Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Machines and apparatus for chemical and oil refining industries

PROCESSES AND TECHNOLOGIES OF PRIMARY GAS AND OIL REFINING

Syllabus of the academic discipline (Syllabus)

Academic discipline requirements	
Level of higher education	***First (bachelor's)***
Discipline	*13 Mechanical Engineering*
Specialty	*133 Industrial mechanical engineering*
Educational program	*Computer-integrated technologies for chemical engineering equipment design*
Discipline status	*Selective*
Form of study	*full-time (day)*
Year of training, semester	*3rd year, spring semester*
Scope of the discipline	*4 credits*
Semester control/control measures	*Credit, MCR, Calculation work*
Class schedule	*http://rozklad.kpi.ua/Schedules/ScheduleGroupSelection.aspx*
Language of instruction	*Ukrainian*
Information about course leader/teachers	*Lecturer /Practical:Associate Professor of the Department of MACORI, Candidate of Technical Sciences, Associate Professor A.R. Stepanyuto, < arstepaniuk@gmail.com >*
Course placement	https://ci.kpi.ua/uk/syllabuses-bac-disciplines/#place

Academic discipline program

Description of the academic discipline, its purpose, subject of study and learning outcomes
The purpose of the academic discipline.
The purpose of the academic discipline is to develop students' competence in:

The purpose of the academic discipline is to develop students' competence in:

- *The ability to generate new ideas (creativity).*
- *The ability to think systematically.*
- *Ability to achieve set goals.*
- *Ability to show initiative and creativity in solving assigned tasks.*
- *The ability to express one's point of view in a convincing and clear manner.*
- *Ability to apply typical analytical methods, quantitative methods of mathematics, physics, engineering sciences, as well as computer software tools to effectively solve chemical engineering problems.*
- *The ability to apply fundamental scientific facts, concepts, theories, and principles to solve professional tasks and practical problems in chemical engineering.*
- *Ability to evaluate and ensure the quality of work performed.*
- *Ability to apply computer-aided design systems and specialized application software to solve problems in chemical engineering*

1.2. Main objectives of the academic discipline.
After mastering the academic discipline, students must demonstrate the following program learning outcomes:

- *Apply computer systems and software to work with texts and their illustrations, process data, and perform calculations.*
- *Know and understand the principles, approaches and methods of chemical equipment engineering and related technologies and the prospects for their development, be able to analyze engineering objects, processes and methods.*
- *Be able to make creative decisions when designing, developing new and improving known elements of technological equipment.*
- *Know basic techniques and be able to perform variant calculations of equipment and technological modes of its operation using computer systems and specialized software, taking into account the laws of chemical and related technology processes when justifying decisions made regarding the development, modernization and operation of equipment throughout its life cycle, as well as the disposal of by-products and waste.*

1. **Prerequisites and postrequisites of the discipline (place in the structural and logical scheme of study according to the relevant educational program)**

List of disciplines that a student must master (requirements for the level of training) for successful mastery of the discipline:

- *Theoretical foundations of heat engineering.*
- *Chemical technology processes and equipment*

list of disciplines that are based on the results of learning in this discipline:

- *Chemical technology processes and equipment-4. Mass transfer processes*
- *Pre-graduate internship*
- *Diploma design*
- *Basics of three-dimensional design*
- *Installation, operation and repair of chemical and oil refining equipment*
- *Heat treatment technologies*

2. **Content of the academic discipline**

Section 1. General information about oil.

Topic 1.1 General information about oil.

Introduction. The goal and objectives of the course are given. The origin and conditions of oil occurrence, oil and gas reserves, main oil and gas-bearing regions are analyzed. Oil reserves are analyzed, and the geopolitical situation of the modern world is analyzed.

Topic 1.2. Chemical and physical composition of oil.

The chemical composition of oil is analyzed. The physical properties of oil and oil products, the properties of oil and distillates are analyzed. The properties of oil from different deposits are analyzed.

Topic 1.3. Analysis methods, classification of oil and petroleum products.

Methods of analysis and classification of oil and oil products are presented. Classification of properties of oil from different deposits is justified.

Topic 1.4. Products of primary and deep oil processing.

The products of primary and deep oil processing and the dependence of product quality on the quality of raw materials are analyzed.

