SYLLABUS
Fall semester 2024-2025 academic years
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)		
HFK 5206	Chemical physics and kinetics	98	15	30	-	5	7

Academic course information

Form of education	Type of course	Types of lectures	Types of practical training	Number of IWS	Form of final control
Blended	Practical	Review, discussion	solving tasks	6	oral
Lecturer	PhD Tursynbek Sabit				
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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)
	LO 1. demonstrate the knowledge gained in the field of chemical physics and kinetics, composition and characteristics of active centers, parameters of spectroscopy methods	ID 1.1. explain the basic laws of chemical physics, kinetics theories and models ID 1.2. describe the composition and characteristics of active centers, parameters of spectroscopy methods
	LO 2. determine the kinetic parameters of chemical physics processes	ID 2.1. calculate of kinetic experimental data ID 2.2. describe chemical physics processes by using the principles of chemical kinetics
	LO 3. determine the composition and characteristics of free radicals and active centers	ID 3.1. determine the composition of free radicals and active centers ID 3.2. calculate the kinetic characteristics of free radicals and active centers
	LO 4. analyze the relationship between the composition of active centers and theirs kinetic characteristics	ID 4.1. formulate requirements for the active centers ID 4.2. explain the mechanism of the chemical physics process
	LO 5. to evaluate the basic processes of chemical physics	ID 5.1. choose the best methods for study of chemical physics processes ID 5.2. provide the material in the form of a presentation
Prerequisites	Chemical Physics; Physical chemistry; Structure of matter, Quantum chemistry	
Post requisites	Advanced Chemical Physics	
Information resources	**Literature**: 1. Califano S. Pathways to Modern Chemical Physics. Springer, 2012. — 293 p. 2. Saito K. Chemical Physics of Molecular Condensed Matter. Springer Nature Singapore Pte Ltd., 2020. — 228 p. 3. Battaglia F., George T.F. Fundamentals in Chemical Physics. Kluwer Academic Publishers, 1998. - 320 p. 4. Мансуров З.А., Онгарбаев Е.К., Кудайбергенов К.К. Химическая физика: учеб. пособие. - Алматы: Қазақ ун-ті, 2015. – 417 с. 5. Мансұров З.А., Оңғарбаев Е.Қ., Құдайбергенов К.К. Химиялық физика: оқу құралы. - Алматы: Қазақ ун-ті, 2018. – 389 б. **Internet-resources:** 1. https://books.google.kz/books/about/Introduction_to_Chemical_Physics.html?id=40k0AAAAIAAJ&redir_esc=y 2. https://books.google.kz/books/about/Pathways_to_Modern_Chemical_Physics.html?id=s-sCt4RT0bMC&redir_esc=y	

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	LO	ID	amount of hours	Maximum score	Form of Knowledge Assessment	The Form of the lesson / platform
Module I							
1	**L.1** Collision theory. The exchange of energy in a collision of particles. Elastic collisions.	LO 1	ID 1.1.	1			Video lecture in MS Teams
1	**PT 1** Basic concepts of chemical kinetics. Experimental methods for studying the kinetics of chemical reactions	LO 2	ID 2.1.	2	15		Webinar in MS Teams
2	**L.2** Inelastic Collisions. Vibrational energy exchange. Nonequilibrium chemical reactions	LO 1	ID 1.2.	1			Video lecture in MS Teams
2	**PT 2** Kinetics of unilateral reactions in closed systems. Part 1	LO 2	ID 2.1.	2	15		Webinar in MS Teams
3	**L.3** Basic concepts of chemical kinetics	LO 1	ID 1.2.	1			Video lecture in MS Teams
3	**PT 3** Kinetics of unilateral reactions in closed systems. Part 2	LO 2	ID 2.1.	2	15		Webinar in MS Teams
3	**IWSP 1 Consultation on the implementation of IWS1**	LO 1	ID 1.1.				Webinar in MS Teams
3	**IWS 1.** From the life of free radicals	LO 2	ID 2.1.		12	Presentation	
4	**L.4** Mass action law for reactions on the surface of a solid	LO 1	ID 1.2.	1			Video lecture in MS Teams
4	**PT 4** Methods for determining the order of the reaction. Integral methods for determining the order of a chemical reaction	LO 2	ID 1.1.	2	15		Webinar in MS Teams
Module II							
5	**L.5** Breakdown of molecules into radicals.	LO 1	ID 1.1.	1			Video lecture in MS Teams
5	**PT 5** Methods for determining the order of the reaction. Differential methods for determining the order of a chemical reaction	LO 3	ID 3.2.	2	15		Webinar in MS Teams
5	**IWSP 2 Consultation on the implementation of IWS2**	LO 1	ID 1.1.				Webinar in MS Teams
5	**IWS 2** The complex world of elementary acts of chemical reactions	LO 3	ID 3.1.		13	Presentation	
5	**MT 1**	LO 1	ID 1.1.		100		
6	**L.6** Breakdown of free radicals	LO 1	ID 1.1.	1			Video lecture in MS Teams

