COURSE DESCRIPTION CARD - SYLLABUS

Course name

Inżynieria chemiczna (Chemical Engineering)

Course

Field of study

Technologia chemiczna (Chemical Technology)

Year/Semester

III/6

Area of study (specialization)

Profile of study

general academic

Level of study

First-cycle studies

Course offered in

Polish

Form of study

full-time

Requirements

elective

Number of hours

Lecture

15

Laboratory classes

15

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

2

Lecturers

Responsible for the course/lecturer:

dr hab. inż. Jacek Różański

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tel. 61 665 2147

Responsible for the course/lecturer:

Prerequisites

Students starting this subject should have basic knowledge in mathematics, physics, chemistry, statistics, engineering graphics, and materials technology. They should also have the ability to use spreadsheets, performing statistical analysis of measurement results and be ready to work in a team.

Course objective

1. Getting students with the basic knowledge of technical rheology, non-Newtonian fluid mechanics.

2. Development of ability of performing rheological studies and practical use of the obtained experimental results.

Course-related learning outcomes

Knowledge

1. Student knows the basic rheological properties of time-independent and time dependent fluids,

viscoelastic fluids, magneto- and electrorheological fluids and methods of their mathematical description - [K_W11]

2. Student knows the theoretical basis of capillary and rotational rheometry, measurement methods of viscoelastic properties of fluid, advantages and disadvantages of the different measurement methods and principles of their selection - [K_W11]

3. Student knows the basic rheological properties of polymeric fluids, two-phase systems and biomaterials used in the chemical industry - [K_W09]

Skills

1. Student can perform rheological measurements using different methods - [K_U07], [K_U28]

2. Student can distinguish, based on the experimental studies, the rheological properties of various non-Newtonian fluids and to use appropriate mathematical rheological models to describe the flow curves - [K_U14]

3. Student is able to find the relation between rheological properties of fluid and their application - [K_U16]

Social competences

1. Student understands the need to enhance their knowledge and skills due to the rapid development in the chemical industry. She/he is aware that continuous training is the way to remain competitive in the labour market - [K_K01]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired during the lecture is verified during the test. The test consists of about 30 closed questions. Minimum threshold: 50% points. The issues, on the basis of which questions are formed, will be sent to students by e-mail using the university e-mail system.

Skills and knowledge acquired as part of the laboratory are verified on a daily basis based on oral answers and 2 final tests, consisting of 30 test questions and 4-6 open questions for the same number of points.

Programme content

The course covers the following topics:

1. The elastic, viscous and viscoelastic response

2. Time as an additional parameter in characterizing material response

3. Non-Newtonian fluids: definition, the concept of a generalized Newtonian fluids, classification

4. Mathematical descriptions of flow curves of time-independent fluids

5. The interpretation of the phenomena of shear thickening and shear thinning

6. Yield stress fluids (microstructure and methods of determining the yield stress)

7. Time-dependent fluids (thixotropy and anti-thixotropy)

8. Normal stress effects (Weissenberg effect, Barus effect)

9. Magnetorheological and electrorheological fluids

10. Viscometric flows

11. Characteristics of viscometers (gravitational capillary viscometers, orifice viscometers, falling ball viscometers)

12. Capillary rheometry - basic equations.

13. Rotational rheometry - basic equations.

14. Rheological properties of selected non-Newtonian fluids

Teaching methods

1. Lecture: multimedia presentation, illustrated with examples on the board.

2. Laboratory exercises: performing rheological measurements using viscometers and rheometers.

Bibliography

Basic

1. M. Dziubiński, T. Kiljański, J. Sęk, Podstawy teoretyczne i metody pomiarowe reologii, Wydawnictwo Politechniki Łódzkiej, Łódź 2014.

2. M. Dziubiński, Kiljański T., Sęk J.: Podstawy reologii i reometrii płynów, Wydawnictwo Politechniki Łódzkiej, Łódź 2009.

3. K. Wilczyński: Reologia w przetwórstwie tworzyw sztucznych, Wydawnictwo Naukowo-Techniczne, Warszawa 2001.

4. Z. Orzechowski, J. Prywer, R. Zarzycki: Mechanika płynów w inżynierii środowiska, WNT, Warszawa 1997.

Additional

1. J. Ferguson, Z. Kembłowski: Reologia stosowana płynów, Wydawnictwo Marcus s.c., Łódź 1995.

2. T. Kiljański, M. Dziubiński, J. Sęk, K. Antosik: Wykorzystanie właściwości reologicznych płynów w praktyce inżynierskiej, Wydawca EKMA Krzysztof Antosik, Warszawa 2009.

3. Z. Kembłowski, T. Kiljański: Ćwiczenia laboratoryjne z reometrii technicznej, Wydawnictwo Politechniki Łódzkiej, Seria: Skrypty, Łódź 1993.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	35	1,5
Student's own work (literature studies, preparation for laboratory classes, preparation for tests) [1]	15	0,5

[1] delete or add other activities as appropriate