STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Steel Structures III		**1010101171010115581**

Field of study	Profile of study (general academic, practical)	Year /Semester
Sustainable Building Engineering First-cycle	**(brak)**	**4 / 7**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**English**	**elective**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours					No. of credits
Lecture: **30**	Classes: **-**	Laboratory: **-**	Project/seminars: **15**		**3**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**3 100%**

Responsible for subject / lecturer:

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Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	- basic knowledge in the field of mathematics, strength of materials, building mechanics, and computer aided design, - basic knowledge in the field of Metal Structures I and II
2	**Skills**	- using available sources of information, - uses building standards (Eurocode) in the field of load collection, determination of load combinations, dimensioning of steel elements and connections, - can model flat (2D) construction systems in any program
3	**Social competencies**	- understands the need to learn throughout life, - can cooperate and work in a group taking on different roles.

Assumptions and objectives of the course:

Knowledge of designing steel portal frames in the context of Eurocodes.

The knowledge of design girders. The knowledge of design double-sided poles. The knowledge of use of various global analyzes in relation to steel constructions. Understaning the role of imperfections in the design of the steel structures.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. is familiar with building code, national standards (PN) and European standards (EN) as well as technical conditions for construction works and low- energy buildings - [KSB_W07]

2. is familiar with principles of constructing and dimensioning elements and joints made of metal - [KSB_W08]

3. is familiar with select computer software packages (including those using BIM technology) assisting in calculation and design of construction, technial amenities in buildings and software packages for assessment and design of low-energy buildings - [KSB_W12]

4. has knowledge in theoretical mechanics, materials strength and principles of general construction development - [KSB_W04]

Skills:

1. can list load combinations acting on construction works and carry out static analysis of rod constructions statically determinate and indeterminate; knows how to determine eigenmodes for simple rod constructions - [KSB_U06]

2. knows how to design select elements and simple constructions on metal - [KSB_U10]

3. knows how to carry out analysis of linear stability and ultimate state limits of simple rod constructions in terms of assessment of critical and ultimate states - [KSB_U13]

Social competencies:

1. takes responsibility for reliability of results and their interpretation - [KSB_K02]
2. has the skill of critical assessment of results of his work - [KSB_K08]

Assessment methods of study outcomes

Description of the methods to check the effects

Colloquium with lecture content covering closed questions and tasks to be solved (KSB_W07, KSB_W08, KSB_U10),

Colloquium on the content of projects in the form of closed questions (KSB_W07, KSB_W08),

Evaluation of individual projects (KSB_W12, KSB_U06, KSB_U10, KSB_U13, KSB_K02, KSB_K08).

Evaluation of lectures

The credit is obtained from obtaining a minimum of 50% of the maximum number of points from the colloquium from the lecture content.

Grading scale:

91% -100% very good (A)

81% -90% good plus (B)

71% -80% good (C)

61% -70% satisfactory plus (D)

51% -60% satisfactory (E)

less than 50% insufficient (F)

Evaluation of the exercise

Not applicable

Evaluation of projects

The credit is obtained from obtaining a minimum of 50% of the maximum number of points from the colloquium from the content of the projects and the correct development of the individual project.

Grading scale:

91% -100% very good (A)

81% -90% good plus (B)

71% -80% good (C)

61% -70% satisfactory plus (D)

51% -60% satisfactory (E)

less than 50% insufficient (F)

Course description

Lecture 1

Subject: Global analysis of frame systems part 1

Contents: The types of global analyzes contained in the Eurocode 1993 will be presented, i.e. with reference to steel constructions. Linear analyzes. Nonlinear analyzes.

Lecture 2

Subject: Second-order effects in the analysis of steel structures

Contents: The criteria for the analysis of second-order effects in the analysis of steel structures will be presented. The effects of P-? and P-? will be discussed.

Lecture 3

Topic: Local incapacity.

Contents: Local instability will be discussed. The principles of determining the load-bearing capacity of class IV cross-sections will be discussed.

Lecture 4

Subject: Rules for forming girders.

Contents: The principles of forming girders and the rules for their dimensioning will be discussed. Examples of the use of girders will be shown.

Lecture 5

Subject: Principles of shaping steel halls part 1

Contents: The principles of shaping steel halls will be discussed, including dilatation, hall housing, secondary elements. The principles of shaping steel halls, including shaping of pillars and transoms, types of static diagrams, basic loads.

Lecture 6

Subject: Two-way folded elements

Contents: types of construction solutions will be discussed, static schemes of purlins, loads, suspensions, dimensioning of bi-directionally bent and compressed elements according to EC3. Numerical example.

