COURSE DESCRIPTION

Rheology of Disperse Systems

Academic year 2026 - 2027

1. Programme-related data

1.1. Higher Education Institution	Babeş-Bolyai University Cluj-Napoca
1.2. Faculty	Chemistry and Chemical Engineering
1.3. Department	Chemical Engineering
1.4. Field	Chemical Engineering
1.5. Level of study	Master
1.6. Degree programme / Qualification	Advanced Chemical Process Engineering/ Master
1.7. Form of education	Full time education

2. Course-related data

2.1. Course title	**Rheology of disperse systems**			Course code	**CME7314**
2.2. Course coordinator	Assoc. Prof. Adina MICLĂUŞ				
2.3. Seminar coordinator	vacant position				
2.4. Year of study	I	2.5. Semester	1	2.6. Type of assessment	Exam
2.7. Course status	Compulsory			2.8. Course type	Specialisation subject

3. Total estimated time (hours per semester of teaching activities)

3.1. Number of hours per week	**4**	of which: 3.2. course	**2**	3.3. seminar/ laboratory	**1/1**
3.4. Total of hours in the curriculum	56	of which: 3.5. course	28	3.6. seminar/ laboratory	**14/14**
Time allocation for individual study (IS) and self-taught activities (ST)					**hours**
Learning from textbooks, course materials, bibliography, and notes (IS)					28
Additional research in the library, on subject-specific electronic platforms, and on-site					14
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					23
Tutoring (professional guidance)					2
Examinations					2
Other activities					-
3.7. Total hours of individual study (IS) and self-taught activities (ST)				**69**	
3.8. Total hours per semester				**125**	
3.9. Number of credits				**5**	

4. Prerequisites (where applicable)

4.1. curriculum-related	Not necessary
4.2 skills-related	Not necessary

5. Specific conditions (where applicable)

5.1. course-related	Students will be present at lectures, seminars and laboratories with phones turned off.
5.2. seminar/laboratory-related	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.

6.1. Competencies resulting from the completion of the degree programme *(as referred to in the curriculum)*[1]

Professional competencies	
Competency code	**Competency**
PC1	Description, analysis and use of elaborate theories and concepts in the fields of chemistry and process advanced chemical engineering.
PC5	Identifying and defining a research theme in the field of chemical engineering process, elaboration and implementation of a plan for achieving the objectives proposed and valuing the scientific research results obtained.
Transversal competencies	
Competency code	**Competency**
TC1	Independent execution of complex professional assignments and autonomous development of project-research activities by using computer-assisted techniques and by observing the norms of professional ethics and moral conduct.
TC2	Planning, monitoring, and assuming the duties of a subordinate professional group. Demonstrating the capacity of coordination, analytical thinking, adaptability and flexibility, collaboration with team members.

6.2. Learning outcomes relevant to the degree programme (as referred to in the curriculum)[2]

Learning outcomes targeted by the subject		
Competency code	**Knowledge and comprehension**	**Specific academic skills**
PC6, CT2	2.Knowledge of concepts and theories specific to resources and quality management for process engineering, in the context of sustainable development	2.Use of qualitative and quantitative methods for assessing risk factors, operational safety and management, in the development of new projects for resources and quality management

7. Subject-specific learning outcomes

Knowledge and comprehension
1. Knowledge of advanced concepts, theories, and methods in the field of chemistry and chemical engineering, relevant for the analysis and modelling of technological processes.
2. Understanding of scientific research methods and the stages of conducting an experimental approach, including hypothesis formulation, experiment design, and result interpretation.
3. Knowledge of the principles of efficient use of resources and tools specific to process engineering, in the context of sustainable development.
Specific academic skills
1. Application of analysis and calculation methods to solve problems specific to chemical engineering, including process modelling and optimization.
2. Design and execution of experiments or applied studies, as well as critical interpretation of results in order to validate proposed solutions.
3. Development and implementation of technical solutions or projects, using project management principles and domain-specific tools.

[1] The professional and/or transversal skills targeted by the subject for which the course description is prepared will be copied from the curriculum of the degree programme. For each competency, the complete entry, including the competency code, will be copied with the exact wording that appears in the curriculum, without any changes. If no competency is copied from either of the two categories, the row corresponding to that category is deleted from the table.

[2] The learning outcomes relevant for the degree programme and targeted by the subject for which the course description is prepared will be listed. The entries, copied without any changes from the Curriculum by subject type (Core Subject/Specialisation Subject/Complementary Subject), are listed under the corresponding competency.

8. Contents

8.1. Course	Teaching and learning methods	Remarks[3]
8.1.1. Introduction. Fundamental concepts of rheology. Specific deformation, shear stress, shear rate. Flow behavior and viscosity. Influence of temperature on viscosity. Elasticity of materials.	Lecture Discussion	
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.	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		

[3] For example, organisational aspects, recommendations for students, specific aspects relating to the course/seminar, such as inviting experts in the field, etc.

