General course information:

Course title:	Metal Structures III	**Course code:**	CE09_S07
Credits:	6	**Work load (hours):**	150
Course level:	Undergraduate ☒	Graduate ☐	
Course type:	Mandatory ☐	Selective ☒	
Course category:	Basic ☐	Orientation ☒	
Semester:	7th	**Hours per week:**	4

Course objectives (capabilities pursued and learning results):

Through this course the students gain the theoretical background as well the required practical knowledge for the design, analysis and evaluation of steel beam-to-column semi-rigid joints, base plate connections, hollow section joints, spatial structures and space frames as well as steel plain frames. Thus, the student is lead to the supplement, enrichment and enhancement of all scientific and practical material required for efficiently facing almost any problem concerning steel structures.

Prerequisites:

Metal Structures I, II
Elastoplastic Analysis of Structures
Engineering Mechanics I, II, III

Instructor's data:

Name:	Dimitrios Sophianopoulos
Level:	Assistant Professor
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Other tutors:	-

Specific course information:

Week No.	**Course contents**	**Hours**	
		Course attendance	**Preparation**
1	Beam to column joints. General classification issues, Design Principles (general observations, moment-rotation characteristic, design moment resistance, rotational stiffness, rotational capacity), Classification of joints, Definitions and Notation (Basic joint components, Structural properties, Column web panel shear resistance), examples of joints, Simulation of joint behavior, classification in conjunction with the type of analysis used, lever arm, transformation parameters.	4	6
2	Structural joints connecting H or I sections. General, Structural properties (Design moment-rotation characteristic, main structural properties and basic joint components), Design Resistance (internal forces, shear forces, bending moments, equivalent T-stub in tension, equivalent T-stub in compression), Design resistance of basic components (column	4	6

	web panel in shear, column web in transverse compression, column web in transverse tension, column flange in transverse bending, end-plate in bending, flange cleat in bending, beam flange and web in compression, beam web in tension, concrete in compression including grout, base plate in bending under compression, base plate in bending under tension, anchor bolt in tension).		
3	Design moment resistance of beam-to-column joints and splices. General, centre of compression, lever arm and force distribution for deriving the design moment resistance, beam-to-column joints with bolted end-plate connections, welded joints, design resistance of column bases with base plates.	4	6
4	Worked examples and exercises for the material taught during the 1st, 2nd and 3rd week.	4	6
5	Worked examples and exercises for the material taught during the 1st, 2nd and 3rd week.	4	6
6	Rotational stiffness. Basic model, stiffness coefficients for basic joint components, end plate connections with two or more bolt rows in tension, general and simplified method, column bases. Rotational capacity.	4	6
7	Worked examples and exercises for the material taught during the 6th week.	4	6
8	Column bases. Characteristic forms and detail. Interaction curves M, N. Worked examples and exercises.	4	6
9	Hollow section joints. General (scope, field of application), Design (general, failure modes of hollow section connections), Welds - design resistance, Welded joints between CHS members (general, uniplanar joints, multiplanar joints), Welded joints between CHS and RHS brace members and RHS chord members (general, unreinforced and reinforced uniplanar joints, multiplanar joints), Welded joints between CHS or RHS brace members and I or H section chords, Welded joints between CHS or RHS brace members and channel section chord members.	4	6
Week No.	**Course contents**	**Hours**	
		Course attendance	**Preparation**
10	Worked examples and exercises on the material taught during the 9th week.	4	6
11	Spatial metal structures and space trusses. Introduction, general features, curves trusses and frames, barrel vaults and domes, single and multilayer grids, Uses and advantages, Design and analysis, Joints and Systems.	4	4
12	Steel plane frames. Basic principles of elastic stability theory, influence of geometric imperfections, influence of deformed structure geometry and sway as well as member imperfections, sway and non-sway frames, coefficients of equivalent buckling length of frame columns – approximate evaluation. Lateral restraints. Worked examples and exercises.	4	4
13	Steel Arches and Steel Shells. Basic Principles, Design principles, EC3 specifications, guidelines for further study. Indicative elements of steel bridges. Discussion.	4	4
14	Review worked examples and exercises.	4	4

Additional hours for:

Class project	Examinations	Preparation for examinations	Educational visit
-	3	15	-

Suggested literature:

1. D. S. Sophianopoulos, Special Topics on Metal Structures, University of Thessaly Press, 1999.
2. Fr. Wald : *Column Bases*, Edicni Stredisco CVUT, Prague 1995.
3. C. Faella, V. Piluso, G. Rizzano : *Structural Steel Semi-Rigid Connections, Theory Design & Software,* CRC Press, 2000.
4. S. L. Chan, P .P. T. Chui: *Non-Linear Static and Cyclic Analysis of Steel Frames with Semi-Rigid Connections*, Elsevier, 2000.
5. Vayas, I. Ermopoulos, G. Ioannidis, Design of Steel Structures, Kleidarithmos Publishing, 2006.
6. Eurocode 3, Design of Steel Structures, Part 1.8: Design of Joints, EN 1993-1-8, 2005.
7. D. S. Sophianopoulos, Elements on Metal Structures, Papasotiriou Publishing, 2006.

Teaching method *(select and describe if necessary* - **weight)***:*		
Teaching	☒	40%
Seminars	☒	5%
Demonstrations	☒	5%
Laboratory	☐	…….%
Exercises	☒	50%
Visits at facilities	☐	…….%
Other *(describe):* …….	☐	…….%
Total		100%

Evaluation method *(select)*- **weight:**				
	written	*%*	*Oral*	*%*
Homework	☐		☒	10
Class project	☐		☐	
Interim examination	☐		☐	
Final examinations	☒	80	☐	
Other *(describe):* Active class participation	☐		☒	