SYLLABUS
Fall semester 2021-2022 academic years
on the educational program "Technology of gas 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)		
TG 4310	Technology of gas chemistry	68	15	0	60	3	7

Academic course information

Form of education	Type of course	Types of lectures	Types of practical training	Number of IWS	Form of final control
Online/off-line	Theoretical	problematic, analytical lecture	Performing laboratory work, solving tasks	3	Test in system Moodle

Lecturer	Kudaibergenov Nurbolat Zharylkasynuly PhD
e-mail	kudaibergenov.n@kaznu.kz
Telephone number	8 701 381 52 91

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)
To develop the ability to analyze the composition, properties, sources of production and ways of using natural, petroleum associated and process gases in the petrochemical industry.	LO 1. Explain about modern processes of field preparation of products from gas, gas condensate, and gas hydrate wells.	ID 1.1 Understand the composition and properties of natural, associated, process gases and gas condensates; ID 1.2 Determine the physical and chemical properties of natural, associated and process gas components.
	LO 2. Description of the chemistry and mechanism of hydrocarbons in gas processing processes	ID 2.1. Be able to describe the chemistry and mechanism of the process of obtaining the final products of gas processing. ID 2.2 Identify chemical and technological production in accordance with the objectives of improving the production efficiency of the target product; ID 2.3 Builds basic, technological and chemical schemes for obtaining processing of hydrocarbon gases.
	LO 3. Be able to make full use of intermediates in the process, evaluating the composition and properties of intermediates in order to create new technological processes	ID 3.1 Be able to prepare natural, associated and process gases for processing. ID 3.2 Determine the optimal parameters of the laboratory process; ID 3.3 Justify the choice of tools for improving the quality of production based on the analysis of the yield and composition of the target product
	LO 4. To analyze and interpret the optimal parameters of technological processes	ID 4.1 Calculate the material balance of the process under study; ID 4.2 Compare calculated data on the material balance of a particular technological process with reference data; ID 4.3 Justify the economic efficiency of the technological process under study
	LO 5. Prediction of characteristics, properties and areas of use of gaseous workings obtained during processing	ID 5.1 Develop a basic technological scheme for waste-free or low-waste production on the example of the technological process under study; ID 5.2 Suggest ways to improve the efficiency of raw materials and energy use for a specific technological process

Prerequisites	Chemical Technology of Organic Substances, General Chemical Technology, Fundamental Processes and Apparatus in Chemical Technology, Theoretical Chemistry
Post requisites	Profile and special disciplines.
Information resources	1. Лапидус А.Л., Голубева И.А., Жагфаров Ф.Г. Газохимия: Учебник для вузов. -2-е изд., перераб. и доп. – М.: Издательский центр РГУ нефти и газа имени И.М. Губкина, 2013. – 405 с. 2. Alireza B. Natural Gas Processing 1st Edition. Gulf Professional Publishing, May 28, 2014, – 896 p., ISBN: 9780080999715 [electronic resource: http://www.sciencedirect.com/science/book/9780080999715]. 3. Vivek Ch. Fundamentals of Natural Gas: An International Perspective. PennWell Books, 2006, – 202 p. [electronic resource: http://www.pennwellbooks.com/petroleum/nontechnical/fundamentals-of-natural-gas-an-international-perspective/]. 4. Суербаев Х. Мұнай-газ ісінің негіздері: Оқулық – Астана: Фолиант, 2008. – 376 б. 5. Ахметов С. А. Технология глубокой переработки нефти и газа: Учеб. пособие для вузов. - Уфа: Гилем, 2002. – 672 с.
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 e-mail n.zh.kudaibergenov@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. Your total assessment will be calculated by a formula: $Total-assessment-on-discipline = (\mathrm{BC1} + ME + \mathrm{BC2}) * 0{,}6 + FE * 0{,}4$

CALENDAR (SCHEDULE) THE IMPLEMENTATION OF THE COURSE CONTENT:

weeks	Topic names	LO	ID	Amount of hours	Maximum score	Form of Knowledge Assessment	The Form of the lesson / platform
Module I. State and prospects of development of the gas processing industry							
1	**L 1.** Basic information about natural gases. The importance of natural gases in the economy. Composition and properties of natural gases and gas condensates. Transport of natural gases.	LO 1	ID 1.1. ID 1.2.	1	3	QS 1	Video lecture in MS Teams https://teams.microsoft.com/l/meetup-join/19%3aIJawa9P9BIouBYAjckBNwfoX7kCTCSxVDgftGFhpQm01%40thread.tacv2/1630866244778?context=%7b%22Tid%22%3a%22b0ab71a5-75b1-4d65-81f7-f479b4978d7b%22%2c%22Oid%22%3a%22a1651ba0-487d-48a0-a5c4-eea007e008fe%22%7d
1	**Lab 1.** Introduction to the safety of work in the laboratory. Basic rules for working in the laboratory with gas cylinders. The development of the	LO 1	ID 1.1. ID	4	8	Analysis, oral and	Off-line laboratory work (Lab. #429)

