UNIVERSITATEA BABEŞ-BOLYAI
BABEŞ-BOLYAI TUDOMÁNYEGYETEM
BABEŞ-BOLYAI UNIVERSITÄT
BABEŞ-BOLYAI UNIVERSITY
TRADITIO ET EXCELLENTIA

Tradiție și Excelență prin
Cultură - Știință - Inovație din 1581

Facultatea de Chimie și Inginerie Chimică

Str. Arany János nr. 11
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SYLLABUS

Rheology of Disperse Systems

University year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	Babeș-Bolyai University Cluj-Napoca
1.2. Faculty	Chemistry and Chemical Engineering
1.3. Department	Chemical Engineering
1.4. Field of study	Chemical Engineering
1.5. Study cycle	Master
1.6. Study programme/Qualification	Advanced Chemical Process Engineering/ Master
1.7. Form of education	Full time education

2. Information regarding the discipline

2.1. Name of the discipline	**Rheology of disperse systems**					Discipline code	**CME7314**
2.2. Course coordinator					Assoc. Prof. Adina MICLĂUȘ		
2.3. Seminar coordinator					Assoc. Prof. Adina MICLĂUȘ		
2.4. Year of study	I	2.5. Semester	1	2.6. Type of evaluation	E	2.7. Discipline regime	DS

3. Total estimated time (hours/semester of didactic activities)

3.1. Hours per week	**4**	of which: 3.2 course	**2**	3.3 seminar/laboratory	1/1
3.4. Total hours in the curriculum	56	of which: 3.5 course	28	3.6 seminar/laborator	14/14
Time allotment for individual study (ID) and self-study activities (SA)					hours
Learning using manual, course support, bibliography, course notes (SA)					28
Additional documentation (in libraries, on electronic platforms, field documentation)					14
Preparation for seminars/labs, homework, papers, portfolios and essays					23
Tutorship					2
Evaluations					2
Other activities:					
3.7. Total individual study hours	**69**				
3.8. Total hours per semester	**125**				
3.9. Number of ECTS credits	**5**				

4. Prerequisites (if necessary)

4.1. curriculum	Not necessary
4.2. competencies	Not necessary

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5. Conditions (if necessary)

5.1. for the course	Students will be present at lectures, seminars and laboratories with phones turned off.
5.2. for the seminar /lab activities	Students will be present at the laboratories with the paper written and studied. Students will be present at the laboratories with the robe. Students may not leave operating apparatus/equipment. Laboratory reports will be done no later than the last week of the teaching activity. Delay will be penalized.

6. Specific competencies acquired [1]

Professional/essential competencies	Development of processes, machines and equipment specific to the process engineering by the knowledge and application of new solutions specific to the real behavior of materials • Use of creative expertise, methods and concepts for analysis and synthesis of new chemical processes. • Use of integrated chemical analysis and synthesis for process development and production of innovative products. • Application of performance evaluation of new modern facilities to improve the decision concerning processes and synthesis.
Transversal competencies	• Realization of tasks according to the demands and in require terms, with the respect of the ethical professional norms • Solving the tasks according to the general objective established in the work group • Permanent information and documentation in the field.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	Knowledge of principles, methods and mechanisms of the bodies' behavior (fluids, solids) subjected to flow/distortion that appears during the real industrial processes.
7.2 Specific objective of the discipline	The ability to establish and to choose the models proper to the studied properties of materials, applying the correct research methods.

8. Content

8.1 Course	Teaching methods	Remarks
8.1.1. Introduction. Fundamental concepts of rheology. Specific deformation, shear stress, shear rate. Flow behavior and viscosity. Influence of	Lecture Discussion	

