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

Department of Machines and Apparatus of Chemical and Oil Refining Production

"Fundamentals of chemical engineering"

The syllabus of the discipline

Details of the discipline	
Level of higher education	**First (bachelor's) degree**
Field of expertise	13 - Mechanical engineering
Specialty.	133 - Industrial machinery engineering
Educational program	"Industrial Engineering"
Status of the educational component	Normative
Scope of the discipline	135 hours/ 4.5 ECTS credits
Year of study, semester	2nd year, fall semester
Form of study	Full-time (daytime)
Class schedule	1 lecture per week and 1 practical lesson every two weeks
Semester control / control measures	Exam / ICR
Language of instruction	English
Information about the course leader / teachers	phD, Associate Professor, Seminsky Oleksandr Olehovych, forstd@ukr.net , @mahnv_kpi
Placement of the course	http://ci.kpi.ua

Program of the discipline

1. Description of the discipline, its purpose, subject matter and learning outcomes

The discipline "Fundamentals of Chemical Engineering" begins the cycle of professional training of higher education applicants in the program "Computer-Integrated Technologies for Equipment Design in Chemical Engineering" and is used as a basis for studying professional educational components and implementing an individual training program for applicants.

The aim of the ***discipline*** is to master the fundamental concepts in the field of chemical engineering, the ability to determine the properties of substances and to perform integral calculations of the parameters of chemical and technological processes.

The discipline forms the following ***competencies***:

- ability to apply knowledge in practical situations;
- ability to plan and manage time;
- ability to conduct research at a certain level;
- ability to communicate in a foreign language;
- the ability to act in a socially responsible and conscious manner;
- skills in the use of information and communication technologies;
- the ability to exercise one's rights and responsibilities as a member of society, to realize the values of a civil (free democratic) society and the need for its sustainable development, the rule of law, human and civil rights and freedoms in Ukraine;
- ability to learn and master modern knowledge.

The ***program learning outcomes*** after studying the discipline include:

- know and understand the principles of technological, fundamental and technical sciences underlying the engineering of chemical and related technologies;
- perform engineering calculations to solve complex problems and practical issues in chemical engineering;
- be able to develop technologies for the manufacture of products and their components, taking into account the phenomena that occur in materials during mechanical, thermal, chemical-thermal, thermomechanical processing, the properties of materials and methods of their processing to ensure the specified properties, features of operation throughout the entire life cycle.

2. Prerequisites and post-requisites of the discipline (place in the structural and logical scheme of study in the relevant educational program)

The discipline is based on the educational components of the program: "Physics", "Chemistry", "Engineering Calculation Software", is complemented by the discipline "Economics and Production Organization" and provides special courses of professional training, primarily "Transfer Processes in Continuous Media" and "Processes and Equipment of Chemical Technology".

3. Content of the discipline

Topic 1: Introduction to chemical engineering.

Topic 2. Substances and their properties.

Topic 3. Balance sheets and balance sheet calculations.

Topic 4. In-depth study of professional issues.

4. Training materials and resources

Basic literature:

1. Avramenko M.O. Physical and colloidal chemistry : a textbook / Avramenko M.O., Kaplaushenko A.G., Pryakhin O.R., Varinsky B.O. [and 2 others] ; Ministry of Health of Ukraine, Zaporizhzhya State Medical University. - Lviv : Magnolia 2006 Publishing House, 2020. - 1204 c.
2. Glossary of chemistry terms / Y.Opeida, O.Shvaika. L.M. Lytvynenko Institute of Physical and Organic Chemistry and Coal Chemistry of the National Academy of Sciences of Ukraine, Donetsk National University - Donetsk: "Weber, 2008. - 758 p.
3. Samoilenko S.O. Physical and colloidal chemistry : a textbook / S.O. Samoilenko, N.O. Otroshko, O.F. Aksenova, V.O. Dobrovolska ; Ministry of Education and Science of Ukraine, Kharkiv State University of Food Technology and Trade. - Kharkiv: World of Books, 2020. - 339 c.
4. Tsvetkova L.B. Physical chemistry: theory and problems: a textbook / L.B. Tsvetkova. - Kyiv : Caravel Publishing House, 2020. - 414 c.
5. Yavorsky V.T. General Chemical Technology / V.T. Yavorsky, T.V. Perekupko, Z.O. Znak, L.V. Savchuk - Lviv: Lviv Polytechnic National University Press, 2009. 410 p.

