SYLLABUS
Fall semester 2024-2025 academic year
Educational program "7M07101 - Petrochemistry"

ID and name of course	**Independent work of the student (IWM)**	**Number of credits**			**General number of credits**	**Independent work of the student under the guidance of a teacher (IWMT)**
		Lectures (L)	**Practical classes (PC)**	**Lab. classes (LC)**		
93497 Mass transfer processes in systems involving a solid phase	4	1,7	3,3	0	5	7

ACADEMIC INFORMATION ABOUT THE COURSE				
Learning Format	**Cycle, module, component**	**Lecture types**	**Types of practical classes**	**Form and platform final control**
Offline	BD/M-3/EC	problematic, lecture-dialogue	Seminar-conversation, problem and tasks solving	Standard written, offline, UC Univer.
Lecturer	Akbayeva Dina Nauryzbayevna, d.ch.sc., associate professor			
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ACADEMIC COURSE PRESENTATION		
Purpose of the course	**Expected Learning Outcomes (LO) ***	**Indicators of LO achievement (ID)**
Forming skills to compose and solve basic equations of mass transfer processes in solid phase systems. Course forms basis for understanding the patterns of mass transfer in porous bodies. Course is focused on: basics of mass transfer in solid phase systems, constitutive equations of dynamics of sorption and ion exchange.	1. Describe 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	
Postrequisites	profile and special disciplines.	
Learning Resources	***Main 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. ***Additional literature:*** 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. 8. Rudopashta S.P., Kartashov E.M. Diffusion in chemical-technological processes. – M.: KolosS, 2009. – 478 c. 9. Tager A.A. Physico-chemistry of polymers. – M.: Scientific World, 2007. – 576 c. **Research infrastructure** 1. Lecture classes, practical works – 123 room. **Professional scientific databases** 1. https://en.wikipedia.org/wiki/ 2. «WEB OF SCIENCE» [site]. – URL: http://www.webofscience.com/ 3. http://scholar.google.com.ua/ **Internet resources** 1. http://elibrary.kaznu.kz/en 2. MOOC/video lectures. 3. http://www.infobook.ru (Sugak. A.V. Processes and devices of chemical technology. 2005.) 4. http://freeboks.net.ua (Gelperin N.I. Main processes and devices of chemical technology. 1981.) 5. http://lib.mexmat.ru (Dytnersky Yu.I. Processes and devices of chemical technology. 1992.)	
Academic course policy	The academic policy of the course is determined by the Academic Policy and the Policy of Academic Integrity of Al-Farabi Kazakh National University. Documents are available on the main page of IS Univer. **Integration of science and education.** The research work of students, undergraduates and doctoral students is a deepening of the educational process. It is organized directly at the departments, laboratories, scientific and design departments of the university, in student scientific and technical associations. Independent work of students at all levels of education is aimed at developing research skills and competencies based on obtaining new knowledge using modern research and information technologies. A research university teacher integrates the results of scientific activities into the topics of lectures and seminars (practical) classes, laboratory classes and into the tasks of the IWST, IWS, which are reflected in the syllabus and are responsible for the relevance of the topics of training sessions and assignments.	

Attendance. The deadline for each task is indicated in the calendar (schedule) for the implementation of the content of the course. Failure to meet deadlines results in loss of points.

Academic honesty. Practical/laboratory classes, IWS develop the student's independence, critical thinking, and creativity. Plagiarism, forgery, the use of cheat sheets, cheating at all stages of completing tasks are unacceptable.

Compliance with academic honesty during the period of theoretical training and at exams, in addition to the main policies, is regulated by the "Rules for the final control", "Instructions for the final control of the autumn / spring semester of the current academic year" , "Regulations on checking students' text documents for borrowings".

Documents are available on the main page of IS Univer.

Basic principles of inclusive education. The educational environment of the university is conceived as a safe place where there is always support and equal attitude from the teacher to all students and students to each other, regardless of gender, race / ethnicity, religious beliefs, socio-economic status, physical health of the student, etc. All people need the support and friendship of peers and fellow students. For all students, progress is more about what they can do than what they can't. Diversity enhances all aspects of life.

