

## 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		<b>Rheological characterization of materials</b>					
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
<b>Distribution of the allocated amount of time:</b>					<b>ore</b>
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...					-
<b>3.7. Total number of hours of individual study</b>		108			
<b>3.8. Total number of hours per semester</b>		150			
<b>3.9. Number of credits (ECTS)</b>		6			

Adresă poștală: Bd. Vasile Pârvan nr. 4, cod poștal 300223,  
Timișoara, jud. Timiș, România  
Număr de telefon: +40-(0)256-592.300 (310)

Adresă de e-mail: [secretariat@e-uvt.ro](mailto:secretariat@e-uvt.ro)

#### 4. Prerequisites (if it is the case)

4.1. curriculum	<ul style="list-style-type: none"> <li>• Solid physics</li> <li>• Electricity and magnetism</li> <li>• Chemistry</li> <li>• Differential and integral calculus</li> </ul>
4.2. competences	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> </ul>

#### 5. Requirements (if it is the case)

5.3 for the lecture	<ul style="list-style-type: none"> <li>• Laptop + projector</li> </ul>
5.4 for the seminar / laboratory	<ul style="list-style-type: none"> <li>• Magnetorheometer</li> <li>• PC.</li> </ul>

#### 6. Specific acquired competences

Professional competences	<ul style="list-style-type: none"> <li>• Capacity to characterize rheological properties of materials in relation with their applications (1 credit);</li> <li>• Use of methods for rheological investigation of materials (1 credit);</li> <li>• Comparison of experimental results with theoretical models (1 credit).</li> </ul>
Transversal competences	<ul style="list-style-type: none"> <li>• Adaptability to new situations by taking decisions and assuming responsibilities (1 credit);</li> <li>• The ability to manage complex projects and to develop partnerships in economic environments (1 credit);</li> <li>• Creativeness and initiative in solving complex problems (1 credit).</li> </ul>

Adresă poștală: Bd. Vasile Pârvan nr. 4, cod poștal 300223,  
Timișoara, jud. Timiș, România  
Număr de telefon: +40-(0)256-592.300 (310)

Adresă de e-mail: [secretariat@e-uvt.ro](mailto:secretariat@e-uvt.ro)

## 7. Course Objectives

7.1 General objective	<ul style="list-style-type: none"> <li>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.</li> </ul>
7.2 Specific objectives	<ul style="list-style-type: none"> <li>CO<sup>1</sup>: Students define concepts and describe specific phenomena own this discipline;</li> <li>ApO<sup>2</sup>: Students properly use laboratory equipment to perform rheological measurements.</li> <li>ApO<sup>3</sup>: Students process experimental data using software packages and correctly interpret the experimental results.</li> <li>ApO<sup>4</sup>: Students to develop their organizational capacity and investigation.</li> <li>AtO<sup>5</sup>: Students develop their teamwork spirit.</li> <li>AtO<sup>6</sup>: Students appreciate and cultivate a scientific environment based on values and quality.</li> </ul>

## 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.	<ul style="list-style-type: none"> <li>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<sup>1</sup>).</li> <li>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<sup>1</sup>).</li> </ul>

Adresă poștală: Bd. Vasile Pârvan nr. 4, cod poștal 300223,  
Timișoara, jud. Timiș, România  
Număr de telefon: +40-(0)256-592.300 (310)

Adresă de e-mail: [secretariat@e-uvt.ro](mailto:secretariat@e-uvt.ro)

<p>7. Viscoelastic behaviour– 2 hours.</p> <p>8. Creep test and Relaxation test– 2 hours.</p> <p>9. Oscillatory tests– 2 hours. - Amplitude sweep test - Frequency sweep test</p> <p>10. Measuring systems– 2 hours.</p> <p>11. Instruments– 2 hours.</p> <p>12. Magnetizable fluids– 2 hours.</p> <p>13. Rheology of magnetizable nanofluids – 2 hours.</p> <p>14. Rheology of magnetizable composites– 2 hours.</p>		<ul style="list-style-type: none"> <li>It will cultivate a scientific environment based on values and quality (AtO<sup>6</sup>).</li> </ul> <p><b>Main bibliography:</b></p> <ul style="list-style-type: none"> <li>ppt presentations for each course (provided by the head of discipline).</li> <li>Mezger, T.G., <i>The Rheology Handbook</i>, Curt R. Vincentz Verlag, Hannover, 2002.</li> </ul>
<p><b>Recomended bibliography:</b></p> <ul style="list-style-type: none"> <li>ppt presentations for each course (provided by the head of discipline).</li> <li>Hackley, V.A., Ferraris, Chiara F., <i>Guide to Rheological Nomenclature: Measurements in Ceramic Particulate Systems</i>, NIST Special Publication 946, January 2001.</li> <li>Ferguson, J., Kemblowski, Z., <i>Applied fluid rheology</i>, Elsevier Applied Science, London, 1991.</li> <li>Larson, R.G., <i>The Structure and Rheology of Complex Fluids</i>, New York – Oxford, Oxford University Press, 1999.</li> <li>Mezger, T.G., <i>The Rheology Handbook</i>, Curt R. Vincentz Verlag, Hannover, 2002.</li> <li>Daniela Resiga, L. Vékás, Doina Bica, Adrian Chiriac, <i>Comportarea reologică a fluidelor magnetizabile</i>, Editura Orizonturi Universitare, Timișoara, 184 pag., 2002. ISBN – 973-8391-00-8.</li> </ul>		
<p><b>8.2 Seminar / laboratory</b></p>	<p><b>Teaching methods</b></p>	<p><b>Remarks, details</b></p>
<p>It will perform rheological and magneto-rheological tests using a Physica MCR 300 rheometer in Rheology Laboratory – National Center for Engineerig of Systems with Complex Fluids, Polytechnica University of Timisoara (<b>14 hours</b>):</p> <p>1. Shear rate dependence of the viscosity. Interpretation of flow / viscosity curves for different materials – 1 hour.</p>	<p>Experiment, date processing and interpretation of experimental data; it will</p>	<p>Students will form / practice / develop:</p> <ul style="list-style-type: none"> <li>ability to handle laboratory equipment, to perform measurements, to process data and to interpret experimental results (ApO<sup>2</sup>, ApO<sup>3</sup>).</li> <li>teamwork spirit (AtO<sup>5</sup>).</li> </ul>