Additional reading:

1. Processes and equipment of chemical technology / Y.M. Kornienko, Y.Y. Lukach, I.O. Mikulonok, B.L. Rakytsky, G.L. Ryabtsev. K.: NTUU "KPI", 2011. - [P. 1. - 300 p.; P. 2.-416 p.].
2. Himmelblau D.M. Basic Principles and Calculations in Chemical Engineering / D.M. Himmelblau, J.B. Riggs. - Pearson Education, Inc. 2012. - 857 p.
3. Perry's Chemical Engineers' Handbook / Editor-in-Chief D.W. Green. - McGraw-Hill Education, 2019. - 2274 p.

Educational content

5. Methods of mastering the discipline (educational component)

Calendar and thematic plan

Week	*The content of the training work*	*SRS (81 hours according to the curriculum)*
Topic 1: Introduction to chemical engineering.		
1, I week	**Lecture 1:** The subject and tasks of chemical engineering, its place and importance in the development of society.	Study the topic of the class. Work with the recommended literature.
Topic 2. Substances and their properties.		
2, II week	**Lecture 2**: The concept of substance. Aggregate states. Gases.	Study the topic of the class. Work with the recommended literature.
3, II week	**Practical session 1:** Molecular kinetic theory of gases and ideal gases.	Working out the topic of the lesson. Carrying out calculations.
4, I week	**Lecture 3:** Crystals, amorphous bodies, liquids.	Study the topic of the class. Work with the recommended literature.
5, II week	**Lecture 4.** Solutions and dispersed systems.	Study the topic of the class. Work with the recommended literature.
6, II week	**Practical lesson 2.** Material calculations.	Working out the topic of the lesson. Carrying out calculations.
7, I week	**Lecture 5.** Concepts and approaches to the calculation of basic properties of substances. Examples.	Working out the topic of the lesson. Work with the recommended literature.
8, II week	**Lecture 6** Concepts and approaches to the calculation of thermophysical properties of substances. Diffusion Examples.	Study the topic of the class. Work with the recommended literature.
9, II week	**Practical lesson 3.** Calculations of basic properties of substances.	Working out the topic of the lesson. Carrying out calculations.
Topic 3. Balance sheets and balance sheet calculations.		
10, I week	**Lecture 7.** Material balances. Principles of their preparation and engineering application. Examples.	Working out the topic of the lesson. Work with the recommended literature.
11, II week	**Lecture 8.** Material balances in systems without chemical transformations.	Working out the topic of the lesson. Work with the recommended literature.
12, II week	**Practical lesson 4.** Calculations of the thermophysical properties of substances and determination of the molecular diffusion coefficient.	Working out the topic of the lesson. Carrying out calculations.

Week	*The content of the training work*	*SRS (81 hours according to the curriculum)*
13, I week	**Lecture 9.** Material balances under conditions of chemical transformations. Terminology of reaction systems. Examples.	Working out the topic of the lesson. Work with the recommended literature.
14, II week	**Lecture 10.** Material balances of modular systems. Examples of construction and calculation of parameters of industrial cycles.	Working out the topic of the lesson. Work with the recommended literature.
15, II week	**Practical lesson 5.** Preparation of material balances based on the materials of lectures 8 and 9. Balance sheet calculations.	Working out the topic of the lesson. Carrying out calculations.
16, I week	**Lecture 11.** The first and second laws of thermodynamics. Entropy. Definition of thermal effects. Influence of changes in external conditions on equilibrium.	Working out the topic of the lesson. Work with the recommended literature.
17, II week	**Lecture 12.** Energy balances. Balances in systems without chemical transformations.	Working out the topic of the lesson. Work with the recommended literature.
18, II week	**Practical lesson 6.** Preparation of material balances based on the materials of lecture 10. Balance sheet calculations.	Working out the topic of the lesson. Carrying out calculations.
19, I week	**Lecture 13.** Energy balances under conditions of chemical transformations.	Working out the topic of the lesson. Work with the recommended literature.
20, II week	**Lecture 14.** Energy balances under conditions of chemical transformations (continued). Enthalpy. Examples.	Working out the topic of the lesson. Work with the recommended literature.
21, II week	**Practical lesson 7.** Drawing up energy balances and calculations.	Working out the topic of the lesson. Carrying out calculations.
Topic 4. In-depth study of professional issues.		
22, I week	**Lecture 15.** Lecture-discussion.	Working out the topic of the lesson. Work with the recommended literature.
23, II week	**Lecture 16.** Lecture-discussion.	Working out the topic of the lesson. Work with the recommended literature.
24, II week	**Practical lesson 8.** Calculations of equilibrium of systems.	Working out the topic of the lesson. Carrying out calculations.

