing technologies; analyses and evaluates the main development trends in chemical and biochemical engineering.	2IPP2.1 Develops and analyses material and energy balances for various chemical and biochemical engineering processes, applying advanced knowledge of fluid mechanics, momentum transfer, and heat and mass transport. 2IPP2.2 Designs and optimises reactors and process equipment, considering process dynamics and effective control of chemical and biochemical reactions.
2IPP4	Formulates and tests research tasks related to modelling and design; integrates knowledge from various areas of chemical engineering and allied disciplines; performs critical analysis and evaluation of results.	2IPP4.1 Defines a research problem in the field of chemical engineering, applying an interdisciplinary approach. 2IPP4.4 Verifies research results by comparing them with literature data and theoretical models.

Course contents

Integration of key unit operations in food processing and their impact on the properties of raw materials and products. Design and analysis of technological processing lines with particular emphasis on equipment selection, process parameters, and the rheology of food systems.

Complementary information

Contents - detailed selection

No.	Contents - detailed selection	Class type
1.	1. Characteristics of preliminary technological steps typical of food processing 2. Operations and processes used in food technology (mechanical, thermal, diffusion-type, physicochemical, membrane, biotechnological) 3. Food preservation methods (freezing and cooling, heating, drying, freeze-drying) and their impact on the quality and safety of food products 4. Rheological properties of semi-finished products and products of the food industry – selection of measuring devices and measurement methodology 5. Presentation of hygiene and sanitary standards and requirements used in food production	Lecture

No.	Contents - detailed selection	Class type
2.	Analysis of the rheological properties of various substrates used in food processing and the resulting products 1. Rheology of food emulsions (creams with a fat content of 12% to 36%) 2. Rheology of cakes (e.g., wheat, rye, corn) 3. Rheology of suspensions (e.g., tomato juice and other juices with fruit particles) 4. Rheology of confectionery masses (e.g., Nutella) Grained (seed) materials 1. Rheology of powders 2. Grain shape analysis (e.g., oats, rolled oats, lentils, peas)	Laboratory classes
3.	Designing a technological line for a given product, including selecting equipment and devices for the production line for a specific production volume. Calculations will be performed taking into account the complex rheological properties of the substrates used. The equipment selection will take into account hygiene and sanitary requirements for food production.	Project work

Teaching methods and techniques, passing conditions

Class type	Teaching methods and techniques	Passing conditions
Lecture	Lecture	Written test: 10 questions graded on a scale of 0-10 Number of points: 50-59: 3.0; 60-69: 3.5; 70-79: 4.0; 80-89: 4.5; 90-100: 5.0
Laboratory classes	Laboratory/computer-based exercises	Completing all exercises and submitting reports. The final score is the average of all exercises. Assessments are based on correct execution of the exercise, the accuracy of the results obtained, and the conclusions drawn.
Project work	Project execution	Timely project completion. The following are assessed: the accuracy of the technological line's machinery and equipment composition, the accuracy of the balance sheet calculations, and the selection of machinery and equipment.

Examination methods, weighed grades

Class type	Examination methods and weighed grades
Lecture	Written assignment: 30%
Laboratory classes	Lab report(s): 30%
Project work	Design Project: 40%

Verification of learning outcomes

Detailed outcome indicators	Verification criteria	Assesment tool (class type)
2IPP2.1	Performing simple balance calculations during a written exam. Calculating mass and energy flows for a given process line capacity in a design project. Presenting the results in the form of Sankey diagrams.	Written assignment (Lecture), Design Project (Project work)
2IPP2.2	Performing calculations to determine the size (dimensions) of the devices using programs available in the computer lab. Developing a design for a device not available on the market.	Design Project (Project work)
2IPP4.1	List of unit (basic) processes necessary in the technological process.	Design Project (Project work)

Detailed outcome indicators	Verification criteria	Assesment tool (class type)
2IPP4.4	The laboratory report should include a comparison of the obtained results with data found in the literature. In the design calculations, verification will be achieved through the selection of equipment (an incorrect calculation will prevent the selection of the appropriate equipment).	Design Project (Project work), Lab report(s) (Laboratory classes)

Literature

Compulsory reading

1. Inżynieria procesowa i aparatura przemysłu spożywczego, Praca zbiorowa pod redakcją P. Lewickiego, PWN, 2005

Other reference materials

1. Maszyny i aparatura technologiczna przemysłu spożywczego, Błasiński H., Pyć K.W., Rzyski E., Wydawnictwo PŁ, 2001

Research and publications

1. Heim A., Krasławski A., Rzyski E., Stelmach J., Aeration of bioreactors by self-aspirating impellers, Chem. Eng. Journal, 58, s.59-63, 1995.
2. Jamroz T., Rzyski E., Sencio B., Stelmach J., Ocena pracy bioreaktora FWL-42, VII Ogólnopolskie Seminarium „Mieszanie", Koszalin-Kołobrzeg, 1996.
3. Stelmach J., Rzyski E., Powierzchnia międzyfazowa i wnikanie masy w zbiornikach z samozasysającym mieszadłem tarczowym, Inż. Chem. Proc., 25, 3/3, s.1639-1644, 2004.
4. Stelmach J., Rzyski E., Efektywność wnikania masy dla mieszadeł samozasysających, XI Konferencja Naukowa-Techniczna „Budowa i eksploatacja maszyn przemysłu spożywczego" BEMS 2004, (21-24.06), Koszalin-Darłówko, 2004.
5. Stelmach E., Krzystek L., Stelmach J., Ledakowicz St., Anaerobowa degradacja organicznej frakcji stałych odpadów komunalnych, Inż. Apar. Chem., 48(40), 3, s.107-108, 2009.
6. Stelmach E., Stelmach J., Krzystek L., Ledakowicz St., Wpływ zawartości węgla i azotu na szybkość produkcji biogazu z organicznej frakcji stałych odpadów komunalnych, Inż. Apar. Chem., 49(41), 1, s.107-108, 2010.

Student workload

Activity type	Average number of hours* needed to complete an activity
Lecture	20
Laboratory classes	20
Project work	30
Preparation of the project	30
Preparation of a report	20
pk: Project presentation session	10
Preparation for the final exam	5

Total student workload	**No. of hours** 135
Workload involving teacher	**No. of hours** 80
Total ECTS points	**ECTS** 5

* activity hour equals to 45 minutes

Directional learning outcomes

Code	Content
2IPP2.1	Develops and analyses material and energy balances for various chemical and biochemical engineering processes, applying advanced knowledge of fluid mechanics, momentum transfer, and heat and mass transport.
2IPP2.2	Designs and optimises reactors and process equipment, considering process dynamics and effective control of chemical and biochemical reactions.
2IPP4.1	Defines a research problem in the field of chemical engineering, applying an interdisciplinary approach.
2IPP4.4	Verifies research results by comparing them with literature data and theoretical models.