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

HF 3302« Chemical Physics»

«6B05301-Chemistry»

Course –3
Semester –5
Number of credits –6

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 «6B05301- 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 "6B05301 - 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)		
HF 3302	Chemical Physics	82	15	15	60	6	8

Academic course information				
Form of education	**Type of course**	**Types of lectures**	**Types of practical training**	**Form of final control**
Full-time	Theoretical / practical	Information Lecture	practical	oral
Lecturer	Prof. Yerdos Ongarbayev			
e-mail	Erdos.Ongarbaev@kaznu.edu.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)
The goal of the discipline is to form the ability to understand the principles of chemical physics	1. demonstrate the knowledge gained in the field of chemical physics	1.1. explain the basic laws of elementary processes in chemistry 1.2. describe the composition and parameters of elementary particles
	2. determine the parameters of homolytic and heterolytic reactions	2.1. calculate of flame temperature, processing and analysis of experimental data 2.2. describe photochemical, radiation, plasma chemical processes by using the principles of thermodynamics
	3. calculate the main parameters of the combustion process	3.1. determine the composition of fuels 3.2. calculate the characteristics of fuels
	4. analyze the relationship between the composition of elementary particles and theirs characteristics	4.1. formulate requirements for the properties of free radicals for the specific case of their use 4.2. explain the mechanism of the elementary processes
	5. to evaluate the theoretical foundations, capabilities, limits and applications of elementary processes in chemistry, elementary particles, photochemistry, radiation chemistry, plasma chemistry, combustion and explosion processes	5.1. choose the optimal conditions for the experiment using thermodynamic and kinetic laws 5.2. provide the material in the form of a presentation
Prerequisites	Fiz1403 Physics, ZK2415 Structure of matter, KH2413 Quantum chemistry	
Post requisites	KDH3504 Chemistry of solids, KMH3505 Chemistry of carbon-containing materials, ZhFh4510 Physics and chemistry of combustion and explosion	
Information resources	**Literature**: 1. Mansurov Z.A. Soot formation: textbook. - Almaty: Kazakh University, 2015. – 166 p. 2. Nazhipkyzy M. Modern Problems of Processes Burning, Detonation, Explosion. - Almaty: Qazaq University, 2017. - 133 p. 3. Mansurov Z.A., Mukasyan A.S., Rogachev A.S. Self-Propagating High-Temperature Synthesis: textbook. - Almaty: Qazaq University, 2018. - 163 p. 4. Kabdulkarimova K.K., Orazbayeva G.D., Aubakirov Y.A. Electrochemical Production Technology. Plasma Chemistry: educational man. - Almaty: Qazaq university, 2017. - 317 p. 5. Мансуров З.А., Онгарбаев Е.К., Кудайбергенов К.К. Химическая физика: учеб. пособие. - Алматы: Қазақ ун-ті, 2015. – 417 с. **6.** 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:

Week	Topic name	Number of hours	Maximum score
Module I Elementary processes in chemistry			
1	**Lec 1.** Tasks, sections and fields of application of chemical physics. Elementary processes in chemistry. Collision theory.	1	
1	**Sem 1.** Basic concepts of chemical kinetics. Experimental methods for studying the kinetics of chemical reactions	1	2
1	**Lab 1.** Laboratory safety instructions. Kinetics of the photochemical decomposition of hydrogen peroxide. Submission of theory and methodology	4	5
2	**Lec 2.** Free radicals and atoms, their formation. Carbenes.	1	
2	**Sem 2.** Kinetics of unilateral reactions in closed systems. Part 1	1	2
2	**Lab 2.** Kinetics of the photochemical decomposition of hydrogen peroxide. Processing laboratory results.	4	5
2	**IWST 1.** Consultation on the implementation of IWS 1. Solution of tasks in photochemistry		
3	**Lec 3.** Homolytic and heterolytic reactions	1	
3	**Sem 3.** Kinetics of unilateral reactions in closed systems. Part 2	1	2
3	**Lab 3.** Kinetics of the photochemical decomposition of hydrogen peroxide. Charting and lab report	4	5
3	**IWS 1.** Solution of tasks in photochemistry		25
4	**Lec 4.** Photochemistry. Kinetics of photochemical reactions	1	
4	**Sem 4.** Methods for determining the order of the reaction. Integral methods for determining the order of a chemical reaction	1	2
4	**Lab 4.** Thermocouple temperature measurement, manufacturing and calibration of thermocouples. Submission of theory and methodology	4	5
4	**IWST 2.** Colloquium (situational task). Solution of.tasks in radiation chemistry		26
5	**Lec 5.** Radiation chemistry. Radiation chemical yield.	1	
5	**Sem 5.** Methods for determining the order of the reaction. Differential methods for determining the order of a chemical reaction	1	2
5	**Lab 5.** Thermocouple temperature measurement, manufacturing and calibration of thermocouples. Processing laboratory results	4	5
Module II Chemistry of high energy			
6	**Lec 6.** Reactions in an electric discharge. Plasma chemistry. Types of Electric Discharges. Plasma-chemical reactions	1	
6	**Sem 6.** Kinetics of complex chemical reactions. Part 1	1	2

