GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Soft matter physics, PG_00071149		
Field of study	Technical Physics, Mathematics, Nanotechnology, Nanotechnology		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Optional subject group
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	4	ECTS credits	1.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr Piotr Weber	
	Teachers	dr Piotr Weber	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	0.0	0.0	15

E-learning hours included: 0.0

eNauczanie source addresses:
Moodle ID: 4172 Fizyka materii miękkiej
https://enauczanie.pg.edu.pl/2025/course/view.php?id=4172

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	15	2.0	8.0	25

Subject objectives

The aim of this course is to familiarize students with the description of typical systems classified as soft matter.
To present the concepts and theories that exist in describing the most important physicochemical properties of soft matter.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_K101] acknowledges the importance of knowledge related to the field of study in solving cognitive and practical problems, critically assessing the information obtained	The student will recognize the importance of the knowledge in solving practical problems.	[SK5] Assessment of ability to solve problems that arise in practice
[K7_U101] is able to formulate complex research problems and adopts appropriate methods, obtaining innovative solutions, cooperating with other people, both as a leader and a team member	Students will be familiar with IT tools for modeling phenomena occurring in soft matter. This allows student to test innovative solutions.	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
[K7_W101] is able to make an in-depth identification of key objects and phenomena related to the field of study, as well as theories that describe them and applicable analytical and design methods	The student can provide examples of soft matter. The student can discuss the physicochemical phenomena observed in such systems.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation

Subject contents

Course content – lecture
This lecture will cover the microscopic, mesoscopic, and macroscopic characteristics of soft matter systems. Typical soft matter systems (colloids, polymers, amphiphilic systems, liquid crystals, emulsions) will be presented, along with the processes and phenomena occurring in soft matter systems. Intermolecular and structural interactions, as well as self-organization processes in soft matter, will be discussed. The rheological properties of soft matter (concepts: viscosity, elasticity, viscoelasticity, relaxation times) and mechanical models used to describe viscoelasticity will be presented. Computer tools used to simulate soft matter systems will be presented. For colloidal systems, methods for obtaining and stabilizing colloidal systems will be presented; the role of the interfacial surface, the electrical double layer, and the double-layer theory will be discussed. For polymers, selected models of polymer dynamics (Rouse model, Zimm model, Doi-Edwards model) will be discussed. Issues related to liquid crystals will be presented.

<table>
<tr><td>Prerequisites and co-requisites</td><td></td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Exam</td><td>50.0%</td><td>100.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>• M. Kleman, O. D. Lavrentovich, Soft matter physics, Springer, 2001
• R. Piazza, Soft Matter, Springer, 2011
• Terrell L. Hill, Thermodynamics of small systems, Dover Publications Inc., 1963
• Jacob N. Israelachvili, Intermolecular and Surface Forces, Elsevier Inc., 2011</td></tr>
<tr><td>Supplementary literature</td><td>• P. W. Atkins, Physical Chemistry, Oxford University Press, 2022
• N. G. Van Kampen, Stochastic Processes in Physics and Chemistry, Elsevier, 2007</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>• With respect to a polymer molecule, explain the concepts of primary structure, secondary structure (conformation), three-dimensional structure, and quaternary structure.
• Describe the measure of polymer chain stiffnesspersistent length.
• Explain the concepts of polymer chain conformation and conformational entropy. Provide the formula for conformational entropy for a one-dimensional coil.
• Explain the concept of a colloidal system. How do we classify colloidal systems?
• Introduce the types of colloidal systems with examples.
• Describe the packing parameter for the formation of supramolecular structures from molecules with hydrophobic and hydrophilic parts (amphiphilic molecules).
• The importance of noise and dissipation in soft matter systems</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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