6	**PT 6** Kinetics of complex chemical reactions. Part 1	LO 2	ID 2.1.	2	15		Webinar in MS Teams
7	**L.7** Crossed molecular beams. Statistical and jet methods	LO 1	ID 1.2.	1			Video lecture in MS Teams
7	**PT 7** Kinetics of complex chemical reactions. Part 2	LO 2	ID 2.1.	2	15		Webinar in MS Teams
8	**L.8** Laser-induced fluorescence spectroscopy	LO 1	ID 1.1.	1			Video lecture in MS Teams
8	**PT 8** Influence of temperature on the rate of chemical reactions. Part 1	LO 3	ID 3.2.	2	15		Webinar in MS Teams
8	**IWSP 3 Consultation on the implementation of IWS3**	LO 1	ID 1.1.				Webinar in MS Teams
8	**IWS 3** "Photo" of a chemical reaction	LO 3	ID 3.2.		12	Presentation	
9	**L.9** Raman laser spectroscopy	LO 1	ID 1.2.	1			Video lecture in MS Teams
9	**PT 9** Influence of temperature on the rate of chemical reactions. Part 2	LO 4	ID 4.1.	2	15		Webinar in MS Teams
	Module III						
10	**L.10** Electronic - non-adiabatic reactions	LO 1	ID 1.1.	1			Video lecture in MS Teams
10	**PT 10** Calculation of rate constants according to the theory of active collisions	LO 4	ID 4.1.	2	15		Webinar in MS Teams
10	**IWSP 4 Consultation on the implementation of IWS4**	LO 1	ID 1.1.				Webinar in MS Teams
10	**IWS 4** X-ray electronic spectroscopy and its application in chemistry	LO 3	ID 3.2.		13	Presentation	
10	**MT (Midterm Exam)**	LO 1	ID 1.1.		100		
11	**L.11** Femtochemistry	LO 1	ID 1.2.	1			Video lecture in MS Teams
11	**PT 11** Thermodynamic aspect of the activated complex theory	LO 3	ID 3.2.	2	15		Webinar in MS Teams
12	**L.12** Femtosecond spectroscopy methods	LO 1	ID 1.1.	1			Video lecture in MS Teams
12	**PT 12** Approximate methods of chemical kinetics. Bodenstein's stationary principle. Part 1	LO 3	ID 3.1.	2	15		Webinar in MS Teams
12	**IWSP 6 Consultation on the implementation of IWS5**	LO 1	ID 1.1.				Webinar in MS Teams
12	**IWS 5** Potential surfaces and chemical reactions	LO 3	ID 3.2.		12	Presentation	
13	**L.13** Dynamics of the transition state during chemical transformation	LO 1	ID 1.1.	1			Video lecture in MS Teams
13	**PT 13** Approximate methods of chemical kinetics. Bodenstein's stationary principle. Part 2	LO 4	ID 4.2.	2	15		Webinar in MS Teams
14	**L.14** Kinetics of ultrafast chemical reactions	LO 1	ID 1.1.	1			Video lecture in MS Teams
14	**PT 14** Kinetics of solid-phase reactions. Part 1	LO 2	ID 2.2.	2	15		Webinar in MS Teams
15	**L.15** Ultra-low temperatures and cold atoms	LO 1	ID 1.1.	1			Video lecture in MS Teams
	PT 15 Kinetics of solid-phase reactions. Part 2	LO 2	ID 2.1.	2	15		Webinar in MS Teams
	IWSP 7 Consultation on the implementation of IWS6	LO 5	ID 5.1.				Webinar in MS Teams
	IWS 6 Low-temperature processes in chemistry and technology	LO 5	ID 5.2.		13	Presentation	
	MT 2	LO 1	ID 1.1.		100		

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