SYLLABUS
Fall semester 2022-2023 academic years
on the educational program "7M07101 - Petrochemistry"

Discipline's code	Discipline's title	Independent work of students (IWS)	Number of credits			Number of credits	Independent work of student with teacher (IWST)
			Lectures (L)	Practical training (PT)	Laboratory (Lab)		
PMSUTF 5207	Mass transfer processes in a system with solid phase	4	3	6	0	9	6

Academic course information				
Form of education	**Type of course**	**Types of lectures**	**Types of practical training**	**Form of final control**
Full-time	Theoretical	problematic, lecture-dialogue	Seminar-conversation, problem solving	Essays in Moodle DLS
Lecturer	Akbayeva Dina Nauryzbayevna, d.ch.sc., associate professor			
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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)
to give students an idea of the main regularities of mass exchange processes occurring in systems involving solid phases, to design devices for carrying out these processes and to form a system of competencies in the context of the qualification requirements of the specialty.	1. Understand the main regularities of mass exchange processes occurring in systems involving solid phases;	1.1. formulates the general regularities of diffusion processes of mass exchange; 1.2. describes the main characteristics of mass transfer processes in a system with solid phase; 1.3. characterizes the methods for determining the optimal and rational technological modes of equipment operation.
	2. Apply scientific knowledge and knowledge of the methodology for calculating the processes of mass transfer in systems involving condensed phases, including methods for modeling mass-exchange processes and the calculation of mass-exchange devices;	2.1. compiles a mathematical description of typical processes of mass transfer in systems involving condensed phases; 2.2. uses the modern information and computer technologies; 2.3. applies the methods for calculating and modeling the processes of mass transfer in systems involving condensed phases.
	3. Evaluate the methods of computational mathematics and mathematical modeling to solve specific problems of calculation and intensification of mass-exchange processes;	3.1. evaluates the mass emission and mass transfer coefficients from the vapor-air mixture; 3.2. calculates the consumption of the adsorbent and the main dimensions of the apparatus with a fluidized bed of zeolite; 3.3. finds the air flow, heating steam and the necessary heat transfer surface of the heater.
	4. Generalize the learning outcomes (for example, in the performance of the IWM) in the context of the discipline;	4.1. uses the mathematical models of processes; 4.2. determines the parameters of processes in industrial devices with the participation of a solid phase; 4.3. analyzes the obtained values by methods of mathematical statistics.
	5. Justify the patterns of mass transfer involving the solid phase in the calculation of chemical equipment.	5.1. justifies the methods of processing experimental data and using their results to substantiate the parameters of mass transfer processes in a system with solid phase; 5.2. compiles the mathematical models of

