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

Department of geoengineering

DESIGN OF CITY UNDERGROUND STRUCTURES

Working program of the academic discipline (Syllabus)

Educational detailsdisciplines	
Level of higher education	***Second (master's)***
Branch of knowledge	*Production and technologies*
Specialty	*184 Mining*
Educational program	*Geoengineering*
Discipline status	*Normative*
Form of education	*daytime*
Year of training, semester	*1st year, fall semester*
Scope of the discipline	*105 (lectures - 18 hours, practical - 18 hours, independent work - 69 hours)*
Semester control/ control measures	*Exam / modular test papers*
Lessons schedule	*http://roz.kpi.ua/*
Language of teaching	*English*
Information about the course leader / teachers	*Lecturer: Doctor of Technical Sciences, Zuievska Natalia Valerievna, (+38)0509821770, znata1770@gmail.com* *Laboratory / Seminary Doctor of Technical Sciences, Zuievska Natalia Valerievna, (+38)0509821770, znata1770@gmail.com*
Placement of the course	

Educational programdisciplines

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

The educational discipline "Designing of urban underground structures" belongs to the professional training cycle of mandatory (normative) educational components. It is intended to provide knowledge, skills and abilities on the issues of modern design of urban underground structures for various purposes.

the purposethe study of the discipline is the formation of students' abilities to justify and apply the most effective methods of designing urban underground structures in various conditions.

subjectthe study of the discipline is the methods and means of designing urban underground structures for various purposes.

Learning outcomesis the acquisition of special competence and skills:

SK4. Ability to develop project documentation (technical task, technical proposals, technical project, working project) for mining and geoconstruction systems;

SK6. The ability to perform design works of special construction methods, mineral development facilities, take special measures for the reconstruction of underground structures and mining enterprises

SK7. Ability to implement general principles of complex optimization during project development

PH6. Identify, pose, solve problems and make informed decisions in professional activities;

PH9. Develop project documentation (technical task, technical proposals, sketch project, technical project, working project) for mining and geoconstruction systems.

PH10. Organize production processes and technical management of systems and technologies of mining and geoconstruction enterprises

PH11. Carry out design works for special construction methods, mineral development facilities, take special measures for the reconstruction of underground structures and mining enterprises

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

The discipline is in the first part (in the first semester) of structural and logical Schemes of educational and professional programs for the preparation of a master's degree in a specialty 184"Mining" under the educational program "Geoengineering". Studying the academic discipline "Design of urban underground structures" is preceded by disciplines from the bachelor's training program in specialty 184 "Mining" (prerequisites): "Technology, mechanization and organization of geotechnical construction", "Building materials and structures of underground structures", "Geoengineering of the metropolis".

Upon completion of the study of this discipline, the knowledge, skills and abilities obtained as a result of the training are required for successful mastering (post-requisites) of the educational components - "Special construction methods", optional disciplines and the completion of a master's thesis.

3. Content of the academic discipline

Chapter 1. BASIC PROVISIONS OF THE DESIGN OF UNDERGROUND STRUCTURES

Topic 1. DESIGN ORGANIZATION

General information about project organizations. Project customers. Work planning and financing of project organizations. Design tasks. Specifications. Technical and economic justification of the construction of underground structures. Typical and experimental projects. Construction project. Working documentation.

Topic 2. FUNDAMENTALS OF DESIGNING UNDERGROUND STRUCTURES

Classification of underground structures. Structural design scheme. Design stages. Raw data and engineering findings for design. Normative design base.

Topic 3. DESIGN OF UNDERGROUND BUILDINGS

Terms. Requirements for finishing materials of underground structures. Choice of structural and technological type of fastening (processing). Principles of calculation of fastenings of underground structures.

Chapter 2. ORGANIZATION OF CONSTRUCTION

Topic 4. DESIGN OF THE CONSTRUCTION ORGANIZATION

Terms. Organizational and technological schemes. Diagrams of the opening of underground structures. Technological schemes of construction of underground structures. Production preparation and documentation. Ensuring the quality of construction and installation works and environmental protection. Operational and dispatching management.

Topic 5. DESIGN OF UNDERGROUND BUILDING CONSTRUCTION TECHNOLOGY

General provisions of the design of technology for the construction of underground structures. Design of vertical trunks. Design of horizontal products. Design of inclined products. Designing the construction of underground structures in an open manner.

