SYLLABUS
Fall semester 2023-2024 academic year
Educational program "6B07102 – Chemical engineering"

ID and name of course	Independent work of the student (IWS)	Number of credits			General number of credits	Independent work of the student under the guidance of a teacher (IWST)
		Lectures (L)	Practical classes (PC)	Lab. classes (LC)		
101779 Thermal and mass transfer processes	4	3	0	6	9	7

ACADEMIC INFORMATION ABOUT THE COURSE

Learning Format	Cycle, component	Lecture types	Types of practical classes	Form and platform final control
Offline	PD/UC	problematic	Performance of laboratory works, solving problems and tests	Testing in Moodle DLS
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)
The purpose of the discipline is to develop the ability to evaluate and design the processes of heat and mass transfer, to choose the appropriate devices, in order to solve the production problems of chemical technology. The following topics will be considered: fundamentals of heat and mass transfer, theory and practice of basic processes, basic laws and general principles of analysis, modeling, calculation and optimization of these processes, their energy supply and hardware design.	1. describe technological processes and devices of chemical technology, using the basic laws of conservation of mass, energy, thermodynamic equilibrium, as well as the laws of kinetics, the theory of similarity, heat and mass transfer;	1.1. formulates the main provisions of the theory of similarity;
		1.2 classifies technological processes and devices for chemical technology;
		1.3 characterizes certain technological processes and devices of chemical technology.
	2. calculate the parameters of the main processes and devices of chemical technology based on the laws of hydraulics, physical modeling, chemical thermodynamics and kinetics;	2.1. defines volume and mass flow rates of liquids and gases;
		2.2. defines the modes of movement of liquids and gases and hydraulic resistance of pipelines;
		2.3. calculates the coefficients of heat and mass transfer and the heat transfer surface.
	3. to establish the optimal conditions for technological processes and chemical technology devices, using the basic calculation equations for heat transfer, heat balance, heat load of devices;	3.1 compares the calculated values of hydraulic characteristics and heat and mass transfer with reference data;
		3.2. defines the optimal conditions for a specific technological process or chemical technology device.
	4. to choose the type of technological process of chemical technology, its stages, modes and devices, based on the basics of mass transfer, kinetic characteristics, material balance and the method of processing equipment;	4.1. identifies the characteristics of technological processes and devices of chemical technology;
		4.2. defines the main stages and their sequence for a specific chemical technology process;
		4.3. compares the calculated characteristics of technological processes and chemical technology devices with standard values.
	5. to draw up schematic diagrams of the chemical technological process of chemical technology on the basis of heat and material balances.	5.1. assembles units in accordance with the sequence of individual stages of chemical technology processes;
		5.2. composes the heat balance of a given chemical-technological process of chemical technology;

		5.3. makes the material balance of a given chemical-technological process of chemical technology.
Prerequisites	higher mathematics, physics, theoretical mechanics, physical chemistry, inorganic chemistry, analytical chemistry.	
Postrequisites	fluid mechanics, specialized and specialized disciplines.	
Learning Resources	***Main literature:*** 1. Lectures on the course «The main processes and devices of chemical technology»: textbook / Authors: D.N. Akbayeva, Zh.T. Eshova. – Almaty: Qazaq university, 2019. – 398 p. 2. Akbayeva D.N., Eshova Zh.T. Methodical manual to laboratory works on the course «The main processes and devices of chemical technology». - Almaty: Qazaq university, 2016. – 80 p. 3. Akbayeva D.N., Eshova Zh.T. Test tasks on discipline "Main processes and devices of chemical technology". - Almaty: Qazaq university, 2015. - 101 p. 4. Romankov P.G., Frolov V.F., Flisyuk O.M. Calculation methods of processes and devices in chemical technology (examples and tasks). – St.-Petersburg: Himizdat, 2009. – 544 p. ***Additional literature:*** 5. Dolmatova M.O. Thermal and mass-exchange processes in chemical technology: textbook. - Ministry of Science and Higher Education of the Russian Federation. Federation, Ural Federal University. - Yekaterinburg: Izd-v. Ural. un-ta, 2019. - 96 p. 6. Kasatkin A.G. Basic processes and devices of chemical technology. – M: Alliance, 2006. – 752 p. 7. Pavlov K.F., Romankov P.G., Noskov A.A. Examples and tasks of a course of processes and devices of chemical technology. – L.: Chemistry, 1987. – 576 p. **Research infrastructure** 1. Lecture classes - 408 lab. 2. laboratory works - 408 lab. **Professional scientific databases** 1. https://ru.wikipedia.org/wiki/ 2. «WEB OF SCIENCE» [site]. – URL: http://www.webofscience.com/ **Internet resources** 1. http://elibrary.kaznu.kz/en 2. http://www.infobook.ru (Sugak. A.V. Processes and devices of chemical technology. 2005.) 3. http://freeboks.net.ua (Gelperin N.I. Main processes and devices of chemical technology. 1981.) 4. 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.