All students, especially those with disabilities, can receive counseling assistance by phone / e- mail mail *+7 (747) 742 61 73; dnakbayeva@bk.ru* or via video link in MS Teams *https://teams.microsoft.com/l/meetup-join/19%3ameeting_NjI1NjVjYjgtZDRjOS00ODA4LThmNWUtZTEzMDBkMDUyMzEz%40thread.v2/0?context=%7b%22Tid%22%3a%22b0ab71a5-75b1-4d65-81f7-f479b4978d7b%22%2c%22Oid%22%3a%2201ccb524-f5a1-4cf5-85f5-61a1b63a05a8%22%7d.*

Integration MOOC (massive open online course). In the case of integrating MOOC into the course, all students need to register for MOOC. The deadlines for passing MOOC modules must be strictly observed in accordance with the course study schedule.

ATTENTION! The deadline for each task is indicated in the calendar (schedule) for the implementation of the content of the course, as well as in the MOOC. Failure to meet deadlines results in loss of points.

You can register for the MOOC "Basic Processes and Apparatuses of Chemical Technology" by clicking here https://open.kaznu.kz/courses/course-v1:kaznu+OPiAHT+2023-2024C2/about

INFORMATION ABOUT TEACHING, LEARNING AND ASSESSMENT

Score-rating letter system of assessment of accounting for educational achievements

Grade	Digital equivalent points	points, % content	Assessment according to the traditional system
A	4.0 _	95-100	Great
A-	3.67	90-94	
B+	3.33	85-89	Fine
B	3.0	80-84	
B-	2.67	75-79	
C+	2.33	70-74	
C	2.0	65-69	Satisfactorily
C-	1.67	60-64	
D+	1.33	55-59	
D	1.0	50-54	
FX	0,5	25-49	Unsatisfactory
F	0	0-24	

Assessment Methods

Criteria-based assessment is the process of correlating actual learning outcomes with expected learning outcomes based on clearly defined criteria. Based on formative and summative assessment.

Formative assessment is a type of assessment that is carried out in the course of daily learning activities. It is the current measure of progress. Provides an operational relationship between the student and the teacher. It allows you to determine the capabilities of the student, identify difficulties, help achieve the best results, timely correct the educational process for the teacher. The performance of tasks, the activity of work in the classroom during lectures, seminars, practical exercises (discussions, quizzes, debates, round tables, laboratory work, etc.) are evaluated. Acquired knowledge and competencies are assessed.

Summative assessment - type of assessment, which is carried out upon completion of the study of the section in accordance with the program of the course. Conducted 3-4 times per semester when performing IWS. This is the assessment of mastering the expected learning outcomes in relation to the descriptors. Allows you to determine and fix the level of mastering the course for a certain period. Learning outcomes are evaluated.

Formative and summative assessment	Points % content
Activity in classes	5
Work in practical classes	20
Independent work	20
Colloquium	15
Final control (exam)	40
TOTAL	100

Calendar (schedule) for the implementation of the content of the course. Methods of teaching and learning.

A week	Topic name	Number of hours	Max. ball
	Module 1. Basics of diffusion processes of mass exchange		
1	**L 1.** General information on the course "Mass transfer processes in a system with solid phase". Discipline content and its purpose.	1	1
	PC 1. Solving tasks on determination of mass emission coefficients.	2	5
2	**L 2.** General regularities of diffusion processes of mass exchange.	1	1
	PC 2. Solving tasks on determination of mass emission coefficients.	2	5
	IWMT 1. Consultations on the implementation of **IWM №1.** Determination the mass transfer coefficient from the vapor-air mixture.		
3	**L 3.** Determination the mass transfer coefficient from the vapor-air mixture.	1	1

