AL-FARABI KAZAKH NATIONAL UNIVERSITY

Faculty of Chemistry and Chemical Technology

Department of Chemical Physics and Material Sciences

APPROVED by
Vice Dean for teaching methods
and educational work
_____ Kudreeva L.K.
protocol № _11_, "_30_"_06_2022

EDUCATIONAL-METHODICAL COMPLEX OF DISCIPLINE

SHSN 6307 «Structure and chemical properties of nanoparticles»

"7M07122 – Nanomaterials and nanotechnologies in chemistry"

Course –2
Semester –3
Number of credits –5

Almaty 2022

Educational-methodical complex of the discipline is made by Dr. of Sc., Prof. Yerdos Ongarbayev.

Based on the curriculum for the educational program "7M07122 – Nanomaterials and nanotechnologies in chemistry"

Reviewed and recommended at the meeting of the department of chemical physics and materials science
«_22_» _____06_____ 2022, protocol № _27_

Head of department _____ M. Tulepov

Recommended by methodical council of the faculty
«_24_» __06___ 2022, protocol № _12_

Chairman of the methodical council of the faculty _____ Bektemisova A.U.

SYLLABUS
Fall semester 2022-2023 academic year
on the educational program "7M07122 – Nanomaterials and nanotechnologies in chemistry"

Discipline's code	Discipline's title	Independent work of students (IWS)	No. of hours per week			Number of credits	Independent work of student with teacher (IWST)
			Lectures (L)	Practical training (PT)	Laboratory (Lab)		
SHSN 6307	Structure and chemical properties of nanoparticles	98	15	30	0	5	7

Academic course information

Form of education	Type of course	Types of lectures	Types of practical training	Form of final control
Full-time	Practical	Information Lecture	practical	oral
Lecturer	Prof. Yerdos Ongarbayev			
e-mail	Erdos.Ongarbaev@kaznu.kz			
Telephone number	+77014575789			

Academic presentation of the course

Aim of course	Expected Learning Outcomes (LO) As a result of studying the discipline the undergraduate will be able to:	Indicators of LO achievement (ID) (for each LO at least 2 indicators)
Discipline is aimed at developing the skills of undergraduates in the field of research structure and chemical properties of nanoparticles	1. demonstrate the knowledge gained in the field of research structure and chemical properties of nanoparticles	1.1. explain the basic laws, theories and models of structure of nanoparticles 1.2. describe the composition and properties of nanoparticles
	2. determine the structure of nanoparticles	2.1. calculate and analysis of structure of nanoparticles 2.2. calculate the characteristics of nanoparticles
	3. determine the composition and chemical properties of nanoparticles	3.1. determine the composition of nanoparticles 3.2. describe chemical properties of nanoparticles by using the principles of thermodynamics
	4. analyze the relationship between the structure of nanoparticles and theirs properties	4.1. formulate requirements for the properties of nanoparticles for the specific case of their use 4.2. explain the structure model of nanoparticles
	5. to evaluate the basic methods for study of properties of various nanoparticles and possible ways to improve them	5.1. choose the best methods for study of properties of nanoparticles 5.2. provide the material in the form of a presentation
Prerequisites	FON 5301 The fundamental basis of nanotechnology, FHOPNN 5207 Physico-chemical methods of obtain nanomaterials and nanostructures, UNMORS 5208 The carbon nanostructured materials on the basis of vegetable raw materials	
Post requisites	UNFGS 6306 Carbon nanotubes, fullerenes and hydrophobic soot, MOKN 6306 Carbon containing metal-organic frameworks in naotechnology	
Information resources	**Literature**: 1. Schmid G. Nanoparticles: from theory to application. Wiley, 2010. 538 p. 2. Donega C.M. Nanoparticles. Workhorses of nanoscience. Springer, 2014. 303 p. 3. Horikoshi S., Serpone N. Introduction to Nanoparticles. In the book: Microwaves in Nanoparticle Synthesis. Wiley, 2013. 4. Khan S., Hossain M.K. Classification and properties of nanoparticles. In the book: Metal Nanoparticle-Based Polymer Composites. Woodhead Publoshing, 2022. 606 p. 5. Barhoum A., Makhlouf A. Fundamentals of Nanoparticles. Elsevier, 2018. 647 p. 6. Nazhipkyzy M., Beisenov R.Y., Mansurov Z.A. The Fundamental Bases of Nanotechnology. - Almaty: Qazaq University, 2018. - 231 p.	

	7. Мансуров З.А., Захидов А.А., Нажипкызы М. Углеродные наноматериалы. - Алматы: Қазақ ун-ті, 2017. - 305 с. **Internet-resources:** 1. https://www.tstu.ru/book/elib/pdf/2008/mich_tkach-a.pdf 2. http://elib.kaznu.kz/book/9010
Academic policy of the course in the context of university moral and ethical values	**Academic Behavior Rules:** All students have to register at the MOOC. The deadlines for completing the modules of the online course must be strictly observed in accordance with the discipline study schedule. ATTENTION! Non-compliance with deadlines leads to loss of points! The deadline of each task is indicated in the calendar (schedule) of implementation of the content of the curriculum, as well as in the MOOC. **Academic values:** - Practical trainings/laboratories, IWS should be independent, creative. - Plagiarism, forgery, cheating at all stages of control are unacceptable. - Students with disabilities can receive counseling at yerdos.ongarbayev@gmail.com.
Evaluation and attestation policy	**Criteria-based evaluation:** assessment of learning outcomes in relation to descriptors (verification of the formation of competencies in midterm control and exams). **Summative evaluation:** assessment of work activity in an audience (at a webinar); assessment of the completed task.