EDUCATIONAL MATERIALS AND RESOURCES

Basic literature

1. Pankratova N. D., Hayko G. I., Savchenko I. O. Development of underground urbanism as a system of alternative project configurations. -Kyiv: Naukova dumka, 2020. -136 p.

2. Samedov A. M. Calculation and design of geotechnical engineering structures. - K.: NTUU "KPI", 2013. - 883 p

3. Tsimbal S.Y. Underground construction: Study guide / S.Y. Cymbal. - K.: KNUBA, 2004.-148 p

4. Tetior A.M. Design and construction of underground structures / A.M. Tetior, V.F. Loginov. - K.: Budivelnyk, 1990. - 167 p.

5. Samedov A. M. Calculation and design of shallow underground structures - K.: NTUU "KPI", 2013. - 852 p.

6. Samedov A. M. Calculation and design of underground structures deeplaying - K.: NTUU "KPI", 2012. - 630 p.

Additional literature

7. DBN A.2.2-3-2014. Composition and content of project documentation for construction. - K.: Ministry of the Region of Ukraine, 2014. -33 p.

8. DBN B.2.1-10:2018. Bases and foundations of buildings and structures. Substantive provisions. - K.: Ministry of the Region of Ukraine, 2019. -35 p.

9. DBN B.2.3-7:2018. Metropolitans. Substantive provisions. - K.: Ministry of the Region of Ukraine, 2019. -33 p.

10. Rules for the technical operation of subways of Ukraine / Order of the Ministry of Infrastructure of Ukraine No. 578 dated 12.11.2014.

11. Basics and foundations. Study guide for students of the specialty "Construction and civil engineering / I.O. Parfentieva, O.V. Vereshko, D.A. Husachuk Lutsk: LNTU, 2017. –296 p.

12. Construction of urban underground structures: training. guide./ A.M. Samedov, V.G. Tailor. - K.: NTUU "KPI", 2011. - 400 p.

Information resources

1. Library of NTUU "KPI",http://kpi.ua/library.
2. National Library of Ukraine named after V.I. Vernadsky,www.nbuv.gov.ua/.
3. National Parliamentary Library of Ukraine,http://www.nplu.org/.
4. State Scientific and Technical Library of Ukraine, www.gntb.gov.ua.

Educationalcontent

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

The general methodical approach to teaching an academic discipline is defined as professionally oriented, according to which the center of the educational process is the student, as a subject of study and a future specialist. To master the educational discipline, the method of analysis and synthesis, as well as the research method of education, is used.

Lecture classes

No. z/p	The name of the topic of the lecture and a list of main questions (a list of didactic tools, references to the literature and tasks on the SRS)
1	*The main provisions of the design of underground structures* *General information about project organizations. Project customers.* *Planning of project work and financing of project organizations.* *Design task. Technical conditions for designing.* *Literature:[1, 2, 7]*
2	*Design organization* *Technical and economic justification of the construction of underground structures.* *Typical and experimental projects. Construction project. Working documentation.* *Literature:[3]*
3	*Fundamentals of designing underground structures* *Classification of underground structures. Structural diagram of the design of urban underground structures. Design stages.* *Literature:[1-3, 8]*
4	*Regulatory support of the design process* *Raw data and engineering findings for design. Normative design base.* *Literature:[4]*
5	*Designing structures of underground structures* *Terms. Requirements for finishing materials of underground structures. Choice of structural and technological type of fastening (processing). Principles of calculation of fastenings of underground structures.* *Literature:[3, 4, 11]*
6	*Preparation of construction organization* *Terms. Organizational and technological schemes. Diagrams of the opening of underground structures. Technological schemes of construction of underground structures.* *Literature:[4, 5]*
7	*Production preparation* *Production preparation and documentation. Ensuring the quality of construction and installation works and environmental protection. Operational dispatching management.* *Literature:[4, 6, 7]*
8	*Peculiarities of designing the technology of construction of underground structures* *General provisions of the design of technology for the construction of underground structures. Design of vertical trunks. Design of horizontal products. Design of inclined products.* *Literature:[4, 6, 9, 10]*
9	*Designing technology of construction of underground structures by open method* *General provisions and design features. Designing the construction of underground structures in an open manner.* *Literature:[5, 6, 12]*

