Module Title:	**M1 History and Philosophy of Science**
Semester(s) in which the module is taught:	1 semester
Person responsible for the module:	Candidate of Philosophical Sciences, Associate Professor Zhienbekova A.A.
Language:	Russian, Kazakh
Relation to the curriculum:	Basic discipline, university component
Teaching methods:	Lectures, seminars
Workload (including contact hours, self-study hours):	Total workload – 120 hours: Lectures – 30 hours; seminars – 15 hours; current MSIW – 50 hours; intermediate MSIW – 10 hours; MSIWT – 15 hours.
Number of credits:	4 ECTS
Prerequisites (conditions) for admission to the module:	Required bachelor modules: Philosophy, Modern history of Kazakhstan
Module Objectives / Expected Learning Outcomes:	The goal is to provide undergraduates with in-depth knowledge about the stages of development of the history and philosophy of science, the place and role of scientific knowledge, cognitive models, principles and methods of scientific knowledge. Once undergraduates have completed this course, they should be able to: - recognize the forms and methods of pre-scientific, scientific and non-scientific knowledge, as well as modern methods of knowledge; - choose ways to solve problems that arise in the course of research activities and require in-depth professional knowledge; - discussthe collective choice of necessary research methods in practical classes, with a critical analysis and understanding of the realities of modern theory and practice based on the methodology of natural science cognition; - organize and comprehensively investigate the features of the classification of sciences in the modern world; - present a creative scientific report on the search for features of studying knowledge about science.
Content:	**Lectures** Content: History and philosophy of natural and technical sciences. Modern European science Science in culture and civilization, the emergence of science, its historical dynamics, the structure of scientific knowledge, philosophical problems of specific sciences. Communication technologies of the XX-I century and their role in modern science. Philosophical problems of the development of modern global civilization. Modern topical methodological, methodological and philosophical problems of natural and social sciences and humanities, as well as special branches of scientific knowledge in accordance with the specialization of undergraduates. **Seminars**: The subject of the history and philosophy of science.Ideological foundations of science.Functions of the philosophy of science.The emergence and development of science.New European science.The main concepts and directions of the non-classical and post-non-classical stages of science development.Structural levels of scientific knowledge.Science as a profession.Philosophical foundations of science and the scientific picture of the world. Scientific traditions and scientific revolutions.11. History and philosophy of natural and technical sciences.History and philosophy of social sciences and Humanities.Philosophical problems of the development of modern global civilization.
Forms of exam/assessment:	Current control - reports on individual studies of pre-scientific, scientific and extra-scientific knowledge with a collective discussion, collective reports and discussions on practical studies of the realities of modern theory and practice; presentations of scientific reports on the search for features of studying

	knowledge about science, abstracts, oral surveys. Final control-examination
Training and examination requirements	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Oral survey – 15 points; Report – 10 points; Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 15 points. Examination (maximum 40 points).
The list of literature to read	1. Barseghyan, H., Overgaard, N., & Rupik, G. (2022). *Introduction to History and Philosophy of Science*. eCampusOntario Open Library 2. Kokhanovsky V.P. Fundamentals of the Philosophy of Science. Moscow: Phoenix, 2017. 3. History and Philosophy of Science. Edited by Kryanev Yu.V., Motorina L.E. Moscow: Infra-M, 2018. 4. Lipkina A.I. Philosophy of Science. Moscow, 2019. 5. Myrzaly S.K. History and Philosophy of Science. Almaty, 2021. (in Kazakh) 6. PhilSci Archive – Open Access Archive for Philosophy of Science. https://philsci-archive.pitt.edu/

Module Title:	**M2 Foreign language (professional)**
Semester(s) in which the module is taught:	1 semester
Person responsible for the module:	PhD, Associate ProfessorA.N. Zhorabekova
Language:	English
Relation to the curriculum:	Basic discipline, university component
Teaching methods:	Practical
Workload (including contact hours, self-study hours):	Total workload – 120 hours: Seminar – 45 hours; Current MSIW – 50 hours; Intermediate MSIW – 10 hours; MSIWT – 15 hours.
Number of credits:	4ECTS
Prerequisites (conditions) for admission to the module:	Bachelor's modules: Foreign Language 1, 2, Professionally Oriented foreign language
Module Objectives / Expected Learning Outcomes:	After completion of the module, master's students should be able to: - perceive and understand public speaking (lectures, presentations, television and Internet programs). - free to read, translate the original literature in the specialty with subsequent analysis, - to participate in professional discussions, scientific debates, round table discussions; - to present a presentation of a scientific research, an article on a specialty in a foreign language; - work with lexicographic sources in a foreign language.
Content:	Studying the subject area of the specialty in a foreign language corresponding to level B2, C1. Reading. Improvement of reading skills: mastering the main types of reading (introductory, study, viewing, search) of foreign-language original sources with varying degrees of content coverage. Formation of the ability to isolate basic semantic blocks in the material, determine logical connections between them, critically comprehend and analyze text fragments depending on specific characteristics and target setting. Writing. Development of skills in preparing written reports on scientific topics in the specialty: scientific report, theses on the topic of scientific research, poster report, referencing of original sources in a foreign language, annotation of scientific text, summary. Basic principles of business writing, preparation of written documentation for international scientific cooperation. Listening. Listen to authentic professionally-oriented materials with native speakers ' speech in audio and video recordings. Understanding the general content of authentic records. Listening to lectures and messages containing professional information. Speaking. Development of oral communication skills in the specialty in a monologue form: a speech with a scientific report, a message, a presentation of a scientific study. Development of professional oral communication skills in the form of dialogue / polylogue: scientific discussion, scientific debates, debates, round-table discussions, use of situational games (casestudies).
Forms of exam/assessment:	Current control: written work on the translation of technical texts, the presentation of technical texts on specialization, tests, role exchange, oral surveys. Final control – Differentiated credit
Training and examination requirements	The final grade consists of continuous assessment (60 points) and the final examination (40 points). The continuous assessment (60 points) includes:

	Completion of classroom and independent assignments - 15 points Presentation of technical texts and defense – 10 points Written tasks – 10 points Oral survey - 10 points Activities provided by the syllabus – 15 points Final control – Oral assessment (maximum 40 points): - Understanding and discussion of professional or research-related topics – 15 points - Presentation and communication skills – 10 points - Use of academic and professional vocabulary – 10 points - Fluency and language accuracy – 5 points
The list of literature to read	1. Harrison R., S. Philot, L. Curnick. New Headway Academic Skills. Reading, Writing, and Study Skills. Oxford University Press, 2019. 2. Technical English. – Oxford University Press, 2019. 3. Stepanova T. A. English for Technical Specialties. - Practical Course. St. Petersburg, 200618 4. English Grammar in Use. Raymond Murphy. – Cambridge University Press, 2018. 5. May P. IELTS. Practice Tests. Oxford University Press, 2018.

Module Title:	**M3 Management Psychology**
Semester(s) in which the module is taught:	1 semester
Person responsible for the module:	PhD Duanaeva S.E.
Language:	Russian, Kazakh
Relation to the curriculum:	Basic discipline, university component
Teaching methods:	Lectures, seminars
Workload (including contact hours, self-study hours):	Total workload – 90 hours: Lectures – 15 hours; seminars – 15 hours; current MSIW – 45 hours; intermediate MSIW – 7.5 hours; MSIWT – 7.5 hours.
Number of credits:	3 ECTS
Prerequisites (conditions) for admission to the module:	Bachelor's modules: Phylosophy, Current problems and modernization of public consciousness
Module Objectives / Expected Learning Outcomes:	Objective: to study the specifics and basic psychological patterns of management activities; to develop skills in analyzing management activities; to improve the efficiency of the organization. Once undergraduates have completed this course, they should be able to: - show sociability and socio-psychological competence in professional activities; - possess the skills of mental self-regulation; - conduct a methodological analysis of the problem of personality psychology; - set and solve psychological problems related to developmentaland коррекционнcorrectional processesами in accordance with the requirements of science and practice; - show positive thinking and initiative in solving current pedagogical and research tasks; - work in a team, offer new motivational solutions to psychological problems related to professional activities.
Content:	**Lectures** Content: Basic approaches and principles of modern psychological science, necessary in the professional activity of highly qualified specialists. Formation of a scientific and theoretical worldview based on fundamental psychological concepts, development of ideas about psychological science that reveal the content of the discipline. Formation of skills and abilities in psychological research of the individual, familiarization with the main methods of experimental psychological research and the main directions of psychocorrective work; practical skills, the ability to apply, interpret and draw up a conclusion based on the results obtained. **Practical classes**: Psychology as a modern science. Basic methods of psychological research.Introduction to personality psychology. Basic theories of personality.Personality and culture, temperament. character, abilities, and emotions. The activity and its main characteristics. Sensation and perception. Attention and memory.Imagination, thinking, speech. Facets of communication: information exchange, interaction.Psychological features of people's perception and understanding of each other.
Forms of exam/assessment:	Current control: Case study, collective discussions on practical studies of the realities of modern theory and practice; presentations, oral surveys. Final control-examination
Training and examination requirements	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Oral survey – 15 points; Case study – 10 points;

	Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 15 points. Examination (maximum 40 points).
The list of literature to read	1. Krylov A.A. Psikhologiya. -M:Prospekt, 2020.-230s. 2.Nemov R.S. Psikhologiya.-M:Prosveshcheniye, 2021,T.1. - 250s. 3. Parboteeah, K. P., Pierce, J. L., Reece, M., et al. (2019). Principles of Management 4. ZHünísbekova ZH.A., Koyshybayeva N.I. Uchebnoye posobiye dlya magistrantov vsekh spetsial'nostey po distsipline «Psikhologiya», Shymkent: YUKGU, 2022g.-180s. 5.Lawton Jean-Marc. Aqa A-Level Psychology: Revision Made Easy .- Hodder Education, 2019. — 256 p.

Module Title:	**M4 Pedagogy and psychology of higher education**
Semester(s) in which the module is taught:	1 semester
Person responsible for the module:	Doctor of Pedagogical Sciences, Professor Almetov N. Sh.
Language:	Russian, Kazakh
Relation to the curriculum:	Basic discipline, university component
Teaching methods:	Lectures, seminars
Workload (including contact hours, self-study hours):	Total workload – 150 hours: Lectures – 30 hours; seminars – 30 hours; current MSIW – 55 hours; intermediate MSIW – 12.5 hours; MSIWT – 22.5 hours.
Number of credits:	5 ECTS
Prerequisites (conditions) for admission to the module:	Bachelor's modules: Philosophy, Current problems and modernization of public consciousness
Module Objectives / Expected Learning Outcomes:	Objective: to develop undergraduates ' skills and abilities to effectively organize professionaland pedagogical activities at the university based on modern psychologicaland pedagogical knowledge. Once undergraduates have completed this course, they should be able to: - discuss the problems of conducting scientific research in higher education and anticipate new needs and requirements of education; - strive for the need for continuous professional developmentя; - analyze pedagogical situations and give them justification; - apply effective university training technologies; - criticize the existing methods of the pedagogical process; - organize lectures and practical classes on specialization among students with the adjustment of the program for a specific educational context.
Content:	**Lectures** Content: Modern paradigms of higher education. The system of higher professional education in Kazakhstan. Methodology of pedagogical science. Methodological apparatus of pedagogical research. Professional competence of a higher school teacher. Organization of the learning process based on the credit system of higher education. Methods and forms of training for future specialists. New educational technologies in higher education. Activities of an adviser, tutor, and office registrar at a university. Technology of drawing up teaching materials.Higher school as a social institution of education and formation of a specialist's personality.The essence and main directions of educational work in higher education institutions. **Seminar classes:** Methodological foundations of higher school pedagogy.A high school teacher and student is a creatively self-developing individual. Priority strategies and trends in the development of higher education, pedagogical patterns, principles and methods.Forms organization of training at the university. The essence and priority strategies of student education, Pedagogical innovation and pedagogical monitoringOrganization of the higher school educational process.Concepts of research, intelligent, and innovative universities.
Forms of exam/assessment:	Current control - Scientific literature review, collective discussions on practical studies of the realities of modern theory and practice; presentations, oral surveys. Final control-examination
Training and examination requirements	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Oral survey – 15 points; Scientific literature review – 10 points; Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points;

	Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 15 points. Examination (maximum 40 points).
The list of literature to read	1. Akhmetova G.K., Isayeva Z.A. Pedagogy: A Manual for Master's Degrees at Universities. - Almaty: Kazakh University, 2022.-328 pages. 2. Shalġynbayeva K.K. Pedagogy. - Astana: Gumilev ENSU Publishing House, 2021. (in Kazakh) 3. Tíleuova S.S. Higher School Pedagogy. - Shymkent, 2023. (in Kazakh). 4. Mynbayeva A.K., Sadvakasova Z.M. Innovative Teaching Methods or How to Teach Interestingly. - Almaty, 2020. -174s.

Module Title:	**M5.1 Resource-saving technologies**
Semester(s) in which the module is taught:	1 semester
Person responsible for the module:	PhD, senior lecturer Karabaev Zh.
Language:	Kazakh
Relation to the curriculum:	Profile discipline, elective component
Teaching methods:	Lectures, laboratory classes, practical classes
Workload (including contact hours, self-study hours):	Total work load-180 hours: Lectures-30 hours; laboratory-30 hours; practical-15 hours; Current MSIW – 60 hrs; Intermediate MSIW – 15 hrs; MSIWT – 30 hrs.
Number of credits:	6 ECTS
Prerequisites (conditions) for admission to the module:	Competence module in the field oftechnologiesand primaryand secondaryых processes of oil refining, production of lubricants,environmentalx problems of production and consumption of petroleum products.
Module Objectives / Expected Learning Outcomes:	The module aims to develop undergraduates ' competencies in modern methods of improving the efficiency of using raw materials, energy and materials in the chemical technology of organic substances, with an emphasis on sustainable development and minimizing environmental impacts. After undergraduates have completed this course, they can: - know the basic principles of resource conservation, methods of analysis of material and energy flows, modern resource-saving technologies and regulatory requirements in the field of environmental protection. - understand the relationship between technological parameters and resource efficiency, the principles of energy-saving technologies, methods of recycling and recycling of waste. - apply methods of analysis of material and energy flows to assess the resource efficiency of technological processes, choose the best solutions to minimize waste and reduce energy consumption. - analyze the product life cycle (LCA) and identify opportunities for improving resource efficiency, evaluate the economic and environmental feasibility of implementing resource-saving technologies. - develop new or upgrade existing technological processes based on the principles of resource conservation, and offer solutions for waste management and recycling. - evaluate the effectiveness of implementing resource-saving technologies and compliance with regulatory requirements in the field of environmental protection - perform technical and economic assessment of chemical technologies, including the analysis of production cost structure, resource, energy and equipment efficiency; - evaluate the investment attractiveness and commercial potential of chemical technology projects, applying the principles of business planning, R&D commercialization, and innovation management

Content:	**Lectures**: Resource-saving concepts in the chemical industry: waste minimization principles, closed production cycles, a circular economy, and improved efficiency in the use of material, public, and water resources. Current trends are reducing the development of the chemical industry; ESG principles and low-carbon production transformation are being implemented. Analysis and optimization of material and flow streams, application of catalytic, membrane, and sorption technologies, integrated resource utilization, Integration of renewable energy systems and hydrogen technologies for sustainable chemical manufacturing. Recycling and disposal of chemical production waste. Application of low-carbon and resource-efficient technologies in chemical production. Digital energy management systems. Development of new catalysts and process flow diagrams, implementation of innovations, product life cycle assessment (LCA), carbon footprint, and, consequently, efficiency. Design and management of resource-efficient production facilities. Technical and economic assessment of resource-saving technologies, structure of structural and economic costs, analysis of resource, energy, and equipment efficiency. Fundamentals of business planning for successful technology projects, assessment of investment attractiveness, results of commercialization of research and development (R&D) and innovation management in the chemical industry. Environmental safety in resource conservation. International and safety standards are consistent with the development, environmental standards, and energy efficiency of industrial enterprises.
	Laboratory classes: Study of methods of heat and mass transfer intensification: study of the influence of various factors on the rate of heat and mass transfer; comparison of the efficiency of various types of heat exchange equipment; assessment of the possibility of using intensified heat exchangers. Research of catalytic processes to increase selectivity and reduce raw material consumption: synthesis of a catalyst for the oxidation of ethylene to ethylene oxide; study of the influence of various factors (temperature, pressure, composition of the reaction mixture) effect on the selectivity and activity of the catalyst; assessment of the possibility of reducing the consumption of raw materials. Study of the processes of recycling polymer waste: sorting and preparation of polymer waste; research of various recycling methods (mechanical, chemical, energy).Determination of the energy efficiency of a gasoline reforming unit: determination of the optimal mode of operation of the reforming unit; calculation of energy costs under different operating modes of the unit; analysis of the impact on environmental indicators; development of recommendations for cost reduction. **Practical classes**: Development of a closed-cycle technological scheme for ethylene production. Modeling and optimization of the heat exchange network of a chemical enterprise: using software for modeling heat exchange processes; searching for the optimal configuration of the heat exchange network to reduce energy consumption. Life cycle assessment (LCA) of polyethylene production: collecting data on all stages of the product life cycle (from raw material extraction to recycling); conducting LCA analysis using specialized software; identifying the most resource-intensive and environmentally significant stages. Development of a design for an associated petroleum gas methane recovery unit: analysis of the associated petroleum gas composition; selection of a methane recovery method; development of a technological scheme for the installation. Technical and economical evaluation of chemical technologies. Assessment of resource, energy, and equipment efficiency in chemical production. Business planning and investment evaluation for chemical technology projects.