Section 2. Oil extraction.

Topic 2.1. Exploration of oil fields, drilling wells, extraction of oil from the ground.

The methods of exploration of oil and gas deposits are substantiated. The prospects for the development of extraction and resources for increasing oil and gas extraction are analyzed. The prospects for oil extraction are analyzed depending on its properties and the region of the deposits.

Topic 2.2. Oil collection and preparation in oil fields.

Oil extraction methods are substantiated. Oil field preparation. Oil transportation to the wellhead. Methods and ways of preparing oil for transportation, transportation methods are analyzed. Oil fields and methods of oil extraction are analyzed. Oil preparation methods are analyzed depending on the properties of oil from different fields.

Chapter 3. Primary oil refining.

Topic 3.1. Oil refining processes.

The main processes of oil refining are substantiated. The classification of processes is given. Modern processes of oil product refining in Ukraine are analyzed.

Topic 3.2. Main refineries of Ukraine and their features

The main schemes of oil refineries are analyzed. The classification of plants is given. The raw materials and products of the refinery are substantiated. The schemes of oil refining plants are analyzed depending on the needs of the economy and the properties of oil from various deposits.

Topic 3.3. Properties of fuels and lubricants.

The properties of fuels and lubricants (octane number, cetane number) are substantiated. Standards for fuels and lubricants are given and analyzed. Fuels and their properties produced in Ukraine are analyzed.

Topic 3.4. Desalination and dehydration processes.

The processes of desalination and dehydration, electrodehydration, separation are analyzed. The schemes of these processes are analyzed. The types and types of desalination and dehydration plants are analyzed.

Topic 3.5. Primary oil refining processes.

Primary oil refining is analyzed. Theoretical foundations and types of installations are analyzed. Simple and complex distillation, steam distillation and dilution are analyzed. Types and types of primary oil refining installations are analyzed depending on its properties.

Topic 3.6. Multicomponent rectification.

Multicomponent rectification is analyzed. Basic laws and concepts are given. An algorithm for calculating a fractionating rectification column is given. Types and types of rectification columns are analyzed. A methodology for sizing elements of a fractionating rectification column is given.

3. Educational materials and resources

5.1 Basic

1. *Primary gas and oil refining processes [Electronic resource]: textbook / NTUU "KPI"; compiled by A. R. Stepanyuk. – Electronic text data (1 file: 291 MB). – Kyiv: NTUU "KPI", 2013. – 126 p. – Screen title. – Access:http://ela.kpi.ua/handle/123456789/2686*
2. *Processes and technologies of primary gas and oil refining: workshop: [Electronic resource] training manual for bachelor's degree applicants in the educational program "Computer-integrated technologies for the design of chemical engineering equipment" speciality 133 "Industrial mechanical engineering" / G11 Mechanical engineering (by specialization) / Igor Sikorsky Kyiv Polytechnic Institute; compilers: A.R. Stepaniuk, G.S. Podyman. – Electronic text data (1 file). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2025. – 155p. (Full text, pdf, 3.51 Mb)*
3. *William L. Leffler Petroleum Refining/PennWell Corp.; 4-st/ 2008 - 270 p*
4. *Methodology for calculating heat exchangers for oil refining industries [Electronic resource]: a textbook for students studying in the direction of "Mechanical Engineering" specialty "Equipment of chemical production and building materials enterprises" / NTUU "KPI" ; compiled by L. G. Voronin, A. R. Stepaniuk, L. I. Ruzhynska. - Electronic text data (1 file: 1.82 MB). - Kyiv: NTUU "KPI", 2010. - 68 p. - Title from the screen. - Access from the university network:http://service.library.ntu-kpi.kiev.ua/documents/E9-10-289.pdf*
5. *Shved M. P., Stepanyuk A. R. Algorithm for calculating an irrigation heat exchanger [Text]: methodical instructions for practical work for students of the specialty "Equipment of chemical production and construction materials enterprises" K.: NTUU "KPI" VPI VPK "Polytechnics". 2008 16 p.*

Educational content

4. Methodology for mastering the academic discipline (educational component)

Lecture classes

Lectures are aimed at:

