GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	TECHNOLOGY OF COLLOIDAL SYSTEMS, PG_00064317		
Field of study	Chemical Technology		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	Optional subject group Specialty subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish -
Semester of study	1	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department Of Biotechnology And Microbiology -> Faculty Of Chemistry -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Adam Macierzanka	
	Teachers	dr hab. inż. Adam Macierzanka dr inż. Aneta Pacyna-Kuchta	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	30.0	0.0	0.0	60

E-learning hours included: 0.0

Additional information:
Online lecture;

Laboratory conducted as practical, in-person classes.

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	60	8.0	32.0	100

Subject objectives

The aim of the course is to provide a broad yet detailed introduction to the chemistry and technology of colloidal systems, incorporating the latest theoretical knowledge. It also aims to present modern measurement methods used to investigate the functional properties of such systems, as well as their current industrial applications.
The course will cover topics related to the theoretical chemistry of colloids and their applications in technological processes and scientific research, with a particular focus on cosmetics.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_K01] critically evaluates the content of cognitive and practical problems	The student is able to apply the methods learned to describe and explain chemical and physical phenomena, as well as technological processes, and to solve simple research and technological problems.	[SK5] Assessment of ability to solve problems that arise in practice
	[K7_U05] uses instrumental methods applied in technology and related fields	The student is able to practically apply knowledge related to the selection and use of instrumental methods in colloid technology and is proficient in using basic techniques for analysing the surface and interfacial properties of surfactants in dispersed systems.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment
	[K7_W01] defines the phenomena, processes and laws of nature used to produce consumer goods and provide services	The student has acquired the essential knowledge required to relate phenomena and processes in modern colloidal system technology used for application purposes.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge

Subject contents	The course content will primarily focus on practical (technological) and theoretical issues in colloid chemistry, as well as on measurement methodologies related to this field, which are applied in science and various industrial sectors utilising dispersed systems. The lecture topics will be divided into two parts: 1. **Fundamental theoretical knowledge in colloid chemistry and technology**, along with practical applications of dispersed systems and the measurement methodologies used to determine their physicochemical properties. Topics will include, among others: • Definition and classification of colloids, and methods of their preparation (condensation and dispersion methods), • Various types of colloids (foams, emulsions, microemulsions, aerosols, gels, etc.), including the basic equipment used for producing dispersed systems, • Intermolecular interactions and interactions between macroscopic systems (physical and specific interactions, electric double layer (EDL), the mechanism of surface charge formation, structure and parameters of the EDL, zeta potential, DLVO theory, etc.), • Surface and interfacial tension, and adsorption at phase boundaries (fundamentals of measurement methods, wetting and contact angle, etc.), • General characteristics and properties of surfactants (structure, classification, biosurfactants, hydrophilic-lipophilic balance (HLB), etc.), • Kinetic properties of colloids (Brownian motion, diffusion, osmosis, etc.), • Rheological properties of dispersed systems (viscosity, viscoelasticity, microviscosity, measurement methods of rheological and microrheological properties, etc.), • Electrokinetic phenomena and optical properties of dispersed systems, • Colloid stability: a. Emulsion stability (flocculation and its mechanisms, coalescence, phase inversion, etc.), b. Stability of foams and gels (phase migration, syneresis, etc.), c. Particle size measurement methods for dispersed systems, d. Methods of evaluating the stability of dispersed systems, • Associative colloids (micellisation, micellar structures, liposomes, solubilisation, etc.), • Overview of traditional and modern microscopic methods used to monitor the structural properties of dispersed systems. *This part of the lecture materials, in addition to essential theoretical knowledge, will focus primarily on techniques for producing colloids and the practical assessment of their functional properties.* 2. **Colloids in industry and scientific research.** Topics covered will include, among others: • Modern measurement methods used to characterise the physicochemical properties of dispersed systems, • Application of colloids as carriers of bioactive substances in cosmetics and cosmeceuticals, pharmaceuticals, etc., • Methods of production and applications of gold and silver nanoparticles, • Bioadhesive systems containing spherical particles applications in cosmetics, etc.,

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Microencapsulation,
Multiple emulsions in biomedical and cosmetic applications,
Systems based on sols and gels used in nano-engineering of cosmetic products, etc.,
Structuring of colloid-based products to improve their stability and obtain desirable product textures,
Structuring of cosmetic dispersions,
Polymerisation in emulsion systems,
Microfluidisation and its applications in the science and technology of dispersed systems,
General overview of methods used for the disposal of waste dispersed systems (e.g., demulsification methods, etc.).

