



# NAME OF THE COURSE

## Calculations and design of equipment. Course project Working program of the academic discipline (Syllabus)

### Details of the academic discipline

Level of higher education	First (bachelor's)
Field of knowledge	G Engineering, Manufacturing and Construction
Specialty	G11 Machine Engineering
Specialization	G11.03 Technological Machines and Equipment
Discipline status	Normative
Form of study	full-time
Year of training, semester	4 course, fall semester
Scope of discipline	1.5 (45)
Semester control/ control measures	Test
Class schedule	According to the teacher's consultation schedule
Language of teaching	Ukrainian
Information about head of the course / teachers	Ph.D., Assoc. Andreiev I. A. <a href="mailto:che@kpi.ua">che@kpi.ua</a>
Placement of the course	<a href="https://ecampus.kpi.ua/">https://ecampus.kpi.ua/</a> , <a href="http://ci.kpi.ua">http://ci.kpi.ua</a>

### Program of educational discipline

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

##### Description of the academic discipline

The course covers the basics of designing vessels and devices, their application, calculations to ensure the strength, reliability and durability of the equipment.

The discipline "Calculations and design of equipment. Course project" considers the calculations and design of vessels and devices of chemical production.

##### The subject of the academic discipline

The discipline "Calculations and design of equipment. Course project" is taught as the main component of the training of qualified specialists in the field of mechanical engineering, resource conservation, ecology and computer-integrated technologies.

Mastering the methods of construction and calculation involves not just mastering certain rules, but rather the development of a peculiar style of thinking, focused on the creation of modern technology in the field of chemical and oil refining engineering.

##### The purpose of the educational discipline

The purpose of studying this discipline is the formation of students of a complex of knowledge, skills, and abilities necessary for qualified design and calculation of typical equipment of the chemical industry. In accordance with the goal, the training of bachelors requires the formation of the following abilities:

- use and application in professional activity of normative methods of calculation of vessels and devices of chemical industries,
- using knowledge of design and construction of typical equipment,

- mastering the method of determining loads that occur during installation, testing and in working conditions,
- receiving information about the current state of equipment elements during operation,
- improvement of chemical production equipment,
- use of the method of calculating stresses and deformations that occur during the operation of typical equipment.

## 2.2. The main tasks of the credit module.

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

### **knowledge:**

- basic designs of machines and devices, typical units and parts and requirements for them;
- materials used in chemical engineering and their properties;
- calculation parameters and rules for their determination;
- conditions of strength, stiffness, stability, vibration resistance, tightness;
- calculation models of shells, plates, rods;
- determination of stresses, analysis of the stress state, permissible and limit loads;
- regulatory methods of calculating vessels and devices;
- development of a structurally perfected product.

### **skill:**

- based on the features of the technological process, determine the initial and limiting conditions and load scheme for the structure,
- on the basis of working conditions, determine the stress-strain state of the structure under static and dynamic thermoforce loads,
- based on the knowledge of theoretical training, using reference books and standards, choose structural materials and seal materials,
- using reference materials, perform calculations regarding the strength of typical equipment,
- perform parametric calculations of typical equipment using known analytical dependencies and reference information,
- take into account the need for assembly, disassembly, transportation and installation of the product,
- on the basis of the acquired knowledge, perform calculations on stiffness, stability, strength and develop design documentation,
- create constructions that are safe in operation.

### **experience:**

- design development of a vessel or apparatus;
- ensuring strength, stability, rigidity, tightness, corrosion resistance, structural integrity and other requirements for elements of chemical equipment.

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

Mastering the discipline "Calculations and design of equipment. Course project" is based on the principles of integration of the complex of knowledge acquired by students during the course of bachelor's education while studying natural and engineering-technical disciplines in the field of "Mechanical Engineering". To successfully master this discipline, it is necessary to have basic knowledge in the field of higher mathematics, physics, resistance of materials, hydraulics, processes and equipment of chemical industries, to be able to use a computer to provide the necessary calculations, to have skills in the field of applied programming, mathematical modeling of processes and systems.

As a result of mastering the discipline, the student will be ready to use fundamental and natural scientific knowledge and methods to solve complex scientific and technical problems in the field of professional and research and innovation activities.

### 3 Content of the academic discipline

For the course project, the vessels and devices of chemical and oil refining industries, which the students got acquainted with during the course "Calculations and design of typical equipment" during the three previous semesters, are brought out.

The numerical output for the options is determined by the teacher when the design assignment is issued.