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 Thermal processes		
1	**L 1.** Thermal processes. Temperature field. Temperature gradient. Fundamental law of heat conductivity. Differential equation of heat conductivity. Heat conductivity of a flat wall at a stationary mode. Heat conductivity of a cylindrical wall.	1	2
	PC 1. Acquaintance to work safety measures in laboratory. Acquaintance with laboratory works: 1) Distillation; 2) Extraction; 3) Absorption.	2	3
2	**L 2.** Convective heat exchange. Equation of heat emission. Criteria of thermal similarity.	1	2
	LC 2. Delivery of the theory and technique of performance of laboratory work №1.	2	7
	IWSP 1. Consultations on the implementation of **IWST 1.** Solution of control tasks on heat exchange processes.		
3	**L 3.** Heat emission during the boiling and condensation. Radiant heat exchange.	1	2
	LC 3. Performance of laboratory work №1.	2	7
	IWST 2. Passing the IWS №1.		12
4	**L 4.** Heat transfer at a stationary mode. Heat transfer through a flat and cylindrical wall. Average temperature pressure. Determination of average temperatures of heat carriers. Thermal isolation.	1	2
	LC 4. Delivery of calculations of laboratory work №1. Delivery of a colloquium on lectures №1-3 (writing-oral).	2	7 8
5	**L 5.** Heating processes. Heating by sharp and deaf steam. Heating by combustion gases, intermediate heat carriers and electric current. Heat-exchange devices.	1	2
	LC 5. Delivery of the theory and technique of performance of laboratory work №2.	2	7
	IWSP 3. Consultations on the implementation of **IWST 2.** Solving control tasks on the processes of evaporation, dissolution and heat capacity.		
6	**L 6.** Evaporation. Definition of a temperature depression. Evaporation modes. Evaporating devices. Heat and material balances of evaporating devices.	1	2
	LC 6. Performance of laboratory work №2.	2	7
	IWST 4. Passing the IWS №2.		12
	MODULE 2 Mass-exchange processes		

7	**L 7.** Mass-exchange processes. Phase balance. Material balance of mass-exchange processes. Main equation of a mass transfer. Average driving force of process of a mass transfer.	1	2
	LC 7. Delivery of calculations of laboratory work №2. Delivery of a colloquium on lectures №4-6 (writing-oral).	2	7 9
Midterm control 1			**100**
8	**L 8.** The modified equation of a mass transfer. Mass-exchange between phases. Convective diffusion. Criteria equation of a convective mass-exchange.	1	2
	LC 8. Delivery of the theory and technique of performance of laboratory work №3.	2	10
9	**L 9.** Absorption. Physical bases of absorption process. Influence of temperature and pressure upon absorption process. Material balance of absorption. Absorbing devices.	1	2
	LC 9. Performance of laboratory work №3.	2	10
	IWST 5. Consultations on the implementation of **IWST 3.** Solving control tasks on mass-exchange processes: absorption, distillation.		
10	**L 10.** Distillation. Characteristic of two-phase systems liquid-steam. Simple distillation. Distillation with water vapor.	1	2
	LC 10. Performance of laboratory work №3.	2	
11	**L 11.** Rectification. Calculation of plates number of a rectifying column. Rectification with different pressure.	1	2
	LC 11. Performance of laboratory work №3.	2	
	IWST 6. Passing the IWS №3.		15
12	**L12.** Adsorption. Balance between phases. Material balance of process of adsorption. Kinetics of adsorption. (SDG 6)	1	2
	LC 12. Performance of laboratory work №3. Delivery of a colloquium on lectures №7-10 (writing-oral).	2	12
13	**L 13.** Extraction. Physical bases of extraction process. Diagram of extraction.	1	2
	LC 13. Performance of laboratory work №3.	2	
	IWST 7. Consultation on the implementation **of IWST 4.** Solving control tasks on mass transfer processes: extraction, adsorption and drying.		
14	**L 14.** Properties of wet air. Material balance of drying. Drying statics. Drying kinetics. Vacuum drying. Drying of gases.	1	2
	LC 14. Delivery of calculations for laboratory work №3. Passing the IWS №4.	2	10 15
15	**L 15.** Crystallization. Physical bases of crystallization process. Methods of crystallization and crystallizers. Material and thermal balances of crystallization process. Membranous processes.	1	2
	LC 15. Discussion of exam tests and tasks. Delivery of a colloquium on lectures №11-15 (writing-oral).	2	14
Midterm control 2			**100**
Final control (exam)			**100**
TOTAL for course			**100**

Dean _____ **A.K. Galeyeva**

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

Lecturer _____ **D.N. Akbayeva**