	PC 3. Solving tasks on determination of mass emission coefficients.	2	5
	IWMT 2. Passing the IWM №1.		17
Module 2. Diffusion of components in systems with a solid phase			
4	**L 4.** General regularities of mass transfer in systems with a solid phase.	1	1
	PC 4. Solving tasks on determination of the consumption of the adsorbent and the main dimensions of the apparatus with a fluidized bed of zeolite.	2	5
5	**L 5.** Classification of solids.	1	1
	PC 5. Solving tasks on determination of the consumption of the adsorbent and the main dimensions of the apparatus with a fluidized bed of zeolite.	2	5
	IWMT 3. Consultations on the implementation of **IWM №2.** Determination of the consumption of the adsorbent and the main dimensions of the apparatus with a fluidized bed of zeolite.		
6	**L 6.** Diffusion in non-porous materials. Diffusion in capillary-porous materials.	1	1
	PC 6. Solving tasks on determination of the consumption of the adsorbent and the main dimensions of the apparatus with a fluidized bed of zeolite.	2	5
	IWMT 4. Passing the IWM №2.		17
7	**L 7.** Diffusion of moisture in a solid material during drying.	1	1
	PC 7. Solving tasks on determination of air flow, heating steam and the necessary heat transfer surface of the heater.	2	5
	Colloquium №1. Delivery of a colloquium on lectures №1-7 (writing-oral).		24
	LEVEL CONTROL 1		**100**
8	**L 8.** Material and heat balances of drying.	1	1
	PC 8. Solving tasks on determination of air flow, heating steam and the necessary heat transfer surface of the heater.	2	5
9	**L 9.** Diffusion of a distributed substance during adsorption.	1	1
	PC 9. Solving tasks on determination of air flow, heating steam and the necessary heat transfer surface of the heater.	2	5
	IWMT 5. Consultations on the implementation of **IWM №3.** Determination of air flow, heating steam, heat transfer surface of the heater, the number of stages of extraction of L-S.		
10	**L 10.** Calculation of the adsorber batch and continuous action.	1	1
	PC 10. Solving tasks on determination of air flow, heating steam and the necessary heat transfer surface of the heater.	2	5
11	**L 11.** Material and heat balance of crystallization.	1	1
	PC 11. Solving tasks on calculation of the material and heat balance of crystallization.	2	5
	IWMT 6. Passing the IWM №3.		16
12	**L 12.** Diffusion of the substance to be distributed during extraction. Calculation of extraction apparatus in the system L-S.	1	1
	PC 12. Solving tasks on calculation of the material and heat balance of crystallization.	2	5
	IWMT 7. Consultation on the implementation **of IWM №4.** Determination of crystals costs and calculation of the vacuum crystallizer.		
Module 3. Diffusion processes in polymeric materials			
13	**L 13.** General regularities of diffusion processes in polymers.	1	1
	PC 13. Solving tasks on determination of the number of stages of extraction of L-S.	2	5
14	**L 14.** Diffusion phenomena in drying process in systems with a polymer solid phase.	1	2
	PC 14. Solving tasks on determination of the number of stages of extraction of L-S.	2	4
	Passing the IWM №4.		16
15	**L 15.** Diffusion phenomena in the adsorption and extraction processes in systems with a polymer solid phase.	1	1
	PC 15. Discussion of program of final exam.	2	5
	Colloquium №2. Delivery of a colloquium on lectures №8-15 (writing-oral).		20
	LEVEL CONTROL 2		**100**

Policy of assessment of master student's independent work

The number of IWM is 4. The assignment is uploaded to the Univer system one week before the due date. The assignments are practical tasks, the solution of which consists of several stages, each of which is evaluated. Each task is accompanied by methodical recommendations.