Practical training

No. z/p	*Name of the subject of the lesson and list of main questions (a list of didactic support, references to the literature and tasks on the SRS)*

1	*Acquaintance with normative and calculated values of soil characteristics.* *Literature:[2].*
2	*Methods of technological and economic evaluation of the design and construction of foundations of various types* *Literature:[3, 5].*
3	*Types of load and influencing factors that are taken into account when calculating foundations* *Literature:[2, 4-6].*
4	*Calculation of the stability of the foundations of walls against shear. Conducting modular control work No. 1.* *Literature:[5].*
5	*Calculation of fastening of pits, types of fastening of walls of pits* *Literature:[2, 5].*
6	*Calculation of flexible free-standing walls* *Literature:[5, 12].*
7	*Determination of active and passive pressures by the elastic line method. Conducting modular control work No. 2.* *Literature:[2, 5, 12].*
8	*Establishment of rational technological schemes for the construction of underground structures* *Literature:[4, 12].*
9	*Justification of technological solutions in the design of the construction of underground construction works* *Literature:[1, 4].*

6. Independent work of student

The student's independent work is the main means of assimilation of educational material in free time from educational classes and contains:

No. z/p	Type of independent work	Numberhours of SRS
1	Preparation for lectures	thirteen
2	Preparation for practical classes	18
3	Preparation for MKR (two MKR for 4 hours)	8
4	Preparation for the exam	30

The name of the topic to be studied independently in preparation for lectures

1. Composition of typical, experimental and individual construction projects of urban underground structures [1]
2. Characteristics of soils and engineering research at design [2, 10]
3. Normative documents for design [1, 7]
4. Types of fastenings of urban underground structures [9, 10]
5. Factors affecting the stability and waterproofing of an underground structure [9, 10]
6. Basic principles of underground structure calculation [9, 10]
7. Acquaintance with existing technologies schemes construction of underground structures [9, 10]
8. Quality control of design and construction and installation works [9]
9. Designing the construction of urban underground buildings in special ways [10]

Politics andCONTROL

7. Policy of academic discipline (educational component)

In the case of distance learning, at the time of each lesson, both lecture and practical, the student must have the Zoom application installed on the device from which he works and visual presence in the video conference mode must be ensured.

The student must familiarize himself with the syllabus on the "Sikorsky" platform (remote resource Google classroom) or in the "KPI Electronic Campus" system.

In the first lesson, the teacher familiarizes the students with recommendations on the organization of study and assimilation of learning outcomes.

The method of studying the discipline consists in providing theoretical material in lectures, which is then consolidated in practical classes by solving individual problems. Theoretical material is provided in the form of lecture notes. An analytical review of resources (independent work of students) is used when working on individual topics independently, when searching for certain information. The level of training of the student in the discipline and its assessment is established by the RSO and is determined based on the results of express controls and modular control works.

The main goals of conducting modular control works:

better assimilation of lecture material; checking the

degree of assimilation of the acquired knowledge;

development of the ability to use acquired knowledge to solve certain problems.

It is planned to carry out two modular control tests (MCR) before each semester of student certification.

MKR are held in practical classes for the 1st academic hour.

MKR consists of three separate tasks of the theoretical course for each student. A set of control tasks for MKR are attached to the syllabus.

Students are obliged to adhere to the general moral principles and rules of ethical behavior specified in the Code of Honor of the National Technical University of Ukraine "Ihor Sikorskyi Kyiv Polytechnic Institute".

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

The student's rating from the credit module is calculated based on 100 points, of which 60 points are the starting component, which is formed from the points of the current control, and 40 are assigned to the semester control, that is, the exam.

Current control:Modular control work, work in practical classes, express control at lectures.

Modular control work (MKR).The MKR is divided into two control papers with a duration of one academic year each. hours – 2×12 points=24 points;

MKR rating scale:

– 11...12 points - the answer is complete;

– 9...10 points - an almost complete answer;

– 7...8 points – an answer with minor flaws;

– 5...6 points – the answer has certain shortcomings or is incomplete;

– 3...4 points - the answer is sufficient.

– 1...2 points – the answer is partial.

Work in practical classes(9 classes for 3 points each);

– 3 points – complete answer;

– 2 points – sufficiently complete answer (at least 75% of the required information);

– 1 point –incomplete answer (at least 50% of the required information) and minor errors;

– 0 points – the answer is missing or incorrect.

