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

chemical and oil refining industries

Course project on processes and equipment of chemical technology

Working program of the academic discipline (Syllabus)

Details of the academic discipline	
Level of higher education	*First (undergraduate)*
Branch of knowledge	*13 mechanical engineering*
Specialty	*133 industrial engineering*
Educational program	*Computer-integrated technologies of chemical engineering equipment design*
Discipline status	*Normative*
Form of education	*full-time (face-to-face/distance)*
Year of training, semester	*3rd year, autumn semester*
Scope of the discipline	*1.5 ECTS credits, 45 hours - SRS*
Semester control/ control measures	*Credits, course projects*
Lessons schedule	*Scientific and pedagogical worker*
Language of teaching	*Ukrainian*
Information about the course leader / teachers	*Head of the course project: Ph.D., senior teacher Serhiy Serhiyovych Haydai GaidaiSS@i.ua*
Placement of the course	*https://ecampus.kpi.ua/*

Program of educational discipline

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

The course project "Course project on processes and equipment of chemical technology" is a component of professional training for the practical activities of a bachelor in industrial mechanical engineering, and belongs to the cycle of professional and practical training. It is a practical basis for calculating processes and designing typical chemical technology equipment. The study of this discipline will allow students to learn the fundamental concepts of thermal and hydromechanical processes, as well as their practical application when performing parametric calculations and structural calculations of individual elements. It will allow you to create a professional basic foundation for the successful development of energy-efficient equipment, as well as the preparation of design documentation.

The discipline contributes to the development of professional self-awareness, the culture of communication, and the formation of theoretical, practical, and personal-motivational components of professional competence.

The subject of the academic discipline

A systematic approach to calculating energy-efficient processes and designing chemical technology equipment, as well as drawing up design documentation.

Interdisciplinary connections

The list of disciplines that the student needs to master (requirements for the level of training):

- *mechanics of materials and structures-1. Basics of resistance of materials;*
- *mechanics of materials and structures-2. Resistance of materials under complex loading;*
- *structural materials and basics of metallurgy;*
- *processes and equipment of chemical technologies;*
- *calculation and design of typical equipment.*

The list of disciplines provided by this educational discipline:

- *Computer-integrated technologies of technological equipment design;*
- *Modeling of synthesis and separation processes;*
- *Innovative technologies for cleaning and processing materials;*
- *Course work on engineering of innovative technologies and equipment;*
- *Diploma project of educational and qualification level "bachelor";*
- *Scientific work on the topic of the master's thesis-2. Research work on the topic of the master's thesis.*

The purpose of this educational discipline*there is the calculation of energy-efficient processes, the design of chemical technology equipment and the drafting of design documentation.*

The main tasks of the academic discipline

According to the requirements of the educational and professional program, after mastering the academic discipline, students must demonstrate the following learning outcomes:

KNOWLEDGE:

- *modern approaches, methods and techniques, solving problems in equipment design;*
- *modern approaches, methods and techniques, solving problems during maintenance, modernization and operation throughout the entire life cycle of technological equipment.*

SKILL*:*

- *using scientific and technical information, regulatory documents and professional knowledge to calculate processes and design new technological equipment.*
- *using scientific and technical information, regulatory documents and professional knowledge to perform design documentation during modernization and operation along the entire life cycle of technological equipment.*
- *perform computer design of equipment, apply computer engineering methods using special software.*

In accordance with the goal, the training of bachelors requires deepening of the competences formed by students:

- *abilityto project activities in the field of engineering and technology;*
- *abilityto present technical documentation in accordance with the requirements of current systems and design documentation standards;*
- *abilityto the analysis of scientific and technical information, domestic and foreign experience in the technique and technology of chemical engineering;*
- *abilityto design technological equipment of chemical industries;*
- *the ability to work independently, individually, to make decisions within the framework of one's professional tasks.*

2. Pre-requisites and post-requisites of the discipline (place in the structural and logical scheme of training according to the relevant educational program)

Prerequisites:*the ability to apply knowledge in practice when evaluating methods of calculating thermal and hydromechanical processes, skills in using information and computer technologies, the ability to search, process and analyze from various sources, the ability to apply knowledge about the basic physico-chemical principles of technological processes of chemical engineering.*

Post-requisites:*the ability to apply knowledge for the practical solution of problems related to the provision of innovative technical solutions for conducting thermal and hydromechanical processes, as well as the choice of an algorithm for its implementation, the ability to use computerized calculation systems to justify technical decisions regarding the selection of existing equipment to increase the energy efficiency of the process, the ability to assess the technical and economic efficiency of systems and their components based on the application of analytical methods and analysis of analogs, the ability to make decisions regarding the selection of structural materials for the creation of innovative equipment.*

After mastering the academic discipline, students will be able to use knowledge of fundamental disciplines and mathematical apparatus to implement professionally-profiled knowledge and practical skills to solve system engineering tasks of creating effective processes and innovative equipment for their implementation.

