KYIV NATIONAL UNIVERSITY OF CONSTRUCTION AND ARCHITECTURE

Department of Steel and Timber Structures

Specialty educational program Construction and civil engineering **Industrial and civil construction**	pages **1** of **5**

"APPROVED"
Head of the department of Steel and Timber Structures

_____ / Sergiy Bilyk /

"01" May 2023

Developer

_____ / Viacheslav Adamenko /

Syllabus
Special training Industrial and civil construction: Advanced Design of Steel and Timber Structures

1) Code according to the educational program: OK9
2) Academic year: 2023/2024
3) Educational level: master's degree
4) Form of education: full-time, extramural
5) Field of knowledge: 19 ARCHITECTURE AND CONSTRUCTION
6) Specialty, name of the educational program: 192 Construction and civil engineering "Industrial and civil construction"
8) Status of the educational component: basic
9) Semester: 1
11) Contact details of the teacher: Viacheslav Adamenko, Ph.D., Associate Professor link to teacher profile https://www.knuba.edu.ua/faculties/bf/kafedri-bf/katedra_mdk/vikladackij-ta-dopomizhnij-sklad-katedri-mdk/adamenko_v_m/ e-mail: adamenko.vm@knuba.edu.ua
12) Language of teaching: English
13) Prerequisites (precursor disciplines that must be studied in order to take this course): Bachelor's degree courses of the same specialty: Construction and Civil Engineering.
14) Purpose of the course: Provide students with competence and learning outcomes in the best practices of advanced design steel and timber structures, using structural engineering software, ability to perform structural analysis and design of steel frame building according to Eurocodes and US codes.

15) Learning outcomes:

No	Learning outcome	A method of testing the educational effect	The form of classes	Reference competence
1.	LO1. Demonstrate the ability to analyses information in the field of professional activity. Be able to identify problems and, based on the knowledge gained, formulate ways to solve them. Make reports on the implementation of work. Critically evaluate work results and identify ways to improve results.	Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	**IC GC1, GC2, GC5, GC8, GC10, PC1, PC2, PC4, PC5**
2.	LO2. Demonstrate the ability to act as an individual taking responsibility for a decision and work in a team. Manage a team when working on complex projects, including in an international format.	Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	**IC GC1, GC3, GC6, GC7, GC8, GC10, PC1, PC2**
3.	LO3. Demonstrate the ability to understand general professional and professionally oriented regulatory documents, technical and scientific publications and use them in their activities to solve non-standard problems.	Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	**IC GC1, GC2, GC6, GC10, PC1, PC2, PC5**
4.	LO 4. Demonstrate the ability to work with technical documentation and modern software tools and technologies for design and construction to solve complex engineering and technical problems in the implementation of complex projects.	Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	**IC GC1, GC2, GC6, GC10, PC1, PC2, PC3, PC5**
5.	LO5. To apply the basic principles, theories and methods of structural mechanics to calculate the interaction of building structures with each other and with the soil environment using innovative computer-aided design systems.	Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	**IC GC2, GC5, PC2, PC3, PC4**
6.	LO6. To be able to assess the features of the construction site and provide appropriate measures of engineering protection and preparation of the construction site in difficult conditions of dense development and / or special geological conditions.	Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	**IC GC1, GC2, GC3, GC6, GC8, GC11, PC2, PC5**
7.	LO7. Demonstrate the ability to design structures of buildings and structures of varying architectural and technical complexity, using modern multidimensional modelling systems. Provide reliable and economically feasible design solutions.	Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	**IC GC1, GC2, GC8, GC10, PC2, PC3, PC4, PC5**
8.	LO 8. Demonstrate the ability to operate, inspect and determine the technical condition of buildings and structures.	Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	**IC GC1, GC2, GC6, PC1, PC2, PC5**

9.	LO 9. Demonstrate the ability to design and carry out the reconstruction of buildings and structures for industrial and civil purposes using prefabricated and monolithic reinforced concrete, metal, stone structures and composite materials.	Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	**IC GC1, GC2, GC5, GC6, GC10, GC11, PC1, PC2**

16) Course structure

lectures, hours		Practical training, hours	laboratory classes, hours	Course project/ course work/ term paper /Control work	Student's independent work, hours	Form of final control
full-time	6	24	-	Course work	69	exam
extramural	6	12	-	Course work	82	exam
Total hours:				135		
The total number of ECTS credits				4,5		
Number of hours (ECTS credits) of classroom workload:				30 hours - full-time 18 hours - extramural		

17) Course content: (separately for each form of classes – L/P/Lab/ KR/SRS)

Module 1. Advanced Design of Steel and Timber Structures.

Lecture classes:

Topic 1. (2 h.) Best practice in steel and timber construction. Industrial, residential and commercial buildings.

Topic 2. (2 h.) Advanced design of steel and timber structures.

Topic 3. (2 h.) Advanced design of structural steel connections.

Module 2. Using Structural Engineering Software for Advanced Design of Steel and Timber Structures

Structural analysis and design of steel frame building according to Eurocodes and US codes (Course work).

Practical classes:

Practical class 1. Creating of a 3D information model of a steel frame building in Robot Structural Analysis Professional. Creation a new project, defining the units, material properties, and other project settings. Defining the building geometry.

Practical class 2. Creating a 3D model of the steel frame building using the modeling tools in Robot Structural Analysis Professional. Defining the location of columns, beams and other structural elements, as well as specifying their sizes and positions.

Practical class 3. Defining the structural elements. Specifying the properties of the structural elements such as the cross-sectional properties of beams and columns, the material properties of steel, etc.

Practical class 4. Defining the loadings. Specifying the loads that acting on the structure, including gravity loads, wind loads, and snow loads. Creating custom load combinations based on specific design requirements.