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
4. R. Z. Tudose, „Ingineria proceselor fizice din industria chimică”, Ed. Academiei Române, vol.I Fenomene de transfer, 2000
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
8. M. Lungu, C. Ibănescu, „Proprietăţi reologice ale sistemelor polimere. Teorie şi aplicaţii”, Ed. Performantica, Iaşi, 2008
9. M. Mateescu, „Reologia alimentului”, Ed. Eurostampa, Timişoara, 2008
10. M. Bercea, „Reologia polimerilor. Ecuaţiile mediului continuu deformabil”, Vol. I, şi „Reologia polimerilor. Comportarea viscoelastică a polimerilor”, Vol. II, Ed. Tehnopress, Iaşi, 2009
11. C. Ibănescu, „Reologia sistemelor polimerice multifazice”, Suport de curs, Iaşi, 2013
12. A. Miclăuş (Ghirişan), V. Pode, „Cazuri particulare de curgere a fluidelor ideale şi reale. Elemente de reologie”, Casa Cărţii de Ştiinţă, Cluj-Napoca, 2018
13. A. Miclăuş (Ghirişan), „Rheology of Disperse Systems”, Curs Power-Point

8.2. Seminar	**Teaching and learning 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.		2 hours at 2 weeks
8.2.3. Mathematical models (functions) for flow and viscosity curves. Numerical application.		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.		2 hours at 2 weeks
8.2.5. Sedimentation of particles in Non-Newtonian fluids. Determination of settling velocity. Hindered settling. Numerical application.		2 hours at 2 weeks
8.2.6. Motion of bubbles and drops. Numerical application.		2 hours at 2 weeks
8.2.7. Flow through packed beds of particles (porous media). Numerical application.		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.		2 hours at 2 weeks
8.3.4. Determination of specific parameters and interpretation of different mathematical models applied to tested fluids.		2 hours at 2 weeks
8.3.5. Experimental measurements for some solutions, emulsions, suspensions, pastes etc., at different thermal conditions.		2 hours at 2 weeks
8.3.6. Determination of specific parameters and interpretation of activation energy obtained for tested systems.		2 hours at 2 weeks
8.3.7. Rheological behavior of viscoelastic systems. Interpretation of some results obtained by oscillatory tests.		2 hours at 2 weeks

Bibliography

1. R.P. Chhabra, J. F. Richardson, „Non-Newtonian Flow in the process Industries. Fundamentals and Engineering Applications”, Ed. Butterworth Heinemann, 1999
2. N. Teodorescu, „Reologie Aplicată”, Ed. Matrix Rom, Bucureşti, 2004
3. Adina Lucreţia 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
4. Thomas G. Mezger, „The Rheology Handbook: For users of rotational and oscillatory rheometers”, 2nd Edition, Ed.Vincentz Network (Coatings Compendia), 2006
5. M. Lungu, C. Ibănescu, „Proprietăţi reologice ale sistemelor polimere. Teorie şi aplicaţii”, Ed. Performantica, Iaşi, 2008
6. M. Mateescu, „Reologia alimentului”, Ed. Eurostampa, Timişoara, 2008
7. A. Miclăuş (Ghirişan), V. Pode, „Cazuri particulare de curgere a fluidelor ideale şi reale. Elemente de reologie”, Casa Cărţii de Ştiinţă, Cluj-Napoca, 2018
8. A. Miclăuş (Ghirişan), „Rheology of disperse Systems”, Curs Power-Point

9. Evaluation

Type of activity	9.1 Evaluation criteria[4]	9.2 Evaluation methods[5]	9.3 Percentage in the final grade
9.4. 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.	
9.5. 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 %
9.6 Minimum standard for passing			
• 6 (six) in lab and examination according to the standard.			

10. SDG labels (Sustainable Development Goals)[6]

	◯	Sustainable Development Generic Label

[4] The evaluation criteria must directly reflect the learning outcomes targeted at the level of the degree programme respectively at the level of the subject. More specifically, the learning outcomes set out in the expected learning outcomes are assessed.

[5] Both final evaluation methods and ongoing evaluation strategies should be established.

[6] Select a single label which, according to the *Implementation of SDG labels in the academic process*, best matches the subject. If the subject addresses sustainable development in a generic manner (i.e. by presenting/introducing the general framework of sustainable development, etc.), then the Sustainable Development generic label may be applied. If none of the labels describe the subject, select the last option: *"No label applies."*

1 FĂRĂ SĂRĂCIE	2 FOAMETE „ZERO”	3 SĂNĂTATE ȘI BUNĂSTARE	4 EDUCAȚIE DE CALITATE	5 EGALITATE DE GEN	6 APĂ CURATĂ ȘI SANITAȚIE	7 ENERGIE CURATĂ ȘI LA PREȚURI ACCESIBILE	8 MUNCĂ DECENTĂ ȘI CREȘTERE ECONOMICĂ	9 INDUSTRIE, INOVAȚIE ȘI INFRASTRUCTURĂ
								xx
10 INEGALITĂȚI REDUSE	11 ORAȘE ȘI COMUNITĂȚI DURABILE	12 CONSUM ȘI PRODUCȚIE RESPONSABILE	13 ACȚIUNE CLIMATICĂ	14 VIAȚA ACVATICĂ	15 VIAȚA TERESTRĂ	16 PACE, JUSTIȚIE ȘI INSTITUȚII EFICIENTE	17 PARTENERIATE PENTRU REALIZAREA OBIECTIVELOR	No label applies

Date of entry:
5 Mai 2026

Signature of course coordinator

Assoc. Prof. Adina MICLĂUȘ

Signature of seminar coordinator

vacant

Date of approval in the department:
5 mai 2026

Signature of the head of department

Prof. habil. dr. ing. Graziella L. Turdean