- *providing modern, holistic in-depth knowledge of the discipline, the level of which is determined by the target setting for each specific topic;*
- *ensuring critical creative work in the process of work together with the teacher;*
- *fostering professional qualities in applicants and developing independent creative thinking in them;*
- *awareness of global trends in the development of science in the field of processes and technology of primary gas and oil refining;*
- *awareness of methods of processing information resources and determination of main directions for solving specific scientific and technical problems;*
- *teaching research materials in a clear and high-quality language, observing structural and logical connections, explaining all the given terms and concepts in a way that is accessible to the audience.*

No. salary	***Title of the lecture topic and list of main questions (list of didactic aids, references to literature and tasks for the SRS)***	***Number hours***
	Chapter 1 General information about oil.	
1	***Information about oil and gas. Origin of oil and gas. Classification of oils. World reserves of oil and gas and main gas-bearing and oil-bearing areas. OPEC countries. Control of oil and gas prices.*** *Introduction. The course aims and objectives are presented. Information about oil and gas is presented. The origin of oil and gas is analyzed. The classification of oils is presented. World oil and gas reserves and the main gas-bearing and oil-bearing regions are analyzed. OPEC countries are presented. Oil and gas price control is analyzed. The properties of oils and their components are analyzed.*	*4*
	Literature[1, 2, 5, 6].	
	Tasks for the CPS: Analysis of oil reserves. Analysis of new hypotheses of the origin of oil and gas. Analysis of the geopolitical situation of the modern world.	
	Section 2. Oil and gas extraction	
2	***Oil and gas exploration. Scheme of location of oil and gas deposits in the ground. Drilling wells*** *Methods and methods of oil and gas exploration are analyzed. The layout of oil and gas deposits in the ground is analyzed. Well drilling methods are analyzed*	*4*
	Literature[1, 2, 5, 6].	
	Task for the CPC: Analysis of the prospects for oil production depending on its properties and the region where the deposits are located.	
3	***Extraction of oil from the ground. Collection and preparation of oil in oil fields. Transportation of oil*** *Oil extraction methods are substantiated. Oil field preparation. Oil transportation to the wellhead. Methods and ways of preparing oil for transportation, transportation methods are analyzed. Oil fields and methods of oil extraction are analyzed. Oil preparation methods are analyzed depending on the properties of oil from different fields.*	*4*
	Literature[1, 2, 5, 6].	
	Tasks for the SRS: Analysis of methods of oil fields for oil production and methods of oil production. Analysis of methods of oil preparation depending on the properties of oil from different fields.	
	Chapter 3. Composition and properties of oil and petroleum products	

4	***Chemical composition and properties of oil. Group composition of oil. Classification of groups of compounds and their characteristics.*** *The chemical composition and properties of oil, the group composition of oil are analyzed. The classification of groups of compounds and their characteristics are substantiated.*	*4*
	Literature[1,2,3,5].	
	Task for the CPS: Analysis of the properties of oil from various deposits.	
5	***Physical properties of oil and petroleum products. Fractional composition of oil. Properties of gasoline, diesel fuels and lubricants*** *The physical properties of oil and oil products, properties of oil and distillates are analyzed. The properties of oil from various deposits are analyzed. The properties of gasoline, diesel fuels and lubricants are analyzed.*	*4*
	Literature[1,2,3,5].	
	Tasks for the CPS: Analysis of the properties of oil from various fields. Analysis of the properties of branded gasolines, diesel fuels, and lubricants.	
	Chapter 4. Primary oil refining	
6	***Main oil refining enterprises of Ukraine. Schemes of oil refineries. Processes of primary oil refining*** *The main schemes of oil refineries are analyzed. The classification of plants is given. The raw materials and products of the refinery are substantiated. The schemes of oil refining plants are analyzed depending on the needs of the economy and the properties of oil from various deposits.*	*4*
	Literature [1, 4, 5, 6, 8].	
	Tasks for the CPS: Analysis of oil refining plant schemes depending on the needs of the economy and the properties of oil from various fields.	
7	***Oil preparation for processing Oil desalination and dehydration. Supply schemes and determination of washing water consumption. Electrodehydrators. Demulsifiers*** *The processes of preparing oil for processing are analyzed. The processes of desalination and dehydration, electrodehydration, separation are analyzed. The schemes of these processes are analyzed. The types and types of desalination and dehydration plants are analyzed.*	*4*
	Literature [1, 4, 5, 6, 8].	
	Tasks for the CTC: Analysis of types and types of desalination and dehydration plants.	
8	***Primary oil refining. Products of primary oil refining. Distillation with gradual evaporation. Distillation with even (equilibrium) evaporation*** *The processes of primary oil refining are analyzed. The theoretical foundations and types of installations are analyzed. Simple and complex distillation are analyzed. Steam distillation and dilution distillation are analyzed. Types and types of primary oil refining installations are analyzed depending on its properties.*	*8*
	Literature [1, 4, 5, 6, 8].	
	Tasks for the CTC: Analysis of the types and types of primary oil refining plants depending on their properties.	
9	*MKR*	
	Literature [1 - 8].	