CALENDAR (SCHEDULE) THE IMPLEMENTATION OF THE COURSE CONTENT:

Week	Topic name	Number of hours	Maximum score
Module I Introduction to nanoparticles			
1	**Lec 1.** Introduction to nanoparticles. Atoms, Nanoparticles, and Bulk Materials	1	
1	**Sem 1.** Molecular-Kinetic Properties of Nanodisperse Systems with Liquid and Gaseous Dispersion Medium. Theoretical part	2	7
2	**Lec 2.** Classification of Nanoparticles	1	
2	**Sem 2.** Molecular-Kinetic Properties of Nanodisperse Systems with Liquid and Gaseous Dispersion Medium. Practical part	2	7
	IWST 1. Consultation on the implementation of IWS 1. Nanoparticle enumeration, size, and shape characterization methods		
3	**Lec 3.** Metal Nanoparticles. Paramagnetic Metal Nanoparticles. Porous and Hollow Metal Nanoparticles.	1	
3	**Sem 3.** Molecular-Kinetic Properties of Nanodisperse Systems with Liquid and Gaseous Dispersion Medium. Solving of tasks	2	7
3	**IWS 1.** Nanoparticle enumeration, size, and shape characterization methods		25
4	**Lec 4.** Semiconductor Nanocrystals and Quantum Dots.	1	
4	**Sem 4.** Optical properties of nanodispersed particles. Theoretical part	2	7
4	**IWST 2.** Colloquium (situational task). Chemical analysis methods of nanoparticles		26
5	**Lec 5.** Functionalization of Metal, Semiconductor, or Quantum Dot Nanoparticles	1	
5	**Sem 5.** Optical properties of nanodispersed particles. Practical part	2	7
Module II Structure, Synthesis, and Application of Nanoparticles			
6	**Lec 6.** Applications of Metal Nanoparticles	1	
6	**Sem 6.** Optical properties of nanodispersed particles. Solving of tasks	2	7
7	**Lec 7.** Structure of CNTs and Fullerenes. Synthesis of CNTs and Fullerenes.	1	
7	**Sem 7.** Dispersion analysis of polydisperse systems. Theoretical part	2	7
7	**IWST 3.** Consultation on the implementation of IWS 2. Surface analysis methods of nanoparticles		
7	**LEVEL CONTROL 1**		100
8	**Lec 8.** Carbon Nanotube Purification. CNT Functionalization	1	
8	**Sem 8.** Dispersion analysis of polydisperse systems. Practical part	2	7
8	**IWS 2.** Surface analysis methods of nanoparticles		11
9	**Lec 9.** Linear nanopolymers. Dendrimer nanoparticles	1	
9	**Sem 9.** Dispersion analysis of polydisperse systems. Solving of tasks	2	7
10	**Lec 10.** Common size and surface-related properties of nanoparticles	1	
10	**Sem 10.** Physical and chemical regularities of processes occurring in nanoporous systems. Theoretical part.	2	7

10	**IWST 4.** Colloquium (situational task). Physiochemical properties characterization methods of nanoparticles		11
	Module III Physicochemical, Electronic, and Mechanical Properties of Nanoparticles		
11	**Lec 11.** Electronic Properties of nanoparticles	1	
11	**Sem 11.** Physical and chemical regularities of processes occurring in nanoporous systems. Practical part.	2	7
12	**Lec 12.** Optical Properties of nanoparticles. Mechanical Properties of nanoparticles	1	
12	**Sem 12.** Physical and chemical regularities of processes occurring in nanoporous systems. Solving of tasks.	2	7
12	**IWST 5.** Consultation on the implementation of IWS 3. Magnetic properties characterization methods of nanoparticles		
13	**Lec 13.** Physicochemical properties of specific nanoparticles	1	
13	**Sem 13.** Physical and chemical regularities of the formation of nanoclusters. Theoretical part	2	7
13	**IWS 3.** Magnetic properties characterization methods of nanoparticles		11
14	**Lec 14.** Properties of Carbon Nanotubes: Metals or Semiconductors	1	
14	**Sem 14.** Physical and chemical regularities of the formation of nanoclusters. Practical part.	2	7
14	**IWST 6.** Colloquium (situational task). Thermodynamic characterization methods of nanoparticles		11
15	**Lec 15.** Magnetic properties of nanoparticles	1	
15	**Sem 15.** Physical and chemical regularities of the formation of nanoclusters. Solving of tasks.	2	7
15	**IWST 7.** Consultation on examination issues		
15	**LEVEL CONTROL 2**		100

Vice Dean L. Kudreeva

Head of the Department M.Tulepov

Lecturer Y.Ongarbayev