COURSE DESCRIPTION CARD - SYLLABUS

Course name

Applied Rheology

Course

Field of study	Year/Semester
Chemical Technology	I/1
Area of study (specialization)	Profile of study
Compoites and nanomaterials	general academic
Level of study	Course offered in
Second-cycle studies	English
Form of study	Requirements
full-time	compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	30	
Tutorials	Projects/seminars	

Number of credit points

2

Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

Prerequisites

The student knows: basis of mathematical analysis, basis of chemistry and physics

The student has the skills: the use of spreadsheets, statistical analysis of measurement results, principles of technical drawings

The student knows the limitations of his knowledge and foresees the need for the dredging.

Course objective

Getting students with the basic knowledge of technical rheology, in particular with properties of non-Newtonian fluids and their microstructure, rheometry and methods of calculation of pressure loss.

Development of ability of perform rheological study and practical use of the results obtained from experiment

Course-related learning outcomes

Knowledge

1. Student knows the basic concepts of rheology: dynamic, kinematic and extensional viscosity, flow and viscosity curves, Deborah number, classification of fluids - [K_W11]

2. 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]

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

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

5. Student knows the methods of calculating the pressure loss for different classes of non-Newtonian fluids in pipelines and columns. - [K_W11, K_W15]

Skills

1. Student is able to select an appropriate measurement method for determining the rheological properties of the various fluids - [K_U08; K_U18]

2. Student can perform rheological measurements using different methods. - [K_U08; K_U12]

3. Student is able to 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_U08]

4. Student is able to find relation between rheological properties of fluid and their application. - [K_U07]

Social competences

1. The student understands the need to broaden their knowledge and skills due to the rapid advances in the chemical industry. He is aware that continuous training is a way to remain competitive in the labor market. - [K_K01]

2. The student can independently and as a team perform various tasks. He is aware of the responsibility for their implementation within the team. - [K_K04]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired as the lecture is verified by the test in the form of a multiple-choice test carried out on the penultimate lecture. The exam consists of 15-20 questions (closed) and the threshold is 50%

of the points. The exam issues are delivered to students at the beginning of each subsequent lecture (for the subject of the previous one).

The knowledge acquired within the laboratory is verified by three colloquium: the first in the form of a closed test, the rest of the open test. In addition, the verification is carried out by student-prepared laboratory exercise reports. Student will obtain positive grade when: all exercises are performed (6), all reports are accepted and student received positive grades from all tests.

Programme content

Elastic, viscose and viscoelastic response; Time as a parameter characterizing the substance response; Simple shear of solids and fluids; Effect of temperature and pressure on the rheological properties of fluids; Non-Newtonian fluids: definition, concept of generalized Newtonian fluid, division; Mathematical rheological models of rheostable fluids; Fluids from the flow limit (the reasons for the method of determining the flow limit); Normal stress effects (Weissenberg effect, Barus effect); Mechanical models of liquid (Maxwell, Kelvin); Electro- and magnetoological liquids; Vicosimetric flows; siscosimeters; Capillary rhemetry of the basic rhemetry equation - basic equations

Teaching methods

Multimedia presentation, presentation illustrated with examples on the table, and resolving tasks provided by the lecturer; laboratory classes

Bibliography

Basic

1. Chhabra R.P., Bubbles, drops and particles in non-Newtonian fluids, CRC Taylor and Francis, Boca Raton 2007.

2. Chhabra R.P., Richardson J.F., Non-Newtonian flow and applied Rheology, Elsevier, Amsterdam 2008.

3. Steffe, J.F. Daubert C.R., Bioprocessing pipelines: Rheology and analysis, Freeman Press, East Lansing 2006.

4. Steffe, J.F., Rheological methods in food proces engineering, Freeman Press, East Lansing 1996..

Additional

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

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

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

4. Z. Kembłowski: Reometria płynów nienewtonowskich, Wydawnictwo Naukowo-Techniczne, Warszawa 1973.

5. A. Ławniczak, A. Mielecki: Ciecze elektro- i magnetoreologiczne oraz ich zastosowania w technice, Wydawnictwo Politechniki Poznańskiej, Poznań 1999.

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

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

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

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	45	1,2
Student's own work (literature studies, preparation fo classes, preparation for defence/exam, project preparation) [1]	5	0,8

[1] delete or add other activities as appropriate