6	**Lab 6.** Thermocouple temperature measurement, manufacturing and calibration of thermocouples. Charting and lab report.	4	5
7	**Lec 7.** Chain reactions. Chain Concepts. Chain origin. Chain continuation	1	
7	**Sem 7.** Kinetics of complex chemical reactions. Part 2	1	2
7	**Lab 7.** Determination of the decomposition rate of a manganese oxalate ion from electronic absorption spectra. Submission of theory and methodology	4	5
7	**IWST 3.** Consultation on the implementation of IWS 2. Solution of tasks in reactions in an electric discharge		
	LEVEL CONTROL 1		100
8	**Lec 8.** Chain termination. Kinetic laws of chain reaction. Chain length.	1	
8	**Sem 8.** Influence of temperature on the rate of chemical reactions. Part 1	1	2
8	**Lab 8.** Determination of the decomposition rate of a manganese oxalate ion from electronic absorption spectra. Processing laboratory results	4	5
8	**IWS 2.** Solution of tasks in reactions in an electric discharge		11
9	**Lec 9.** Features of explosive reactions. N.N.Semenov theory of thermal explosion.	1	
9	**Sem 9.** Influence of temperature on the rate of chemical reactions. Part 2	1	2
9	**Lab 9.** Determination of the decomposition rate of a manganese oxalate ion from electronic absorption spectra. Charting and lab report	4	5
10	**Lec 10.** Types of flames. Normal burning rate. Detonation	1	
10	**Sem 10.** Calculation of rate constants according to the theory of active collisions	1	2
10	**Lab 10.** Thermodynamic calculation of the equilibrium characteristics of combustion processes. Submission of theory and methodology	4	5
10	**IWST 4.** Colloquium (situational task). Solution of tasks in the kinetics of chain reactions		11
	Module III Macrokinetic		
11	**Lec 11.** Vibrational chemical reactions	1	
11	**Sem 11.** Thermodynamic aspect of the activated complex theory	1	2
11	**Lab 11.** Thermodynamic calculation of the equilibrium characteristics of combustion processes. Processing laboratory results. Charting and lab report	4	5
12	**Lec 12.** Self-propagating high temperature synthesis (SHS). SHS thermodynamics	1	
12	**Sem 12.** Approximate methods of chemical kinetics. Bodenstein's stationary principle. Part 1	1	2
12	**Lab 12.** Calculation of the volume rate of heat release according to the temperature profile. Submission of theory and methodology.	4	5
12	**IWST 5.** Consultation on the implementation of IWS 3. Calculations of explosive reaction parameters		
13	**Lec 13.** SHS-technologies for obtaining materials	1	
13	**Sem 13.** Approximate methods of chemical kinetics. Bodenstein's stationary principle. Part 2	1	2
13	**Lab 13.** Calculation of the volume rate of heat release according to the temperature profile. Processing laboratory results. Charting and lab report	4	5
13	**IWS 3.** Calculations of explosive reaction parameters		11
14	**Lec 14.** Soot formation at combustion of hydrocarbons. Phenomenology of low temperature soot formation	1	
14	**Sem 14.** Kinetics of solid-phase reactions. Part 1	1	2
14	**Lab 14.** Determination of the calorific value and combustion parameters of combustible gases. Submission of theory and methodology	4	5
14	**IWST 4.** Colloquium (situational task). Calculation of parameters of combustion and detonation processes.		11
15	**Lec 15.** Environmental pollution by nitrogen oxides. The formation of nitrogen oxides	1	
15	**Sem 15.** Kinetics of solid-phase reactions. Part 2	1	2
15	**Lab 15.** Determination of the calorific value and combustion parameters of combustible gases. Processing laboratory results. Charting and lab report	4	5
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