	theoretical data on marking of gas cylinders.		1.2.			written discussion	
Friday 23.00 - deadline for delivery of QS, TK, IT							
2	**L 2.** Main directions of use and processing of natural gases. The main directions of natural gas processing in the world. Quality requirements for commercial natural gas and gas processing products	LO 1	ID 1.1. ID 1.2.	1	3	QS 2	Video lecture in MS Teams
2	**IWSP 1. Consultation on the implementation of IWS 1**					Discussion	Webinar in MS Teams
2	**Lab 2.** Discussion of the main issues related to working with gases in laboratories. Familiarity with the General provisions of the methodology for performing the work "Determination of natural gas specific density by air".	LO 1	ID 1.1. ID 1.2.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
Friday 23.00 - deadline for delivery of QS, TK, IT							
Module II. Primary processing of hydrocarbon gases.							
3	**L 3.** Preparation of natural gases for processing. Cleaning of gases from mechanical impurities. Drying of natural hydrocarbon gases	LO 3	ID 3.1.	1	3	QS 3	Video lecture in MS Teams
3	**Lab 3.** The development of the theoretical part and executing the work "Determination of natural gas specific density by air".	LO 3	ID 3.2. ID 3.3.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
3	**IWS 1.** Main natural gas fields in Kazakhstan. Gas processing plants in Kazakhstan.	LO 1	ID 1.1.	1	20	Report, oral discussion	Off-line oral presentation (Lab. #429)
Friday 23.00 - deadline for delivery of QS, TK, IT							
4	**L 4.** Preparation of natural gases for processing. Cleaning of gases from chemical impurities.	LO 3	ID 3.1.	1	3	QS 4	Video lecture in MS Teams
4	**Lab 4.** Submission of calculations and drawing up the material balance of the work "Determination of natural gas specific density by air". Introduction to the General provisions of the methodology for performing the work "Determination of natural gas moisture»	LO 4	ID 4.1. ID 4.2.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
4	**IWSP 2. Consultation on the implementation of IWS 2**					Discussion	Webinar in MS Teams
Friday 23.00 - deadline for delivery of QS, TK, IT							
5	**L 5.** Production of sulfur from hydrogen sulfide-containing gases. Methods for obtaining helium from natural gases	LO 2	ID 2.1. ID 2.2.	1	3	QS 5	Video lecture in MS Teams
5	**Lab 5.** The development of the theoretical part and performing the work "Determination of natural gas moisture".	LO 1	ID 1.1. ID 1.2.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
5	**Colloquium №1**				25	Test	Off-line
Friday 23.00 - deadline for delivery of QS, TK, IT							
	MT 1				100		
6	**L 6.** Separation of hydrocarbon gases. Extraction of liquid hydrocarbon components from natural gases. Low-temperature separation (LTS)	LO 2	ID 2.1. ID 2.2. ID 2.3.	1	3	QS 6	Video lecture in MS Teams

6	**Lab 6.** Submission of calculations and drawing up the material balance of the work "Determination of natural gas specific density by air". Introduction to the General provisions of the "Hydroalcoxycarbonylation of olefins in the presents of metal complex catalysts"method.	LO 4	ID 4.1. ID 4.2.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
6	**IWSP 3. Consultation on the implementation of IWS 2**			1		Discussion	Webinar in MS Teams
Friday 23.00 - deadline for delivery of QS, TK, IT							
7	**L 7.** Methods for extracting C2-C5 hydrocarbons from natural gases	LO 5	ID 5.1. ID 5.2.	1	3	QS 7	Video lecture in MS Teams
7	**Lab 7.** The development of the theoretical part and performing the work "Hydroalkoxycarbonylation of olefins in the presence of metal-complex catalysts". The theory of metal complex compounds.	LO 3	ID 3.1. ID 3.2.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
Friday 23.00 - deadline for delivery of QS, TK, IT							
8	**L 8.** Stabilization and processing of gas condensates. The stabilization of natural gasoline. Stabilization of crude gas condensate carried out by gas from the well. Cleaning of gas condensates from sulfur compounds. Processing of gas condensates into commercial fuels.	LO 1	ID 1.1. ID 1.2.	1	3	QS 8	Video lecture in MS Teams
8	**Lab 8.** Introduction to the laboratory autoclave unit for performing the work "Hydroalcoxycarbonylation of olefins in the presents of metal complex catalysts". Calibration of the thermocouple and pressure gauge.	LO 2	ID 2.3.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
8	**IWSP 4. Consultation on the implementation of IWS 2**			1		Discussion	Webinar in MS Teams
8	**IWS 2**. Chemical conversion of individual hydrocarbons into petrochemical products.	LO 4	ID 4.1.	1	20	Report, oral discussion	Off-line laboratory work (Lab. #429)
Friday 23.00 - deadline for delivery of QS, TK, IT							
Module III. Chemical processing of hydrocarbon gases.							
9	**L 9.** Thermal and thermocatalytic transformations of lower paraffin hydrocarbons. Production of acetylene from hydrocarbon raw materials.	LO 3	ID 3.3.	1	3	QS 9	Video lecture in MS Teams
9	**Lab 9.** Implementation of methods for calculating and preparing reagents and components of the catalytic system. Carrying out absolution of ethyl alcohol.	LO 4	ID 4.2. ID 4.3.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
Friday 23.00 - deadline for delivery of QS, TK, IT							
10	**L 10.** Production of lower olefins. Production of olefins by pyrolysis. Main directions of using olefin hydrocarbons.	LO 3	ID 3.1.	1	3	QS 10	Video lecture in MS Teams
10	**Lab 10.** Performance of the work «Hydroalcoxycarbonylation of olefins in the presents of metal complex catalysts».	LO 3	ID 3.2.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
10	**IWSP 5. Consultation on the implementation of IWS 3**			1			Webinar in MS Teams
10	**Midterm Exam**				25	Test	Off-line