[1] One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

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temperature on viscosity. Elasticity of materials.		
8.1.2. Systems with uniform properties Linear rheological behavior of fluids with uniform properties (Newton's fluid, Hook's solid and St. Venant's plastic). Mathematical models for systems with ideal behavior.	Lecture Discussion	
8.1.3. Viscous fluids with non-Newtonian time-independent behavior Fluids with time-independent structure (shear thinning or pseudo-plastic flow behavior, shear thickening or dilatants flow behavior). Rheological model functions, specific flow curves and viscosity functions.	Lecture Discussion	
8.1.4. Viscous fluids with non-Newtonian time-independent behavior. Yield point. Determination of the yield point. Rheological model functions for flow curves including a yield point.	Lecture Discussion	
8.1.5. Viscous fluids with non-Newtonian time-dependent behavior Time-dependent fluid flow behavior (thixotropic fluids). Rheological model functions, specific flow curves and viscosity functions. Structural decomposition and regeneration. Test methods.	Lecture Discussion	
8.1.6. Viscous fluids with non-Newtonian time-dependent behavior Time-dependent fluid flow behavior (rheopexic fluids). Rheological model functions, specific flow curves and viscosity functions. Structural decomposition and regeneration. Test methods.	Lecture Discussion	
8.1.7. Materials with multiple properties Introduction. Viscoelastic behavior. Basic principles. Theoretical and mechanical models for viscoelastic liquids (Maxwell) and viscoelastic solids (Voigt-Kelvin). Complex models: Burgers, Lethersich, Zener. Creep and creep recovery curves. Examples of the behavior of viscoelastic materials in practice.	Lecture Discussion	
8.1.8. Materials with multiple properties Oscillatory tests - "dynamic mechanical analysis" (DMA). Elastic behavior and characteristic rheological parameters. Specific tests: amplitude sweep, frequency sweep and temperature sweep.	Lecture Discussion	
8.1.9. Rheology of polymeric liquid systems Rheological behavior of colloidal solutions. Factors that influence the viscosity and rheological behavior of solutions.	Interactive lecture	
8.1.10. Rheology of polymeric liquid systems	Lecture Discussion	

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Rheological behavior of emulsions and gels. Factors that influence the viscosity and rheological behavior of emulsions and gels.		
8.1.9. Rheology of polymeric liquid systems Rheological behavior of colloidal solutions. Factors that influence the viscosity and rheological behavior of solutions.	Lecture Discussion	
8.1.10. Rheology of polymeric liquid systems Rheological behavior of emulsions and gels. Factors that influence the viscosity and rheological behavior of emulsions and gels.	Lecture Discussion	
8.1.11. Rheology of polymeric liquid systems Rheological behavior of suspensions and pastes. Influence of different factors on viscosity and rheological behavior. Complex fluids.	Lecture Discussion	
8.1.12. Rheometry. Rheological measurements in static regime. Rotational rheometers. Measuring systems and specific tests.	Lecture Discussion	
8.1.13. Rheometry. Rheological measurements in dynamic regime. Oscillatory rheometers. Measuring systems and specific tests.	Lecture Discussion	
8.1.14. Rheometry. Temperature-dependent flow behavior (rotation). Temperature-dependent visco-elastic behavior (oscillation).	Lecture Discussion	

Bibliography

1. R. Z. Tudose, T. Volintiru, N. Asandei, M. Lungu, E. Merică şi Gh. Ivan, „Reologia compuşilor macromoleculari, I. Introducere în reologie”, Ed. Tehnică, Bucureşti, 1982
2. R. Z. Tudose, T. Volintiru, N. Asandei, M. Lungu, E. Merică şi Gh. Ivan, „Reologia compuşilor macromoleculari, II. Reologia stării lichide”, Ed. Tehnică, Bucureşti, 1984
3. R.P. Chhabra, J. F. Richardson, „Non-Newtonian Flow in the process Industries. Fundamentals and Engineering Applications”, Ed. Butterworth Heinemann, 1999
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5. N. Teodorescu, „Reologie Aplicată”, Ed. Matrix Rom, Bucureşti, 2004
6. Adina L. Ghirişan, „Separarea fizico-mecanică a sistemelor eterogene solid-lichid”, Ed. Casa Carţii de Ştiintă, Cluj-Napoca, (subcap. Comportarea reologică a sistemelor eterogene solid-lichid), 2005
7. Thomas G. Mezger, „The Rheology Handbook: For users of rotational and oscillatory rheometers”, 2nd Edition, Ed.Vincentz Network (Coatings Compendia), 2006
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10. M. Bercea, „Reologia polimerilor. Ecuaţiile mediului continuu deformabil”, Vol. I, şi „Reologia polimerilor. Comportarea viscoelastică a polimerilor”, Vol. II, Ed. Tehnopress, Iaşi, 2009
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13. A. Miclăuş (Ghirişan), „Rheology of Disperse Systems”, Curs Power-Point

