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

UNMORS 6304 «The carbon nanostructured materials on the basis of vegetable raw materials»

""7M05320 – Chemical Physics""

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 ""“7M05320 – Chemical Physics”""

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 "7M05320 – Chemical Physics"

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)		
UNMORS 6304	The carbon nanostructured materials on the basis of vegetable raw materials	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 properties of carbon nanostructured materials on the basis of vegetable raw materials	1. demonstrate the knowledge gained in the field of research structure and properties of carbon nanostructured materials on the basis of vegetable raw materials	1.1. explain the basic laws, theories and models of structure of carbon nanomaterials 1.2. describe the composition and properties of carbon nanomaterials
	2. determine the physical properties of carbon nanostructured materials on the basis of vegetable raw materials	2.1. calculate and analysis of physical properties of carbon nanomaterials 2.2. calculate the physical characteristics of carbon nanomaterials
	3. determine the composition and chemical properties of carbon nanostructured materials on the basis of vegetable raw materials	3.1. determine the composition of carbon nanomaterials 3.2. describe chemical properties of carbon nanomaterials by using the principles of thermodynamics
	4. analyze the relationship between the structure of carbon nanostructured materials on the basis of vegetable raw materials and theirs properties	4.1. formulate requirements for the properties of carbon nanomaterials for the specific case of their use 4.2. explain the structure model of carbon nanomaterials
	5. to evaluate the basic methods for study of properties of various carbon nanostructured materials on the basis of vegetable raw materials and possible ways to improve them	5.1. choose the best methods for study of properties of carbon nanomaterials 5.2. provide the material in the form of a presentation
Prerequisites	HFK 5206 Chemical physics and kinetics, HFTT 5207 Chemical physics of solids	
Post requisites	APS 6304 Adsorption and porous structure, UN 6305 Carbon nanomaterials	
Information resources	**Literature**: 1. Gogotsi Y., Presser V. (Eds.) Carbon Nanomaterials. 2nd Edition. – Taylor and Francis Group, LLC, CRC Press, 2014. – 531 p. 2. Sattler K.D. (Ed.) Carbon Nanomaterials Sourcebook. Volume I: Graphene, Fullerenes, Nanotubes, and Nanodiamonds. Taylor & Francis Group, LLC, Boca Raton, FL, USA, 2016. - 630 p. 3. Zhou K. (ed.) Carbon Nanomaterials: Modeling, Design, and Applications. CRC Press, 2020. - 483 p. 4. Tagmatarchis N. Advances in Carbon Nanomaterials: Science and Applications. CRC Press, Taylor & Francis Group, LLC, 2012. – 400 p. 5. Carbon Nanomaterials in Biomedicine and the Environment / ed. by Z. A. Mansurov. - Singapore: Jenny Stanford Publishing, 2020. - 447 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:

Weeks	Topic name	Number of hours	Maximum score
Module I Fullerenes and single-walled carbon nanotubes			
1	**Lec 1.** Nano Forms of Carbon. Quantum Confinement in Carbon Nanomaterials. Raman Spectroscopy of Nanocarbons	1	
1	**Sem 1.** Classification of nanomaterials and nanotechnologies	2	7
2	**Lec 2.** Physical Properties of Fullerenes. Chemical Properties and Reactions of Fullerenes	1	
2	**Sem 2.** Estimation of the share of surface atoms in nanoparticles	2	7
2	**IWST 1.** Consultation on the implementation of IWS 1. Purification, Isolation, and Characterization of Fullerenes		
3	**Lec 3.** Functionalized Fullerenes. Applications of Fullerenes	1	
3	**Sem 3.** Melting point of nanoparticles	2	7
3	**IWS 1.** Purification, Isolation, and Characterization of Fullerenes		25
4	**Lec 4.** Properties of Single-Walled Carbon Nanotube (SWCNT). Purification of SWCNTs	1	
4	**Sem 4.** Sintering temperature of nanopowders	2	7
4	**IWST 2.** Colloquium (situational task). Purification and Characterization of Single-Walled Carbon Nanotube		26
5	**Lec 5.** Applications of Single-Walled Carbon Nanotubes	1	
5	**Sem 5.** Catalytic properties of nanoparticles	2	7
Module II Multiwalled carbon nanotubes and carbon fibers			
6	**Lec 6.** Purification and Functionalization of Multiwalled Carbon Nanotubes (MWCNTs)	1	
6	**Sem 6.** Study of the structure of carbon nanomaterials	2	7
7	**Lec 7.** Applications of Multiwalled Carbon Nanotubes (MWCNTs)	1	
7	**Sem 7.** Study of the structure of nanocrystalline materials. Part 1	2	7
7	**IWST 3.** Consultation on the implementation of IWS 2. Purification and Characterization of Multiwalled Carbon Nanotubes		
7	**LEVEL CONTROL 1**		100
8	**Lec 8.** Mechanical Properties of Grown Vapor-Grown Carbon Fiber (VGCF). Transport Properties of VGCF. Applications of VGCF	1	
8	**Sem 8.** Study of the structure of nanocrystalline materials. Part 2	2	7
8	**IWS 2.** Purification and Characterization of Multiwalled Carbon Nanotubes		11
9	**Lec 9.** Mechanical Properties of Carbon Nanofibers. Applications of Carbon Nanofiber	1	

9	**Sem 9.** Study of the structure of nanocomposite materials	2	7
10	**Lec 10.** Properties of Graphene and Graphene Oxide	1	
10	**Sem 10.** Study of the structure of nanoporous materials	2	7
10	**IWST 4.** Colloquium (situational task). Characterization of Graphene and Graphene Oxide		11
	Module III Graphene nanoforms		
11	**Lec 11.** Chemical Reactivity of Graphene Oxide. Applications of Graphene and Graphene Oxide	1	
11	**Sem 11.** Study of properties of lubricant-cooling liquids modified with carbon micro- and nanoparticles	2	7
12	**Lec 12.** Potential Applications of Graphene Nanoribbon (GNR)	1	
12	**Sem 12.** Spatial structure of carbon nanoparticles. Part 1	2	7
12	**IWSP 5.** Consultation on the implementation of IWS 3		
13	**Lec 13.** Properties of Graphene Quantum Dots. Applications of Graphene Quantum Dots	1	
13	**Sem 13.** Spatial structure of carbon nanoparticles. Part 2	2	7
13	**IWS 3.** Characterization of Graphene Nanoribbon (GNR)		11
14	**Lec 14.** Physical Properties of Carbon Black. Surface Area, Porosity, and Adsorption Properties of Carbon Black. Applications of Carbon Black	1	
14	**Sem 14.** Enthalpy of formation of carbon nanotubes	2	7
14	**IWST 6.** Colloquium (situational task). Characterization of Graphene Quantum Dots		11
15	**Lec 15.** Applications of Carbon Nanospheres. Classification, Structure, and Physicochemical Properties of Carbon Nano-Onions	1	
15	**Sem 15.** Nanotubes for hydrogen energy	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