Practical classes

They should help applicants develop creative thinking, a creative approach to the scientific substantiation of the direction and methodology of research. The main tasks of the cycle of practical classes:

- *to help applicants deepen their theoretical knowledge in the field of processes and technology of primary gas and oil refining;*
- *to facilitate training of applicants in the methodology for determining the properties of oils and the features of their processing;*
- *to form criteria for assessing the efficiency of primary gas and oil refining processes.*

No. salary	***Title of the topic of the practical lesson and list of main questions (list of didactic material, references to literature and tasks for the CTS)***	***Number hours***
	Chapter 3. Composition and properties of oil and petroleum products	
1	*Chemical composition and properties of oil. Group composition of oil. Classification of groups of compounds and their characteristics.*	
	Determination of thermophysical properties of oil fractions.	*2*
	Literature 1.	
	VTS: prepare the Topic Chemical and physical composition of oil.	
	Literature 1-5	
2	*Physical properties of oil and petroleum products. Fractional composition of oil.*	
	Construction of distillation curves. Determination of the number of fractions of petroleum products in oils	*2*
	Literature 1	
	VTS: prepare the Topic Products of primary and deep oil refining.	
	Literature 1	
	Chapter 4. Primary oil refining	
	Main oil refining enterprises of Ukraine. Schemes of oil refineries. Processes of primary oil refining	
3	*Perform vertical separator calculation. Perform horizontal separator calculation*	*2*
	Literature 1	
	VTS: prepare Topic Primary oil refining processes. Separators	
	Literature 1	
	Topic 4.2 Preparation of oil for processing	
4	*Determination of the amount of flushing water for parallel and sequential flushing water supply schemes.*	*2*
	Literature 1	
	VTS: prepare Topic Desalination and dehydration processes. Oil washing process	
	Literature 1	
	Oil desalination and dehydration. Supply schemes and determination of washing water consumption. Electrodehydrators. Demulsifiers	
5	*Perform a parametric calculation of an electrodehydrator. Perform a parametric calculation of a steam generator for the evaporation of hydrocarbon gases.*	*2*
	Literature 1	
	VTS: prepare the Topic Desalination and dehydration processes. Electrodehydrators	
	Literature 1	
	Primary oil refining. Products of primary oil refining. Distillation with gradual evaporation. Distillation with even (equilibrium) evaporation	

6-7	*Perform a parametric calculation of a stripping column.*	*4*
	Literature 1	
	VTS: prepare the Topic Primary oil refining processes. Evaporation plants	
	Literature 1	
8-9	*Perform parametric calculation of a fractionating distillation column*	*4*
	VTS: prepare Topic. Gas fractionation. Separation of saturated and unsaturated hydrocarbon gases.	
	Literature 1	
	Topic 4.5 Calculation of single evaporation of a hydrocarbon mixture. Multiple evaporation. Distillation with reflux. Distillation in vacuum with water vapor. Combined electrodesalination and oil dehydration plant.	

Calculation work

One calculation work is planned.

The main goal of the calculation work is to improve the level of mastery of the material being taught, which will simplify the assimilation of the material by students and ensure more complete control by the teacher over the implementation of the curriculum by students.

The tasks and implementation methodology are included in the methodological instructions posted on the website.http://ci.kpi.ua/uk/.

5. Student's independent work

Independent work accounts for 50% of the study of the credit module, which also includes preparation for the test. The main task of independent workapplicants– is the deepening of worldview and scientific knowledge in the areas defined in the lectures, by searching for the necessary information, developing perseverance and creative search in the formation of working hypotheses to intensify the transfer processes.