3. Content of the academic discipline

The course project includes:

- *explanatory note;*
- *design documentation from assembly drawings of the apparatus (machine), assembly drawings of universities, drawings of original parts. The total volume of drawings – 2 drawings of A1 format and 1 drawing of A2 format;*
- *specifications to drawings.*

The course project is carried out according to an individual task on the following topics:

- *Heat exchange devices;*
- *Evaporation units;*
- *Dryers.*

The output data for options is determined by the teacher. Titles of topics and initial data are specified for each student of the group when forming the final list of names (taking into account the requirements of interested enterprises and organizations).

4. Educational materials and resources

Basic literature:

1. *Kornienko Y. M. Processes and equipment of chemical technology 1: textbook / Y. M. Kornienko, Yu. Yu. Lukach, I. O. Mikulonok, V. L, Rakytskyi, G. L. Ryabtsev // K.: NTUU "KPI". – 2011. – Part 1. - 300 C.*

2. *Y. M. Kornienko Processes and equipment of chemical technology 2: Textbook / Y. M. Kornienko, Y. Yu. Lukach, I. O. Mikulonok, V. L. Rakytskyi, G. L. Ryabtsev // K.: NTUU KPI". – 2011. – Part 2. – 416 p.*

3. *Calculation and design of typical equipment: coursework [Electronic resource]: study guide for students of specialty 133 "Industrial mechanical engineering", educational program "Equipment of chemical, oil refining and pulp and paper industries" / KPI named after Igor Sikorskyi; compiled by: A. R. Stepaniuk, O. G. Zubriy – Electronic text data (1 file: 3.87 Mbytes). – Kyiv: KPI named after Igor Sikorskyi, 2022. – 100 p.*

4. *Construction design of equipment: course project [Electronic resource]: study guide for students studying in specialty 133 "Industrial mechanical engineering", specialization "Engineering and computer-integrated technologies of design of innovative industrial equipment" / KPI named after Igor Sikorskyi; compiled by: A. R. Stepaniuk, O. G. Zubriy – Electronic text data (1 file: 2.4 MB). – Kyiv: KPI named after Igor Sikorskyi, 2022. – 93 p.*
5. *Calculation and design of typical equipment-4. Course work: Requirements for course work [Electronic resource]: study guide for bachelor's degree holders in specialty 133 "Industrial mechanical engineering / I. A. Andreev; KPI named after Igor Sikorsky. – Electronic text data (1 file: 3.39 MB). – Kyiv: KPI named after Igor Sikorskyi, 2022. - 71 p.*
6. *Andreev, I. A. Design and calculation of support nodes of vessels and apparatus of chemical industries [Electronic resource]: training. manual for students specialty 133 "Industrial mechanical engineering" / I. A. Andreev; KPI named after Igor Sikorsky. – Electronic text data (1 file: 3.26 MB). – Kyiv: KPI named after Igor Sikorskyi, 2021. - 94 p.*
7. *Andreev, I. Reinforcement of holes in vessels and devices [Electronic resource]: study guide for students of specialty 133 "Industrial mechanical engineering", educational and professional program "Equipment of chemical, oil refining and pulp and paper industries" / Ihor Andreev ; KPI named after Igor Sikorsky. – Electronic text data (1 file: 3.07 MB). – Kyiv: KPI named after Igor Sikorskyi, 2021. – 72 p.*
8. *Andreev, I. Calculation of column apparatus for strength and stability [Electronic resource]: study guide for students of specialty 133 "Industrial mechanical engineering", educational and professional program "Equipment of chemical, oil refining and pulp and paper industries" / I. Andreev; KPI named after Igor Sikorsky. – Electronic text data (1 file: 4.51 MB). – Kyiv: KPI named after Igor Sikorskyi, 2021. – 112 p.*
9. *Andreev, I. Detachable strong-tight joints [Electronic resource]: study guide for students of specialty 133 "Industrial mechanical engineering", educational and professional program "Equipment of chemical, oil refining and pulp and paper industries" / Ihor Andreev; KPI named after Igor Sikorsky. – Electronic text data (1 file: 4.65 MB). – Kyiv: KPI named after Igor Sikorskyi, 2020. – 138 p.*
10. *Tovazhnyansky L. L. Processes and devices of chemical technology / L. L. Tovazhnyanskyi, A. L. Gotlinska, V. O. Nechyporenko. I. S. Chernyshov // Kharkiv, NTU. – 2006. – Part 1. - 540 S.*
11. *Tovazhnyanskyi, L. L. Processes and devices of chemical technology / L. L. Tovazhnyanskyi, A. L. Gotlinska, V. O. Nechyporenko, I. S. Chernyshov. - Kharkiv, National Technical University. – 2006. – Part 2. - 540 S.*