Week	*The content of the training work*	*SRS (81 hours according to the curriculum)*
25, I week	**Lecture 17.** Lecture-discussion.	Working out the topic of the lesson. Work with the recommended literature.
26, II week	**Lecture 18.** Lecture-discussion.	Working out the topic of the lesson. Work with the recommended literature.
27, II week	**Practical lesson 9.** Module control work	Preparing for a module test.

Note. Lectures on topic 4 are aimed at increasing students' interest in in-depth study of professional issues and include: lectures at the request of students, presentations by representatives of the scientific community and specialized industries, speeches by graduates who have gained professional recognition, etc.

6. Independent work of the student

The types of independent work are listed in the table in paragraph 5, according to the academic weeks and scheduled classes.

Policy and control

7. Policy of the academic discipline (educational component)

A system of requirements for students:

- **rules for attending classes** - attendance at all types of classes (lectures, practical classes) is mandatory both in classrooms and in distance learning. In the latter case, classes are held in Zoom conferences and students "attend" them by connecting to the links provided by teachers;
- **rules of behavior in the classroom** - not to interfere with other students' listening to lectures or working in practical classes by unnecessary activities or conversations (including by phone). In the classroom and during distance learning at home, follow safety rules;
- **rules for crediting practical classes and awarding points for their completion** - the teacher evaluates the student's work during the class, the quality and timeliness of the presentation of the results of the assignment;
- **rules for awarding incentive and penalty points** - no incentive points are provided; 1 penalty point is awarded for absence from class without a valid reason or for late completion of practical assignments;
- **policy of deadlines and retakes**:
  1) all assignments are submitted and evaluated exclusively during classroom sessions;
  2) retakes of the exam are carried out according to the schedule established at the university level within the timeframe determined by the teacher and communicated to students when the rating scores are announced;
- **Policy on Academic Integrity** - students are required to comply with the provisions of the Honor Code and the requirements of academic integrity during the educational process.

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

Current control: evaluation of work in practical classes (completion of tasks in each class is evaluated up to 5 points, the maximum for all practical classes is 40 points), a module test is evaluated with a maximum of 20 points.

Calendar control: is carried out twice a semester on weeks 7-8 and 14-15 as a monitoring of the current state of fulfillment of SilaBus requirements - a student receives "satisfactory" during the first and second calendar control if his/her current rating is at least 0.5 of the maximum number of points possible at the time of control.

Semester control is conducted in the form of an exam consisting of two parts: written and oral. The written part involves answering three questions (two theoretical and one practical). The questions are formulated in tickets. The oral part consists of a questionnaire on the course topics related to the questions in the ticket. Theoretical questions are worth a maximum of 12 points, and practical questions are worth a maximum of 16 points.

Conditions of admission to semester control:

- admission to the exam is possible only if you have successfully completed all practical classes and attended at least two-thirds of the lectures;
- students who received a total rating score of < 25 during the semester are not allowed to take the exam.

Table of correspondence between rating points and grades on the university scale:

Number of points	*Assessment.*
100-95	Excellent
94-85	Very good
84-75	Okay.
74-65	Satisfactory
64-60	Enough
Less than 60	Unsatisfactory
The conditions for admission are not met	Not allowed

9. Additional information on the discipline (educational component)

Retakes are conducted according to a "soft" scheme (with the points gained during the semester). In this case, 10 penalty points are awarded for each retake.

The syllabus of the discipline:

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Approved at the meeting of the Department of Machines and Apparatus of Chemical and Oil Refining Production (Protocole No. 20 of June 20, 2024).

Approved by the Methodological Commission of the Faculty of Engineering and Chemistry (Protocole No. 11 of June 28, 2024).