Titles of topics and initial data are clarified for each student of the group during the formation of the final name list, provided that the requirements of interested enterprises and organizations are taken into account, and are approved at the meeting of the department at the beginning of the semester.

### 4 Educational materials and resources

#### *Basic literature*

1. Розрахунок і конструювання обладнання: рекомендації до виконання курсового проекту: навч. посіб. для здобувачів ступеня бакалавра за освіт. програмою «Комп'ютерно-інтегровані технології проектування обладнання хімічної інженерії» спец. 133 Галузеве машинобудування. Київ: КПІ ім. Ігоря Сікорського, 2024. 78 с. URL: <https://ela.kpi.ua/handle/123456789/65007>.
2. Андреев І. А. Конструювання і розрахунок основних елементів посудин та апаратів: підруч. для здобувачів ступеня бакалавра за спец. 133 Галузеве машинобудування. Київ: КПІ ім. Ігоря Сікорського, 2024. 428 с. URL: <https://ela.kpi.ua/handle/123456789/65136>.
3. Андреев І.А. Конструювання і розрахунок типового устаткування хімічних виробництв. Основні положення. Елементи тонкостінних посудин, навантажених внутрішнім тиском. Навч. посібник. – К.: «Видавництво «Політехніка», 2011. – 272 с.
4. Андреев І.А., Мікульонюк І.О. Розрахунок, конструювання та надійність обладнання хімічних виробництв: Термінологічний словник. – К.: ІВЦ “Видавництво «Політехніка» , 2002. – 216 с.
5. Андреев І.А., Зубрій О.Г., Мікуленок І.О. Застосування матеріалів у хімічному машинобудуванні. Сталі і чавуни,- К.: ІЗМН, 1999. – 148 с.
6. Андреев І.А., Зубрій О.Г. Конструювання та розрахунок апаратів високого тиску, - К.: ІЗМН, 1999. – 144 с.
7. І. А. Андреев, І.О. Мікульонюк. Розрахунок лінзових і сильфонних компенсаторів. Навч. посібник. – К.: «Видавництво «Політехніка», 2008.-88 с.
8. І. А. Андреев. Розрахунок колонних апаратів на міцність і стійкість [Електронний ресурс]: навч. посіб. для студ. спеціальності 133 «Галузеве машинобудування», освітньо-професійної програми «Обладнання хімічних, нафтопереробних та целюлозно-паперових виробництв» / І. А. Андреев; КПІ ім. Ігоря Сікорського. – Електронні текстові дані (1 файл: 4,53 Мбайт). – Київ : КПІ ім. Ігоря Сікорського, 2021. – 112 с. <https://ela.kpi.ua/handle/123456789/38716>.
9. Укріплення отворів в посудинах та апаратах [Електронний ресурс]: навч. посіб. для студ. спеціальності 133 «Галузеве машинобудування», освітньо-професійної програми «Обладнання хімічних, нафтопереробних та целюлозно-паперових виробництв» / І. А. Андреев; КПІ ім. Ігоря Сікорського. – Електронні текстові дані (1 файл: 3,1 Мбайт). – Київ : КПІ ім. Ігоря Сікорського, 2021. – 72 с. <https://ela.kpi.ua/handle/123456789/42254>.
10. Конструювання і розрахунок опорних вузлів посудин і апаратів хімічних виробництв [Електронний ресурс]: навч. посіб. для студ. спеціальності 133 «Галузеве машинобудування» / І. А. Андреев; КПІ ім. Ігоря Сікорського. – Електронні текстові дані (1 файл: 3,3 Мбайт). – Київ : КПІ ім. Ігоря Сікорського, 2021. – 94 с. <https://ela.kpi.ua/handle/123456789/45669>.
11. Ігор Андреев. Конструювання і розрахунок кожухотрубних теплообмінників [Електронний ресурс]: навч. посіб. для студ. спеціальності 133 «Галузеве машинобудування» Київ: КПІ ім. Ігоря Сікорського, 2022. – 140 с. URL: <https://ela.kpi.ua/handle/123456789/50426>.
12. Ігор Андреев. Розрахунок технологічних трубопроводів: навч. посіб. для студ. спеціальності 133 «Галузеве машинобудування». Київ: КПІ ім. Ігоря Сікорського, 2023. 104 с. URL: <https://ela.kpi.ua/handle/123456789/52475>.