		chemical technological processes; 5.3. finds the ways to solve them and interpret the professional (physical) meaning of the result obtained in drying, adsoption, crystallization and extraction.
Prerequisites	Mathematics, Physics, Theoretical and applied mechanics, Fundamental processes and apparatus in chemical industry, General chemical technology	
Post requisites	profile and special disciplines.	
Information resources	**Literature:** 1. Ishanhodjaeva M.M. Physical chemistry. Part 1. Diffusion in systems with a solid phase. - SPb.: SPbGTURP, 2017. - 35 p. 2. Tsvetkov S.K. Mass transfer processes in systems involving the solid phase. - SPb.: SPbU, 2017. - 50 p. 3. Romankov P.G., Frolov V.F., Flisyuk O.M. Calculation methods of processes and devices in chemical technology (examples and tasks). – St.-Petersburg: Himizdat, 2011. – 544 p. 4. Frolov V.F. Lectures on the course "Processes and devices of chemical technology". – St. Petersburg: Himizdat, 2008. – 608 p. 5. Dytnersky Yu.I. Processes and devices of chemical technology: in 2 books. – M.: Alliance, 2015. 6. Razinov A.I., Sukhanov P.P. Mass transfer processes with a solid phase participation. Tutorial. – Kazan: KNRTU, 2012. – 96 p. 7. Kasatkin A.G. Basic processes and devices of chemical technology. – M: Alliance, 2006. – 752 p.	
Academic policy of the course in the context of university moral and ethical values	**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 e-mail: dnakbayeva@bk.ru	
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	Max. score***
	Module 1. General regularities of diffusion processes of mass exchange		
1	**Lec 1.** General information on the course "Mass transfer processes in a system with solid phase". Discipline content and its purpose.	2	2
1	**Sem 1.** Solving tasks on determination of mass emission coefficients.	4	4
2	**Lec 2.** General regularities of diffusion processes of mass exchange.	2	2
2	**Sem 2.** Solving tasks on determination of mass emission coefficients.	4	4
2	**IWSP 1. Consultation on the implementation of IWS 1.** Determination the mass transfer coefficient from the vapor-air mixture.		
3	**Lec 3.** Determination of mass emission coefficients in systems involving the solid phase.	2	2
3	**Sem 3.** Solving tasks on determination of mass emission coefficients.	4	4
3	**Delivery of IWS 1.**		20
	Module 2. Diffusion of components in systems with a solid phase		
4	**Lec 4.** General regularities of mass transfer in systems with a solid phase.	2	2
4	**Sem 4.** Solving tasks on determination of the consumption of the adsorbent and the main dimensions of the apparatus with a fluidized bed of zeolite.	4	4
5	**Lec 5.** Classification of solids.	2	2
5	**Sem 5.** Solving tasks on determination of the consumption of the adsorbent and the main dimensions of the apparatus with a fluidized bed of zeolite.	4	4
5	**IWSP 2. Consultation on the implementation of IWS 2.** Determination of the consumption of the adsorbent and the main dimensions of the apparatus with a fluidized bed of zeolite.		
6	**Lec 6.** Diffusion in non-porous materials. Diffusion in capillary-porous materials.	2	2
6	**Sem 6.** Solving tasks on determination of the consumption of the adsorbent and the main dimensions of the apparatus with a fluidized bed of zeolite.	4	4
6	**Delivery of IWS 2.**		20

7	**Lec 7.** Diffusion of moisture in a solid material during drying.	2	2
7	**Sem 7.** Solving tasks on determination of air flow, heating steam and the necessary heat transfer surface of the heater.	4	4
7	**IWSP 3. Colloquium №1.** Write an essay on the given topics.		18
	LEVEL CONTROL 1		**100**
8	**Lec 8.** Material and heat balances of drying.	2	2
8	**Sem 8.** Solving tasks on determination of air flow, heating steam and the necessary heat transfer surface of the heater.	4	4
9	**Lec 9.** Diffusion of a distributed substance during adsorption.	2	2
9	**Sem 9.** Solving tasks on determination of air flow, heating steam and the necessary heat transfer surface of the heater.	4	4
9	**IWSP 4. Consultation on the implementation of IWS 3.** Determination of air flow, heating steam and the necessary heat transfer surface of the heater.		
10	**Lec 10.** Calculation of the adsorber batch and continuous action.	2	2
10	**Sem 10.** Solving tasks on determination of air flow, heating steam and the necessary heat transfer surface of the heater.	4	4
11	**Lec 11.** Material and heat balance of crystallization.	2	2
11	**Sem 11.** Solving tasks on calculation of the material and heat balance of crystallization.	4	4
11	**Delivery of IWS 3.**		17
12	**Lec 12.** Diffusion of the substance to be distributed during extraction. Calculation of extraction apparatus in the system L-S.	2	2
12	**Sem 12.** Solving tasks on calculation of the material and heat balance of crystallization.	4	4
12	**IWSP 5. Consultation on the implementation of IWS 4.** Determination of the number of stages of extraction of L-S.		
	Module 3. Diffusion processes in polymeric materials		
13	**Lec 13.** General regularities of diffusion processes in polymers.	2	2
13	**Sem 13.** Solving tasks on determination of the number of stages of extraction of L-S.	4	4
14	**Lec 14.** Diffusion phenomena in drying process in systems with a polymer solid phase.	2	2
14	**Sem 14.** Solving tasks on determination of the number of stages of extraction of L-S.	4	4
14	**Delivery of IWS 4.**		17
15	**Lec 15.** Diffusion phenomena in the adsorption and extraction processes in systems with a polymer solid phase.	2	2
15	**Sem 15.** Discussion of program of final exam.	4	4
15	**IWST 6. Colloquium №2.** Write an essay on the given topics.		18
	LEVEL CONTROL 2		**100**

Dean — Galeyeva A.K.

Head of Chair — Aubakirov E.A.

Lecturer — Akbayeva D.N.