Adresă poștală: Bd. Vasile Pârvan nr. 4, cod poștal 300223,  
Timișoara, jud. Timiș, România  
Număr de telefon: +40-(0)256-592.300 (310)

Adresă de e-mail: [secretariat@e-uvt.ro](mailto:secretariat@e-uvt.ro)

<ol style="list-style-type: none"> <li>2. Temperature dependence of the viscosity– 1 hour.</li> <li>3. Influence of the solid and hydrodynamic volumic fraction on the viscosity of some magnetic fluid samples – 2 hours.</li> <li>4. Influence of the applied magnetic field on the viscosity of some magnetizable fluids – 1 hour.</li> <li>5. Creep test and relaxation test – 1 hour.</li> <li>6. Amplitude sweep and Frequency sweep – 1 hour.</li> <li>7. Static and dinamic yield stress measurements– 1 hour.</li> <li>8. Influence of the applied magnetic field on the yield stress of some magnetizable fluids – 1 hour.</li> <li>9. Influence of the volumic fraction on the yield stress of some magnetizable fluids – 1 hour.</li> <li>10. Application of the time-temperature superposition principle to magnetic nanofluids – 2 hour.</li> <li>11. Colloquy – 2 hours.</li> </ol>	<p>use analogies and algorithms.</p>	<ul style="list-style-type: none"> <li>• organizational ability and investigation (ApO<sup>4</sup>).</li> </ul> <p>It will also track cultivating a scientific environment based on values and quality (AtO<sup>6</sup>).</p> <p>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<sup>3</sup>). To obtain performance will follow the development of the ability to conceive a right to make a report Laboratory (CO<sup>1</sup>, ApO<sup>4</sup>). In the last meeting it will hold a laboratory colloquium.</p> <p><b>Main bibliography:</b></p> <ul style="list-style-type: none"> <li>• Laboratory reports (provided by the head of discipline).</li> <li>• Mezger, T.G., <i>The Rheology Handbook</i>, Curt R. Vincentz Verlag, Hannover, 2002.</li> </ul>
<p><b>Recomended bibliography:</b></p> <ul style="list-style-type: none"> <li>• Hackley, V.A., Ferraris, Chiara F., <i>Guide to Rheological Nomenclature: Measurements in Ceramic Particulate Systems</i>, NIST Special Publication 946, January 2001.</li> <li>• Mezger, T.G., <i>The Rheology Handbook</i>, Curt R. Vincentz Verlag, Hannover, 2002.</li> <li>• Laboratory reports (provided by the head of discipline).</li> </ul>		

### 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

Adresă poștală: Bd. Vasile Pârvan nr. 4, cod poștal 300223,  
Timișoara, jud. Timiș, România  
Număr de telefon: +40-(0)256-592.300 (310)

Adresă de e-mail: [secretariat@e-uvt.ro](mailto:secretariat@e-uvt.ro)

Activity	10.1 Assesment criteria	10.2 Assesment methods	10.3 Weight in the final mark
10.4 <b>Course</b>	<ul style="list-style-type: none"> <li>Students identify concepts and describe / explain the specific phenomena of this discipline in a given context (GO, CO<sup>1</sup>).</li> </ul>	<i>Summative assessment</i> <ul style="list-style-type: none"> <li>Written test.</li> </ul>	<b>50%</b>
10.5. Seminar / <b>laboratory</b>	<ul style="list-style-type: none"> <li>Students grouped into teams (AtO<sup>5</sup>) devise a comprehensive report on a topic specified topic (ApO<sup>4</sup>), to show how to make measurements (ApO<sup>2</sup>) and processing / interpretation of data (ApO<sup>3</sup>). Teams present and discuss these reports (AtO<sup>5</sup>, AtO<sup>6</sup>).</li> </ul>	<i>Formative assessment:</i> <ul style="list-style-type: none"> <li>Periodic assessment tests.</li> <li>Laboratory colloquium.</li> </ul>	<b>50%</b>
<b>10.6 Minimum needed performance for passing</b>			
Mark 5 is corresponds to the minimum accumulated knowledge, i.e. for the student capacity to:			
<ul style="list-style-type: none"> <li>Define the main terms of rheology</li> <li>Describe the types of rheological behaviour</li> <li>Describes the main rheological methods of investigation of materials</li> <li>Attendance in class: course - 50% , labs - 100%.</li> </ul>			

Date of completion:  
19.09.2021

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



Date of approval:

Director of the department)  
Associate Professor Dr. Nicoleta ȘTEFU,

Adresă poștală: Bd. Vasile Pârvan nr. 4, cod poștal 300223,  
Timișoara, jud. Timiș, România  
Număr de telefon: +40-(0)256-592.300 (310)

Adresă de e-mail: [secretariat@e-uvt.ro](mailto:secretariat@e-uvt.ro)