Forms of exam/assessment:	Current control: - submission of a literary review, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Training and examination requirements	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Scientific literature review – 15points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 5 points. Examination (maximum 40 points).
The list of literature to read	1.Resource- and Energy-Saving Technologies in the Chemical Industry: Scientific Monograph / Y.L. Bilonoga, V.V. Stybel, O.R. Maksysko et al. – Riga, Latvia: Baltija Publishing, 2022. – 272 p. 2.Handbook of Process Integration (PI): Minimisation of Energy and Water Use, Waste and Emissions / edited by Jiří Jaromír Klemeš. – 2nd ed. – Cambridge: Woodhead Publishing, 2022. – 1190 p. 3.Energy Saving and Carbon Reduction: Approaches for Energy and Chemical Industries / Tony A. Chen. – Singapore: Springer Nature, 2022. – 682 p. 4.Handbook of Biofuels Production: Processes and Technologies / edited by Rafael Luque, Carol Sze Ki Lin, Keith Wilson, James Clark. – 3rd ed. – Cambridge: Woodhead Publishing, 2022. – 882 p.

Module Title:	**M5.2 Prospects for the development of the production of motor fuels from hydrocarbon raw**
Semester(s) in which the module is taught:	1 Semester
Person responsible for the module:	PhD, senior lecturer Karabaev Zh.
Language:	Kazakh
Relation to the curriculum:	Profile discipline, elective component
Teaching methods:	Lectures, laboratory classes, practical work
Workload (including contact hours, self-study hours):	Total work load-180 hours: lectures-30 hours; laboratory-30 hours; practical-15 hours; Current Independent Work (IW) – 60 hrs; Intermediate IW – 15 hrs; Guided Independent Work (with teacher) – 30 hrs.
Number of credits:	6 ECTS
Prerequisites (conditions) for admission to the module:	Competence in the technology of secondary oil refining processes, theoretical and practical aspects of rational production and use of petroleum products, special technologies for the production of motor fuels from petroleum raw
Module Objectives / Expected Learning Outcomes:	The module aims to provide undergraduates with in-depth knowledge of current trends in the development of motor fuel production, including alternative sources of raw materials, promising technologies and quality requirements for future fuels, and generate ideas for continuous improvement of product quality. After master's students have completed this course, they are able to: - know the classification of motor fuels, characteristics and quality requirements for gasoline, diesel fuels and alternative fuels, promising technologies for processing hydrocarbon raw materials. - understand the relationship between the composition and properties of motor fuels and their operational characteristics, the influence of various factors on the efficiency and environmental safety of fuel production, and the principles of modern oil and gas refining processes. - apply theoretical knowledge to analyze technological schemes for the production of motor fuels, choose optimal solutions to improve the quality of fuels and reduce the environmental burden, perform calculations necessary for the design of new and modernization of existing processes. - analyze promising areas of development of the fuel industry, assess the economic and environmental feasibility of introducing new technologies, compare different types of motor fuels according to their characteristics and environmental impact. - develop new compositions of motor fuels with improved operational and environmental characteristics, offer innovative solutions for upgrading existing and creating new technological processes for fuel production. - evaluate the compliance of the quality of motor fuels produced with the current regulatory requirements, determine the potential for reducing emissions of pollutants and greenhouse gases when using various types of fuels; - design and manage research and development (R&D) projects and prepare feasibility studies for innovative technologies in the production of digestible phosphates and nitrates; - analyze the efficiency and risks of technological solutions and develop rational process schemes based on technical, economic, and environmental criteria.

Content:	**Lectures** Content: The modern fuel industry in the context of global trends in the production and consumption of motor fuels, the role of oil and gas in the energy balance, energy transition, decarbonization, and climate policy. Prospects for the development of low-carbon energy sources, including biofuels, synthetic fuels, hydrogen, and renewable energy sources. Properties and requirements for modern and promising motor fuels. Technologies for deep oil and gas refining, digitalization, energy efficiency, and the integration of traditional and innovative processes. Analysis of gasoline, diesel, and aviation fuel production technologies, as well as GTL, CTL, BTL, Power-to-Liquid, hydrogen technologies, and CCUS. Environmental, economic, and technological aspects, product life cycle assessment, principles of sustainable development of motor fuel production. Design, management of research and development (R&D) and investment projects, feasibility study of innovative solutions in oil refining industry. Analysis of efficiency and risks, development of rational schemes for processing hydrocarbon and renewable raw materials.
	Recommendation of oil refining options based on the results of their research; development of promising schemes for deep oil refining for fuel; calculations of promising processes for processing hydrocarbon raw materials. Modern oil refining processes for the production of gasoline and diesel fuels. Alternative processes for the production of motor fuels: production of synthetic gasoline and diesel fuel from gas (GTL technologies). Requirements for the quality of motor fuels of the future: stricter environmental requirements; reduction of sulfur, aromatic hydrocarbons and olefins; increase in the octane number of gasoline and cetane number of diesel fuels; prospects for the use of biofuels and synthetic fuels. Economic and environmental aspects of motor fuel production. Prospects for the production of hydrogen as a motor fuel.
	Laboratory classes: Determination of the octane number of gasoline by research and motor methods: study of the design and principle of operation of the octanometer; preparation of reference mixtures; conducting octane number measurements; analysis of the results. Practical determination of the cetane number of diesel fuel. Determination of the fractional composition of gasoline and diesel fuel by gas chromatography. Determination of sulfur content in petroleum products by X-ray fluorescence analysis. Investigation of the influence of additives on the properties of motor fuels: preparation of gasoline with various additives. Studying the influence of additives on the properties of motor fuels
	Practical classes: Analysis of the technological scheme of a catalytic reforming unit. Calculation of the material balance of the alkylation process. Evaluation of the economic efficiency of implementing GTL technology. Development of the composition of gasoline with improved environmental characteristics. Analysis of regulatory documents regulating the quality of motor fuels: study of state standards and technical regulations for gasoline and diesel fuel; comparison of the requirements of various regulatory documents; preparation of a conclusion on the compliance of fuel quality with regulatory requirements. Feasibility study and investment assessment of innovative motor fuel production projects. Analysis of technological efficiency, risks and rational processing schemes for hydrocarbon and renewable feedstocks
Forms of exam/assessment:	Current control: experimental design development, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination

Training and examination requirements	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Experimental design development – 15points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 5 points. Examination (maximum 40 points).
The list of literature to read	1.Petroleum Refining and Natural Gas Processing / H.K. Abdel-Aal, M. Aggour, M.A. Fahim. – Boca Raton: CRC Press, 2021. – 712 p. 2.Modern Petroleum Refining Processes / C.S. Hsu, P.R. Robinson. – Cham: Springer, 2022. – 518 p. 3.Transportation Fuels: Technologies for the Future / M. Speight. – Cambridge: Woodhead Publishing, 2021. – 456 p. 4.Advances in Clean Hydrocarbon Fuel Processing / K. Inamuddin, A.M. Asiri. – Singapore: Springer Nature, 2023. – 389 p. 5.Sustainable Production of Fuels and Chemicals from Hydrocarbon Resources / A. Basile, F. Dalena. – Amsterdam: Elsevier, 2022. – 475 p.

Module Title:	**M6. 1 Nanostructured polymer materials**
Semester(s) in which the module is taught:	1 Semester
Person responsible for the module:	Doctor of Technical Sciences, Professor Syrmanova K. K.
Language:	Russian
Relation to the curriculum:	Profile discipline, elective component elective component
Teaching methods:	Lectures, practical classes, laboratory classes
Workload (including contact hours, self-study hours):	Total work load-180 hours: lectures-30 hours; laboratory-30 hours; practical-15 hours; Current MSIW – 60 hrs; Intermediate MSIW – 15 hrs; MSIW – 30 hrs.
Number of credits:	6 ECTS
Prerequisites (conditions) for admission to the module:	Bachelor's degree modules: General Chemical Technology, Physics and Polymer Chemistry
Module objectives / Expected learning outcomes	Objective: to study methods for the synthesis, structure, properties, and application of nanostructured polymer materials to create new high-performance products and coatings. After undergraduates have completed this course, they are able to:: - new methods for obtaining nanostructured polymers (self-assembly, polymerization in limited volumes, use of nanoparticles); - interpret the physical and chemical basis of nanostructuring (phase transitions, interaction at the interface, mechanisms of morphology formation); - use knowledge about the properties of nanostructured polymers to select a material for a specific task; - compare different types of nanoparticles and their effect on the properties of polymer materials; - formulate hypotheses about the relationship between the structure and properties of nanostructured polymer materials; - evaluate the influence of various factors on the properties of nanostructured polymer materials.
Content	**Lectures** Content**:** The concept of nanostructured polymers: definition, classification, principles of nanostructure formation in polymer systems. Methods for obtaining nanostructured polymers: self-assembly, polymerization in limited volumes, use of nanosystems (nanoparticles, nanotubes, graphene structures) as fillers. Physical and chemical bases of nanostructuring: phase transitions, interaction at the interface, mechanisms of morphology formation. Types of nanostructured polymer materials: nanocomposites, block copolymers, polymer membranes, polymer nanogels. Methods of studying the structure and properties: electronic and atomic forceатомносиловая microscopy, X-ray diffraction, spectroscopy, thermal analysis. Functional properties of nanostructured polymers: high mechanical strength, barrier properties, conductivity, selectivity. Applications: medical implants and drug delivery systems, protective coatings, filtration membranes, electronics, packaging materials. Prospects for the development of nanostructured polymer technologies, environmental and economic aspects of their use. **Laboratory classes:** Preparation of NPM (nanostructured polymer materials) by introducing nanoparticles into a polymer solution.Production of prototypes of filled polymer materials by injection molding, extrusion and hot pressing. Mixtures of polymers. Preparation of polymer mixtures by melt compounding. Preparation of nanocomposites based on carbon nanomaterials. Investigation of the microstructure of polymer materials by electron and atomic force microscopy. **Practical classes:** Determining the properties of composite materials.

	Classification and properties of polymer materials. Technology of three-dimensional materials for structural purposes with nanoscale structural elements. Determination of the critical diameter of nanoparticles. Changes in the properties of NPM depending on the particle size. Investigation of the sedimentation stability of nanoparticles in polymer solutions depending on the method of nanoparticle dispersion. Investigation of morphology and physical and mechanical properties of the obtained NPM.
Forms of examinations / assessments	Current control: - submission of a report, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Scientific report – 15points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 5 points. Examination (maximum 40 points).
References for reading	1.Nanotechnologies in Chemical Technology of Polymer Production: Study Guide / V.A. Lipin. – Saint Petersburg: VSHTE SPbSUPTD, 2020. – 72 p. 2.Introduction to Nanotechnology: Study Guide / Yu.A. Timoshina, E.F. Voznesensky. – Kazan: Kazan National Research Technological University, 2019. – 156 p. 3.Processes for Obtaining Nanomaterials: Study Guide / A.P. Amosov, E.I. Latukhin, P.E. Yudin. – Samara: Samara State Technical University, 2019. – 248 p. 4.Polymer Nanocomposites: Processing, Characterization, and Applications / Joseph H. Koo. – 2nd ed. – New York: McGraw-Hill Education, 2021. – 688 p. 5.Nanostructured Polymer Materials and Nanocomposites / Vikas Mittal. – Cham: Springer Nature, 2022. – 412 p. 6. Advanced Polymer Nanocomposites: Science and Applications / Sabu Thomas, Raju Thomas, Aji P. Mathew. – Amsterdam: Elsevier, 2023. – 524 p.

Module Title:	**M6. 2 Ways to intensify the production and processing of elastomers**
Semester(s) in which the module is taught:	1 Semester
Person responsible for the module:	Doctor of Technical Sciences, Professor Syrmanova K. K.
Language:	Kazakh, Russian
Relation to the curriculum:	Profile discipline, component of choice
Teaching methods:	Lectures, practical classes, laboratory classes
Workload (including contact hours, self-study hours):	Total work load-180 hours: lectures-30 hours; laboratory -30 hours; practical -15 hours; Current MSIW– 60 hrs; MSIW– 15 hrs; MSIWT – 30 hrs.
Number of credits:	6 ECTS
Prerequisites (conditions) for admission to the module:	Competencies in general chemical technology, physics and polymer chemistry
Module objectives / Expected learning outcomes	Objective: to deepen the knowledge of undergraduates on the practical basics of elastomer technology, to acquire skills in creating elastomeric materials with specified properties. After master's students have completed this course, they are able to: - know the current requirements for the ingredients of rubber compounds; - explain the principles of intensifying the production and processing of elastomers; - select the composition of the rubber compound for the specified operating conditions; - evaluate the impact of new ingredients on the properties of elastomers; - propose new technological solutions for intensifying the production and processing of elastomers; - evaluate the prospects for using new materials and technologies in the production of elastomers.
Content	**Lectures** Content: Ways to intensify the production and processing of elastomers. Modern requirements for the ingredients of rubber compounds. Modern processes and equipment for the production and processing of elastomers. Obtaining elastomeric materials with specified properties. New ingredients to improve the properties of elastomers. **Laboratory classes:** Quality assessment and preparation of elastomers for processing. Assessment of the degree of contamination, determination of the Muni viscosity, determination of the content of volatile substances. Preparation of rubbers for mixing (mastication, preheating). Study of the influence of ingredients on the properties of rubber compounds: the influence of fillers on the rheological and physical-mechanical properties of rubbers; the influence of plasticizers on the technological and operational properties of rubbers; the influence of vulcanizing agents on the kinetics of vulcanization and properties of vulcanizates. Composing rubber compounds for various purposes using different types of ingredients. Evaluation of rheological properties of rubber mixtures on various laboratory equipment (rheometer, viscometer). Development of the optimal composition of the rubber compound for the specified operating conditions. Variation of technological parameters of the vulcanization process and evaluation of the effect on the properties of the obtained rubbers. **Practical classes:** Calculation of rubber compound compositions for various operating conditions. Development of a rubber compound formulation for a specific product, taking into account the requirements for its properties. Modeling of elastomer processing processes. Simulation of the rubber compound extrusion process and optimization of parameters to obtain a

	profile with specified dimensions and properties. Analysis of the causes of defective rubber products and development of methods for its elimination. Analysis of samples of defective rubber products and development of recommendations for improving the technological process. Evaluation of the economic efficiency of intensifying the production and processing of elastomers. Comparison of economic efficiency of various methods of processing elastomers.
Forms of examinations / assessments	Current control: - group project, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Group project – 15points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 5 points. Examination (maximum 40 points).
Bibliography for reading	1.Special Purpose Elastomers: Synthesis, Structure-Property Relationship, Compounding, Processing and Applications. L. Priya, A. Chandra. – Berlin: Springer, 2019. – 428 p. 2.Literature Report of Elastomer Sealing Materials and Cement Systems. G. Kwatia, C. Ezeakacha, S. Salehi. – Norman, Oklahoma: University of Oklahoma, 2018. – 80 p. 3.Thermoplastic Elastomers: Materials and Applications. A.K. Bhowmick, H.L. Stephens. – Boca Raton: CRC Press, 2018. – 480 p. 4.Handbook of Elastomers: New Developments and Technology. B. Rodgers. – New York: CRC Press, 2021. – 624 p. 5.Elastomers and Rubber Compounding Materials / A.K. Bhowmick. – Amsterdam: Elsevier, 2022. – 512 p. 6.Advanced Elastomeric Materials and Processing Technologies. S. Thomas, R. Joseph. – Singapore: Springer Nature, 2023. – 446 p.

