SYLLABUS

1. Information on the study programme

1.1. University	West University of Timisoara
1.2. Faculty	PHYSICS
1.3. Department	PHYSICS
1.4. Study program field	PHYSICS
1.5. Study cycle	MASTER
1.6. Study program / qualification	PHYSICS AND TECHNOLOGY OF ADVANCED MATERIALS / according to COR: Analyst - 251201; Research assistant in physics - 211103; Physicist - 211101; Teacher - 233002; Education reviewer – 235106.

2. Information on the course

2.1. Course title			**Rheological characterization of materials**				
2.2. Lecture instructor			Associate Professor Dr. Daniela SUSAN-RESIGA				
2.3. Seminar / laboratory instructor			Associate Professor Dr. Daniela SUSAN-RESIGA				
2.4. Study year	2	2.5. Semester	3	2.6. Examination type	**E**	2.7. Course type	**Opt** PTAM 2303

3. Estimated study time (number of hours per semester)

3.1. Attendance hours per week	3	Out of which: 3.2 course	2	3.3. seminar/laboratory	0/1
3.4. Attendance hours per semester	42	Out of which: 3.5 course	28	3.6. seminar/laboratory	0/14

Distribution of the allocated amount of time:	**ore**
Study of literature, course handbook and personal notes	60
Supplementary documentation at library or using electronic repositories	19
Preparing for seminar/laboratories, homework, reports etc.	19
Exams	5
Tutoring	5
Other activities…	-

3.7. **Total number of hours of individual study**	108
3.8. **Total number of hours per semester**	150
3.9. **Number of credits (ECTS)**	6

4. Prerequisites (if it is the case)

4.1. curriculum	• Solid physics • Electricity and magnetism • Chemistry • Differential and integral calculus
4.2. competences	• General competencies: the ability of analysis and synthesis; accumulation of basic general knowledge; proper use of terminology in physics and computer science in written and oral communication in English; Basic Skills PC operating; ability to work independently and in teams. • Professional Skills: identification and proper use of the main physical laws and principles in a given context; use of software packages for data analysis and processing.

5. Requirements (if it is the case)

5.3 for the lecture	• Laptop + projector
5.4 for the seminar / laboratory	• Magnetorheometer • PC.

6. Specific acquired competences

Professional competences	• Capacity to characterize rheological properties of materials in relation with their applications (1 credit); • Use of methods for rheological investigation of materials (1 credit); • Comparison of experimental results with theoretical models (1 credit).
Transversal competences	• Adaptability to new situations by taking decisions and assuming responsibilities (1 credit); • The ability to manage complex projects and to develop partnerships in economic environments (1 credit); • Creativeness and initiative in solving complex problems (1 credit).

7. Course Objectives

7.1 General objective	• GO: Students identify specific concepts and phenomena of this discipline in a given context, and apply this knowledge in analysis and processing of experimental data.
7.2 Specific objectives	• CO^1: Students define concepts and describe specific phenomena own this discipline; • ApO^2: Students properly use laboratory equipment to perform rheological measurements. • ApO^3: Students process experimental data using software packages and correctly interpret the experimental results. • ApO^4: Students to develop their organizational capacity and investigation. • AtO^5: Students develop their teamwork spirit. • AtO^6: Students appreciate and cultivate a scientific environment based on values and quality.

8. Content

8.1 Lecture – 28 hours	Teaching methods	Remarks, details
1. Introduction – 2 hours. 2. Flow behaviour and viscosity– 2 hours. - Definitions of terms: shear stress, shear rate, viscosity. 3. Flow behaviour and viscosity– 2 hours. - Flow and viscosity curves. - Model function for flow curves 4. Flow behaviour and viscosity– 2 hours. - Time-dependent behaviour of materials - Temperature-dependent behaviour of materials 5. Rotational test– 2 hours. 6. Elastic behaviour and shear modulus– 2 hours.	Lectures, introductory conversation, heuristic conversation, illustration, use of analogies and algorithms, conversation retaining and deepening knowledge conversation.	• The lecture will be interactive, directing learning is facilitated by engaging of students in conversation episodes - to capture their attention, for updating of knowledge previous acquired and to systematization / fixing of new knowledges (GO and CO^1). • It will track the formation of general competence: ability to analyze and synthesize; accumulation of basic general knowledge; proper use of terminology in physics and computer science in written and oral communication in English (GO and CO^1).