Practical class 5. Analyzing the structure. Running a structural analysis to determine the forces and moments in each member of the frame. Reviewing the results of the analysis to ensure that the structure is safe and meets the required design criteria. Optimizing the design. Based on the analysis results, optimizing the design by adjusting the sizes of members or modifying the geometry to improve the performance of the structure.

Practical class 6. Structural steel connection calculation with Robot Structural Analysis Professional according to Eurocode. Defining the connection type. Choosing the appropriate connection type, such as bolted or welded, based on the design requirements and constraints. Defining the connection details. Specifying the details of the connection, such as the number and size of bolts, the thickness of the plates, and the weld sizes.

Practical class 7. Analyzing the connection. Running a structural analysis to determine the stresses and deformations in the connection under the applied loads. Checking the strength of the connection against the applied loads using appropriate design codes and standards, such as AISC or Eurocode. Checking the serviceability of the connection, such as deflections under the applied loads. Based on the analysis and design checks, optimizing the design by adjusting the size and layout of the connection details to improve its performance.

Practical class 8. Structural steel connection design with IDEA StatiCa according to Eurocode. Geometry modeling. Defining the members, plates, bolts, and other relevant elements of the connection. Defining the material properties of the steel members, including their grades, yield strengths, and other relevant properties.

Practical class 9. Specifying the loads on the connection. This includes both the external loads applied to the connection (gravity loads, wind loads, snow loads) as well as the internal forces and moments generated by the

structural system.
Practical class 10. Analysis. IDEA StatiCa performing a nonlinear analysis of the connection to determine its strength and stiffness. This analysis accounts for the complex interactions between the various elements of the connection, including the bolts, plates, and members.
Practical class 11. Design optimizing. IDEA StatiCa automatically optimizing the connection design to minimize material usage and cost while still meeting the required strength and stiffness requirements. Code compliance. The software checking the connection design against the relevant building codes and standards to ensure compliance.
Practical class 12. Report generation. IDEA StatiCa generating a comprehensive report that includes all the relevant information about the connection design, including the geometry, material properties, loads, analysis results, and design optimization details.

Course work on the topic:
«Structural analysis and design of steel frame building according to Eurocodes and US codes».
Composition of the course work:
Calculation and explanatory note (up to 30 pages of handwritten or printed text):
1. Information about creation of a 3D information model of a steel frame building in Robot Structural Analysis Professional.
2. Results of the structural analysis of the steel frame building in Robot Structural Analysis Professional.
3. Results of the structural steel connection calculation with Robot Structural Analysis Professional according to Eurocode.
4. Information and results of a structural steel connection design with IDEA StatiCa.

18) Basic literature:
Textbooks:
1. Claudio Bernuzzi, Benedetto Cordova. Structural Steel Design to Eurocode 3 and AISC Specifications. John Wiley & Sons, Ltd, 2016, 520 p.
2. Metalevi konstruktsii: Pidruchnyk dlia studentiv vyshchykh navchalnykh zakladiv / Nilov O.O., Permiakov V.O., Shymanovskyi L.V., Bilyk S.I., Lavrinenko L.I., Bielov I.D.,Volodymyrskyi V.O. – Vydannia 2-e. - K.: Stal, 2010. – 869 s.

19) Additional sources:
1. EN 1990 (2002) (English): Eurocode – Basis of structural design [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]
2. EN 1991-1-1 (2002) (English): Eurocode 1: Actions on structures – Part 1-1: General actions - Densities, self-weight, imposed loads for buildings [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]
3. EN 1991-1-3 (2003) (English): Eurocode 1: Actions on structures - Part 1-3: General actions - Snow loads [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]
4. EN 1991-1-4 (2005) (English): Eurocode 1: Actions on structures - Part 1-4: General actions - Wind actions [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]
5. EN 1993-1-1 (2005) (English): Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]
6. EN 1995-1-1 (2004) (English): Eurocode 5: Design of timber structures - Part 1-1: General - Common rules and rules for buildings [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]

20) Educational achievement evaluation system (distribution of points):

Current assessment		Final control (control work)	Sum
module 1	module 2		
30	30	40	**100**

21) Conditions for admission to the final control:

The condition for admission to the exam is to defend the course work and attend lectures. For a good reason (illness or other force majeure circumstances), attendance at lectures may be replaced by an essay on the topic of the lecture to take into account points in the final control (Or can be replaced by listening to the course on the MS platform Teams and independent processing of the course outline).

An applicant who has not fulfilled the requirements of the work program is not allowed to take the final control. An applicant who has a final grade for the educational component (after completing all types of work) from 35 to 59 points is assigned an additional test session. In this case, he/she must complete all types of work in accordance with the established requirements for the content of the relevant content modules in the period between the main and additional sessions.

The applicant has the right to protest the results of the control (appeal). The rules for filing and considering an appeal are determined by the internal documents of KNUCA, which are posted on the KNUCA website and the content of which is communicated to applicants before starting the discipline.

22) Academic Integrity Policy:

It is carried out at the university in accordance with the REGULATIONS on measures to support academic integrity at the Kyiv National University of Construction and Architecture (valid in accordance with the order of the rector No. 180 of April 21, 2020).

The results of students' learning on the principles of academic integrity and academic writing are the ability to: act in professional and educational situations from the standpoint of academic integrity and professional ethics; independently perform academic tasks; correctly refer to sources of information when borrowing ideas, statements, information.

Copying during testing and other written surveys is prohibited (including using mobile devices). In the case of discovery of facts of write-off by the acquirer, he receives another task. In case of repeated detection, an additional class is assigned for testing.

23) Link to the page of the electronic educational and methodological complex of the discipline:

https://org2.knuba.edu.ua/course/view.php?id=2293