Syllabus
Course Program

Equipment and Basics of Designing Environmentally Safe Technologies Using CAD

Specialty
101 – Ecology

Institute
Institute of Education and Science in Mechanical Engineering and Transport

Educational program
Engineering ecology

Department
Chemical Engineering and Environment Protection (154)

Level of education
Master's level

Course type
Optional

Semester
1

Language of instruction
English, Ukrainian

Lecturers and course developers

Musii Tseitlin
musii.tseitlin@khpi.edu.ua
Doctor of Technical Sciences, Professor

Experience of teaching work - 32 years. Author and co-author of more than 250 scientific and methodical publications, as well as 20 patents. Delivers lectures on the following courses: "Design of environmental protection complexes using CAD", "Engineering systems of water supply and drainage", "Fundamentals of thermodynamics", "Methods of processing experimental information and research results"
More about the lecturer on the department's website

Volodymyr Babenko
volodymyr.babenko@khpi.edu.ua
Candidate of Technical Sciences, Associated Professor

Experience of teaching work - 17 years. Author and co-author of more than 40 scientific and methodical publications.
Delivers lectures on the following courses:"Environmental monitoring", "Topography with the basics of cartography", "Radioecology", "Methods for measuring environmental parameters", "Geoecology".
More about the lecturer on the department's website

General information

Summary

The discipline develops students' knowledge of constructions and principles of operation of environmentally safe production equipment, as well as the use of modern technologies of automated production design that meet modern requirements for minimizing the impact on the environment. In the

course of training, students will learn about technologies and equipment for increasing energy efficiency, the degree of use of raw materials and reducing waste and gas emissions.

Course objectives and goals

Acquaintance of students with the equipment used in environmentally safe technologies, methods and systems of design of such technologies and capabilities of CAD in design; formation of skills in the use of equipment calculation methods and execution of drawings with the help of "KOMPAS", Auto CAD, Microsoft Visio, etc. programs.

Format of classes

Lectures, laboratory work, independent work, consultations. The final control is an exam

Competencies

The ability to apply modern methods of calculating conditions for conducting processes, geometric dimensions of devices, as well as optimization calculations of processes and devices for the development of new environmental protection technologies, as well as the ability to use modern computer software complexes for the design of environmental protection objects and devices.

Learning outcomes

The ability to use knowledge of the physico-chemical essence of the main technological processes, as well as calculation methods and automated design of modern equipment and environmentally safe technologies to optimize environmental protection processes and equipment.

Student workload

The total scope of the discipline is 180 hours. (6 ECTS credits): lectures – 32 hours, laboratory work – 32 hours, practical work – 16, independent work – 100 hours

Course prerequisites

Possession of competences and learning outcomes, which are provided for by the standard of higher education in the specialty 101 "Ecology" of the first bachelor's level, as well as general knowledge of natural sciences

Features of the course, teaching and learning methods, and technologies

Lectures are conducted interactively using multimedia technologies. In practical and laboratory classes, reproductive and problem-solving learning methods are used and attention is focused on solving real problems of environmentalization of industrial production, as well as skills are formed in the use of equipment calculation methods and execution of drawings with the help of KOMPAS, AutoCAD, Microsoft Visio, etc. programs.

Program of the course

Topics of the lectures

Topic 1. Introduction
The purpose of the course and the main areas of development of environmentally safe technologies and equipment
Topic2. Technology of separation of gas mixtures in the gas-liquid system
Basic provisions of the theory of absorption and its use in the calculation of mass transfer in the gas-liquid system
Topic3. Absorption equipment
Classification, construction types and principles of absorption equipment
Topic4. Separation of disperse systems.
Concept of dispersed systems, terminology. Technology and equipment for separation of suspensions. Technology and equipment for separation of gas and dust systems.