Additional literature:

12. *Methodical instructions for the implementation of a course project for students of the specialty "Equipment of chemical production and building materials enterprises" from the discipline "Calculation and design of rotating equipment elements" Electronic resource of NTUU "KPI" comp. O.H. Zubrii, S.V. Gulienko. - Kyiv. NTUU "KPI", 26 p.*
13. *A.S. Timonin Fundamentals of design and calculation of chemical, technological and protective equipment. Directory. Ed. 2nd revised and supplemented. In 3 volumes, N. Bochkareva Publishing House, Kaluga. 2002.*
14. *DNAOP 0.00-1.07-94* Rules for the construction and safe operation of vessels operating under pressure, -K.: Derzhnadrazohoranova prati, 1998 273p.*
15. *GOST34233.1-2017Vessels and devices. STANDARDS AND METHODS OF STRENGTH CALCULATION. General requirements.*
16. *GOST 34233.2—2017 Vessels and apparatus STANDARDS AND METHODS OF STRENGTH CALCULATION Calculation of cylindrical and conical shells, convex and flat bottoms and lids.*
17. *GOST34233.3—2017 Vessels and apparatus STANDARDS AND METHODS OF STRENGTH CALCULATION Strengthening of holes in shells and bottoms under internal and external pressure. Calculation of the strength of shells and bottoms with external.*

18. *GOST 34233.6-2017 Vessels and apparatus STANDARDS AND METHODS FOR STRENGTH CALCULATION Strength calculation for low-cycle loads.*
19. *GOST 34233.8—2017 Vessels and devices. STANDARDS AND CALCULATION METHODS FOR STRENGTH. Vessels and devices with jackets.*

Information resources on the Internet:

20. *Ministry of Strategic Industries of Ukraine [Electronic resource]. – 2021. – Access mode:https://mspu.gov.ua.*
21. *Union of Chemists of Ukraine [Electronic resource]. – 2021. – Access mode: http://chemunion.org.ua/uk.*
22. *International congress of chemical process [Electronic resource]. – 2021. – Access mode: https://2020.chisa.cz.*
23. *Digital management of the construction process – developed by entrepreneurs for entrepreneurs [Electronic resource]. – 2021. – Access mode: https://www.chisa.dk.*

Educational content

1. Methods of mastering an educational discipline (educational component)

Independent work of student

The purpose of independent work is to master the knowledge of the material of the discipline, to master the methods of process calculations and design developments; development of problem formulation skills and ways to solve them, mastering knowledge about constructions and calculations through personal information search, formation of active interest and creative approach in educational work.

*Independent work also includes determining the properties of materials and calculated values according to standards, developing schemes, tables, graphs, and making drawings*components and parts, as well as development of specifications for drawings. The work is performed using computer equipment.

List of main questions:

	Title of sections and topics	*Distribution of SRS hours*
	Chapter 1. Explanatory note	
1	***1.1. Introduction.*** *In the introduction, the methods of obtaining and the areas of use of the substance (raw material) given in the task are given, and the choice of the type of equipment for the implementation of the process (according to the task) is justified.*	***1.0***
2	***1.2. Description of the design and principle of its operation, description of the main components and details***	***1.0***
3	***1.3. Creation of technical characteristics of the device***	***0.5***
4	***1.4. Parametric calculation of the device***	***11.0***
5	***1.5. Design calculation of the device***	***1.0***
6	***1.6. Calculation of fittings of the apparatus***	***1.0***
7	***1.7. Hydraulic calculation of the device***	***1.0***
8	***1.8. Inspection of nodes and parts for strength, stability, rigidity and tightness***	***1.0***
	Chapter 2. Drawings	
9	***2.1. Execution of assembly drawing of the device***	***11.0***
10	***2.2. Completion of assembly drawings of apparatus units*** *In the absence of a total number of drawings on 2×A1+1×A2 formats, detail drawings are also performed*	***10.0***
	Section 3. Specifications	
11	***3.1. Device (machine) specification***	***1.0***
12	***3.2. Specifications for assembly drawings of apparatus units***	***3.0***
	Chapter 4. Forming a folder for submitting a course project to the archive	
thirteen	***4.1. Cover sheet for the folder***	***0.2***
14	***4.2. Specification per folder*** *The specification for the folder contains a list of all the documentation that makes up the course project (Explanatory note, drawings and specifications for drawings with an indication of formats and number of pages)*	***0.8***
15	***4.3. Abstract and task***	***0.5***
16	***Preparation of the project for defense***	***1.0***
Total for the semester:		***45***