Module Title:	**M7 Research work of a master's student 1**
Semester(s) in which the module is taught:	1 semester
Person responsible for the module:	Candidate of Technical Sciences, Associate Professor DaurenbekN.M., Doctor of Technical Sciences, Professor BeisenbayevO.K., Candidate of Technical Sciences, Professor Turebekova G.Z
Language:	Russian, Kazakh
Relation to the curriculum:	
Teaching methods:	Consultations with the supervisor
Workload (including contact hours, self-study hours):	Total work load – 30 hours:
Number of credits:	1 ECTS
Prerequisites (conditions) for admission to the module:	Competencies in planning and setting up research projects
Module objectives / Expected learning outcomes	After completing research in the 1st semester, a master's student can: - justify the choice of the topic of the master's thesis, revealing its relevance, scientific novelty, theoretical and practical significance.
Content	- formulate the purpose, objectives, object and subject of the research based on the analysis of the problem area and scientific literature. - analyze and interpret the main scientific sources, forming the theoretical basis of research. - choose and characterize the methodological apparatus necessary to achieve the goals and solve the research tasks. - create a master's thesis preparation work plan, distributing the stages of scientific work and predicting deadlines. - evaluate the contribution of the preliminary stage of research to the overall structure of the master's thesis, formulating conclusions about the work done. Relevance and theoretical and applied significance of the chosen topic of the master's thesis, taking into account the current directions of scientific research and the needs of practice. The purpose and objectives of performing research work (R & D) in accordance with the logic of the development of a scientific problem. The object and subject of research, the limits of their consideration in the context of the tasks set. Justification of the choice of the dissertation topic based on the analysis of the current state of the scientific field and its priority areas. Assessment of the scientific novelty and significance of the proposed results, the theoretical and practical value of the proposed conclusions. Analytical review of domestic and foreign literature sources, key theoretical concepts considered in the framework of the dissertation topic. Development of a master's thesis preparation work plan, structuring it in stages, including theoretical analysis, experimental research activities and evaluation of the effectiveness of solutions. Determination of the sequence of tasks within the academic semester with reference to the resources of the laboratory base of the department. Conclusions based on the results of research performed in the first semester, with an emphasis on the degree of elaboration of the theoretical part, the formation of the methodological base and the actualization of further research stages. Assessment of the contribution of the work done to the overall content and structure of the master's thesis, identification of prospects for further scientific research. A generalized list of literature sources used, reflecting the degree of knowledge of the topic, theoretical approaches, applied solutions and the level of development of the problem under study.
Forms of exams / assessments	Current control: the results of scientific research, performed technological calculations. Final control – Differentiated credit (written research report and oral defense).

Requirements for training and exams	Submission of a written research (internship) report and oral defense before the examination committee. The written report is assessed for a maximum of 60 points: Compliance with academic writing and integrity requirements – 10 points; Relevance of the research objectives and quality of literature review - 10 points; Description of research methodology – 10 points; Quality of the research data analysis – 15 points; Validity of conclusions and practical recommendations – 10 points; Correct referencing and presentation quality – 5 points. The oral defense is assessed for a maximum of 40 points: - Understanding of the objectives, methodology and results of the work – 15 points - Presentation, logical structure and clarity of explanations – 10 points - Professional competence and use of technical terminology – 10 points - Ability to discuss the results and draw justified conclusions – 5 pointsThe final grade is the sum of the points awarded for the written report and the oral defense (maximum 100 points).
List of references for reading	1.QMS SKU PR 7.28-2024 Organization and conduct of scientific (experimental)work- research work of undergraduates and doctoral students 2. Zotov Yu.L., Mednikov E.V., et al. Chemical Technology. Alternative and Biodiesel Fuels. Ed. by Yu.V. Popov. — Volgograd: VolGTU, 2017. — 196 p. — ISBN 978-5-9948-2558-7. 3. Kapustin V.M., Ershov M.A., Khakimov R.V. Motor Gasolines with High-Octane Additives: A Textbook. — Moscow: Gubkin Russian State University of Oil and Gas (National Research University), 2021. — 160 p.

Module Title:	**M 8. Pedagogical practice**
Semester(s) in which the module is taught:	2 Semester
Person responsible for the module:	Candidate ofTechnical Sciences, Associate ProfessorDaurenbekN.M., DoctorofTechnical Sciences, ProfessorBeisenbayevO.K., Candidate ofTechnical Sciences, ProfessorTurebekova G.Z
Language:	Russian, Kazakh
Relation to the curriculum:	Basic university component
Teaching methods:	
Workload (including contact hours, self-study hours):	Total workload-120 hours
Number of credits:	4 ECTS
Prerequisites (conditions) for admission to the module:	Competencies in the field of pedagogy and psychology of higher education
Module objectives / Expected learning outcomes	After a master's student completes this course, they are able to: - integrate theoretical knowledge into real-world pedagogical situations, applying it for effective learning and student development. - adapt them depending on the context and specifics of the academic discipline. - fundamentalsы of professional and pedagogical culture of teaching, general pedagogical skills, theoretical and methodological foundations of higher school pedagogy. - establish contact witho studentsами, transfer knowledge effectively, and maintain feedback. - evaluate students ' academic performance, as well as self-assessment ofy their teaching activities. - useть digitale toolsы and platformsы in the learning process, including distance learning and electronic resources.
Content	Development of professional research culture in the field of chemical technology of organic substances, as a condition of pedagogical skill and pedagogical creativity, formation of professional and pedagogical skills, culture of scientific and pedagogical thinking. Development of educational and methodical documents on the profile discipline. Preparation and conduct of practical and laboratory classes in special disciplines. Development of new active forms of conducting classes with students and their application in practical classes.
Study / examination results forms of control:	Current control: the results of scientific research, performed technological calculations. Final control – Differentiated credit (written research report and oral defense).

Requirements for training and exams	Submission of a written pedagogical practice report and oral defense before the examination committee. The written report is assessed for a maximum of 60 points: Compliance with academic writing and integrity requirements – 10 points; Quality of planning and implementation of teaching activities – 15 points; Application of appropriate teaching methods, learning technologies, and assessment strategies – 10 points; Reflection on teaching practice, analysis of challenges, and professional development – 15 points; Correct referencing and overall presentation quality – 10 points. The oral defense is assessed for a maximum of 40 points: - Understanding of the objectives, methodology and results of the work – 15 points - Presentation, logical structure and clarity of explanations – 10 points - Professional competence and use of technical terminology – 10 points - Ability to discuss the results and draw justified conclusions – 5 points The final grade is the sum of the points awarded for the written report and the oral defense (maximum 100 points).
Reading list	1.Higher Education Pedagogy: Textbook / G.K. Akhmetova, Z.A. Isayeva. – Almaty: Qazaq Universiteti, 2021. – 352 p. 2.Higher Education Pedagogy: Study Guide / S.S. Tileuova. – Shymkent: Alem Publishing House, 2020. – 280 p. 3.Innovative Teaching Methods in Higher Education: Study Guide / A.K. Mynbayeva, Z.M. Sadvakasova. – Almaty: Qazaq Universiteti, 2021. – 256 p. 4.Active Forms and Methods of Teaching at University: Study Guide / Z.A. Isayeva et al. – Almaty: Qazaq Universiteti, 2022. – 240 p. 5.Andragogy: Modern Technologies for Organizing and Conducting the Educational Process: Study Guide / Yu.N. Dresher. – Moscow: Yurait Publishing House, 2021. – 295 p.

Module Title:	**M9. 1 Advanced technologies of petrochemical synthesis**
Semester(s) in which the module is taught:	2 Semester
Person responsible for the module:	Module Doctor of Technical Sciences, Professor O. K. Beisenbayev
Language:	Russian, Kazakh
Relation to the curriculum:	Basic discipline, optional component
Teaching methods:	Lectures, laboratory classes
Workload (including contact hours, self-study hours):	Total work load – 120 hours: Lectures-30 hours; laboratory-15 hours; Current MSIW – 50 hrs; MSIW – 10 hrs; MSIWT – 15 hrs.
Number of credits:	4ECTS
Prerequisites (conditions) for admission to the module:	Competencies in chemistry and technology of secondary oil refining processes, technologies of organic and petrochemical production, technologies of lubricants production, special technologies of motor fuel production
Module objectives / Expected learning outcomes	Objective: to expand and deepen theoretical knowledge on current issues of petrochemical synthesis; to instill practical skills for developing energy-and material-saving environmentally friendly technological productions. After undergraduates have completed this course, they can: - list modern technologies for the production of oxygen-containing compounds, halogen and nitro derivatives, synthetic detergents, rubbers, plastics and fibers; - compare different technologies for the production of petrochemical products, analyzing their advantages and disadvantages; - choose the optimal technological schemes for the production of target petrochemical synthesis products, based on the specified conditions and requirements; - analyze the effect of process parameters (temperature, pressure, catalyst) on the yield and selectivity of target products; - propose new applications for petrochemical products based on their unique properties; - evaluate the environmental safety of various petrochemical synthesis technologies.
Content	**Lectures** Content: Petrochemistry as a field of modern chemical science. New methods for obtaining organic products from petrochemical raw materials. Significance and place of isomerization processes in the organic synthesis industry. Scientific basis of modern processes of isomerization of paraffin, olefin C4-C6 and alkylaromatic hydrocarbons. Scientific basis ofisomerization of oximes, basic laws of the process, products obtained. Scientific basis of cyclohexanonoxime isomerization in caprolactam. Modern technologies for the production of oxygen-containing compounds, halogen and nitro derivatives, synthetic detergents, rubbers, plastics, etc. fibers. Using artificial intelligence to predict the properties of petrochemical products. **Laboratory classes:** Study of the influence of catalysts on the process of isomerization of alkanes: analysis of the influence of the nature of the catalyst on the yield of isomerized products. Investigation of the xylene isomerization process: determination of optimal process conditions for obtaining the target product. Modeling of the C4-C6 olefin isomerization process: using software to optimize the process. Synthesis and analysis of properties of oxygen-containing compounds. Synthesis and investigation of properties of polymer polystyrene. Using artificial intelligence methods to predict the octane number of

	gasoline. Analysis of the technological scheme of synthetic rubber production: environmental and economic assessment of the process.
Forms of exams/assessments	Current control: - research design, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Research design – 10points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
References for reading	1. Kulprathipanja S., Rekoske J.E., Wei D., Slone R.V., Pham T., Liu C. Modern Petrochemical Technology: Methods, Manufacturing and Applications. — Weinheim: Wiley-VCH, 2021.-296p. 2. Speight J.G. Handbook of Petrochemical Processes. — Boca Raton: CRC Press, 2021. — 580 p. — ISBN 978-1-032-23623-0. 3. Speight J.G. Handbook of Petroleum Refining. — Boca Raton: CRC Press, 2020. — 790 p. — ISBN 978-0-367-57440-6. 4. Zotov, Yu.L., Mednikov, E.V., et al. Chemical Technology. Alternative and Biodiesel Fuels. Edited by Yu.V. Popov. — Volgograd: Volgograd State Technical University, 2019. — 196 p. — ISBN 978-5-9948-2558-7. 5. Beisenbayev O.K., Mamytov K.Zh.. Technology of Organic and Petrochemical Production: Textbook for Higher Education Institutions. — Almaty, 2022. — 328 p. 6. Beisenbayev O.K., et al.. Laboratory Practical Work on Organic and Petrochemical Production Technology (Kazakh, Russian, English). — Shymkent: Aelem, 2022. — 204 p. 7. Bardic D.L., Leffler, W.L.. Petrochemistry. — 3rd ed., revised and enlarged. — Moscow: Olimp-Business, 2019. — 496 p. — ISBN 5-9693-0017-4.

Module Title:	**M9. 2 Innovative technologies of oil refining and petrochemistry**
Semester(s) in which the module is taught:	2 semestr
Person responsible for the module:	Module Doctor of Technical Sciences, Professor Beisenbayev O. K.
Language:	Russian, Kazakh
Relation to the curriculum:	Basic discipline, elective component
Teaching methods:	Lectures, laboratory
Workload (including contact hours, self-study hours):	Total workload-120 hours: lectures-30 hours; laboratory-15 hours; Current MSIW – 50 hrs; MSIW – 10 hrs; MSIWT – 15 hrs.
Number of credits:	4ECTS
Prerequisites (conditions) for admission to the module:	Competencies in the field of technology of primary and secondary processes of processing of petroleum raw materials, technology of production of lubricants, special technology of production of motor fuels
Module objectives / Expected learning outcomes	Objective: to deepen the knowledge of undergraduates in the field of innovative technologies of oil refining and petrochemistry, aimed at increasing the depth of oil refining, improving the quality of petroleum products obtained, and modernizing and improving oil refining and petrochemistry technologies. After undergraduates have completed this course, they can: - describe new technologies underlying the production of products that meet international standards (for example, Euro-6 fuels, biodiesel, eco-friendly polymers); - explain the impact of various options for modernization and reconstruction of plants on the characteristics of products and compliance with environmental standards; - apply knowledge about trends and new technologies to analyze the current state and development prospects of Kazakhstan - 's energy sector. to identify factors affecting the economic efficiency and environmental safety of oil refining and petrochemical processes; - to propose new types of petrochemical products with improved characteristics and environmental properties; - to assess the environmental safety and sustainability of oil refining and petrochemical processes.
Content	**Lectures** Content**:** Trends in the development of world and Kazakhstan oil refining and petrochemistry. New technologies underlying the production of products that meet international standards. Structure of secondary processes and increasing the depth of oil refining. Alternative options for modernization and reconstruction of existing installations that ensure the production of products that meet environmental quality standards. **Laboratory classes:** Modeling of the catalytic cracking process using specialized software: determination of optimal conditions for the process. Evaluation of the effectiveness of various catalysts for oil refining processes: study of the activity, selectivity and stability of catalysts. Practical development of methods for analyzing the quality of petroleum products (determination of the octane number, sulfur content, and aromatic hydrocarbons). Modeling of the oil product hydrotreatment process: optimization of the process to reduce the content of sulfur and nitrogen.
Forms of exams/assessments	Current control: - case study analysis, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points).

	Continuous assessment (maximum 60 points) includes: Case study analysis – 15 points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 15 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
References for reading	1. Speight, James G. Handbook of Petrochemical Processes. — Boca Raton: CRC Press, 2021. — 580 p. — ISBN 978-1032236230. 2. Mohammed C. Al-Kinany, Saud A. Aldrees. Advanced Catalysis Processes in Petrochemicals and Petroleum Refining: Emerging Research and Opportunities. 2020. -257p. 3. Speight, James G. Handbook of Petroleum Refining Processes. — 4th ed. — New York: McGraw-Hill Education, 2020. — 1400 p. — ISBN 978-0071820516. 4. Leffler, William L. Petroleum Refining in Nontechnical Language. — 5th ed. — Tulsa: PennWell Corporation, 2021. — 208 p. — ISBN 978-1593701581. 5. Gary, James H.; Handwerk, Glenn E.; Kaiser, Mark J. Petroleum Refining: Technology and Economics. — 5th ed. — Boca Raton: CRC Press, 2017. — 496 p. — ISBN 978-0824753788. 6. Kasatkin, A.G. Fundamental Processes and Apparatus of Chemical Technology. — Moscow: Khimiya, 2018. — 751 p.

Module Title:	**M10.1. Selected chapters of Petrochemistry**
Semester(s) in which the module is taught:	2 Semester
Person responsible for the module:	Doctor of Technical Sciences, Professor O. K. Beisenbayev
Language:	Russian, Kazakh
Relation to the curriculum:	Profile discipline, elective component
Teaching methods:	Lectures, laboratory, practical classes
Workload (including contact hours, self-study hours):	Total work load – 210 hours: Lectures-30 hours; laboratory-30 hours; practical-30 hours; MSIW – 65 hrs; MSIW – 17.5 hrs; MSIWT – 37.5 hrs.
Number of credits:	7ECTS
Prerequisites (conditions) for admission to the module:	Competencies in the field of fundamentals of organic synthesis and petrochemistry
Module objectives / Expected learning outcomes	Objective: to deepen the knowledge of undergraduates in the field of industrial petrochemical processes in order to solve practical problems related to production improvement. After master's students have completed this course, they are able to: - demonstrate knowledge of key trends in the development of the petrochemical industry at the global and regional levels; - compare various systemic patterns of petrochemical processes and assess their impact on the efficiency and selectivity of processes; - choose the best technological solutions for processing a specific type of alternative raw materials into the target product; - identify the strengths and weaknesses of various technological solutions for processing alternative raw materials; - develop a development strategy for a petrochemical enterprise taking into account current trends and available types of alternative raw materials; - evaluate the environmental safety and sustainability of petrochemical processing processes.
Content	**Lectures Content:** Trends in the development of the petrochemical industry. Involvement of alternative raw materials in the production of basic organic synthesis and petrochemical products. System regularities of petrochemical processes. Creation of models of technological installations and industrial production complexes. Technological design of industrial petrochemical processes. Analysis of the operating mode of technological objects. **Laboratory classes:** Modeling of petrochemical processes using Aspen Plus (or similar software): modeling catalytic cracking reactor; modeling of a distillation column for the separation of hydrocarbon fractions. Study of the influence of various factors on the rate and selectivity of petrochemical reactions: study of the effect of temperature on the yield of the target product in the alkylation reaction; study of the influence of the nature of the catalyst on the selectivity of hydrogenation of unsaturated compounds. Analysis of the operating mode of an existing industrial plant: collecting data on the plant's operating parameters (temperature, pressure, raw material consumption, product composition); analyzing deviations from the normal operating mode and developing recommendations for optimizing the process. Investigation of the processes of separation of petrochemical products: rectification of a binary mixture (separation of benzene and toluene); extraction of aromatic hydrocarbons from oil fractions. Synthesis and characterization of polymer materials: synthesis of polystyrene by emulsion polymerization; determination of the molecular weight and thermal properties of the resulting polymer. **Practical classes:** Analysis of trends in the development of the petrochemical industry: study of reports of analytical agencies and scientific

	publications; preparation of a presentation on the prospects for the development of a specific segment of the petrochemical industry. Development of a technological scheme for the production of a target petrochemical product from alternative raw materials: selection of raw materials and technological route; calculation of the material and heat balance of the process. Solving problems related to optimization of parameters of petrochemical processes: optimization of temperature and pressure in the reactor; optimization of raw material composition. Analysis of technological risks in the implementation of new technologies: identification of potential hazards and development of measures to prevent them; development of an action plan in case of emergency situations. Development of a business plan for the implementation of innovative technologies in the petrochemical industry: market analysis and competitive environment; assessment of investment costs and operating expenses; calculation of project economic efficiency indicators (NPV, IRR, Payback period).
Forms of exams/assessments	Current control: - article review, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Article review – 10points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Calculation of material and heat balance of the process - 5 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 5 points. Examination (maximum 40 points).
References for reading	1. Sujgenbaeva A.Zh., Sakibaeva S.A., Zhantasova U.S., Orazymbetova A.O. Selected Chapters of Petrochemistry in Tables and Schemes: Study Guide for Master's Students. — Shymkent: M. Auezov South Kazakhstan University, 2019. — 185 p. 2. Chaudhuri U.R. Petrochemistry and Petroleum Refining: Processes, Technologies, Integration. Translated from English (Fundamentals of Petroleum and Petrochemical Engineering, 2018). Edited by O.F. Glagoleva, I.A. Golubeva. — 2020. — 432 p. 3.Timofeev V.S., Serafimov L.A., Timoshenko A.V. Principles of Technology of Basic Organic and Petrochemical Synthesis. — 3rd ed., revised and enlarged. — Moscow: Vysshaya Shkola, 2019. — 408 p. 4. Speight J.G. The Chemistry and Technology of Petroleum. — 4th ed. — CRC Press, 2020. — 954 p. 5. Skoblo A.I., Molokanov Yu.K., Vladimirov A.I., Shchelkunov V.A. Processes and Equipment of Oil Refining and Petrochemistry. — 4th ed., revised and enlarged. — Moscow: Gubkin Russian State University of Oil and Gas, 2021. — 726 p. — ISBN 978-5-91961-072-4.