Topic 5.Technologies and equipment for conducting chemical reactions
Catalytic and non-catalytic chemical reactions. Designs and principles of operation of chemical reactors
Topic 6.Equipment for heating and cooling.
Theoretical foundations of heat transfer. Heat exchange equipment. Secondary energy resources. Equipment for recovery and utilization of secondary heat.
Topic 7 Design of environmentally safe production
What is a project? The structure of the project organization. The content of the project and the sequence of its development.
Topic 8.CAD and its implementation in the design process
CAD structure. Opportunities that CAD provides to the design process.

Topics of the workshops

Topic 1. Methodology for calculating heat and material balances of the absorption process.
Topic 2. Determination of the mass transfer process and the main dimensions of the absorber
Topic 3.Calculation of hydrodynamic characteristics of equipment.
Topic 4. Selection of equipment for separation of dispersed systems.
Topic 5.Selection of the type of chemical reactor.
Topic 6.Calculation of the heat balance of the heat exchange process.
Topic 7.Selection of equipment for separating gas from dust.
Topic 8.Selection of equipment for solid and liquid fraction separation.

Topics of the laboratory classes

Laboratory work is aimed at acquiring primary skills in making drawings using programs used in CAD
Topic 1. Acquisition of primary skills of creating block diagrams.
Topic 2. Acquisition of primary skills of creating layout diagrams of CAD equipment in the room.
Topic 3.Acquiring the skills of placing CAD equipment in an office space.
Topic 4. Acquisition of skills in the CAD program for creating a map-diagram of the location of equipment
Topic 5.Acquisition of skills in the CAD program to create equipment for separating gas from dust.
Topic 6.Acquisition of skills in the CAD program for the creation of equipment for the separation of solid and liquid fractions.
Topic 7.Acquisition of skills in the CAD program for building a 3D model.
Topic 8. Acquisition of skills in the CAD program to build a drawing based on an existing 3D model.

Self-study

The course involves the completion of an individual task in the form of a term paper, which concerns the calculation of an absorber for cleaning gases from harmful impurities. Independent work also includes:
1. Elaboration of lecture material.
2. Preparation for practical (laboratory, seminar) classes
3. Improving the skills of performing calculations and drawings using a computer.
4. Acquaintance with additional literature.

Course materials and recommended reading

1. . Chemical Process Equipment. Selection and Design Book, Revised Second Edition, 2010. https://doi.org/10.1016/C2009-0-25918-6
https://www.sciencedirect.com/book/9780123725066/chemical-process-equipment
2. Solid-Liquid Separation. Lecturer in Chemical Engineering, University of Bradford. Editor Ladislav Svarovsky, Dipl. Ing., Ph.D., C.Eng., M.I.Chem.E. http://himatekkim.ulm.ac.id/id/wp-content/uploads/2021/06/Svarovsky-L-%E2%80%93-Solid-Liquid-Separation-4th-Edition.pdf
3. PLANT DESIGN AND ECONOMICS FOR CHEMICAL ENGINEERS. Max S. Peters, Klaus D. Timmerhaus https://www.davuniversity.org/images/files/study-material/PLANT%20DESIGN%20AND%20ECONOMICS%20FOR%20CHEMICAL%20ENGINEERS.pdf
4. Chemical Process Equipment, Selection and Design, Third Edition, James R. Couper, W. Roy Penney, James R. Fair Stanley M. Wal https://www.slideshare.net/MarianitaPrez/chemical-process-equipment-selection-and-designpdf

Assessment and grading

Criteria for assessment of student performance, and the final score structure

100% of the final grade consists of assessment results in the form of an exam (40%) and ongoing assessment (60%). Exam: written task and oral answer Current assessment: practical work - 20%, calculation task - 25%, control work -15%.

Grading scale

Total points	National	ECTS
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.
Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website:http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/

Approval

Approved by

2023/08/31 Head of the department
Oleksii SHESTOPALOV

2023/08/31 Guarantor of the educational program
Musii TSEITLIN