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<tr><td>Prerequisites and co-requisites</td><td>A general knowledge of the fundamentals of physical chemistry, chemical technology, and biotechnology.</td></tr>
<tr><td>Assessment methods and criteria</td><td>
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<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Laboratory classes</td><td>100.0%</td><td>40.0%</td></tr>
<tr><td>Written examination</td><td>50.0%</td><td>60.0%</td></tr>
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Recommended reading	Basic literature	M. Fanun, ***Colloids in biotechnology***, CRC Press 2011; I.D. Morrison, ***Colloidal dispersions***, Wiley 2002; J. Sjoblom, ***Emulsions and emulsion stability***, CRC Press 2006; L.D. Rhein, ***Surfactants in personal products and decorative cosmetics***, CRC Press 2007; B.P. Binks, ***Modern aspects of emulsion science***, RCS 1998; S.E. Friberg, ***Food emulsions***, Marcel Dekker 1997; J.J. Wille, ***Skin delivery systems***, Blackwell 2006; IFSCC, ***Introduction to cosmetic emulsions and emulsification***, Micelle Press 1997; R. Zana, ***Dynamics of surfactant self-assemblies***, Taylor & Francis 2005; G.L. Hasenhuettl, ***Food emulsifiers and their applications***, Chapman & Hall 1997; K. Holmberg, ***Applied surfaces and colloid chemistry***, Wiley 2002; D. Myers, ***Surfaces, interfaces, and colloids***, Wiley-VCH 1999; M.J. Rosen, ***Industrial utilization of surfactants***, AOCS 2000; N. Garti, ***Thermal behaviour of dispersed systems***, Marcel Dekker 2001; L.H Tan Tai, ***Formulating detergents and personal care products***, AOCS Press 2000; P. Ghosh, ***Colloid and interface science***, PHI Learning Private Ltd., New Delhi, 2009; E.S. Hedges, ***Colloids***, Hedges Press, 2007; ***Current review articles in scientific journals.***

	Supplementary literature	C.E. Stauffer, ***Emulgatory***, WNT, Warszawa 2001; H. Sonntag, ***Koloidy***, PWN, 1982; E.T. Dutkiewicz, ***Fizykochemia powierzchni***, WNT, Warszawa 1998; R. Zieliński, ***Surfaktanty***, WAEP, Poznań 2000; G. Schramm, ***Reologia podstawy i zastosowania***, OWN, Poznań 1998; L. Sobczyk, A. Kisza, ***Chemia fizyczna dla przyrodników***, PWN, Warszawa 1977; P. W. Atkins, ***Podstawy chemii fizycznej***, PWN, Warszawa 1999; H. Buchowski, W. Ufnalski, ***Roztwory***, WNT, Warszawa 1995.
	eResources addresses	Adresy na platformie eNauczanie: Technologia układów koloidalnych 2024/2025 - Moodle ID: 29221 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29221
Example issues/ example questions/ tasks being completed	What functional properties of a colloidal system may directly result from its type and structure? How can these properties be determined and modified? What production methods and equipment should be used depending on the desired type of emulsion to be produced (e.g., simple o/w and w/o emulsions, microemulsions, multiple emulsions, etc.)? Can colloidal systems of different types be combined in order to obtain a product with a specific microstructure and functional properties? If so, what criteria (e.g., physicochemical) should be taken into account? How can the stability of such products be assessed?	
Work placement	Not applicable	

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