Module Title:	**M10.2. Chemical reactor design**

Semester(s) in which the module is taught:	2 Semester
Person responsible for the module:	Candidate of Technical Sciences, Associate Professor Daurenbek N. M.
Language:	Russian, Kazakh
Relation to the curriculum:	Profile discipline, elective component
Teaching methods:	Lecture, laboratory, practical
Workload (including contact hours, self-study hours):	Total work load – 210 hours: lectures-30 hours; laboratory-30 hours; practical-30 hours; MSIW – 65 hrs; MSIW – 17.5 hrs; MSIWT – 37.5 hrs.
Number of credits:	7ECTS
Prerequisites (conditions) for admission to the module:	Competence module in the field of general chemical technology, equipment of petrochemical refineries.
Module objectives / Expected learning outcomes	Objective: to deepen the knowledge of undergraduates in the field of industrial petrochemical processes in order to solve practical problems related to production improvement. - list the design requirements for columns, reaction chambers, and heat exchangers used in chemical reactors; - explain the relationship between the type of chemical process and the choice of the optimal reactor type; - apply knowledge about reactor types and models to select the optimal reactor design for a particular chemical process; - analyze the influence of various factors (temperature, pressure, reagent concentration, type of catalyst) on the efficiency of chemical reactors; - propose methods for intensifying chemical processes in reactors; - choose the optimal type of chemical reactor for a particular chemical process, taking into account economic, environmental and technological factors.
Content	**Lectures** Content: Modern chemical processes. Reactor design analysis, chemical reactor models. Design of continuous (catalytic), periodic (autoclaves, agitator systems) and semi-periodic reactors action (catalytic reforming). Design of reactors with adiabatic and isothermal media. Design of columns, reaction chambers, and heat exchangers. **Laboratory classes**: Study of the hydrodynamics of ideal reactors of various types:experimental determination of the residence time in reactors of ideal mixing and ideal displacement;comparison of experimental and theoretical data.Investigation of the thermal regimes of chemical reactors:studying the effect of temperature on the rate and selectivity of chemical reactions; limiting theheat transfer coefficients in various types of reactors.Modeling of chemical reactors using software:modeling of thermal and mass transfer processes in the reactor; optimization ofthe reactor design using simulation results.Study of mixing processes in reactors with mechanical agitators:determining the optimal agitator geometry to ensure efficient mixing; andmeasuring the power consumed by the agitator.Investigation of the operation of a flow reactor with a fixed catalystbed: determination ofoptimal process parameters (temperature, pressure, raw material consumption); andstudy of the effect of the catalyst particle size on the process efficiency. **Practical classes:** Development of a technical specification for the design of a chemical reactor for a given process:limiting the requirements for the reactor (performance, selectivity, safety); selecting thetype of reactor and structural materials.Calculation of the main parameters of a chemical reactor (volume, heat exchange surface area, hydraulic resistance):calculation based on kinetic data and process requirements; andusing different reactor models. Development of design documentation for a chemical reactor using CAD:creation of reactor drawings and individual components; development ofequipment specifications.Analysis

	of risks associated with the operation of chemical reactors:identification of potential hazards; development ofemergency prevention measures. Development of a control system for the operation of a chemical reactor:selection of control and measuring devices and actuators; development ofa process control algorithm.
Forms of exams/assessments	Current control: research problem solving, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Research problem solving – 10points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
List of literature	1. Uglev N.P. Theory of Chemical Reactors: Introduction to the Basic Course. — Perm: Perm National Research Polytechnic University Publishing House, 2019. — 234 p. 2. Fogler H. Scott. Elements of Chemical Reaction Engineering. — 5th ed. — Pearson, 2096. — 1050 p. 3. Hill C.G., Root T.W. Chemical Engineering: Kinetics and Reactor Design. — 2nd ed., 2020. — 576 p. 4. Chaudhuri U.R. Petrochemistry and Petroleum Refining: Processes, Technologies, Integration. Translated from English (Fundamentals of Petroleum and Petrochemical Engineering, 2016). Edited by O.F. Glagoleva, I.A. Golubeva. — 201420. — 432 p. 5. Froment G.F., Bischoff K.B., De Wilde J. Chemical Reactor Analysis and Design. — 3rd ed. — Wiley, 2020. — 912 p. 6. Nauman E. Bruce. Chemical Reactor Design, Optimization, and Scaleup. — 2nd ed. — Hoboken: Wiley, 2018. — 656 p. — ISBN 978-0-470-10525-2. 7. Leffler, William L. Petroleum Refining for the Nontechnical Person (2nd revised ed.). — Moscow: Olimp-Business, 2019. — 224 p. — (For professionals and non-specialists). — ISBN 5-901028-05-8.

Module Title:	**M11.1. Scientific basis for creating polymer composite materials**

Semester(s) in which the module is taught:	2 Semester
Person responsible for the module:	Doctor of Technical Sciences, Professor Syrmanova K. K.,PhD, Associate Professor Kydyralieva A. Sh
Language:	Kazakh, Russian
Relation to the curriculum:	Profile discipline, elective component
Teaching methods:	lectures, practical works, laboratory tests Work
Workload (including contact hours, self-study hours):	Total work load – 210 hours: Lectures-30 hours; laboratory-30 hours; practical-30 hours; MSIW – 65 hrs; MSIW – 17.5 hrs; MSIWT – 37.5 hrs.
Number of credits:	7 ECTS
Prerequisites (conditions) for admission to the module:	Competence module in organic chemistry, chemistry and physics of polymers, nanostructured polymer materials
Module objectives / Expected learning outcomes	**Objective:** to deepen knowledge on the technology of composite polymer materialsin order toform the principles of engineering approach for undergraduates to assess the possibilities of creating new composite polymer materials. After undergraduates have completed this course, they can: - determine the main types of polymer composite materials (PCM), their components and classification; - interpret the rheological properties of polymer systems in relation to the processes of obtaining composite materials; - draw up prescription and technological maps for the manufacture of various polymer composites; - analyze the results of experimental studies of the physical, mechanical and thermal properties of PCM; - optimize the composition of composites using neural networks (based on knowledge about their principles and capabilities); - offer innovative solutions to improve existing technologies for processing and quality control of PCM.
Content	**Lectures** Content**:** Scientific basis of polymer composite materials (PCM) development. Chemical properties and chemical transformations of IUDs in the process of their processing into CPM. Rheology of polymer systems in the preparation of composite polymer materials. Plastic masses as multicomponent systems. Modern ways of processing thermoplastics in KPM. Modern technologies for producing composite materials. Types of PCM. Filled polymers. Mixtures of polymers. Foamed polymers. Other types of composite materials. Optimization of composite composition using neural networks. **Practical classes:** Structure formation in the processes of KM processing. Mechanics of PCM. Thermal processes in KM processing processes. Promising composite materials based on polyimides. Composite materials based on thermoplastic binders. Electrically conductive composite materials. Highly heat-resistant composite materials. Composite materials with nanoscale filler. Ultra-high-strength composite materials. Composite materials with enhanced dielectric properties. Promising organosilicon composite materials **Laboratory classes.** Study of the properties of the main components of polymer nanocomposite materials. Production of polymer composite materials. Gluing of polymer composite materials. Investigation of physical and mechanical properties of polymer nanocomposite materials. Investigation of thermophysical properties of polymer composite materials. Study of the combustibility of polymer composite materials. Modern methods of PCM quality control.
Forms of exams / assessments	Current control: - research presentation preparation, successful execution of technological calculations for the experiment; written and oral surveys.

	Final control– examination
Requirements for study and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: research presentation preparation – 10 points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
References:	1. Vshivkov S.A., Tyukova I.S., Rusinova E.V. Polymer Composite Materials: Study Guide. — Yekaterinburg: Ural Federal University named after the First President of Russia B.N. Yeltsin (UrFU), 2022. — 230 p. — ISBN 978-5-7996-3436-0. 2. Nadda Ashok Kumar, Sharma Swati, Bhat Rajeev. Biopolymers. — Springer, Cham, 2022. — 410 p. 3. Rajeshkumar G., Devnani G.L., Sinha Shishir, Sanjay, M.R. Bast Fibers and Their Composites: Processing, Properties and Applications. — Springer, 2022. — 263 p. 4. Kerber M.L., Vinogradov G.V., Gorbunova I.Y., Kovalchuk A.V. Polymer Composite Materials: Structure, Properties, Technology. — 5th ed., revised and enlarged. — St. Petersburg: Profession Publishing Center, 2018. — 640 p. 5. Adamenko N.A., Agafonova G.V., FetisovmA.V. Polymer Composite Materials. — Volgograd: Volgograd State Technical University, 2019. — 96 p. — ISBN 978-5-9948-2150-3.

Module Title:	**M11. 2. Modern tire manufacturing processes**

Semester(s) in which the module is taught:	2 Semester
Person responsible for the module:	Candidate of Technical Sciences, Professor Turebekova G.Z.
Language:	Kazakh, Russian
Relation to the curriculum:	Profile discipline, elective component
Teaching methods:	Lectures, laboratory, practical classes
Workload (including contact hours, self-study hours):	Total work load – 210 hours: Lectures-30 hours; laboratory-30 hours; practical-30 hours; MSIW – 65 hrs; MSIW – 17.5 hrs; MSIWT – 37.5 hrs.
Number of credits:	7 ECTS
Prerequisites (conditions) for admission to the module:	Competence module in the field of organic and petrochemical production technology.
Module objectives / Expected learning outcomes	Module objectives: to expand the knowledge of undergraduates about the current state and trends in the development of tire production in order to develop alternative options for the modernization and reconstruction of existing technological lines and equipment for tire production. After a master's student completes this course, they will master: - determine the current state and trends in the development of tire production; - summarize information about modern innovations in tire production; - apply knowledge to identify the type of rubber, fillers and vulcanizing agents in rubber mixtures; - analyze the influence of components in the developed formulations on the properties of the finished product; - formulate new approaches to the use of modern materials (silanized fillers, bioresins); - evaluate the effectiveness of using new materials and technologies in tire production.
Content	**Lectures** Content: Current state and development trends of tire production; scientific-theoretical and chemical-technological bases of manufacturing tires for various purposes, environmental aspects of the tire production industry. Management of modern technological processes of tire production. Elastomeric materials for the production of tires with specified properties; development of alternative options for modernization and reconstruction of existing equipment. **Laboratory classes**: Studying the chemical composition of rubber compounds for tires. Determination of the type of rubber, fillers, and vulcanizing agents. Analysis of mixture properties (viscosity, rheological parameters).Mixing rubber compositions. Practice working with a laboratory mixer. Determination of the optimal mixing time and temperature. Extrusion of rubber compounds. Studying the process of forming a tire profile. Influence of temperature and pressure on the quality of the workpiece. Molding of tire components. Prototyping of the tread and frame. Control of geometry and uniformity. Vulcanization of rubber products. Study of the process using a laboratory vulcanizer. Influence of temperature and time of vulcanization on physical and mechanical properties. Testing the physical properties of rubber. Determination of strength, elasticity, and resistance to deformation. Comparison of properties before and after vulcanization.

	Practical classes: Assembly and construction of a tire product. Assembling the frame, tread, and sidewall. Study of design features of modern tires. Quality control of rubber blanks and tires. Visual inspection, measurement of dimensions, detection of defects. Using modern methods of non-destructive testing. Analysis of technological processes in tire factories. Analysis of production schemes: mixing, extrusion, pressing, vulcanization. Identify bottlenecks and suggestions for optimization. Modern innovations in tire manufacturing. Use of new materials (silanized fillers, bioresins). Automation and robotization of production stages. Design of tire rubber formulations for specific operating conditions. Development of an experimental mixture for the tread or sidewall. Determination of the influence of components on the properties of the finished product.
Forms of examinations / assessments	Current control: submission of an analytical report, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for study and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Analytical report – 10 points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
References for reading	1. Brendan Rodgers. Tire Engineering: An Introduction. — 1st ed. — CRC Press, 2020. — 302 p. 2. Ivanov I.A. Automobile Tires: Yesterday, Today, Tomorrow. — Moscow: Infra-Engineering, 2019. — 256 p. 3. Karmanova, O.V. Basic Processes of Tire Manufacturing. — Moscow: Publishing House of Bauman Moscow State Technical University, 2019. — 150 p.4. 4. Rodgers B. Tire Engineering: An Introduction. — 1st ed. — CRC Press, 2020. — 336 p. 5. John S. Dick. Rubber Technology: Compounding and Testing for Performance. — Hanser, 2020. — 900 p. 6. Rainer Liedtke. Tire Technology: Design and Manufacturing. — Springer, 2019. — 350 p.