#### *Additional literature*

13. Посудини та апарати сталеві зварні. Загальні технічні умови: СОУ МПП 71.120-217:2009. – [Прийнято та надано чинності: наказ Мінпромполітики від 07.07.2009, №459]. – К.: Міністерство

промислової політики України, 2009. – 339 с. – (стандарт Міністерства промислової політики України).

14. ГОСТ 34233.1–12–2017 (Міждержавні стандарти).

### **5 Methods of mastering an educational discipline (educational component)**

Practical assimilation of the discipline is achieved both by purposeful selection of subjects for individual classes and by organization of the course project implementation process.

The course project is carried out according to an individual task and drawn up in the form of an explanatory note.

The course project consists of four sections, which include several subsections.

The course project must contain the following materials: an explanatory note to the course project and drawings.

The explanatory note to the course project should contain:

tasks for the course project;

a list of abbreviations, conventional designations and terms;

introduction;

the purpose and area of use of the vessel or device, which contains subsections: description of the technological process and the choice of the type of vessel or device and its place in the technological scheme;

section technical requirements for the vessel or device;

a section describing and justifying the selected design of the vessel or apparatus, which contains subsections: description of the structure, main component units and parts of the vessel or apparatus and the selection of materials;

a section of calculations confirming the operability and reliability of the design of the vessel or apparatus;

conclusions;

References;

Applications.

The graphic part of the course project must contain drawings of the vessel or apparatus, its constituent parts on three A1 formats and their specifications.

### **6 Independent work of the student**

When teaching the educational discipline "Calculations and design of equipment. Course project", the student's independent work takes up the main time of studying the credit module, taking into account the preparation for the credit. Independent work of students includes the preparation and implementation of all necessary components of the course project. Mastery of knowledge on the required topic is carried out by independent processing of the material of the previous lectures of the course "Calculation and design of typical equipment" and detailed familiarization with the relevant sections of the recommended basic and additional literature and independent scientific and informational search on one's own initiative.

## **Policy and control**

### **1 Policy of academic discipline (educational component)**

Rules for the implementation of the course project: Attending consultations on the course project is a mandatory component of studying the material. Students are obliged to take an active part in the educational process, to perform all the necessary calculations and drawings on time, not to be distracted by activities unrelated to the educational process.

***Policy of deadlines, rescheduling and promotion rules:***

Incentive points are awarded for:

active work on the implementation of the course project - 10 points;

The course project must be completed before the start of the credit session. Failure to meet the deadline will result in a 20% reduction in the maximum number of points.

### **Academic Integrity Policy:**

The policy of the academic discipline is built taking into account the norms of the legislation of Ukraine regarding academic integrity, the Code of Honor of NTU "Ihor Sikorsky Kyiv Polytechnic Institute" and is determined by the system of requirements that the teacher presents to the student when studying the discipline (rules of behavior in classes, absences, retakes, etc.).

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

The course project rating has two components. The first (starting) characterizes the student's work on the course project and its result - the quality of the explanatory note and graphic material. The second component characterizes the quality of the student's defense of the course project. The scale of the starting component is 40 points, and the defense component is 60 points.

#### **1 Starting component:**

- the timeliness of the work schedule for the course project – 5–3 points;
- modernity and justification of the decisions made – 12–7 points;
- correct application of analysis and calculation methods – 10–6 points;
- quality of design, compliance with the requirements of regulatory documents – 6–4 points;
- quality of graphic material and compliance with standards – 7–4 points.

#### **2. The coursework defense component:**

- report quality – 10–6 points;
- degree of mastery of the material – 15–9 points;
- the degree of substantiation of the decisions made – 15–9 points;
- the ability to defend one's opinion – 20–12 points.

According to the rating scale<sup>®</sup>, the maximum number of points is 100.

A necessary condition for admission to the defense is the completion of the course project in full.

Distribution of rating points that students receive after studying the credit module and completing the assessment.

<b>Content module</b>	<b>Total points</b>
Implementation of the course project	40
<b>Semester control</b>	
Test	60
<b>Together:</b>	<b>100</b>

The sum of the rating points received by the student after mastering the discipline and passing the exam is transferred to the final grade according to the table:

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

**Working program of the academic discipline (syllabus)** was compiled by an associate professor of the Department of the Academy of Sciences of the Russian Academy of Sciences, Ph.D. Andreev Ihor Anatoliyovych

**Approved** by the Department of Machines and Apparatus of Chemical and Oil Refining Industries (Protocol No. 20 dated 12.06.2025)

**Agreed** by the Methodical Commission of the Faculty of Engineering and Chemistry (protocol No. 11 dated 27.06.2025)