Lecture 7

Subject: Stability of the portal halls columns

Contents: The issues of defining the buckling lengths of portal halls in sway and non-swing systems will be discussed. Double-branch column. Numerical example.

Lecture 8

Topic: Stability of fullframe bolts of portal halls

Content: The issue of stability of full-wall bolts will be discussed, including the rules for determining buckling lengths in flexure and flexion buckling. Numerical example.

Lecture 9

Subject: Shaping nodes in layouts of portal halls part 1

Contents: Principles of forming foundation, eaves and ridge knots.

Lecture 10

Subject: Shaping nodes in layouts of portal halls part 2

Contents: The breakdown of nodes will be discussed due to their stiffness and load capacity in EC3 terms.

Lecture 11

Subject: Shaping nodes in layouts of portal halls part 2

Contents: Numerical example of calculating the support node (rigid, articulated).

Lecture 12

Subject: Imperfections in the dimensioning of portal halls systems part 1

Contents: Discussion of imperfection in steel constructions.

Lecture 13

Subject: Imperfections in the dimensioning of portal halls systems part 2

Contents: Discussion of imperfections in EC3 terms (arched and inclination imperfections). Numerical example.

Lecture 14

Subject: Summary of lecture content.

Contents: Repetition and summary of material from lectures 1 to 13.

Lecture 15

Subject: Colloquium covering lecture content.

Content: Colloquium covering lecture content.

Project 1

Subject: Introduction - design of a frame system with a girdle made of welded plate.

Contents: Issuing of project topics, discussion of the rules for passing projects, discussion of the principle of project implementation.

Project 2

Subject: Software

Contents: Presentation of possible project implementation tools. Example of hall modeling in 2D in the static analysis program (BIM).

Project 3

Topic: Loads and statics.

Contents: Presentation of rules for defining loads in indoor systems and static analysis. Second order effects. Example. Consultations.

Project 4

Subject: Dimensioning of roof bolts and inter-story floor girder made of welded plate plate using a computer program (BIM).

Contents: Example of dimensioning of roof bolts and plate girder. Consultations.

Project 5

Topic: Dimensioning a column using a computer program (BIM).

Contents: Example of dimensioning a column. Consultations.

Project 6

Topic: Dimensioning nodes using a computer program (BIM)

Content: Example. consultations

Project 7

Subject: Submission of projects.

Content: Colloquium

Basic bibliography:

1. The Behaviour and Design of Steel Structures to EC3.S, Trahair, M.A. Bradford, D.A. Nethercot, L. Gardner , Balkema, 2007
2. EN 1990 - Basis of structural design
3. EN 1991-1-1 - Densities, self-weight, imposed loads for buildings
4. EN 1991-1-3 - Snow loads
5. EN 1991-1-4 - Wind loads
6. EN 1993-1-1 - Design of steel structures - Part 1-1
7. EN 1993-1-3 - Design of steel structures - Part 1-3
8. EN 1993-1-5 - Design of steel structures - Part 1-5
9. EN 1993-1-8 - Design of steel structures - Part 1-8
10. Design of a Steel Structures 2nd Edition, L. da Silva, R. Simones and H. Gervasio, Willey Ernst&Sohn 2016

Additional bibliography:

1. Structural Design of Steelwork to EN 1993 and EN 1994, Lawrence Martin, Elsevier, 2007
2. Steel Buildings: Analysis and Design, 4th Edition, Stanley W. Crawley, Robert M. Dillon, John Wiley & Sons , 2008
3. R Studziński, P Ordziniak, Wymiarowanie słupów stalowych dwugałęziowych, Builder, 21, s. 74-77, 2017
4. R Studziński, P Ordziniak, Wybrane aspekty modelowania prętowych konstrukcji stalowych, Materiały Budowalne, 12, s. 70-72, 2016
5. R Studziński, P Ordziniak, Wyznaczenie sprężystego momentu krytycznego dla dowolnych przekrojów otwartych i zamkniętych, Materiały Budowlane, 9, s. 125-127, 2015

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures (contact hours)	30
2. Participation in projects (contact hours)	15
3. Preparation for the colloquium (independent work)	5
4. Preparation for passing lectures (independent work)	15
5. Preparation of an individual project (independent work)	25
6. Participation in consultations (contact with the teacher)	5

Student’s workload

Source of workload	hours	ECTS
Total workload	95	3
Contact hours	50	2
Practical activities	15	0