RUBRICATOR OF THE SUMMATIVE ASSESSMENT OF IWM №1-4

Independent work of the student №1 (17% of 100% MC)

Criterion	"Excellent"	"Good"	"Satisfactory"	"Unsatisfactory"

	15-20%	10-15%	5-10%	0-5%
Application of the information provided in the methodological recommendations	A thorough understanding theory, equations and formulas from lectures №1-3 and recommended textbooks. The presented course of mass emission coefficient determination is correct.	Understanding of theory, equations and formulas from lectures №1-3 and recommended textbooks. The solution algorithm of mass emission coefficient determination is correct, but there are inaccuracies.	Limited understanding of theory, equations and formulas from lectures №1-3 and recommended textbooks. The progress of problem solving of mass emission coefficient determination is not presented.	Superficial understanding/lack of understanding of theory, equations and formulas from lectures №1-3 and recommended textbooks. The progress of problem solving of mass emission coefficient determination is not presented.
Quantitative results of the task	Good at linking key concepts of lectures №1-3. Excellent grounding of arguments with evidence from empirical research in finding references and calculating intermediate values.	Relates key concepts of the lectures №1-3. Supports arguments with evidence from empirical research.	Limited connection of key concepts of lectures №1-3. Limited use of empirical research evidence.	Little or no connection of key concepts of the lectures №1-3. Little or no use of empirical research.
Completeness and literacy of the assignment	Offers competent practical recommendations, suggestions on the possible algorithm of mass emission coefficient determination.	Offers some competent practical recommendations, suggestions on the on the possible algorithm of mass emission coefficient determination.	The proposed recommendations are insubstantial, not based on careful analysis, and shallow.	Little or no practical guidance or very poor quality guidance.
Letter, APA style	The writing demonstrates clarity, conciseness and correctness. Strictly follows the APA style.	The letter demonstrates clarity, conciseness and correctness. Basically follows the APA style.	The letter has some key errors and clarity needs to be improved. There are mistakes in following the APA style.	The writing is unclear, it is difficult to follow the content. Lots of mistakes in following the APA style.

Independent work of the student №2 (17% of 100% MC)

Criterion	**"Excellent"** 15-20%	**"Good"** 10-15%	**"Satisfactory"** 5-10%	**"Unsatisfactory"** 0-5%
Application of the information provided in the methodological recommendations	A thorough understanding theory, equations and formulas from lectures №4-6 and recommended textbooks. The presented course of determination the consumption of the adsorbent, the diameter and height of the adsorber is correct.	Understanding of theory, equations and formulas from lectures №4-6 and recommended textbooks. The solution algorithm of determination the consumption of the adsorbent, the diameter and height of the adsorber is correct, but there are inaccuracies.	Limited understanding of theory, equations and formulas from lectures №4-6 and recommended textbooks. The progress of of determination the consumption of the adsorbent, the diameter and height of the adsorber is not presented.	Superficial understanding/lack of understanding of theory, equations and formulas from lectures №4-6 and recommended textbooks. The progress of of determination the consumption of the adsorbent, the diameter and height of the adsorber is not presented.
Quantitative results of the task	Good at linking key concepts of lectures №4-6. Excellent grounding of arguments with	Relates key concepts of the lectures №4-6. Supports arguments	Limited connection of key concepts of lectures №4-6. Limited use of empirical research evidence.	Little or no connection of key concepts of the lectures №4-6. Little or no use of empirical research.

	evidence from empirical research in finding references and calculating intermediate values.	with evidence from empirical research.		
Completeness and literacy of the assignment	Offers competent practical recommendations, suggestions on the possible algorithm of calculation problems tasks 1-2.	Offers some competent practical recommendations, suggestions on the on the possible algorithm of calculation problems tasks 1-2.	The proposed recommendations are insubstantial, not based on careful analysis, and shallow.	Little or no practical guidance or very poor quality guidance.
Letter, APA style	The writing demonstrates clarity, conciseness and correctness. Strictly follows the APA style.	The letter demonstrates clarity, conciseness and correctness. Basically follows the APA style.	The letter has some key errors and clarity needs to be improved. There are mistakes in following the APA style.	The writing is unclear, it is difficult to follow the content. Lots of mistakes in following the APA style.

