COURSE DESCRIPTION CARD - SYLLABUS

Course name
Technical rheology [S1TCh2>RT]

Course

Field of study
Chemical Technology

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

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

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Lecturers

Prerequisites

Students starting this subject should have basic knowledge in mathematics, physics, chemistry, statistics, engineering graphics, physical chemistry, thermodynamics, chemical engineering, 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 25 closed questions. Minimum threshold: 51% 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. The online test will be conducted on the same terms via the eKursy platform.
Skills and knowledge acquired as part of the laboratory are verified on a daily basis based on oral answers. To pass the laboratory you must:
1. Provide an oral answer from the material contained in the exercises and from the given issues (each failing grade must be corrected to a positive).
2. Perform all laboratory exercises provided in the study program
3. Get passes for reports on the exercises performed.
4. The final grade will be issued based on the arithmetic mean calculated from all grades obtained from the oral responses according to the scale: up to 2.74 - unsatisfactory; from 2.75 to 3.24 - sufficient; from 3.25 to 3.74 - a sufficient plus; from 3.75 to 4.24 - good; from 4.25 to 4.74 - a good plus; from 4.75 - very good.
Passing the laboratory will be in an online form, carried out on the same terms via the eMeeting platform or another platform recommended by the Poznań University of Technology.

Programme content

Issues in the field of technical rheology, non-Newtonian fluid mechanics.

Course topics

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	2,00
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)	20	1,00