Policy and control

6. Academic discipline policy (educational component)

Rules for class attendance and behavior in class

Attendance at classes is mandatory.Applicantsare obliged to take an active part in the educational process, not to be late for classes or miss them without good reason, not to interfere with the teacher conducting classes, and not to be distracted by activities unrelated to the educational process.

Rules for assigning incentive and penalty points

- *Incentive points can be awarded by the teacher exclusively for the completion of creative works and working hypotheses.*
  But their sum cannot exceed 10% of the rating scale.
- *Penalty points are not provided within the framework of the academic discipline.*

Deadline and Rescheduling Policy

In the event of academic arrears in academic discipline or any force majeure circumstances,applicantsshould contact the teacher to agree on an algorithm of actions related to solving existing problems.

Academic Integrity Policy

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the lack of references when using printed and electronic materials, quotes, opinions of other authors. Hints and copying when writing tests or conducting classes are unacceptable.

The policy and principles of academic integrity are defined in Section 3 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". More details:https://kpi.ua/code

Academic Conduct and Ethics Policy

ApplicantsThey should be tolerant, respect the opinions of others, formulate objections in a correct form, and adequately provide feedback in class.

The norms of ethical behavior of students and employees are defined in Section 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". More details:https://kpi.ua/code

7. Types of control and rating system for assessing learning outcomes (RSO)

Distribution of study time by types of classes and tasks in the discipline according to the working curriculum:

Semester	Study time		Distribution of teaching hours				Control measures		
	Loans	academic year	Lectures	Practical	Lab work	CRC	MKR	RR	Semester control
8	4	120	36	18	–	66	1	1	test

A student's rating in a discipline consists of the points he receives for:

The applicant's rating for a credit module consists of the points he receives for his work in practical classes, lectures, and MCR.

The semester test is an exam.

Rating (weighting) points system and evaluation criteria

Systemrating points and evaluation criteria:

Weighted score for questions in lectures 1 point each

The weighted score for practical classes is 4 points;

Weighted score for RR 5 points

Weighted score for MCR 5 points

Weighted score for the test is 41 points

Criteria for evaluating the performance of a practical task

Completeness and signs of task completion	***Points***
The task is fully completed.	*4*
Minor deficiencies under point 1	*3*
Late completion of the task	*2.5*
Untimely completion of the task, shortcomings under item 1	*2*
Poor performance of the task	*1*
Failure to complete the task	*0*

Thus, the semester rating scale for a credit module is:

$$R = 18 \cdot 1 + 4 \cdot 8 + 1 \cdot 5 + 1 \cdot 4 + 1 \cdot 41 = 18 + 32 + 5 + 4 + 41 = 100 \text{ points}$$

According to the results of the training work in the first 7 weeks, the "ideal applicant" should score 20 points. At the first certification (8th week), the applicant receives "passed" if his current rating is at least 20 points.

According to the results of the training work, the "ideal applicant" should score 90 points in 13 weeks of study. At the second certification (week 14), the applicant receives "passed" if his current rating is at least 40 points.

The maximum score is 100. To receive credit for the automatic credit module, you must have a rating of at least 60 points.

Applicants who have scored less than 0.6 R during the semester, as well as those who want to increase their overall rating, take a credit test. In this case, all the points they received during the semester are canceled. The test tasks contain questions that relate to different sections of the credit module. The list of credit questions is given in Section 9.

To get creditsFor the final grade, the sum of all R rating points received during the semester is converted according to the table:

Number of points	***Rating***
95...100	*perfectly*
85...94	*very good*
75...84	*good*
65...74	*satisfactorily*
60...64	*enough*
RD<60	*unsatisfactorily*
Admission conditions not met	*not allowed*

8. Additional information on the discipline (educational component)

An indicative list of questions that are submitted for semester control

The ticket consists of three questions, two questions placed in part 1 and a task from part 2.

Part 1.

