COURSE DESCRIPTION CARD - SYLLABUS

Course name
Metal structures I [N1Bud1>KMET1]

Course

Field of study
Civil Engineering

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
20

Laboratory classes
0

Other (e.g. online)
0

Tutorials
10

Projects/seminars
10

Number of credit points

4,00

Coordinators

dr inż. Marcin Chybiński
marcin.chybinski@put.poznan.pl

Lecturers

Prerequisites

KNOWLEDGE: The student starting this subject should have knowledge of mathematics, physics, chemistry, strength of materials and mechanics of buildings. He should also have the ability to obtain information from the indicated sources and be ready to cooperate as part of the team. SKILLS: A student starting this course should have the ability to obtain information from the indicated sources, interpret them, draw conclusions, formulate and justify opinions and be ready to cooperate as part of a team. SOCIAL COMPETENCES: A student starting this subject should be aware of the responsibility for the reliability of the results of his / her work and their interpretation, should be ready to independently supplement and expand knowledge in the field of construction, and should be aware of the need to increase professional and personal competences and understand the need for continuous training out.

Course objective

The aim of the course is to familiarize students with the following topics: characteristics of metal structures, technology of steel and steel products production, steel grades and markings, physical and mechanical properties of steel, tests of mechanical properties, the influence of temperature and variable loads on the behavior of steel, steel corrosion, anti-corrosion protection and fire protection of steel structures, connections in steel structures, classification of steel sections, general and local stability of steel elements, basic structural elements, classification of nodes

Course-related learning outcomes

Knowledge:
Student know building legislation, Polish standards (PN) and European standards (EN), technical conditions of constructing building facilities, as well as basic ideas and rules in the field of intellectual and industrial property protection.
Student knows detailed rules of constructing and dimensioning elements and metal connections; concrete, wooden, and brick building facilities.
Student have advanced knowledge of building materials and their properties, research methods, basic elements of design as well as performance and assembly technologies (including environment-friendly materials).
Student have detailed knowledge of the technologies of building engineering and rules of selecting tools, machines, and equipment to perform construction works.

Skills:
Student can classify buildings building structures.
Student are able to design selected elements and simple metal, concrete, wooden and brick constructions, working individually or as part of a team.
Student are able to dimension basic structural elements in the units of civil, industrial, road, bridge and railroad building, working individually or as part of a team.
Student are able to perform the analysis of linear stability and ultimate limit capacity of simple bar structures, in the aspect of evaluating critical and ultimate limit states of constructions and dynamic analysis of simple bar structures in the aspect of evaluating resonance states.
Student are able to read and interpret architectural, building, installation and geodetic drawings, prepare graphic documentation in a traditional way and using selected CAD software (including the BIM technology).

Social competences:
Student take responsibility for the accuracy and reliability of work results and their interpretation.
Student are ready to critically evaluate the knowledge and received content, and critically evaluate the results of their own work.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
The knowledge acquired during the lectures is verified through a written test carried out in the last weeks of classes, consisting of variously scored questions (test and / or open).
The knowledge acquired during the tutorials is verified as part of a written test carried out in the last weeks of classes.
The knowledge acquired during the projects verified as part of the design of the given structure and its oral defense.
The basic evaluation criterion is obtaining the appropriate number of points. Passing threshold above 50% of points. Grading scale:
over 90 to 100% of points - very good (A)
over 80 to 90% of points - good plus (B)
over 70 to 80% of points - good (C)
over 60 to 70% of points - a satisfactory plus (D)
over 50 to 60% of points - satisfactory (E)
up to 50% of points - insufficient (F)

Programme content

Lectures
Basic concepts and general characteristics of metal structures. Steel production technology - metallurgical and steelmaking processes, assortment of steel and welded products. Profile steel production technology and a range of cold bent products.
Steel grades and markings used in construction. Physical and mechanical properties of steel. Research on mechanical properties. Influence of temperature and variable loads on the behavior of steel. Steel corrosion as well as corrosion and fire protection of steel structures.
Load capacity and dimensioning of connections:
a) Welded joints - division, classification, dimensioning. Basic welding processes. Weld defects and basic issues concerning the quality of welded joints. Principles of constructing welded joints.
b) Bolt connections - division, classification, dimensioning. Types of bolts, description of bolts, nuts, washers and holes. Design and dimensioning rules for lap and butt joints for bolts.
Classification of sections. The concept of a plastic hinge and redistribution of internal forces.
General stability of elements in compression and bending. Local stability. Influence of imperfections on the stability of selected steel elements.
Principles of constructing and dimensioning basic structural elements:
a) tensile elements,
b) axially compressed elements,
c) axially compressed single-branch and multi-branch elements of axially compressed columns,
d) bending elements.
Classification of knots: rigid, flexible (semi-rigid), nominal pinned. Calculation of load capacity, stiffness and rotation capacity of nodes. The influence of nodes susceptible to the distribution of internal forces.
Tutorials
Design examples of welded joints (butt and fillet welds) and bolted joints (lap and butt joints).
Projects
Design exercise consisting in the individual design of three joints: one welded joint with fillet welds and two bolted joints: lap and butt joints.

