SYLLABUS

1. Information regarding the programme

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 of study	Chemical Engineering
1.5 Study cycle	Master
1.6 Study programme / Qualification	**Advanced Chemical Process Engineering)/ Master Chemical Engineer**

2. Information regarding the discipline

2.1 Name of the discipline	**Rheology of disperse systems - CMX7312**						
2.2 Course coordinator		Conf. Adina MICLĂUŞ					
2.3 Seminar coordinator		Conf. Adina MICLĂUŞ					
2.4 Year of study	I	2.5 Semester	1	2.6. Type of evaluation	E	2.7 Type of discipline	Ob

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

3.1 Hours per week	3	Of which: 3.2 curs	2	3.3 seminar/laboratory	1
3.4 Total hours in the curriculum	42	Of which: 3.5 curs	28	3.6 seminar/laboratory	14

Time allotment:	ore
Learning using manual, course support, bibliography, course notes	36
Additional documentation (in libraries, on electronic platforms, field documentation)	32
Preparation for seminars/labs, homework, papers, portfolios and essays	32
Tutorship	4
Evaluations	4
Other activities:	

3.7 Total individual study hours	108
3.8 Total hours per semester	150
3.9 Number of ECTS credits	6

4. Prerequisites (if necessary)

4.1. curriculum	● Not necessary
4.2. competencies	● Not necessary

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. ● Laboratory reports will be done no later than the last week of the teaching activity. ● Delay will be penalized.

6. Specific competencies acquired

Professional competencies		Development of processes, machines and equipment specific to the process engineering by promoting new solutions to improve processes, optimal operation and control • 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	• Knowledge of principles, methods and mechanisms of the bodies' behavior (fluids, solids) subjected to flow/distortion which appears during the real industrial processes.
7.2 Specific objectives	• 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
Introduction. Fundamental concepts of rheology. Specific deformation, shear stress, shear rate. Flow behavior and viscosity. Elasticity.	Interactive lecture	1 lecture, 2 hours
Systems with uniform properties Linear rheological behavior of fluids with uniform properties (Newton's fluid, Hook's solid and St. Vanant's plastic). Model functions for systems with ideal behavior.	Interactive lecture	1 lecture, 2 hours
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. Yield point. Determination of the yield point.	Interactive lecture	2 lectures, 4 hours
Viscous fluids with non-Newtonian time-dependent	Interactive lecture	2 lectures, 4 hours

behavior Time-dependent fluid flow behavior (thixotropic and rheopexic fluids). Rheological model functions, specific flow curves and viscosity functions. Structural decomposition and regeneration. Test methods for investigating thixotropy and rheopexy.		
Materials with multiple properties Viscoelastic behavior. Basic principles. Theoretical and mechanical models: Maxwell, Voigt-Kelvin, Lethersich, Zener. Examples of the behavior of viscoelastic liquids and solids in practice.	Interactive lecture	2 lectures, 4 hours
Rheology of liquid systems Rheology behavior of solutions, colloids, emulsions, suspensions and pastes: influence of solid concentration, shape, size and distribution of disperse phase, influence of mechanical and hydrodynamic effects on the rheological behavior. Electro-viscous effect. Analysis methods.	Interactive lecture	3 lectures, 6 hours
Rheometry. Rheological measurements in static and dynamic regime. Rotational and oscillatory rheometers. Measuring systems and tests. Creep tests. Relaxation tests.	Interactive lecture	3 lectures, 6 hours

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. Z. Tudose, T. Volintiru, N. Asandei, M. Lungu, E. Merică şi Gh. Ivan, „Reologia compuşilor macromoleculari, III. Reologia stării solide", Ed. Tehnică, Bucureşti, 1987
4. R.P. Chhabra, J. F. Richardson, „Non-Newtonian Flow in the process Industries. Fundamentals and Engineering Applications", Ed. Butterworth Heinemann, 1999
5. R. Z. Tudose, „Ingineria proceselor fizice din industria chimica", Ed. Academiei Române, v.I Fenomene de transfer, 2000
6. N. Teodorescu, „Reologie Aplicată„, Ed. Matrix Rom, Bucureşti, 2004
7. 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
8. Thomas G. Mezger, „The Rheology Handbook: For users of rotational and oscillatory rheometers", 2nd Edition, Ed. Vincentz Network (Coatings Compendia), 2006
9. M. Lungu, C. Ibănescu, „Proprietăţi reologice ale sistemelor polimere. Teorie şi aplicaţii", Ed. Performantica, Iaşi, 2008
10. Bercea, M., „Reologia polimerilor. Comportarea viscoelastică a polimerilor", Vol. II, Ed. Tehnopress, Iaşi, 2009

8.2 Seminars / laboratory work	Teaching methods	Remarks
Viscosity. Influence of thermodynamic parameters on	Problems	2 hours

viscosity of liquid systems. Fitting functions for temperature-dependent viscosity curves. Determination of activation energy.	Discussions Analysis	
Experimental determination of fluids viscosity using different types of rotational rheometers (Hoeppler, Visco-Star, Brookfield). Interpretation of obtained results.	Experimental tests Discussions Interpretation	2 hours
Determination of specific flow curves and viscosity curves for different Newtonian and non-Newtonian fluids by the rotational rheometer Rheotest 2. Analyze and interpretation of obtained results.	Experimental tests Discussions Interpretation	3 hours
Rheological behavior solutions, emulsions, suspensions, pastes etc. Interpretation of characteristic flow curves.	Problems Discussions	2 hours
Rheological behavior of viscoelastic systems. Interpretation of oscillatory tests.	Problems Discussions	3 hours
Colloquium		2 hours

Bibliography

1. N. Teodorescu, „Reologie Aplicată„, Ed. Matrix Rom, București, 2004
2. Adina Lucreția Ghirișan, „Separarea fizico-mecanică a sistemelor eterogene solid-lichid", Ed. Casa Cartii de Știintă, Cluj-Napoca, (subcap. Comportarea reologică a sistemelor eterogene solid-lichid), 2005
3. Thomas G. Mezger, „The Rheology Handbook: For users of rotational and oscillatory rheometers", 2nd Edition, Ed.Vincentz Network (Coatings Compendia), 2006
4. M. Lungu, C. Ibănescu, „Proprietăți reologice ale sistemelor polimere. Teorie și aplicații", Ed. Performantica, Iași, 2008

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.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the 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 ability to establish and	The presence to colloquium depends on participation to the laboratory work and on the quality of reports. The exam is oral. It will assess thinking, reliability and replies argument.	60 %

	to choose the models proper to the studied properties of materials, applying the correct research methods.		
10.5 Seminar/lab activities	Capacity to analyze the theoretical and experimental models proper to describe the rheological behavior of bodies/fluids in real applications.	The reports of the lab work will be done no later than the last week of the teaching activity.	40 %
	The activity during the lab work and the quality of reports.		

10.6 Minimum performance standards

- 6 (six) in lab and examination according to the standard.
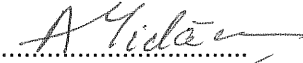

Date   Signature of course coordinator   Signature of seminar coordinator

27.03.2015

Date of approval   Signature of the head of department