Module Title:	**M12.1. Organic Gas Chemistry**
Semester(s) in which the module is taught:	2 semester
Person responsible for the module:	Candidate of Chemical Sciences, Professor Khaldarov N.K.
Language:	Kazakh, Russian
Relation to the curriculum:	Profile discipline, elective component
Teaching methods:	Lectures, laboratory classes, practical classes
Workload (including contact hours, self-study hours):	Total work load – 150 hours: Lectures-30 hours; laboratory-15 hours; practical-15 hours; Current MSIW – 55 hrs; MSIW – 12.5 hrs; MSIWT – 22.5 hrs.
Number of credits:	5 ECTS
Prerequisites (conditions) for admission to the module:	Competencies in the field of hydrocarbon gas processing
Module objectives / Expected learning outcomes	The goal is to expand the knowledge, skills and abilities of undergraduates in the field of organic gas chemistry. for the implementation of highly efficient technological processes of gas chemistry. After the master's student completes this course, they are able to: - name the flow diagrams of gas processing plants and the main products of primary processing of natural gases; - summarize information about the production methods of lower olefins, polyolefins and oxygen-containing products; - apply knowledge to identify the components of natural gases and gas condensates using chromatography; - analyze the influence of various factors on the yield and quality of gas processing products; - propose ways to intensify and optimize gas processing processes; - propose innovative solutions to improve the efficiency of gas processing enterprises.
Content	**Lectures**: Main directions of use and processing of natural gases. Raw material base of gas processing in Kazakhstan. Current state of the gas processing industry in Kazakhstan.Composition of natural gases and gas condensates. Flow diagrams of gas processing plants, basic products of primary processing of natural gases. Quality requirements for commercial natural gas and gas processing products. Preparation of natural gases for processing. Methods of gas purification from mechanical impurities. Methods of drying natural gases. Cleaning of gases from chemical impurities. Chemistry and technology of the Claus process. Separation of hydrocarbon gases. Low-temperature separation. Extraction of C2-C5 hydrocarbons from natural gases. Ways to get cold water. Basic low-temperature processes of separation of hydrocarbon gases. Methods for producing helium concentrate. Stabilization and processing of gas condensates. Stabilization of gas gasoline. Purification of gas condensates from sulfur compounds. Cleaning of fuel fractions from mercaptans. Processing of gas condensates. Production of automobile gasolines. Thermal and thermocatalytic transformations of lower paraffinic hydrocarbons. Preparation of acetylene from calcium carbide. Production of acetylene from natural gas. Production of lower olefins. Production of olefins by pyrolysis. Catalytic dehydrogenation of paraffinic hydrocarbons C4-C5. Production of isobutylene. Butadiene production. Production of polyolefins. Polymerization plastics. Oxidation of lower paraffinic hydrocarbons. Methane oxidation. Synthesis gas production methods. Methanol synthesis. Production of oxygen-containing products from gaseous olefin hydrocarbons. Production of alcohols. **Laboratory classes:** Chromatographic studies of the composition of

	natural gas. Determination of the density of natural and associated gases. Determination of water in gas condensate. Investigation of the CO2 absorption process. Determination of the sulfur compound in the gas condensate composition by the lamp method. Determination of the relative gas density. Determination of water in the composition of gas condensate by the Dean-Stark method. Determination of the octane number of gas condensate. Determination of mechanical impurities in the gas condensate composition. **Practical classes**: Industrial organic synthesis and transformations of alkanes, alkenes,alkadienes, and alkynes. Industrial organic synthesis and transformations of aliphatic halogen-derived hydrocarbons. Industrial organic synthesis of alcohols. Industrial organic synthesis of aldehydes and ketones, carboxylic acids and their derivatives. Industrial organic synthesis of sulfonic acids, nitro compounds, and amines. Industrial organic synthesis of naphthenic hydrocarbons and arenes. Industrial organic synthesis of sulfonic acid and nitro compounds. Industrial organic synthesis of aromatic alcohols, aromatic aldehydes and ketones. Industrial organic synthesis of aromatic carboxylic acids. Industrial organic synthesis of five-and six-membered heterocycles.
Exam/Assessment forms	Current control: case study, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Case study – 10 points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
References:	1. Lapidus, A. L., Golubeva, I. A., & Zhagfarov, F. G. Gas Chemistry: Textbook for Higher Education Institutions. 2nd ed., revised and supplemented. Moscow: Gubkin Russian State University of Oil and Gas, 2020. 511 p. 2.Arutyunov, V. S., Golubeva, I. A., Eliseev, O. L., & Zhagfarov, F. G. Technology of Hydrocarbon Gas Processing. Moscow: Yurait Publishing House, 2021. 723 p. 3. Karpov, A. B., Kozlov, A. M., & Zhagfarov, F. G. Modern Methods of Gas and Gas Condensate Analysis*:* Study Guide. Moscow: Publishing Center of Gubkin Russian State University of Oil and Gas, 2021. 180 p. 4.Golubeva, I. A., & Meleshko, M. A. Properties and Applications of Helium and Technologies for Its Production from Natural Gases: Study Guide. Moscow: Publishing Center of Gubkin Russian State University of Oil and Gas (National Research University), 2021. 148 p. 5.Kidnay, A. J., Parrish, W. R., & McCartney, D. Fundamentals of Natural Gas Processing. Translated from the 2nd English edition; edited by O. P. Lykov and I. A. Golubeva. Saint Petersburg: Professiya Publishing House, 2019. 664 p. 6.Akhmetov, S. A. Technology of Deep Oil and Gas Processing: Study Guide. Ufa: Gilem Publishing House, 2019. 672 p.

Module Title:	**M12.2. Production of carbon black from gas raw**
Semester(s) in which the module is taught:	2 Semester
Person responsible for the module:	Candidate of Technical Sciences, Associate Professor Daurenbek N. M.
Language:	Kazakh, Russian
Relation to the curriculum:	Basic discipline, elective component
Teaching methods:	Lectures, laboratory, practical classes
Workload (including contact hours, self-study hours):	The total workload is 180 hours: lectures-30 hours; laboratory - 30 hours, practical - 15 hours, current MSIW-60 hours; intermediate MSIW-30 hours; MSIWT -15 hours.
Number of credits:	6 ECTS
Prerequisites (conditions) for admission to the module:	Competence in the field of hydrocarbon gas processing and thermal processes of oil refining
Module objectives / Expected learning outcomes	The goal is to deepen theoretical and practical knowledge about the processes of soot production from gas raw materials and solve practical problems to improve production. After undergraduates have completed this course, they can: - determine the most important properties of soot and their significance in various industries. - explain the mechanisms of soot formation and thermal decomposition of hydrocarbons. - apply knowledge about the interaction of carbon black with reaction products to optimize production processes. - analyze various furnace methods of soot production and evaluate their effectiveness. - create technological schemes for cleaning industrial waste associated with soot production. - formulate recommendations for optimizing soot production processes, taking into account economic and environmental factors.
Content	**Lectures** Content: The most important properties of soot. Modern ideas about the mechanism of the soot formation process. Thermal decomposition of hydrocarbons as a method for producing soot. Laminar and turbulent diffusion combustion. Interaction of soot with reaction products. Modern technologies of soot production. Reception and preparation of raw materials. Furnace production methods. Production of soot by precipitation from a diffusion flame. Soot production by thermal decomposition without air access. Production of active, low-active and semi-active furnace soot. Modern methods and equipment for soot capture. Granulation and compaction of soot. Industrial waste treatment. Application of soot. **Laboratory classes**:Study of the properties of the initial gas feedstock: analysis of the composition of the gas mixture (methane, ethane, propane, etc.), determination of the main physical and chemical characteristics. Investigation of thermal decomposition of gas raw materials for the production of soot: pyrolysis at various temperatures, determination of the yield of soot and gaseous products. Characterization of the resulting soot: determination of the specific surface area (BET method), morphological analysis of soot (microscopy), determination of particle size and distribution. Study of the influence of process parameters on the quality of soot: the influence of temperature, holding time, pressure on the properties of soot. Analysis of environmental aspects of the soot production process: determination of CO, CO2, and Nox emissions; methods for cleaning gas streams. **Practical classes**:The main methods of soot production from gas raw materials: thermal, oxidative, plasma, etc.Factors affecting the quality and yield of soot. Safety precautions when working with gas raw

	materials and soot. Thermodynamics and kinetics of the process of pyrolysis of hydrocarbon rawmaterials. Technological schemes of soot production by oxidizing method. Design and operating principle of diesel particulate reactors. Analysis of typical problems that arise during the operation of diesel particulate reactors. Technological schemes of soot production by thermal method. Cleaning of waste gases from harmful impurities (hydrogen sulfide, sulfurous anhydride). Waste gas heat recovery. Methods of soot quality control. Soot modification. Environmental aspects of soot production.
Forms of examinations / assessments	Current control: mini research project, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Mini research project – 10 points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
References:	1. Arutyunov, V. S., Golubeva, I. A., Eliseev, O. L., & Zhagfarov, F. G. Technology of Hydrocarbon Gas Processing: Textbook. Moscow: Yurait Publishing House, 2023. 723 p. 2.Ivanovsky, V. I. Carbon Black. Processes and Equipment: Study Guide. 2nd ed., revised and supplemented. Omsk: BLANKOM Printing House, 2019. 256 p. 3.Dronov, S. V., & Pekarevsky, B. V. Petroleum Processing Technology. Part 2: Thermal and Thermocatalytic Processes: Study Guide. Saint Petersburg: Saint Petersburg State Institute of Technology (Technical University), 2020. 134 p. 4.Donnet, J.-B. (Ed.). Carbon Black: Science and Technology. 2nd ed. London; New York: Routledge, 2018. 884 p. 5.Zuev, V. P., & Mikhailov, V. V. Carbon Black Production. Moscow: Khimiya Publishers, 2019. 318 p.

Module Title:	**M 13. Research work of a master's student 2**
Semester(s) in which the module is taught:	2 semester
Person responsible for the module:	Candidate of Technical Sciences, Associate Professor Daurenbek N. M., Doctor of Technical Sciences, Professor Beisenbayev O. K., Candidate of Technical Sciences, Professor Turebekova G. Z.
Language:	Russian, Kazakh
Relation to the curriculum:	
Teaching methods:	Consultations with the supervisor
Workload (including contact hours, self-study hours):	The total work load is 90 hours.
Number of credits:	3 ECTS
Prerequisites (conditions) for admission to the module:	
Module objectives / Expected learning outcomes	After completing research in the 2nd semester, a master's student can: - Formulate and refine the research task based on the problems and goals of the dissertation research. - Substantiate the relevance, scientific and practical significance of the tasks set, demonstrating an understanding of the research context. - Develop methods for solving research problems, taking into account theoretical approaches and specific conditions of the research object. - collect, process and systematize factual material necessary for analysis and drawing conclusions. - Evaluate the reliability and sufficiency of the collected data to ensure the scientific validity of the results of the dissertation work. - analyze the methods and approaches used in the research in terms of their effectiveness and compliance with the goals of the dissertation. - Evaluate the predicted results of the study according to the criteria of scientific novelty and practical applicability. - Formulate conclusions about the contribution of the research performed to the structure and content of the master's thesis, outline the directions of further work.
Content	Formulation and refinement of the research task based on the identified scientific problems and in accordance with the purpose of the dissertation research. Substantiation of the relevance of the chosen direction, scientific novelty and applied significance of the tasks set, demonstration of mastery of the context of modern scientific discussion within the thematic field of work. Development of methods for solving research problems, taking into account the applicable theoretical approaches and features of the research object. Collection, processing and systematization of factual material necessary for analysis, in compliance with the requirements of reliability, reproducibility and completeness of scientific data. Assessment of the degree of sufficiency and reliability of the empirical base of the study to ensure the objectivity and validity of the results obtained. Analysis of the applied methods and approaches, identifying their relevance, effectiveness and compliance with the goals of the master's thesis. Evaluation of the predicted results based on the criteria of scientific novelty, significance, and potential practical applicability.
	Formulation of conclusions about the contribution of the research work performed to the formation of the content and structure of the master's thesis, determination of the direction of further scientific research and planning of subsequent stages of research activities.

Forms of exams / assessments	Current control: the results of scientific research, performed technological calculations. Final control – Differentiated credit (written research report and oral defense).
Requirements for training and exams	Submission of a written research (internship) report and oral defense before the examination committee. The written report is assessed for a maximum of 60 points: Compliance with academic writing and integrity requirements – 10 points; Relevance of the research objectives and quality of literature review - 10 points; Description of research methodology – 10 points; Quality of the research data analysis – 15 points; Validity of conclusions and practical recommendations – 10 points; Correct referencing and presentation quality – 5 points. The oral defense is assessed for a maximum of 40 points: - Understanding of the objectives, methodology and results of the work – 15 points - Presentation, logical structure and clarity of explanations – 10 points - Professional competence and use of technical terminology – 10 points - Ability to discuss the results and draw justified conclusions – 5 points The final grade is the sum of the points awarded for the written report and the oral defense (maximum 100 points).
List of references for reading	1. QMS SKU PR 7.28-2024 Organization and conduct of scientific (experimental)work- research work of undergraduates and doctoral students. 2. QMS SKU PR 7.29-2024 Organization of scientific internships for undergraduates and doctoral students. 3.GOST 7.32 – 2021. Research Report. Structure and Design Rules.

Module Title:	**M 14. Research practice**
Semester(s) in which the module is taught:	3 semester
Person responsible for the module:	Candidate ofTechnical Sciences, Associate ProfessorDaurenbekN.M., DoctorofTechnical Sciences, ProfessorBeisenbayevO.K., Candidate ofTechnical Sciences, Professor Turebekova G.Z.
Language:	Russian, Kazakh
Relation to the curriculum:	
Teaching methods:	Experimental research, consultations with the supervisor, progress reports
Workload (including contact hours, self-study hours):	Total workload-180 hours
Number of credits:	6 ECTS
Prerequisites (conditions) for admission to the module:	Teaching practice
Module objectives / Expected learning outcomes	The goal is to acquire professional skills in applying theoretical and practical knowledge obtained during the training period, collect, analyze and summarize materials for writing a research report with its subsequent use in writing a master's thesis. After a master's student completes this course, they will master: - the ability to formulate hypotheses, set research goals and objectives, and choose methods to achieve them. - ability to collect, process and analyze quantitative and qualitative data, as well as draw conclusions based on the results obtained. - ability to present research results in scientific communities, including preparing and conducting presentations at conferences. - ability to evaluate existing research, analyze its advantages and disadvantages, and develop your own ideas and approaches. - be able to prepare scientific publications designed in accordance with the requirements of the academic standard. - various research methods, including experimental, sociological and statistical approaches. - ability to find, analyze and critically evaluate scientific sources and literary reviews. - solve scientific and practical problems in the field of ecology and sustainable development through research, interpretation of research data and international cooperation.
Content	Design and implementation of complex and interdisciplinary research, analysis and generalization of scientific and technical information with the involvement of information resources; implementation of experimental research, generalization of research results in the form of a report, scientific article and presentation to a wide audience. Performing theoretical and experimental research on the topic of the dissertation.
Forms of exams / assessments	Current control: the results of scientific research, performed technological calculations. Final control – Differentiated credit (written research report and oral defense).

Requirements for training and exams	Submission of a written research practice report and oral defense before the examination committee. The written report is assessed for a maximum of 60 points: Compliance with academic writing and integrity requirements – 10 points; Relevance of the research objectives and quality of the literature review – 10 points; Description and implementation of research methodology – 10 points; Quality of data collection, analysis, and interpretation of research findings – 15 points; Validity of conclusions and contribution to the research project – 10 points; Correct referencing and overall presentation quality – 5 points. The oral defense is assessed for a maximum of 40 points: - Understanding of the objectives, methodology and results of the work – 15 points - Presentation, logical structure and clarity of explanations – 10 points - Professional competence and use of technical terminology – 10 points - Ability to discuss the results and draw justified conclusions – 5 points The final grade is the sum of the points awarded for the written report and the oral defense (maximum 100 points).
Reading list	1. QMS SKU p 7.05-2024 rules for organizing and conducting professional practice of students and determining organizations as bases of practice of M. Auezov SKU 2.Haghi A.K. et al. (Eds.) Applied Chemistry and Chemical Engineering, Volume 2: Principles, Methodology, and Evaluation Methods .- Apple Academic Press Inc., 2018. — 393 p. 3. Haghi A.K. et al. (Eds.) Applied Chemistry and Chemical Engineering, Volume 3: Interdisciplinary Approaches to Theory and Modeling with Applications.-AppleAcademicPressInc., 2018. — 407 p. 4. GOST 7.32 – 2021. Research Report. Structure and Design Rules.

Module Title:	**M15. 1 Chemistry and technology of biologically active additives**
Semester(s) in which the module is taught:	3 semester
Person responsible for the module:	Doctor of Technical Sciences, Professor Beisenbayev O. K.
Language:	Russian, Kazakh
Relation to the curriculum:	Profile discipline, component of choice
Teaching methods:	Lectures, laboratory classes
Workload (including contact hours, self-study hours):	Total work load-180 hours: lectures-30 hours; laboratory-30 hours; practical training.-15h , Current MSIW – 30 hrs; MSIW – 15 hrs; MSIWT – 60 hrs.
Number of credits:	6 ECTS
Prerequisites (conditions) for admission to the module:	Competencies in biochemistry, processes and apparatuses of chemical technology, analytical methods of technical practice
Module objectives / Expected learning outcomes	Objective: to study in-depth the chemical nature, methods of synthesis, isolation, analysis and industrial production of biologically active additives (BAAS) used in medicine, food and chemical industry. After undergraduates have completed this course, they can: - list the main sources of dietary supplements and methods of their isolation and synthesis; - explain the relationship between the chemical structure of BAS and their biological activity; - apply the acquired knowledge to select the optimal method for the extraction of BAS from plant raw materials; - analyze data on the biological activity of BAS and evaluate their potential effectiveness; - propose new methods to improve the stability and bioavailability of BAS; - argue your opinion on current issues of the development of the dietary supplement industry and offer innovative solutions.
Content	**Lectures** Content**:** Classification of biologically active substances: vitamins, antioxidants, amino acids, polyphenols, fatty acids, prebiotics, probiotics, etc. Chemical structure and properties of dietary supplements, their metabolic pathways and mechanisms of action in the human body. Sources of dietary supplements: natural (plant, animal, microbiological raw materials) and synthetic. Methods of synthesis, modification and extraction of biologically active compounds: organic synthesis, biotechnological approaches, extraction by supercritical liquids, chromatographic purification. Technological processes of dietary supplements production, including formulation development, selection of carriers, methods of encapsulation, microencapsulation and stabilization of active components. Physico-chemical methods of quality control of dietary supplements, including spectroscopy, chromatography, titrimetry and thermal analysis. Standardization, registration and certification of dietary supplements in accordance with international and national standards (GMP, ISO, TR CU). Ecological and resource-saving technologies of dietary supplements production. Current areas of development: creation of functional food products, personalized supplements, nanotechnologies in the field of delivery of active substances. **Laboratory classes:** Extraction of biologically active substances from plant rawmaterials. Determination of the antioxidant activity of BAS by various methods. Study of the BAS microencapsulation process. Synthesis and modification of BAS. Modification of a natural polysaccharide (for example, chitosan) to improve its properties (solubility, bioavailability; analysis of the obtained products using IR spectroscopy or NMR.