Express control at lectures(9 lecture classes for 1 point each):

– 1 point – correct answer;

– 0 points - wrong answer

Calendar control:is held twice a semester as a monitoring of the current state of fulfillment of the syllabus requirements.

Evaluation of students during the calendar control (for 8 and 14 weeks of semesters) is carried out according to the value of the student's current rating at the time of certification. If the value of this rating is at least 50% of the maximum possible at the time of certification ("ideal student"), the student is considered certified. Otherwise, "not certified" is displayed in the certification information. Also, the student is not certified if he fails to complete the semester individual assignment, the deadline for submission of which was before the certification week, or if he does not complete all the practical work planned for that time.

The condition of the first attestation is obtaining at least 14 points. The condition of the second attestation is obtaining at least 28 points.

Semester control:examination

A necessary condition for admission to the exam is the submission of missed lectures, completion of practical classes and a starting rating of at least 30 points.

At the exam, students perform a written test. Each task contains two theoretical questions (tasks) and one practical one. Theoretical questions (tasks) are valued at 14 points according to the following criteria:

– 13-14 points – complete answer, at least 90% of the required information;

– 10-12 points – sufficiently complete answer, at least 75% of the required information or minor inaccuracies;

– 7-9 points – an incomplete answer, at least 60% of the required information and some errors;

– 5-6 points – an incomplete answer that has certain shortcomings and errors, at least 45% of the required information;

– 3...4 points - the answer is partial, has significant shortcomings;.

– 1...2 points - the answer to the question is almost absent, incorrect.

The practical task is valued at 12 points

– 11-12 points – complete answer, at least 90% of the required information (complete, error-free solution of the task);

– 9-10 points – sufficiently complete answer, at least 75% of the required information or minor inaccuracies (complete solution of the task with minor inaccuracies);

– 7-8 points – an incomplete answer, at least 60% of the required information and some errors (the task was completed with certain shortcomings);

– 5-6 points – an answer that has certain shortcomings and errors, at least 45% of the required information;

– 3...4 points – partial solution of the task, has significant shortcomings;.

– 1...2 points – the task is unsolved or incorrect.

The sum of the starting points of the scoreboards for the examination component is transferred toexamination assessment according to the table:

Rating evaluation of the acquirer	University scale of assessments of the level of acquired competences
95...100	Perfectly
85...94	Very good
75...84	Fine
65...74	Satisfactorily
60...64	Enough
Less than 60	Unsatisfactoril y
Failure to meet the conditions for admission to the exam	Not allowed

9. Additional information on the discipline (educational component)

List of issues to be fulfilled MKR MKR

No. 1

1. *General information about project organizations.*
2. *Project customers.*
3. *Work planning and financing of project organizations.*
4. *Design task.*
5. *Technical conditions for designing.*
6. *Technical and economic justification of the construction of underground structures.*
7. *Typical and experimental projects.*
8. *Construction project.*
9. *Working documentation.*
10. *Classification of underground structures.*
11. *Structural design scheme.*
12. *Design stages.*
13. *Initial data for design.*
14. *Engineering searches for design.*
15. *Normative design base.*

MKR No. 2

16. *General provisions regarding the design of structures of underground structures.*
17. *Requirements for finishing materials of underground structures.*
18. *Choice of structural and technological type of fastening (processing).*
19. *Principles of calculation of fastenings of underground structures.*
20. *General provisions regarding the design of the construction organization.*
21. *Organizational and technological schemes of construction.*
22. *Diagrams of the opening of underground structures.*
23. *Technological schemes of construction of underground structures (tunnels).*
24. *Technological schemes for the construction of underground structures (chambers).*
25. *Technological schemes of construction of underground structures (vertical shafts and blind shafts and chambers).*
26. *Preparation of production and documentation during the organization of construction.*
27. *Ensuring the quality of construction and installation works and environmental protection. Operational and dispatching management.*
28. *Design of vertical trunks.*
29. *Design of horizontal products.*
30. *Designing the construction of underground structures in an open manner.*

Working program of the academic discipline (syllabus):

Compiled by Professor, Doctor of Technical Sciences, Zuievska N.V.

Approved by the Department of Geoengineering (protocol No 18 17.06.2022)

Approved by the Methodical Commission of the SR IEE (Protocol No. 12 of 24.06.2022)