1. Analyze the origin of oil. Hypotheses of the origin of oil.
2. Analyze the diagram of the drilling rig.
3. Analyze the classification of oils.
4. Analyze oil reserves and the world's main gas-bearing regions.
5. Analyze the structural diagrams of pumps for extracting oil from the field.
6. Analyze oil reserves and the world's main gas-bearing regions.
7. Analyze oil reserves and main gas-bearing areas of Ukraine.
8. Analyze means of removing oil from deposits
9. Analyze oil exploration methods.
10. Analyze the structural diagrams of pumps for extracting oil from the field.
11. Analyze the physical properties of oil.
12. Detonation of gasoline, octane number. Motor and research method for determining octane number.
13. Analyze the properties of automotive gasolines.
14. Analyze the chemical composition of oil
15. Analyze oil refining processes at refineries
16. Analyze means of removing oil from deposits
17. Analyze the classification of oils.
18. Analyze means of removing oil from deposits
19. Analyze primary oil refining schemes
20. Analyze the physical properties of oil.
21. Analyze oil reserves and the world's main gas-bearing regions.
22. Analyze the origin of oil. Hypotheses of the origin of oil.
23. Analyze oil reserves and main gas-bearing areas of Ukraine.
24. Analyze the structural diagrams of pumps for extracting oil from the field.
25. Analyze the physical properties of oil.
26. Analyze the origin of oil. Hypotheses of the origin of oil.
27. Analyze devices for removing oil from fields
28. Analyze oil refining processes at oil refineries
29. Analyze the structural diagrams of pumps for extracting oil from the field.

Part 2.

You received 1,000 tons of oil.

Required for option No. ___ (table 1) and No. ___ (table 2):

1. Construct a boost curve for a given oil
2. Determine the percentage of the fraction specified by the teacher in the oil.
3. Determine the average relative density and average density (for average temperature) of the oil fraction specified by the teacher for the liquid phase of the fraction;

4. Determine the average characteristic factor of the fraction specified by the teacher;
5. Determine the specific average enthalpy of the fraction indicated by the teacher;
6. Determine the average heat capacity (for the average temperature) of the oil fraction specified by the teacher for the liquid phase;
7. Determine the amount of energy that must be removed when cooling the fraction specified by the teacher by 20 degrees.

Table 1.

Version	1	2	3	4	5	6	7	8	9
Oil, . volume % / ..Temperature,)C	Oklahoma low-sulfur	Californian heavy	Alaskan NORTH slope	Arabic easy	Lesser-sulfur Louisanthe	West Texas sulfur	Nigerian Bonny Light	Ukraine. Poltava field well No. 12	Russia. Tyumen field. Well No. 31
<45	5.1	–	8	11	10	13	15	15	5
45…105	9.2	–	7	9	8	12	12	12	8
105…125	4.0	–	4	4	5	3	4	9	5
125…155	5.7	4.2	5	6	7	10	9	8	3
155…200	9.3	5.1	6	8	10	7	7	8	5
200…230	5.4	4.8	5	6	6	6	8	7	3
230…260	5.8	8.5	7	7	7.5	6	8	10	6
260…290	4.7	7.9	6	7	6.5	6	7	4	8
290…345	10.8	8.0	6	5	5	5	5	9	10
345…400	8.6	14.8	9	5	5	5	5	6	11
400…480	13.5	15.1	14	9	9	8	12	5	11
480…540	5.9	13.4	16	13	15	13	8	7	12
>540	12.0	18.1	7	10	6	6	–	–	13

Table 2. Fractions and their densities:

Version	Faction	Density of petroleum product fractions ρ_4^{20} ,
1.	Hydrocarbon gases (ethane, methane, propane, butane)	0.29
2.	Gasoline (in foreign literature – petrol)	0.75
3.	Naphtha (heavy gasoline, gasoline-legroin fraction or legroin)	0.856
4.	Jet fuel	0.86
5.	Kerosene – solvent	0.88
6.	Household kerosene and lighting kerosene	0.90
7.	Diesel fraction	0.92
8.	Gasoil	0.95
9.	Oil fuel	0.97
10.	Tar	0.99

The working program of the academic discipline (syllabus):
Compiled by Associate Professor of the Department of MACORI, Candidate of Technical Sciences, Associate Professor Andriy Stepaniuk

Approved by the Department of the Institute of MACORI (Minutes No. 20 dated 12.06.2025)

Approved by the Methodological Commission of the Faculty (Minutes No. 11 dated 06/27/2025)