	Chromatographic separation and identification of BAS. **Practical classes:** Development of a dietary supplement formulation based on the specified criteria: selection of the optimal combination of active components, carriers and excipients; evaluation of the compatibility of components and stability of the formulation; calculation of the required amount of ingredients for the production of a certain batch of dietary supplements. Study of regulatory documentation and quality standards of dietary supplements: study of GMP (Good Manufacturing Practice) standards for the production of pharmaceutical products and dietary supplements; preparation of a package of documents for the registration of dietary supplements. Working with BAS databases. Search for information on biological activity and application: analysis of scientific publications and patents in the field of dietary supplements; evaluation of the effectiveness and safety of BAS based on scientific data.
Forms of exams / assessments	Current control: technology development, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Technology development – 15points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 5 points. Examination (maximum 40 points).
Bibliography for reading	1.Ivanova, L. A., Voyno, L. I., & Ivanova, I. S. Food Biotechnology: Study Guide. In 2 Books. Book 2: Processing of Plant Raw Materials. Edited by I. M. Gracheva. Moscow: KolosS, 2018. 472 p. 2.Mezenova, O. Ya. Homeostasis and Nutrition: Study Guide. Moscow: Kolos, 2019. 318 p. 3.Zainullin, R. A., et al. Functional Food Products: Study Guide. Moscow: KNORUS, 2019. 304 p. 4.Rogov, I. A., Antipova, L. V., & Dunchenko, N. I. Food Chemistry: Textbook. Moscow: KolosS, 2020. 853 p. 5.Kovalenko, L. V. Biochemical Foundations of the Chemistry of Biologically Active Substances: Study Guide. Moscow: BINOM. Laboratory of Knowledge, 2021. 230 p. 6.Popova, N. N., Popov, E. S., & Shchetilina, I. P. Food and Biologically Active Additives: Study Guide. Voronezh: Voronezh State University of Engineering Technologies, 2019. 67 p. Electronic resource. 7.Tolmacheva, T. A., & Nikolaev, V. N. Industry Technology: Technology of Confectionery Products: Study Guide. Saint Petersburg: Lan Publishing House, 2022. 132 p. Electronic resource. 8.Donchenko, L. V., Sokol, N. V., Shcherbakova, E. V., & Krasnoselova, E. A. Food Chemistry. Additives: Study Guide for Secondary Vocational Education. 2nd ed., revised and supplemented. Edited by L. V. Donchenko. Moscow: Yurait Publishing House, 2019. 223 p. Electronic resource. 9.Musaeva, N. M. *Food and Biologically Active Additives: Educational and Methodological Guide*. Makhachkala: Dagestan State Agrarian University named after M. M. Dzhambulatov, 2019. 91 p. Electronic resource.

Module Title:	**M15. 2 Prospective processes for producing sulfur from hydrocarbon gases**
Semester(s) in which the module is taught:	3 Semester
Person responsible for the module:	Candidate of Technical Sciences, Associate Professor Daurenbek N. M.
Language:	Kazakh, Russian
Relation to the curriculum:	Profile discipline, elective component
Teaching methods:	Lectures, laboratory, practical classes
Workload (including contact hours, self-study hours):	Total work load-180 hours: Lectures-30 hours; laboratory-30 hours; practical-15 hours; Current MSIW MSIW – 30 hrs; MSIW MSIW – 15 hrs; MSIWT – 60 hrs.
Number of credits:	6 ECTS
Prerequisites (conditions) for admission to the module:	Competencies in innovative technologies of oil refining and petrochemistry
Module objectives / Expected learning outcomes	Objective: to deepen the knowledge of advanced processes for producing sulfur from hydrocarbon gases; and to use this knowledge to solve practical problems related to improving production. After undergraduates have completed this course, they can: - determine the main sources of hydrogen sulfide in hydrocarbon gases and regulatory requirements for the content of sulfur in commercial gases; - explain the thermodynamic and kinetic foundations of the Claus process and its modifications; - apply the principles of thermodynamics and kinetics to calculate the equilibrium composition and rate of reactions in the Claus process; - to assess the prospects for the introduction of new technologies for gas purification from hydrogen sulfide and sulfur production in various industries; - suggest ways to improve the efficiency and environmental safety of existing sulfur production processes; - assess the environmental risks associated with the production and use of sulfur and propose measures to minimize them.
Content	**Lectures** Content: Current level of development of processes of processing of sulfur-containing hydrocarbon gases in the world practice and Kazakhstan. Features of the modern raw material base of sulfur production. Analysis of the main problems of gas sulfur production, natural gas desulfurization and acid gas release. The main problems of sulfur production by the Claus method. Issues of improving the efficiency of the thermal and catalytic stages of the Claus plant. Mechanisms of conversion of hydrogen sulfide and other organosulfur compounds to elemental sulfur. Technological schemes of sulfur production plants, the range of products obtained. Selection of the method and conduct of sulfur analysis. **Laboratory classes**: Analysis of the composition of natural and associated gas containing H2S and other sulfur-containing compounds. Analysis of the quality and composition of the products obtained from sulfur production plants. Methods of analysis and quality control of sulfur: physical and chemical methods of analysis (melting point, gray sulfide acid, solubility): spectroscopic and chromatographic methods. **Practical classes:** Thermodynamics and kinetics of Klaus reactions. Modifications of the Claus process: analysis of various modifications of the Claus process: a direct-flow process, a process with flow splitting, a process with gas cooling, etc. (comparison of various modifications of the Claus process in terms of sulfur yield and energy efficiency); features of the technological design of various modifications of the Claus process; selection of the optimal modification of the Claus process depending on the composition of the source gas and the required degree of purification.

	Alternative sulfur production processes: an overview of promising sulfur production processes; comparison of alternative processes with the Claus process in terms of economic efficiency and environmental friendliness. Utilization and application of sulfur: the main areas of use of sulfur: production of sulfuric acid, sulfur concrete, sulfur asphalt, etc. ; problems of transportation and storage of sulfur; prospects for expanding the scope of sulfur; technologies for obtaining high-quality elemental sulfur.
Forms of exams / assessments	Current control: case study, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Case study – 15 points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 5 points. Examination (maximum 40 points).
References:	1. Rahimpour, M. R., Makarem, M. A., & Meshksar, M. Advances in Natural Gas: Formation, Processing and Applications. Vol. 1: Natural Gas Formation and Extraction. Amsterdam: Elsevier, 2024. 418 p. 2.Kidnay, A. J., Parrish, W. R., & McCartney, D. G. Natural Gas Processing: Technology and Engineering Design. Amsterdam: Elsevier, 2021. 873 p. 3. Almegren, H. Advances in Natural Gas Technology. Rijeka: IntechOpen, 2021. 556 p. 4. Wang, X. Advanced Natural Gas Engineering. Houston, TX: Gulf Publishing Company, 2020. 417 p. 5. Nikolaev, V. V., Busygin, I. G., & Busygina, N. V. Basic Processes of Physical and Physicochemical Gas Processing. Moscow: Nedra Publishers, 2019. 184 p.

Module Title:	**M16. 1 General chemical technology of synthetic fibers**
Semester(s) in which the module is taught:	3 Semester
Person responsible for the module:	Doctor of Technical Sciences, Professor O. K. Beisenbayev
Language:	Russian, Kazakh
Relation to the curriculum:	Profile discipline, university component
Teaching methods:	Lectures, laboratory classes
Workload (including contact hours, self-study hours):	Total work load – 150 hours: Lectures-30 hours; laboratory-30 hours; Current MSIW – 55 hrs; MSIW – 12.5 hrs; MSIWT – 22.5 hrs.
Number of credits:	5ECTS
Prerequisites (conditions) for admission to the module:	Competencies in general chemical technology, organic and petrochemical production
Module objectives / Expected learning outcomes	Objective: to expand the current understanding of chemical and physico-chemical processes underlying chemical fiber technology; to acquire skills in the synthesis and research of special fibers with special properties. After undergraduates have completed this course, they can: - list the main methods of synthesis, molding and modification of synthetic fibers; - explain the mechanism of action of various modifying agents; - apply the knowledge gained for the independent synthesis of polyester or polyamide; - analyze the influence of various factors (temperature, time, reagent concentration) on the process of obtaining fiber and its properties; - develop a recipe for a new modified fiber with the specified properties; - justify the choice of a specific fibers for a specific application, considering its advantages and disadvantages.
Content	**Lectures** Content**:** Modern chemical fibers, basic principles of their production and research. Modern technologies for the production of polyester, polyamide and polyolefin synthetic fibers and other synthetic fibers. Modern devices and methods of testing synthetic fibers. Production of special fibers with special properties. Theoretical bases of textile materials modification processes. **Laboratory classes:** Synthesis of polyester (polyethylene terephthalate-PET): carrying out esterification of terephthalic acid and ethylene glycol. PET melt fiber forming: preparation of PET melt (drying, degassing); fiber forming by extrusion through a die followed by drawing. Synthesis of polyamide (polyamide-6 or polyamide-6,6). Modification of polyester or polyamide fibers: hydrophilization of the fiber surface by treatment with alkali or plasma; dyeing the fiber with dispersed or acidic dyes (depending on the type of fiber); study of the effect of modification on the sorption properties and strength of the fiber. Investigation of the structure and properties of synthetic fibers by various methods: determination of strength and elongation at break; determination of shrinkage during heating; determination of humidity and hygroscopicity; analysis of the fiber structure by microscopy (optical or electronic).
Forms of exams/assessments	Current control: - Technology development, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Technology development – 15points Midterm assessment 1 – 10 points;

	Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 15 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
References for reading	1.Khammatova, E. A., Gainutdinov, R. F., & Matveev, Yu. N. Development of Technologies for the Production of Modified Composite Fibrous Materials Used in Petrochemical and Oil Refining Complexes. Kazan: Kazan National Research Technological University, 2019. 264 p. 2.Sakibayeva, S. A., Zhantasova, U. S., Suygenbayeva, A. Zh., & Orazymbetova, A. O. Selected Chapters of Petrochemistry in Tables and Diagrams: Study Guide. Shymkent: M. Auezov South Kazakhstan State University, 2019. 185 p. 3.Chaudhuri, U. R. Petrochemicals and Petroleum Refining: Processes, Technologies, and Integration. Translated from English; edited by O. F. Glagoleva and I. A. Golubeva. Saint Petersburg: Professiya Publishing House, 2019. 432 p. 4.Timofeev, V. S., Serafimov, L. A., & Timoshenko, A. V. Principles of Technology of Basic Organic and Petrochemical Synthesis: Study Guide. 3rd ed., revised and supplemented. Moscow: Vysshaya Shkola, 2018. 408 p. 5.Globa, A. I., & Prokopchuk, N. R. Resource- and Energy-Saving Technologies in Plastics Production: Educational and Methodological Guide. Minsk: Belarusian State Technological University, 2020. 122 p.

Module Title:	**M16. 2 Rational methods of processing heavy oils and oil residues**
Semester(s) in which the module is taught:	3 semester
Person responsible for the module:	Candidateof Technical Sciences, Associate Professor Daurenbek N. M., Candidateof Technical Sciences, Professor Pusurmanova G. Zh
Language:	Kazakh, Russian
Relation to the curriculum:	Basic discipline, university component
Teaching methods:	Lectures, laboratory classes
Workload (including contact hours, self-study hours):	Total work load – 150 hours: Lectures-30 hours; laboratory-30 hours; Current MSIW – 55 hrs; MSIW – 12.5 hrs; MSIWT – 22.5 hrs.
Number of credits:	5ECTS
Prerequisites (conditions) for admission to the module:	Competence module in the field of production of motor fuels from hydrocarbon raw materials; innovative technologies of oil refining and petrochemistry.
Module objectives / Expected learning outcomes	Objective: to expand the knowledge of undergraduates on rational methods of processing heavy oils and oil residues in order to develop new approaches to processing heavy oils and oil residues. After undergraduates have completed this course, they can: - demonstrate knowledge on modern technologiesдемонстрdemonstrate knowledgея of up-to-datем technologiesям and the processof amproduction of heavy oil and processing of oil waste; efficient use of apparatuses and equipment of oil refineries; - apply information technology skills to modernize new technologies for processing heavy oil and oil waste, technological processes, networks and equipment for deep oil refining, obtaining, processing and analyzing the results obtained; - analyze domestic and foreign scientific and technical literature on rational methods of heavy oil processing and oil waste processing; - select the best options for processing heavy oil and oil waste, determine the main requirements for equipment and equipment for processing heavy oil raw materials; - develop new technological processes for processing heavy oil and oil waste, technical specifications for equipment design and modernization of existing technological processes.
Content	**Lectures** Content: State and prospects of technologies for processing and improving heavy raw materials and oil residues.Main directions of development of thermal processes of deep processing of oil residues. Thermal processes of processing heavy hydrocarbon raw materials. Thermal condensation processes. Hydrothermal processes of processing heavy oil residues. Catalytic cracking of residual raw materials. Preparation of raw materials for catalytic processes.Industrial plants for catalytic cracking of residual raw materials. Problems of processing mixed and residual raw materials at KKF installations. Hydrogenation processes of heavy oil waste processing. Reactions that occur during the catalytic hydrotreatment of oil residues. Catalysts for hydrotreating oil residues. Processes of hydro-refining of oil residues.Hydrodesulfurization of residues in the schemes of oil refineries. Hydrocracking. Combined processes for processing leftovers. **Laboratory classes**: Study of physical and chemical properties of heavy oils. Obtaining oil residues and their investigation. Visual and simulation modeling of the vacuum oil distillation process. Determination of coking of heavy oil residues by Conradson. Determination of the content of resins and asphaltenes in heavy oil residues.Determination of particle sizes of oil dispersed systems by the conductometric method. Separation of oil dispersed systems by step extraction method. Determination of colloid stability at normal and high temperatures.Quantitative determination of the group

	composition of oil residues according to Markusson. Investigation of the process of periodic coking of oil residues and the resulting products. Investigation of the oxidation process of oil residues and the resulting products. Investigation of the process of catalytic cracking of petroleum raw materials in a laboratory installation with псевдоожиженныма fluidized bed of catalyst.
Forms of exams / assessments	Current control: - research presentation preparation, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for study and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Research presentation preparation – 15points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 15 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) –10 points. Examination (maximum 40 points).
References:	1.Daurenbek, N. M. Processing of Heavy and Residual Petroleum Feedstocks: Study Guide. Almaty: Lantar Books, 2023. 230 p. 2.Daurenbek, N. M. Modern and Promising Thermolytic Processes of Oil Refining: Study Guide. Almaty: Lantar Books, 2023. 192 p. 3.Kaldygozov, E., Iztileuov, G. M., & Bolysbek, A. A. Visbreaking of Petroleum Residues: Study Guide. Shymkent: M. Auezov South Kazakhstan University, 2018. 120 p. 4.Kaldygozov, E. K., & Kaldygozov, A. E. Hydrocatalytic Processes of Petroleum Feedstock Processing: Study Guide. Shymkent: Alem Publishing House, 2020. 208 p. 5.Speight, J. G. Heavy Oil Production Processes. London: Gulf Professional Publishing, 2021. 173 p. 6.Ongarbayev, E. K., Doszhanov, E. O., & Mansurov, Z. A. Processing of Heavy Oils, Petroleum Residues, and Wastes. Almaty: Al-Farabi Kazakh National University, 2021. 256 p.