Course topics

Lectures
Basic concepts and general characteristics of metal structures. Steel production technology - metallurgical and steelmaking processes, assortment of steel and welded products. Profile steel production technology and a range of cold bent products. Steel grades and markings used in construction. Physical and mechanical properties of steel. Research on mechanical properties. Influence of temperature and variable loads on the behavior of steel. Steel corrosion as well as corrosion and fire protection of steel structures.
Load capacity and dimensioning of connections:
a) Welded joints - division, classification, dimensioning. Basic welding processes. Weld defects and basic issues concerning the quality of welded joints. Principles of constructing welded joints.
b) Bolt connections - division, classification, dimensioning. Types of bolts, description of bolts, nuts, washers and holes. Design and dimensioning rules for lap and butt joints for bolts.
Classification of sections. The concept of a plastic hinge and redistribution of internal forces.
General stability of elements in compression and bending. Local stability. Influence of imperfections on the stability of selected steel elements.
Principles of constructing and dimensioning basic structural elements:
a) tensile elements,
b) axially compressed elements,
c) axially compressed single-branch and multi-branch elements of axially compressed columns,
d) bending elements.
Classification of knots: rigid, flexible (semi-rigid), nominal pinned. Calculation of load capacity, stiffness and rotation capacity of nodes. The influence of nodes susceptible to the distribution of internal forces.
Tutorials
Design examples of welded joints (butt and fillet welds) and bolted joints (lap and butt joints).
Projects
Design exercise consisting in the individual design of three joints: one welded joint with fillet welds and two bolted joints: lap and butt joints.

Teaching methods

Lecture: information lecture, problem lecture, demonstration

Tutorials: exercise method
Projects: method of design and demonstration

Bibliography

Basic
1. PN-EN 1991 Eurokod 1. Podstawy projektowania konstrukcji i oddziaływania na konstrukcje
2. PN-EN 1993 Eurokod 3. Projektowanie konstrukcji stalowych
3. PN-90/B-03200 Konstrukcje stalowe. Obliczenia statyczne i projektowanie
4. Kurzawa Z., Polus Ł., Podstawy projektowania konstrukcji stalowych, Wydawnictwo Uczelniane Państwowej Wyższej Szkoły Zawodowej im. Prezydenta Stanisława Wojciechowskiego w Kaliszu, Kalisz, 2016.
5. Kurzawa Z., Polus Ł., Szumigała M., Stany graniczne i odporność pożarowa elementów stalowych według Eurokodu 3, Wydawnictwo Politechniki Poznańskiej, Poznań, 2016.
6. Bródka J., Kozłowski A., Projektowanie i obliczanie połączeń i węzłów konstrukcji stalowych t. 1, PWT, Warsawa, 2013.
7. Bródka J., Kozłowski A., Projektowanie i obliczanie połączeń i węzłów konstrukcji stalowych t. 2, PWT, Warsawa, 2015.
8. Kozłowski A., Konstrukcje stalowe, Część 1 Wybrane elementy i połączenia, Wyd. Politechniki Rzeszowskiej, 2014.
9. Goczek J., Supeł Ł., Gajdzicki M., Przykłady obliczeń konstrukcji stalowych, Wyd. Politechniki Łódzkiej, 2013.
Additional
1. Kurzawa Z., Rzeszut K., Szumigała M., Stalowe konstrukcje prętowe. Cz. 3, Konstrukcje z łukami, elementy cienkościenne, pokrycia membranowe, elementy zespolone, dachy pierścieniowe i belki podsuwnicowe, Wydawnictwo Politechniki Poznańskiej, Poznań, 2017.
2. Kurzawa Z., Stalowe konstrukcje prętowe, Część 1: Hale przemysłowe oraz obiekty użyteczności publicznej, Wydawnictwo Politechniki Poznańskiej, Poznań, 2012.
3. Kurzawa Z., Stalowe konstrukcje prętowe. Cz. 2: Struktury przestrzenne, przekrycia cięgnowe, maszty i wieże, Wydawnictwo Politechniki Poznańskiej, Poznań, 2011.
4. Kurzawa Z., Chybiński M., Projektowanie konstrukcji stalowych, Wydawnictwo PP, Poznań, 2008.
5. Łubiński M., Filipowicz A., Żółtowski W., Konstrukcje metalowe cz. I, Arkady, Warszawa, 2008.
6. Łubiński M., Żółtowski W., Konstrukcje metalowe cz. II, Arkady, Warszawa, 2008.
7. Biegus A., Nośność graniczna stalowych konstrukcji prętowych, Wyd. PWN, Warszawa, 1997.
8. Bogucki W., Żyburtowicz M., Tablice do projektowania konstrukcji metalowych, Arkady, Warszawa, 1996.

Breakdown of average student's workload

	Hours	ECTS
Total workload	130	5,00
Classes requiring direct contact with the teacher	38	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	92	3,50