Independent work of the student №3 (16% of 100% MC)

Criterion	**"Excellent"** 15-20%	**"Good"** 10-15%	**"Satisfactory"** 5-10%	**"Unsatisfactory"** 0-5%
Application of the information provided in the methodological recommendations	A thorough understanding theory, equations and formulas from lectures №7-11 and recommended textbooks. The presented course of determination the flow of air, heating steam and the required heat transfer surface of the heater is correct.	Understanding of theory, equations and formulas from lectures №7-11 and recommended textbooks. The solution algorithm of determination the flow of air, heating steam and the required heat transfer surface of the heater is correct, but there are inaccuracies.	Limited understanding of theory, equations and formulas from lectures №7-11 and recommended textbooks. The progress of determination the flow of air, heating steam and the required heat transfer surface of the heater is not presented.	Superficial understanding/lack of understanding of theory, equations and formulas from lectures №7-11 and recommended textbooks. The progress of of determination the flow of air, heating steam and the required heat transfer surface of the heater is not presented.
Quantitative results of the task	Good at linking key concepts of lectures №7-11. Excellent grounding of arguments with evidence from empirical research in finding references and calculating intermediate values.	Relates key concepts of the lectures №7-11. Supports arguments with evidence from empirical research.	Limited connection of key concepts of lectures №7-11. Limited use of empirical research evidence.	Little or no connection of key concepts of the lectures №7-11. Little or no use of empirical research.
Completeness and literacy of the assignment	Offers competent practical recommendations, suggestions on the possible algorithm of calculation problems tasks 1-2.	Offers some competent practical recommendations, suggestions on the on the possible algorithm of calculation problems tasks 1-2.	The proposed recommendations are insubstantial, not based on careful analysis, and shallow.	Little or no practical guidance or very poor quality guidance.
Letter, APA style	The writing demonstrates clarity, conciseness and correctness. Strictly follows the APA style.	The letter demonstrates clarity, conciseness and correctness. Basically follows the APA style.	The letter has some key errors and clarity needs to be improved. There are mistakes in following the APA style.	The writing is unclear, it is difficult to follow the content. Lots of mistakes in following the APA style.

Independent work of the student №4 (16% of 100% MC)

Criterion	"Excellent" 15-20%	"Good" 10-15%	"Satisfactory" 5-10%	"Unsatisfactory" 0-5%
Application of the information provided in the methodological recommendations	A thorough understanding theory, equations and formulas from lectures №12-14. and recommended textbooks. The presented course of problem solving of crystallization is correct.	Understanding of theory, equations and formulas from lectures №12-14 and recommended textbooks. The solution algorithm of crystallization is correct, but there are inaccuracies.	Limited understanding of theory, equations and formulas from lectures №12-14 and recommended textbooks. The progress of problem solving of crystallization is not presented.	Superficial understanding/lack of understanding of theory, equations and formulas from lectures №12-14 and recommended textbooks. The progress of problem solving of crystallization is not presented.
Quantitative results of the task	Good at linking key concepts of the lectures №12-14. Excellent grounding of arguments with evidence from empirical research in finding references and calculating intermediate values.	Relates key concepts of the lectures №12-14. Supports arguments with evidence from empirical research.	Limited connection of key concepts of the lectures №12-14. Limited use of empirical research evidence.	Little or no connection of key concepts of the lectures №12-14. Little or no use of empirical research.
Completeness and literacy of the assignment	Offers competent practical recommendations, suggestions on the possible algorithm of calculation problems tasks 1-6.	Offers some competent practical recommendations, suggestions on the on the possible algorithm of calculation problems tasks 1-6.	The proposed recommendations are insubstantial, not based on careful analysis, and shallow.	Little or no practical guidance or very poor quality guidance.
Letter, APA style	The writing demonstrates clarity, conciseness and correctness. Strictly follows the APA style.	The letter demonstrates clarity, conciseness and correctness. Basically follows the APA style.	The letter has some key errors and clarity needs to be improved. There are mistakes in following the APA style.	The writing is unclear, it is difficult to follow the content. Lots of mistakes in following the APA style.

Dean _____ **A.K. Galeyeva**

Chair of the Academic Committee on the Quality of Teaching and Learning _____ **A.U. Bektemissova**

Head of Department _____ **E.A. Aubakirov**

Lecturer _____ **D.N. Akbayeva**