Module Title:	**M17.1 Development and application of additives for modifying the properties of fuels and oils**
Semester(s) in which the module is taught:	3 Semester
Person responsible for the module:	Candidate of Technical Sciences, Associate Professor Daurenbek N. M., Candidate of Technical Sciences, Professor Pusurmanova G. Zh
Language:	Kazakh, Russian
Relation to the curriculum:	Profile discipline, component optional
Teaching methods:	Lectures, practical work
Workload (including contact hours, self-study hours):	Total workload-150 hours: lectures-30 hours; laboratory-30 hours; Current MSIW – 55 hrs; MSIW – 12.5 hrs; MSIWT – 22.5 hrs.
Number of credits:	5 ECTS
Prerequisites (conditions) for admission to the module:	Competence module in the field of production of motor fuels from hydrocarbon raw materials; innovative technologies of oil refining and petrochemistry.
Module objectives / Expected learning outcomes	Objective: to expand knowledge on the development and application of additives for modifying the properties of fuels and oils; to develop skills in obtaining and researching additives for petroleum products. After undergraduates have completed this course, they can: - list the key components in various types of additives and their effect on the properties of fuels and oils; - describe the production processes of the main types of additives, including sulfonates, alkylphenols, sulfur-and phosphorus-containing compounds, viscous and depressant additives; - apply knowledge about the mechanism of action of additives to select the most appropriate additives for specific tasks (for example, increasing the detonation capacity of the fuel). reduce the solidification temperature of diesel fuel); - compare the advantages and disadvantages of various types of additives in terms of their effectiveness, cost, environmental friendliness and compatibility with other components of fuels and oils; - develop a formulation of a new type of additive for modifying the properties of fuels or oils with specified characteristics; - evaluate: the economic feasibility of introducing new additives and their technologies. industrial production.
Content	**Lectures** Content: The main directions of work in the development of modern additives for various types of oils and petroleum fuels, based on the features of their functional purpose and mechanism of action. Classification of fuel additives. Ignition modifiers. Oxygenates. Burning modifiers.Additives that increase fuel stability. Cleaning additives.Dispersant additives for boiler fuels. Additives and means for the use of fuel at low temperatures. Friction modifiers. Anti-corrosion additives. Modifiers of colloidal chemical properties. Fuel additives for various purposes. Determination of detonation resistance of motor fuels. Determination of the flammability of motor fuels.Methods of analysis of depressant additives. Methods of analysis of depressant additives. Determination of the amount of active substance in compounds. Determination of the copolymer composition.Molecular weight and determination of the molecular weight distribution. Methods for evaluating the composition of motor oils with additives. Classification of additives to lubricants. Antioxidant additives (oxidation inhibitors). Detergents-dispersant additives to oils (detergents-dispersants). Additives that improve the lubricating properties of oils. Viscous additives to oils. Depressant additives for petroleum oils. Anti-corrosion additives. Additives that increase the stickiness of oils. Anti-foam additives. Specific additives.Synthetic oils and additives to them. Synthetic hydrocarbon and ester oils. Multifunctional (complex) oil additives.

	Production processes of oil additives. Preparation of sulfonate additives. Preparation of additives based on alkylphenols and their derivatives. Preparation of sulfur-and phosphorus-containing additives.Preparation of viscous and depressant additives. Control and regulation of technological parameters. Improvement of additive manufacturing processes. Main apparatuses and equipment of plants for the production of oil additives. Reaction apparatuses. Rectification devices. Heat exchangers. Pumps. Devices for separation of mechanical impurities. **Laboratory classes**: Determination of the properties of straight-run gasoline fractions and oxygenates. Determination of the octane number of gasoline fractions before and after the addition of octane-boosting additives.Preparation and testing of cetane-enhancing compounds. Investigation of changes in low-temperature properties of fuel with the introduction of depressor additives. Determination of the solidification temperature of diesel fractions before and after the introduction of depressant additives.Determination of the properties of oil fractions and commercial oils. Preparation and testing of a multifunctional additive for motor oils.Investigation of changes in the low-temperature properties of oil with the introduction of depressant additives. Determination of the solidification temperature of base oils before and after the introduction of depressant additives. Application of quantum chemical calculations to correlate the structure and structure of additives.
Forms of exams / assessments	Current control: submission of an analytical report, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Analytical report – 10 points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 10 points; Completion and defense of practical works – 10 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
References:	1. Daurenbek N.M. Theoretical foundations and technology of oil and oil product additives. Textbook. - Almaty: Adal kitap, 2022. – 296 p. 2. Dorogochinskaya V.A., Danilov L.M., Tonkonogov V.P. Additives to fuels and lubricants. -M.: Russian State University of Oil and Gas (NIU) named after I.M. Gubkin, 2017. - 290 p. 3. Daurenbek N.M. Theoretical and practical foundations of rational production and use of oil products: textbook / N.M. Daurenbek. – Almaty: Daryn, 2024.– 378 p. 4. Beisenbayev O.K., Isa A.B. And others Laboratory practical course on the technology of organic and petrochemical production. Textbook (Kazakh, Russian, English) Shymkent: "Alem" 2024.- 206 p. 5. M. Mortier, M. F. Fox, S. T. Orszulik. Chemistry and Technology of Lubricants. — 3rd Edition, Springer, 2019. — 561 p

Module Title:	**M17.2 Scientific fundamentals of compounding elastomeric compositions**

Semester(s) in which the module is taught:	3 Semester
Person responsible for the module:	Candidate of Technical Sciences, Professor Turebekova G.Z.
Language:	Kazakh, Russian
Relation to the curriculum:	Profile discipline, component of choice
Teaching methods:	Lectures, laboratory, practical classes
Workload (including contact hours, self-study hours):	Total work load-150 hours: lectures-30 hours; laboratory-30 hours; Current MSIW – 55 hrs; MSIW – 12.5 hrs; MSIWT– 22.5 hrs.
Number of credits:	5 ECTS
Prerequisites (conditions) for admission to the module:	Competencies in the field of nanostructured polymer materials
Module objectives / Expected learning outcomes	**Objective:** to develop undergraduates ' deep knowledge of the scientific and practical basics of compounding elastomeric compositions, to acquire practical skills in manufacturing and testing elastomeric materials and products. After a master's student completes this course, they can: - list the names of modern rubbers, innovative additives and methods of processing rubber waste; - interpret the results of studies on the compatibility of components and their influence on the properties of rubbers; - conduct experiments to study the influence of various factors on the properties of rubbers; - identify patterns and trends in the development of new formulations of rubber compounds; - develop new formulations of rubber compounds with improved properties based on to - formulate proposals for improving the technological processes of rubber products production.
Content	**Lectures** Content: General characteristics of rubber products. Scientific basis for compounding elastomeric compositions. Fillers of elastomeric compositions. Innovative in production. Plasticizers and softeners. Research of mixed plasticizers. Stabilizers and antirads. Scientific basis for creating rubbers with special properties. Technological active additives. Components of vulcanizing systems.Special reagents for vulcanization. Modern rubbers. New developments and areas of improvement of vulcanizing systems. Ecology and waste management. **Laboratory classes**: Study of compatibility of prescription drugs ingredients. Research in the field of creating rubbers with improved special properties. Investigation of the influence of the organic part of oil sludge on the properties of special rubbers. Investigation of the influence of modified zeolite on the physical and mechanical properties of special rubbers. Investigation of the influence of sulfur of PKOP LLP on the properties of special rubbers. Investigation of the influence of used oils of Hill corporation LLPon the properties of special rubbers. Investigation of the effect of soapstock fatty acids on the physical and mechanical properties of vulcanizates. Investigation of the influence of bitumen on the technological properties of rubber compounds. Investigation of the influence of the formulation composition on the technological properties of frost-resistant rubbers. Investigation of the effect of the formulation composition on the physical and mechanical properties of magnetic rubbers.

	Investigation of the effect of the formulation composition on the technological properties of radiation-resistant rubbers. Development of the formulation of rubber compounds using gossypol resin. Investigation of the influence of the ingredients of rubber mixtures on the properties of radiation resistance of rubbers. Investigation of the influence of the composition of the technological formulation on the properties of magnetic rubbers. Investigation of the effect of the formulation composition on the properties of medical rubbers. **Practical classes**: Development of rubber compounds for flat drive belts and conveyor belts. Development of rubber compounds for the production of V-belts. Development of materials for compression and tension layers. Development of rubbers for elastic layer and cord lining. Development of rubbers for promazki fabrics. Development of rubber compounds for molded rubber products. Development of rubber compounds for non-plastic products. Development of rubber compounds for the production of hoses. Development of chamber rubber mixtures (for the inner layer of the sleeve). Development of frame rubber compounds for intermediate layers. Development of oil-free rubber compounds. Development of rubber compounds for the outer layer. Development of rubber compounds for technical plates. Development of rubber compounds for ebonite products. Development of adhesive composition for the production of belts.
Forms of exams / assessments	Current control: case study, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for study and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Case study – 15 points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 15 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
References for reading	1. Amelina N.V., Belyaev P.S., Klinkov A.S., Sokolov M.V. Kinetika i apparaturno-tehnologicheskoe oformlenie processa izgotovleniya rezinovyh nitej iz lateksa. Tambov: TGTU, 201. 9— 80 p. 2. Sakibaeva S.A., Syrmanova K.K., Negim E.S. Tehnologiya elastomerov. Uchebnik. Shymkent: «Әlem», 2023 – 252p. 3. Sakibaeva S.A., Bimbetova G.Zh. i dr. Novye materialy i processy v rezinovoj promyshlennosti. Kurslekcij. Shymkent: «Bejne», 2018. -202s. 7MarkJ.E., ErmanB., RolandM. (Eds.). The science and technology of rubber. FourthEdition. — AcademicPress, 2023. - 801 p. 4. Shashok Zh. S., Uss E. P., Krotova O. A., Leshkevich A. A. Osnovy recepturostroeniya elastomernyh kompozicij: Laboratornyj praktikum. Minsk: Belorusskij gosudarstvennyj tehnologicheskij universitet, 2021. – 84 p. 5. Gajsin A. R. Tehnologiya rezinotehnicheskih izdelij. Kazan: Kazanskij nacionalnyj issledovatelskij tehnologicheskij universitet, 2018. – 340 s. 10. Barlow F. W. Rubber compounding: principles, materials, and techniques. CRC Press, 2018. – 566 p.

Module Title:	**M18. 1 Special products of oil refining and petrochemistry**
Semester(s) in which the module is taught:	3 Semester
Person responsible for the module:	Candidate of Technical Sciences, Associate Professor Daurenbek N.M.,
Language:	Kazakh, Russian
Relation to the curriculum:	Profile discipline, elective component
Teaching methods:	Lectures, laboratory work
Workload (including contact hours, self-study hours):	Total workload-150 hours: lectures-30 hours; laboratory-30 hours; Current MSIW – 55 hrs; MSIW – 12.5 hrs; MSIWT – 22.5 hrs.
Number of credits:	5 ECTS
Prerequisites (conditions) for admission to the module:	Competence module in the field of resource-saving technologies, innovative technologies of oil refining and petrochemistry
Goals of the module / Expected learning outcomes	**Objective:** to expand the knowledge of undergraduates about the current state and prospects of production, quality improvement, application of technical fluids and special products, to generate ideas for continuous improvement of product quality. After a master's student completes this course, they can: - list the main requirements for the quality and application areas of technical fluids, special products of oil production, process oils, preservative and protective lubricants, solid petroleum products; - explain the relationship between the chemical composition, physico-chemical properties and functional characteristics of special petroleum products; - apply the knowledge gained to choose the optimal brands of technical fluids, lubricants and other special petroleum products for specified operating conditions; - analyze the influence of various factors (temperature, pressure, humidity, pollution) on the performance characteristics of special petroleum products; - develop recommendations for improving the quality and expanding the scope of application of special petroleum products; - develop new methods for recycling or processing waste from special petroleum products production.
Content	**Lectures** Content: Technical fluids. Special products of oil production. Lubricating and cooling technological means (STS). Process oils (plasticizer andsoftener oils). Preservative and protective lubricants. Solid petroleum products. Technical, economic and environmental problems of production and practical application of technical fluids and special products, their impact on reliability and efficiency in the operation of equipment. Selection of promising grades and brands of fuel, lubricants and special fluids **Laboratory classes**: Determination of the physical and chemical properties of technical fluids: determination of the viscosity (kinematic and dynamic) of various technical fluids (brake fluids, hydraulic oils) at different temperatures; determination of the density, flash point and pour point of technical fluids; comparison of the results obtained with the requirements of standards and assessment of the suitability of the liquid for a specific application. Analysis of lubricating and cooling technological means (STS). Research of plasticizer andsoftener oils for rubber products (RTI). Analysis of preservative and protective lubricants. Research of solid petroleum products (paraffins, ceresins, petrolatum).
Forms of exams / assessments	Current control: mini research project, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination

Requirements for study and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Mini research project – 15 points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 15 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
References for reading	1.Kapustin V.M., Ershov M.A., Khakimov R.V. Motor Gasolines with High-Octane Additives: A Textbook. – Moscow: Gubkin Russian State University of Oil and Gas (National Research University), 2021. – 160 p. 2. Oil and Gas Refining Technology: A Textbook / compiled by E.N. Ivashkina, E.M. Yuryev, N.I. Krivtsova, N.S. Belinskaya; Tomsk Polytechnic University. – Tomsk: Publishing House of Tomsk Polytechnic University, 2021. – 172 p. 3. Emelyanycheva E. Oil and Oil Products. Basic Properties and Laboratory Analysis: A Textbook / Vagapov B.; – Kazan: KNITU PRESS, 2020. – 100 p. 4. Emelyanycheva, E.A. Obtaining petroleum products from rectangular oil fractions and residues: monograph / A.I. Abdullin, S.M. Petrov; Kazan. research technol. univ; E.A. Emelyanycheva. - Kazan: KNITU, 2020. - 80 p. 5. Kapustin, V. M. Oil processor's handbook / Vladimir Mikhailovich Kapustin, Mikhail Grigorievich Kukes; Gubkin Russian State University of Oil and Gas - Moscow: Chemistry, 2018 - 416 p.

Module Title:	**M18. 2 Industrial Ecology of hydrocarbon systems**
Semester(s) in which the module is taught:	3 Semester
Person responsible for the module:	Candidate ofTechnical Sciences, Associate Professor Daurenbek N.M.
Language:	Kazakh, Russian
Relation to the curriculum:	Profile discipline, elective component
Teaching methods:	Lectures, laboratory classes
Workload (including contact hours, self-study hours):	Total workload-150 hours: lectures-30 hours; laboratory-30 hours; Current Independent Work (IW) – 55 hrs; Intermediate IW – 12.5 hrs; Guided Independent Work (with teacher) – 22.5 hrs.
Number of credits:	5 ECTS
Prerequisites (conditions) for admission to the module:	Competence module in the field of resource-saving technologies, innovative technologies of oil refining and petrochemistry
Module objectives / Expected learning outcomes	**Objective:** to deepen knowledge about scientific and technical problems of oil refining; world achievements in the field of oil refining technology in the world and in Kazakhstan, allowing to carry out a set of economic, organizational, engineering and technical measures to reduce and store waste, as well as to obtain additional economic benefits from obtaining useful products. After a master's student completes this course, they can: - determine the principles of "green chemistry" in relation to the industrial processing of hydrocarbons; - compare different technologies for the production of hydrocarbons in terms of their environmental impact on an industrial scale; - propose solutions to reduce greenhouse gas emissions at the refinery; - compare and analyze different methods of industrial waste disposal; - develop a project to modernize production facilities in order to reduce the environmental burden; - assess the risks associated with the introduction of a new technology for industrial processing of hydrocarbons.
Content	**Lectures** Content: Analysis of environmental problems of processing of hydrocarbon systems, environmental monitoring, production of hydrocarbon systems with improved environmental characteristics, environmental quality management, industrial and environmental safety in the processing of hydrocarbon systems. Management of technological processes of processing of hydrocarbon raw materials, production of organic substances in compliance with the safety of life and environmental cleanliness. **Laboratory classes**: Determination of pollutants in industrial emissions and wastewater. Soil analysis for the presence of pollutants in the vicinity of an industrial facility. Study of associated petroleum gas (APG) utilization methods at industrial facilities. Study of industrial desulfurization processes oil and petroleum products. Investigation of the effect of bioadditives on the operational and environmental characteristics of gasoline under industrial standards. Calculation of the environmental load from the use of various types of fuel on an industrial scale. Development of measures to reduce emissions of pollutants at a specific industrial enterprise. Development of a response plan for emergency oil spills on the territory of an industrial facility.
Forms of exams / assessments	Current control: environmental risk assessment, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination

Requirements for study and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: Environmental risk assessment – 15 points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of laboratory works – 15 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
References for reading	1. Semenov V. V., Ivahnyuk S. G.Tehnologiya identifikacii istochnikov neftyanyh zagryaznenij. -M.: Lan, 2024.-240 p. 2. Ivanter E. V.Ekologiya proizvodstva. -M.: Lan, 2024.-232 p. 3. Aganov A. A., Gluhov S. Yu., Zhurkovich V. V., Pimenova M. A., Hajdarov A. G.Obrashenie s tverdymi kommunalnymi i promyshlennymi othodami. Voprosy modelirovaniya i prognozirovaniya. .-M.: Lan, 2023.-352 p. 4. Shirokov Yu. A.Ekologicheskaya bezopasnost na predpriyatii. -M.: Lan, 2022.-360 p. 5. James G. Speight. Handbook of Industrial Hydrocarbon Processes, 2nd Edition. Gulf Professional Publishing.-2019.-806p.

