General course information:

Course title:	Metal Structures III	Course o	ode:	CE09_S07	
Credits:	6	Work load (hours):		150	
Course level:	Undergraduate	X	Gradu	ate	
Course type:	Mandatory		Selective 🗵		X
Course category:	Basic		Orientation 🗵		X
Semester:	7 th	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		
Office:	114A		
Tel. – email:	+30 24210 74145 - <u>dimsof@civ.uth.gr</u>		
Other tutors:	-		

Specific course information:

Week No.		Hours		
	Course contents	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 compression, column lange in transverse bending, end-plate in bending, flange clear in bending, beam flange and web in compression, beam web in tension, concrete in compression including grout, base plate in bending under compression, hase plate in bending, under tension, andror boti in tension). 4 6 3 abstimum oncent resistance of beam-to-column joints and splices. General, centre of compression, lever arm and force distribution for deriving the design moment resistance, beam- toint, design instance of column bases with base plates. 4 6 4 Worked samples and exercises for the material taught during. 4 6 5 Worked samples and exercises for the material taught during. 4 6 6 Rotational suffices. Basic model, stiffness coefficients for basic joint components, end plate connections with two or more boti rows in transon, general and simplified method, column bases. 4 6 7 Worked examples and exercises for the material taught during. 4 6 8 Column bases. Characteristic forms and detail. Interaction rows in transon, general unplant, orinth, subplant pinth, Welded joints between CH5 and RH5 brace members and RH5 chord members (general, unplant orinth, Welded joints between CH5 and RH5 brace members and roth or kH5 brace members and rotation connections, Welded joints between CH5 and RH5 brace members and roth are general, unplant, unminforced and retrinforee andurent section rotation in the section chords, Welded join				
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 bolled 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 1°.2 and 3° week. 4 6 5 Worked examples and exercises for the material taught during the 1°.2 and 3° 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. 4 6 7 Worked examples and exercises for the material taught during the 6° week. 4 6 8 Column bases. Characteristic forms and detail. Interaction curves M. N. Worked examples and exercises. 4 6 9 Worked examples and exercises for the material taught during the 6° week. 4 6 9 Rotational cipacity. 4 6 9 Worked examples and exercises for the material taught during the members and 1 or 1 section chords with base plates. 4 6 9 Rotational cipacity. 10 File S brace members and 1 or 1 section chords weed thores and this between CHS members. 4 6 10 Worked examples and exercises on the material taught during the 9° week. 4 6		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		
$ \begin{array}{c c c c c } \hline 4 & Worked examples and exercises for the material taught during the 14, 24 and 34 week. $	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	4	6
3 the 1+7, 2 st and 3 ^{sh} 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 6 th 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). Welds - design resistance, Welded joints between CH5 members (general, uniplanar joints, multiplanar joints, multiplanar joints, multiplanar joints, multiplanar joints, multiplanar joints, welded joints between CH5 or RHS brace members and channel section chords. Welded joints between CH5 or RHS brace members and channel section chord members. 4 6 10 Worked examples and exercises on the material taught during the 9 th week. 4 6 11 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 systa sevel as member upportioned evaluation. Lateral restraints. Worked examples and exercises. 4 4 13 Steel Arches and Steel Shells. Basic Principles, Design, principles, Design. 4 4 <td>4</td> <td>Worked examples and exercises for the material taught during</td> <td>4</td> <td>6</td>	4	Worked examples and exercises for the material taught during	4	6
6 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 6 th 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), besign (general, failure modes of hollow section connections), Welds - design resistance, Welded joints between CH5 members (general, unipharar joints), Welded joints between CH5 and RHS brace members and RHS chord members (general, unipharar joints), Welded joints between CH5 or RHS brace members and channel section chord members. 4 6 Week No. Course contents Hours 10 Worked examples and exercises on the material taught during the 9 th week, single and multilayer grids, Uses and advantages, Design and analysis, joints and Systems. 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 </td <td>5</td> <td>the 1st, 2nd and 3rd week.</td> <td>4</td> <td>6</td>	5	the 1 st , 2 nd and 3 rd week.	4	6
/ the 6 th week. 4 0 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 I or H section chords. 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 10 Worked examples and exercises on the material taught during the 9 th week. 4 6 11 Spatial metal structures and space trusses. Introduction, general features, curves trusses and frames, barrel vaults and dornes, 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 geometry and sway as well as member imperfections, sway and non-sway frame, coefficients of equivalent bucking length of frame columns - approximate evaluation. Lateral restraits. Worked examples and exercises. 4 4 13 Steel Shells. Basic Principles, Discussion. 4 4	6	joint components, end plate connections with two or more bolt rows in tension, general and simplified method, column bases. Rotational capacity.	4	6
8 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 Image: Course attended the section chords, Welded examples and exercises on the material taught during the 9 th week. Hours 10 Worked examples and exercises on the material taught during the 9 th 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 advantage, 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, Discussion. 4 4	7	the 6 th week.	4	6
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14Review worked examples and exercises.44	13	Steel Arches and Steel Shells. Basic Principles, Design principles, EC3 specifications, guidelines for further study.	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	\boxtimes	40%	
Seminars	⊠	5%	
Demonstrations	⊠	5%	
Laboratory		%	
Exercises	\boxtimes	50%	
Visits at facilities		%	
Other (describe):			
		%	
Total		100%	

Evaluation method (select)- weight:				
	<u>written</u>	<u>%</u>	<u>Oral</u>	<u>%</u>
Homework				
			\boxtimes	10
Class project				
Interim examination				
Final examinations	X	80		
Other (describe):			X	
Active class				
participation				