Policy and control

Policy of academic discipline (educational component)

The system of requirements for the student:
–students are obliged to actively participate in the educational process;
–do not interfere with the teacher conducting consultation classes;
–not to be distracted during consultations by activities not related to the educational process;
–turn off phones during the consultation class (in the case of an online class, turn off the microphone when entering and turn it on only if necessary);
–use means of communication only to search for information (on the teacher's Google drive or on the Internet, etc.).

Rules for assigning incentive and penalty points

Incentive points can be awarded by the teacher for active and honest performance of work and for creative works and working hypotheses.
The sum of incentive points cannot exceed 25% of the rating scale.
Penalty points within the academic discipline, as a rule, are not provided.

Policy of deadlines and rescheduling

In the event of academic debts arising from the academic discipline or any force majeure circumstances, students should contact the teacher to coordinate actions related to solving the existing problems.

Policy of academic integrity

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the absence of references when using printed and electronic materials, quotes, opinions of other authors. Inadmissible prompts and write-offs during writing tests, conducting classes, tests, exams.
The policy and principles of academic integrity are defined in Chapter 3 of the Code of Honor of the National Technical University of Ukraine "Ihor Sikorsky Kyiv Polytechnic Institute". More details:https://kpi.ua/code.

Policy of academic behavior and ethics

Students should be tolerant, respect the opinions of others, formulate objections in the correct form, adequately support feedback during classes.
Standards of ethical behavior of students and employees are defined in Chapter 2 of the Code of Honor of the National Technical University of Ukraine "Ihor Sikorskyi Kyiv Polytechnic Institute". More details:https://kpi.ua/code

2. Types of control and rating system for evaluating learning outcomes (RSO)

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

Semester	*Training time*		*Distribution of study hours*				*Control measures*		
	Credits	*Acad. hours*	*Lectures*	*Practical*	*Lab. do*	*SRS*	*MKR*	*RR*	*Semester control*
5	*1.5*	*45*	*0*	*0*	*0*	*45*	*0*	*0*	*test*

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

–execution of calculations, drawings, specifications and preparation of the KP before submission - 60 points;

–the answer to the assessment is 40 points.

System of rating (weighted) points and evaluation criteria

The starting rating (during the semester) consists of points that the student receives for: work on the projectduring the semester:

– justification of the decisions made - 10-6 points;
– correct application of analysis and calculation methods - 15-8 points;
– quality of design, compliance with the requirements of regulatory documents - 6-4 points;
– quality of graphic material and compliance with standards - 20-10 points.
– the timeliness of the work schedule for the course project - 9-0 points;
Total: ***max – 60 points; min – 28 points.***
project protection:
report quality – 6-4 points;
– degree of mastery of the material - 12-10 points;
– degree of substantiation of the decisions made - 12-10 points;
– the ability to defend one's opinion - 10-8 points
sum: max40 minutes 3
together: 10060

Intersessional certification

According to the results of work for the first 7 weeks, the maximum possible number of points is 25 points (ready-made calculations). At the first certification (8th week), the student receives "certified" if his current rating is at least 10 points (ready-made parametric calculation).

According to the results of 13 weeks of training, the maximum possible number of points is 32 points. At the second certification (week 14), the student receives "certified" if his current rating is not less than 16 points (ready calculations and assembly drawing of the device).

Thus, the rating semester scale from the credit module is:

$$R = r_{semester} + r_{defense} = 60 + 40 = 100 \text{ points}$$

Test

A condition for a student's admission to the test is a completed folder with a course project to be submitted to the archive with all necessary calculations, assembly drawing of the device with the specification for it, and a starting rating of at least 26 points.

At the test, students defend the course project, describing everything that was done during its implementation, show drawings with explanations, and also answer the teacher's questions about the project itself (40 points).

*The sum of starting points and points for the examination control work is transferred to the examination grade in accordance with*table:

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

Working program of the academic discipline (syllabus):

Folded*Art. Lecturer, Ph.D., Gaidaim S.S.*

Approved*by the department of MAHNV (protocol No. 20, dated 06.21.2022)*

Approved*at the meeting of the methodological commission of the CEF (protocol No. 10, dated 06.24.2022)*