Friday 23.00 - deadline for delivery of QS, TK, IT							
10	**MT (Midterm)**				100		
11	**L 11.** Catalytic dehydrogenation of paraffin C_4-C_5 hydrocarbons. Production of isobutylene. The production of butadiene. Production of 2-methylbutadiene-1,3 (isoprene). The main directions of using isobutylene and diene hydrocarbons.	LO 2	ID 2.1. ID 2.2. ID 2.3.	1	3	QS 11	Video lecture in MS Teams
11	**Lab 11.** Determining the optimal parameters of the process «Hydroalcoxycarbonylation of olefins in the presents of metal complex catalysts».	LO 3	ID 3.2.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
Friday 23.00 - deadline for delivery of QS, TK, IT							
12	**L 12.** Technology for the production of carbon black (soot). The scope and classification of carbon blacks. Structure and properties of soot. Methods for producing soot. The selection, cleaning, and pelleting carbon black.	LO 5	ID 5.1. ID 5.2.	1	3	QS12	Video lecture in MS Teams
12	**Lab 12.** Mastering the technique of vacuum distillation of reaction products. Performing the work of vacuum distillation of reaction products.	LO 3	ID 3.3.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
12	**IWSP 6. Consultation on the implementation of IWS 3**			1		Discussion	Webinar in MS Teams
Friday 23.00 - deadline for delivery of QS, TK, IT							
13	**L 13.** Oxidative transformations of gaseous hydrocarbons. Oxidation of lower paraffin hydrocarbons. Methane oxidation. Oxidation of C_2-C_4 hydrocarbons. Mechanism of hydrocarbon oxidation.	LO 2	ID 2.1. ID 2.2. ID 2.3.	1	3	QS 13	Video lecture in MS Teams
13	**Lab 13.** Mastering the method of analysis of liquid products of the process. Determination of refractive indices using a Refractometer.	LO 5	ID 5.2.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
Friday 23.00 - deadline for delivery of QS, TK, IT							
14	**L 14.** The synthesis gas and chemical products based on it. Methods of synthesis gas production. Production of liquid hydrocarbons based on syngas. Methanol synthesis.	LO 3	ID 3.1. ID 3.2.	1	3	QS 14	Video lecture in MS Teams
14	**Lab 14.** Calculation and preparation of the material balance of the process. Submission of a report on work completion.	LO 4	ID 4.1. ID 4.2.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
14	**IWSP 7. Consultation on the implementation of IWS 3**			1		Discussion	Webinar in MS Teams
14	**IWS 3** Main problems of the gas chemical industry.	LO 5	ID 5.1. ID 5.2.	1	20	Report, oral discussion	Off-line laboratory work (Lab. #429)
Friday 23.00 - deadline for delivery of QS, TK, IT							
15	**L 15.** Production of oxygen-containing products from gaseous olefin hydrocarbons. Oxidation of olefin hydrocarbons. Alcohol production.	LO 3	ID 3.1. ID	1	3	QS 15	Video lecture in MS Teams

			3.2.				
15	**Lab 15.** Based on the data obtained during the experiment, was developed a possible mechanism for the reactions "Hydroalcoxycarbonylation of olefins in the presents of metal complex catalysts".	LO 2	ID 2.1.	4	8	Analysis, oral and written discussion	Off-line laboratory work (Lab. #429)
15	**Colloquium №2**				25	Test	Off-line
Friday 23.00 - deadline for delivery of QS, TK, IT							
	MT 2				100		

[Abbreviations: QS - questions for self-examination; TK - typical tasks; IT - individual tasks; CW - control work; MT - midterm.

Comments:

- Form of L and PT: webinar in MS Teams / Zoom (presentation of video materials for 10-15 minutes, then its discussion / consolidation in the form of a discussion / problem solving / ...)
- Form of carrying out the CW: webinar (at the end of the course, the students pass screenshots of the work to the monitor, he/she sends them to the teacher) / test in the Moodle DLS.
- All course materials (L, QS, TK, IT, etc.) see here (see Literature and Resources, p. 6).
- Tasks for the next week open after each deadline.
- CW assignments are given by the teacher at the beginning of the webinar.]

Dean Tassibekov H.S.

Chairman of the Faculty Methodical Council Mangazbayeva R.A.

Head of the Department Aubakirov E.A.

Lecturer Kudaibergenov N.Zh.