7. Viscoelastic behaviour– 2 hours. 8. Creep test and Relaxation test– 2 hours. 9. Oscillatory tests– 2 hours. - Amplitude sweep test - Frequency sweep test 10. Measuring systems– 2 hours. 11. Instruments– 2 hours. 12. Magnetizable fluids– 2 hours. 13. Rheology of magnetizable nanofluids – 2 hours. 14. Rheology of magnetizable composites– 2 hours.		• It will cultivate a scientific environment based on values and quality (AtO[6]). **Main bibliography:** • ppt presentations for each course (provided by the head of discipline). • Mezger, T.G., *The Rheology Handbook*, Curt R. Vincentz Verlag, Hannover, 2002.
Recomended bibliography: • ppt presentations for each course (provided by the head of discipline). • Hackley, V.A., Ferraris, Chiara F., *Guide to Rheological Nomenclature: Measurements in Ceramic Particulate Systems,* NIST Special Publication 946, January 2001. • Ferguson, J., Kemblowski**,** Z., *Applied fluid rheology*, Elsevier Applied Science, London, 1991. • Larson, R.G., *The Structure and Rheology of Complex Fluids*, New York – Oxford, Oxford University Press, 1999. • Mezger, T.G., *The Rheology Handbook*, Curt R. Vincentz Verlag, Hannover, 2002. • Daniela Resiga, L. Vékás, Doina Bica, Adrian Chiriac, *Comportarea reologică a fluidelor magnetizabile*, Editura Orizonturi Universitare, Timişoara, 184 pag., 2002. ISBN – 973-8391-00-8.		
8.2 Seminar ***/*** laboratory	**Teaching methods**	**Remarks, details**
It will perform rheological and magneto-rheological tests using a Physica MCR 300 rheometer in Rheology Laboratory – National Center for Ingineerig of Systems with Complex Fluids, Polytehnica University of Timisoara (**14 hours**): 1. Shear rate dependence of the viscosity. Interpretation of flow / viscosity curves for different materials – 1 hour.	Experiment, date processing and interpretation of experimental data; it will	Students will form / practice / develop: • ability to handle laboratory equipment, to perform measurements, to process data and to interpret experimental results (ApO[2], ApO[3]). • teamwork spirit (AtO[5]).

2. Temperature dependence of the viscosity– 1 hour. 3. Influence of the solid and hydrodynamic volumic fraction on the viscosity of some magnetic fluid samples – 2 hours. 4. Influence of the applied magnetic field on the viscosity of some magnetizable fluids – 1 hour. 5. Creep test and relaxation test – 1 hour. 6. Amplitude sweep and Frequency sweep – 1 hour. 7. Static and dinamic yield stress measurements– 1 hour. 8. Influence of the applied magnetic field on the yield stress of some magnetizable fluids – 1 hour. 9. Influence of the volumic fraction on the yield stress of some magnetizable fluids – 1 hour. 10. Application of the time-temperature superposition principle to magnetic nanofluids – 2 hour. 11. Colloquy – 2 hours.	use analogies and algorithms.	• organizational ability and investigation (ApO^4). It will also track cultivating a scientific environment based on values and quality (AtO^6). It will consider the appropriate use of numerical methods and statistical analysis in processing of specific data. Experimental data and graphs will be achieved using Excel and Origin (ApO^3). To obtain performance will follow the development of the ability to conceive a right to make a report Laboratory (CO^1, ApO^4). In the last meeting it will hold a laboratory colloquium. **Main bibliography:** • Laboratory reports (provided by the head of discipline). • Mezger, T.G., *The Rheology Handbook*, Curt R. Vincentz Verlag, Hannover, 2002.
Recomended bibliography: • Hackley, V.A., Ferraris, Chiara F., *Guide to Rheological Nomenclature: Measurements in Ceramic Particulate Systems,* NIST Special Publication 946, January 2001. • Mezger, T.G., *The Rheology Handbook*, Curt R. Vincentz Verlag, Hannover, 2002. • Laboratory reports (provided by the head of discipline).		

9. Correlations between the content of the course and the requirements of the professional field and relevant employers.

• *Rheological characterization of materials* gives work skills in almost all domains in which the future graduate can work.

10. Evaluation

Activity	10.1 Assesment criteria	10.2 Assesment methods	10.3 Weight in the final mark
10.4 **Course**	• Students identify concepts and describe / explain the specific phenomena of this discipline in a given context (GO, CO^1).	*Summative assessment* • Written test.	**50%**
10.5. Seminar **/ laboratory**	• Students grouped into teams (AtO^5) devise a comprehensive report on a topic specified topic (ApO^4), to show how to make measurements (ApO^2) and processing / interpretation of data (ApO^3). Teams present and discuss these reports (AtO^5, AtO^6).	*Formative assessment:* • Periodic assessment tests. • Laboratory colloquium.	**50%**
10.6 Minimum needed performance for passing			
Mark 5 is corresponds to the minimum accumulated knowledge, i.e. for the student capacity to: • Define the main terms of rheology • Describe the types of rheological behaviour • Describes the main rheological methods of investigation of materials • Attendance in class: course - 50% , labs - 100%.			

Date of completion:
15.09.2022

Course instructor:
Associate Professor
Dr. Daniela SUSAN-RESIGA,

Susan-Resiga Daniela

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Date: 2022.09.15 09:55:53 +03'00'

Date of approval:

Director of the department)
Associate Professor Dr. Cătălin MARIN,