Module Title:	**M19.1. Modeling of chemical and technological processes of oil refining**
Semester(s) in which the module is taught:	3 Semester
Person responsible for the module:	Candidate of Technical Sciences Zhaksanova A. N.
Language:	Russian
Relation to the curriculum:	Basic discipline, elective component
Teaching methods:	Lecture, practical classes
Workload (including contact hours, self-study hours):	Total work load – 150 hours: Lectures-30 hours; practical – 30 hours, Current MSIW – 55 hrs; MSIW – 12.5 hrs; MSIWT – 22.5 hrs.
Number of credits:	5 ECTS
Prerequisites (conditions) for admission to the module:	Resource-saving technologies, Development prospects for the production of motor fuels from hydrocarbon raw materials, Modern technologies of petrochemical synthesis, Innovative technologies of oil refining and petrochemistry, Selected chapters of petrochemistry
Module objectives / Expected learning outcomes	Objective: to train undergraduates in the use of MatLab and ChemCad software tools for modeling and analyzing chemical and technological processes of oil refining. Once undergraduates have completed this course, they should be able to: - develop mathematical models of oil refining chemical and technological processes. - apply MATLAB for numerical modeling, data analysis, and solving engineering problems. - simulate oil refining processes and equipment using Aspen Plus and related process simulation software. - analyze and validate simulation results using sensitivity analysis and model verification techniques. - optimize operating conditions of oil refining processes using mathematical and computational methods. - interpret modeling results to support process design, operation, and performance improvement.
Content	**Lectures** content**:** Mathematical modeling as a modern method for analyzing, researching, designing, and optimizing chemical-engineering processes in oil refining. Classification and development of mathematical models, numerical methods, algorithmization, linear programming, transport problems, heat transfer, and thermal integration models. Fundamentals of modeling in MATLAB, including working with matrices, plotting graphs, programming, and modeling distillation, cracking, hydrotreating, heat transfer, and reaction kinetics. Modeling of process flow diagrams in ChemCad and industrial packages such as Aspen Plus, Aspen HYSYS, Aspen EDR, and FLARE: selecting thermodynamic models, calculating equipment, modeling key oil refining processes, heat exchangers, and flare systems. Comparison of modeling results, accuracy assessment, verification and validation of models, sensitivity analysis, and optimization of process modes using mathematical programming. Fundamentals of kinetic modeling of complex chemical reactions and their application to industrial process optimization. **Practical classes:** Mathematical modeling. Data entry and analysis in MATLAB. Mathematical modeling. Plotting using PLOT. The Mesh and Surf functions in MATLAB. The MATLAB conditional operator. Loop operator for MATLAB. Solving systems of nonlinear algebraic equations in MATLAB. Mathematical analysis of the model. Working with mathematical functions in Matlab. The least squares method. Computer calculation of the Runge-Kutta method. Simulation of crude oil distillation processes using Aspen. Modeling heat exchanger performance and design in Aspen. Energy integration of oil

	refining processes using Aspen
Forms of exams / assessments	Current control: mini research project, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: mini research project – 15 points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of practical works – 15 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
References for reading	1. Sheldon Lee: Mathematical Modeling and Simulation with MATLAB. University of Alaska Southeast. 2021 – 213 p. 2. Liliane Maria Ferrareso Lona: A Step by Step Approach to the Modeling of Chemical Engineering Processes. 2019 – 173 p. 3. Kravcov A.V., Usheva N.V., Kuzmenko E.A., Fyodorov A.F. Matematicheskoe modelirovanie himiko-tehnologicheskih processov. Tomsk., 2019. – 135 p. 4. Schefflan, R. Introduction to Aspen Plus // Teach Yourself the Basics of Aspen Plus. – Hoboken: John Wiley & Sons, 2011. – Chapter 1 5. Bogolyubova M. N. Sistemnyj analiz i matematicheskoe modelirovanie: uchebnoe posobie / M. N. Bogolyubova ; Tomskij politehnicheskij universitet. – Tomsk : Izd-vo TPU, 2021. – 104 p. 6. AspenTech. Aspen eLearning Catalog. – Bedford, MA: Aspen Technology, Inc., 2025.

Module Title:	**M19.2. Digital technologies for design and analysis of petrochemical production facilities**
Semester(s) in which the module is taught:	3 semester
Person responsible for the module:	Candidate of Technical Sciences, Associate Professor Daurenbek N. M.
Language:	Kazakh, Russian
Relation to the curriculum:	Profile discipline, elective component
Teaching methods:	Lectures, practical classes
Workload (including contact hours, self-study hours):	Total workload -150 hours: lectures-30 hours; practical -30 hours; Current MSIW– 55 hrs; MSIW – 12.5 hrs; MSIWT – 22.5 hrs.
Number of credits:	5 ECTS
Prerequisites (conditions) for admission to the module:	Resource-saving technologies.
Module objectives / Expected learning outcomes	Objective: Developing professional competencies in the fields of digital modeling, analysis, design, and optimization of petrochemical production using modern software systems, as well as acquiring skills in developing digital models of technological processes to solve research and engineering problems. Learning Outcomes After completing this course, the student will be able to: - Explain the principles of digital modeling of chemical engineering processes and the role of digital technologies in the petrochemical production life cycle. -Develop mathematical models of chemical engineering processes in MATLAB. -Model petrochemical process flow diagrams in ChemCAD. -Use Aspen Plus to calculate material and heat balances, model reactors, distillation columns, heat exchange equipment, and optimize process flow. - Model oil and gas processes and feedstock preparation systems in Aspen HYSYS. - Perform thermal calculations and design heat exchange equipment in Aspen EDR. -Analyze flare system safety and calculate their performance in Aspen Flare System Analyzer. - Analyze computer modeling results, evaluate the effectiveness of process solutions, and make engineering decisions based on digital models.
Content	**Lectures** Content: Digital transformation of the petrochemical industry. Modern CAD/CAE systems and digital twins of technological processes. Fundamentals of mathematical modeling of chemical engineering processes: model construction, material and heat balances. Application of MATLAB for engineering calculations, numerical solution of equations, processing of experimental data, optimization and visualization of results. Use of ChemCAD for creating process flow diagrams, selecting thermodynamic models and modeling heat transfer processes, rectification, compression and chemical reactors. Application of Aspen Plus and Aspen HYSYS for modeling petrochemical processes, sensitivity analysis, optimization, calculation of oil and gas treatment processes, separation of mixtures and energy systems. Use of Aspen EDR for designing heat exchangers and Aspen Flare System Analyzer for calculating flare systems. Integration of AspenTech software packages, creation of digital twins, analysis of energy efficiency, cost effectiveness and sustainability of production. Modern digital technologies, artificial intelligence and machine learning in the design and optimization of petrochemical production. **Practical classes**: Performing engineering calculations, working with matrices, solving systems of algebraic and differential equations, plotting graphs, modeling chemical reaction kinetics, processing experimental data, and

	optimizing process parameters in MATLAB. Creating process flow diagrams, selecting thermodynamic models, and modeling heat exchange, compression, throttling, flow mixing, and rectification processes in ChemCAD. Building process flow diagram models, calculating material and heat balances, modeling reactor processes, and optimizing operating modes in Aspen Plus. Modeling hydrocarbon feedstock preparation, calculating heat exchange equipment, and flaring systems in Aspen HYSYS, Aspen EDR, and Aspen Flare System Analyzer. Developing a comprehensive digital model of a petrochemical plant, analyzing the modeling results, and preparing a technical report.
Forms of exams / assessments	Current control: mini research project, successful execution of technological calculations for the experiment; written and oral surveys. Final control– examination
Requirements for training and exams	The final grade consists of continuous assessment (60 points) and the final examination (40 points). Continuous assessment (maximum 60 points) includes: mini research project – 15 points Midterm assessment 1 – 10 points; Midterm assessment 2 – 10 points; Completion and defense of practical works – 15 points; Mastery of lecture material (attendance, participation, quizzes, in-class activities) – 10 points. Examination (maximum 40 points).
References:	1. Sheldon Lee: Mathematical Modeling and Simulation with MATLAB. University of Alaska Southeast. 2021 – 213 p. 2. *Generation and Update of a Digital Twin in a Process Plant/* J. Stjepandić, J. Lützenberger, P. Kremer.-Springer International Publishing. 2024.-209p. 3. Building Industrial Digital Twins/P.van Schalkwyk, Sh.V.Nath, Sh.Nath -Packt Publishing. 2021.-209p. 4. Liliane Maria Ferrareso Lona: A Step by Step Approach to the Modeling of Chemical Engineering Processes. 2017 – 173 p. 5.Modern Petroleum Refining Processes / C.S. Hsu, P.R. Robinson. – Cham: Springer, 2022. – 518 p. 6. Handbook of Petrochemical Processes/James G. Speight. -CRC Press-2019. – 518 p. 7. Schefflan, R. Introduction to Aspen Plus // Teach Yourself the Basics of Aspen Plus. – Hoboken: John Wiley & Sons, 2011. – Chapter 1 8. AspenTech. Aspen eLearning Catalog. – Bedford, MA: Aspen Technology, Inc., 2025.

Module Title:	**M 20. Research work of a master's student 3**
Semester(s) in which the module is taught:	3 semester
Person responsible for the module:	Candidate of Technical Sciences, Associate Professor Daurenbek N.M., Doctor of Technical Sciences, Professor Beisenbayev O.K., Candidate ofTechnical Sciences, Professor Turebekova G.Z.
Language:	Russian, Kazakh
Relation to the curriculum:	
Teaching methods:	Experimental research, consultations with the supervisor, progress reports
Workload (including contact hours, self-study hours):	The total work load is 90 hours.
Number of credits:	3 ECTS
Prerequisites (conditions) for admission to the module:	Teaching practice
Module objectives / Expected learning outcomes	After completing research in the third trimester, a master's student can: - Justify the choice of methods for solving the research problem, arguing for their scientific and practical applicability. - Apply the developed methods in practice, obtaining reasonable and reproducible results. - Conduct an economic analysis of the data obtained, identifying dependencies, patterns and estimated performance indicators. - Interpret the results of the study, formulating logically verified and scientifically reasoned conclusions. - Evaluate the significance of the problem under study in the context of modern scientific and practical achievements, determining its place in the professional sphere. - Formulate directions for further scientific research based on the identified problems, limitations and prospects.
Content	Justification of the choice of methods for solving the research problem, taking into account their theoretical validity and practical applicability in the conditions of a specific research object. Application of the developed methods as part of the experimental and analytical part of the work, ensuring reliable, reproducible and scientifically based results. Interpretation of research results, formulation of logically verified, reasoned conclusions that correspond to the goals and objectives of the dissertation. Assessment of the significance of the problem under study, taking into account current scientific trends and achievements of applied practice, determining its place in the professional and industry environment. Formulation of promising directions for further scientific research, based on the identified limitations, scientific gaps and potential for further development of the topic.
Forms of exams / assessments	Current control: the results of scientific research, performed technological calculations. Final control – Differentiated credit (written research report and oral defense).

Requirements for training and exams	Submission of a written research (internship) report and oral defense before the examination committee. The written report is assessed for a maximum of 60 points: Compliance with academic writing and integrity requirements – 10 points; Relevance of the research objectives and quality of literature review - 10 points; Description of research methodology – 10 points; Quality of the research data analysis – 15 points; Validity of conclusions and practical recommendations – 10 points; Correct referencing and presentation quality – 5 points. The oral defense is assessed for a maximum of 40 points: - Understanding of the objectives, methodology and results of the work – 15 points - Presentation, logical structure and clarity of explanations – 10 points - Professional competence and use of technical terminology – 10 points - Ability to discuss the results and draw justified conclusions – 5 points The final grade is the sum of the points awarded for the written report and the oral defense (maximum 100 points).
List of references for reading	1. QMS SKU PR 7.28-2024 Organization and conduct of scientific (experimental)work- research work of undergraduates and doctoral students 2. QMS SKU PR 7.29-2024 Organization of scientific internships for undergraduates and doctoral students

Module Title:	**M 21. Research work of a master's student 4**
Semester(s) in which the module is taught:	4 trimester
Person responsible for the module:	Candidate ofTechnical Sciences, Associate ProfessorDaurenbekN.M., DoctorofTechnical Sciences, ProfessorBeisenbayevO.K., Candidate ofTechnical Sciences, Professor Turebekova G.Z
Language:	Russian, Kazakh
Relation to the curriculum:	
Teaching methods:	Consultations with the supervisor
Workload (including contact hours, self-study hours):	The total work load is 510 hours.
Number of credits:	17 ECTS
Prerequisites (conditions) for admission to the module:	Teaching practice, Research practice,
Module objectives / Expected learning outcomes	After a master's student completes this course, they will master: - ability to present research results in scientific communities, including preparing and conducting presentations at conferences. - ability to evaluate existing research, analyze its advantages and disadvantages, and develop your own ideas and approaches. - ability to prepare scientific publications designed in accordance with the requirements of the academic standard.
Content	Presentation of the results of the research carried out in the framework of scientific and professional communities, preparation of reports, scientific reports and presentations at conferences of various levels in accordance with the topic of the master's thesis. Evaluation of existing scientific research, their comparative analysis, identification of strengths and weaknesses, formation of the author's position and offer original approaches to solving research problems. Preparation of scientific publications reflecting the key provisions and results of the dissertation work, designed in accordance with the current academic standards and requirements of scientific publications.
Forms of exams / assessments	Current control: the results of scientific research, performed technological calculations. Final control – Differentiated credit (written research report and oral defense).
Requirements for training and exams	Submission of a written research (internship) report and oral defense before the examination committee. The written report is assessed for a maximum of 60 points: Compliance with academic writing and integrity requirements – 10 points; Relevance of the research objectives and quality of literature review - 10 points; Description of research methodology – 10 points; Quality of the research data analysis – 15 points; Validity of conclusions and practical recommendations – 10 points; Correct referencing and presentation quality – 5 points. The oral defense is assessed for a maximum of 40 points: - Understanding of the objectives, methodology and results of the work – 15 points - Presentation, logical structure and clarity of explanations – 10 points - Professional competence and use of technical terminology – 10 points - Ability to discuss the results and draw justified conclusions – 5 points The final grade is the sum of the points awarded for the written report and the oral defense (maximum 100 points).
List of references for reading	QMS SKU PR 7.28-2024 Organization and conduct of scientific (experimental)work- research work of undergraduates and doctoral students of QMS SKU PR 7.29-2024 Organization of scientific internships for undergraduates and doctoral students

Module Title:	**M22. Preparation and defense of Master's thesis**
Semester(s) in which the module is taught:	4 semester
Person responsible for the module:	Candidate of Technical Sciences, Associate Professor DaurenbekN.M., Doctor of Technical Sciences, Professor Beisenbayev O.K., Candidate of Technical Sciences, Professor Turebekova G.Z
Language:	Russian, Kazakh
Relation to the curriculum:	
Teaching methods:	
Workload (including contact hours, self-study hours):	The total work load is 240 hours.
Number of credits:	8 ECTS
Prerequisites (conditions) for admission to the module:	Teaching practice, Research practice, R & D 1,2,3,4
Module objectives / Expected learning outcomes	The goal is to demonstrate the level of research qualification of the master's student, the ability to independently conduct scientific research, test the ability to solve specific scientific and practical problems presentation of skills for public discussion and defense of scientific ideas, suggestions and recommendations . After the master's student completes the study of this course, he will master: - the ability to correctly draw up a master's thesis in accordance with the requirements of scientific standards, including the structure, references, bibliography, and other formal elements. - ability to present research results clearly and logically, using a scientific style and appropriate terminology. - create and present presentations for the thesis defense, including highlighting key research results and conclusions. - ability to correctly and confidently answer questions from members of the dissertation Council, arguing their conclusions and approaches. - ability to prepare scientific articles based on the results of the master's thesis for publication in scientific journals. - ability to critically evaluate your work, correct errors, and improve the quality of your text before submitting for defense. - self-confidence in the public defense of the work, the ability to convey the importance and significance of the research. - ability to make a report on the work done, taking into account all stages of the study and the results obtained.
Summary	Systematization of research results in the form of a master's thesis, presentation to a wide audience. Final qualification work of the graduate of the master's program, confirming the competencies acquired in the course of training in accordance with the chosen specialization of training.
Exam/Assessment forms	Current control: the results of scientific research, performed chapters Final control – Differentiated credit (written thesis and oral defense).

Requirements for training and examinations	Submission of the Master's thesis and oral defense before the examination committee. The written thesis is assessed for a maximum of 60 points: Compliance with academic writing and integrity requirements – 10 points; Relevance of the research topic, quality of the literature review, and formulation of research objectives – 10 points; Scientific rigor and appropriateness of the research methodology – 10 points; Quality of data analysis, interpretation of findings, and originality of the research – 15 points; Validity of conclusions, practical significance, and contribution to the field – 10 points; Correct referencing and overall presentation quality – 5 points. The oral defense is assessed for a maximum of 40 points: - Scientific understanding and accuracy of responses – 15 points; - Ability to justify research methodology, results and conclusions – 10 points; - Quality of scientific presentation and use of professional terminology – 10 points; - Ability to engage in scientific discussion and critical reflection – 5 points. The final grade is the sum of the points awarded for the written thesis and the oral defense (maximum 100 points).
	Current control: the results of scientific research, performed chapters Final control – Differentiated credit (written thesis and oral defense).
References for reading	1. QMS SKU P 7.38-2024 position. ABOUT THE MASTER'S THESIS (PROJECT)

Last updated: July, 2026