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8.2 Seminar	Teaching methods	Remarks
8.2.1. Viscosity. Influence of thermodynamic parameters on viscosity of liquid systems. Fitting functions for temperature-dependent viscosity curves. Determination of activation energy.	Problems Discussions Analysis and interpretation	2 hours at 2 weeks
8.2.2. Shear stress and shear rate. Calculation of shear rates for technical processes.	Problems Discussions Analysis and interpretation	2 hours at 2 weeks
8.2.3. Mathematical models (functions) for flow and viscosity curves. Numerical application.	Problems Discussions Analysis and interpretation	2 hours at 2 weeks
8.2.4. Laminar flow in circular tubes for Non-Newtonian fluids. Determination of velocity, flow rate and pressure drop. Numerical application.	Problems Discussions Analysis and interpretation	2 hours at 2 weeks
8.2.5. Sedimentation of particles in Non-Newtonian fluids. Determination of settling velocity. Hindered settling. Numerical application.	Problems Discussions Analysis and interpretation	2 hours at 2 weeks
8.2.6. Motion of bubbles and drops. Numerical application.	Problems Discussions Analysis and interpretation	2 hours at 2 weeks
8.2.7. Flow through packed beds of particles (porous media). Numerical application.	Problems Discussions Analysis and interpretation	2 hours at 2 weeks
8.3 Laboratory		
8.3.1. Rheometry. Presentation of some viscometers and rheometers. Methods used for viscosity determination.	Discussions	2 hours at 2 weeks
8.3.2. Experimental determination of fluids viscosity using different types of viscometers (Hoeppler, Visco-Star, Brookfield).	Experimental tests Discussions Analysis and interpretation	2 hours at 2 weeks
8.3.3. Experimental measurements for different Newtonian and Non-Newtonian fluids using the rotational rheometer Rheotest II at constant temperature. Interpretation of rheological behavior using specific curves.	Experimental tests Discussions Analysis and interpretation	2 hours at 2 weeks
8.3.4. Determination of specific parameters and interpretation of different mathematical models applied to tested fluids.	Experimental tests Discussions Analysis and interpretation	2 hours at 2 weeks
8.3.5. Experimental measurements for some solutions, emulsions, suspensions, pastes etc., at different thermal conditions.	Experimental tests Discussions Analysis and interpretation	2 hours at 2 weeks
8.3.6. Determination of specific parameters and interpretation of activation energy obtained for tested systems.	Experimental tests Discussions Analysis and interpretation	2 hours at 2 weeks
8.3.7. Rheological behavior of viscoelastic systems. Interpretation of some results obtained by oscillatory tests.	Experimental tests Discussions Analysis and interpretation	2 hours at 2 weeks

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9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- To establish the formative content of the course and laboratory work teaching and research personal from chemistry and chemical engineering departments from our faculty and from other universities have been invited.
- By instructing the theoretical and practical concepts of **Rheology of disperse systems** course, the students will get the knowledge in accordance with the competencies included in the Diploma Supplement and the qualifications from ANC.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	The capacity to understand the relevance of Rheology in Materials Science and Engineering and to apply the knowledge gained in solving real-world engineering problems.	The presence to exam depends on participation to the laboratory work and on the quality of reports.	60 %
	The ability to establish and to choose the models proper to the studied properties of materials, applying the correct research methods.	The reports of the lab work will be done no later than the last week of the teaching activity.	
10.5 Seminar/laboratory	Capacity to analyze the theoretical and experimental models proper to describe the rheological behavior of materials in real applications. The activity during the lab work and the quality of reports.	Students will be evaluated during the semester (at seminar and laboratory), in order to verify the individual interest, correctness of learning and knowledge gained.	40 %

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10.6 Minimum standard of performance
• 6 (six) in lab and examination according to the standard.

11. Labels ODD (Sustainable Development Goals)[2]

Date:
30.03.2025

Signature of course coordinator

Signature of seminar coordinator

Date of approval:
...21.04.2025

Signature of the head of department
.....

[2] Keep only the labels that, according to the *Procedure for applying ODD labels in the academic process*, suit the discipline and delete the others, including the general one for *Sustainable Development* – if not applicable. If no label describes the discipline, delete them all and write „*Not applicable*.".