CZĘSTOCHOWA UNIVERSITY of TECHNOLOGY
FACULTY OF CIVIL ENGINEERING
FIELD OF STUDY: CIVIL ENGINEERING
COURSE DESCRIPTION

Subject						Course code	Year / Semester	
Structural Mechanics I						**WB_BUD_D_I_MB1**	**II**	**4**
Type of class						**Level of studies**	**ECTS**	
Lecture	**Classes**	**Laboratory**	**Project**	**Seminar**	**Exam**	BSc programme		
1	**1**	**-**	**2**	**-**	**E**	intramural studies	**6**	
Specjalność		**KBI / TOZB / AwB**		**Profile of studies:**		**general**		
Unit:				***Department of Technological Mechanics***				
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I. SUBJECT CHARTER

SUBJECT OBJECTIVE	
O1	Knowledge of basic principles and concepts of structural mechanics
O2	The skills of preparing influence lines for statically determinate systems and the determination of the extreme function based on the influence line
O3	Acquiring knowledge in the field of classification and resolution of statically determinate regimes

PRE-REQUISITE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES	
1	Knowledge of mechanics and strength of materials
2	Knowledge of mathematics in the field of mathematical analysis
3	Knowledge of basic concepts in the design of the bar

LEARNING OUTCOME	
S1	Has a theoretical knowledge of structural mechanics in the field of statically determinate systems
General skills/abilities	
S2	Has the skill to use literature and other materials related to the engineering problem to be solved
Basic engineering skills/abilities	
S3	Has the skill to preparing the influence line using the static method for statically determinate systems.
S4	Has the skill to preparing the influence lines using the kinematic method for statically determinate systems
Skills directly related to solving an engineering task	
S5	Has the skill to calculate the extreme functions based on influence lines
S6	Has the skill to calculate the displacements for statically determinate systems
Personal and social competences	
S7	Able to work independently and in a team

CONTENTS OF STUDY		
Type of classes – Lecture		**Number of hours**
L1	Introduction. Classification and characteristics of engineering structures, physical and mathematical model of structure - the calculation scheme.	1
L2	Kinematic analysis of the structure. Examples.	1
L3	Moving loads. Principles of preparation of the influence line - static method.	1

L4	Kinematic method for influence line preparation. Principle of reciprocity of reactions and displacements (Rayleigh) and the principle of reciprocity of displacements (Maxwell).	1
L5	Continuous beams. Principles of preparation of influence lines for continuous hinged beams.	2
L6		
L7	Use of the influence lines. Influence lines in case of nodal loads.	1
L8	Basic of theory of truss systems. Examples.	1
L9	Influence lines for truss systems - static and kinematic method.	2
L10		
L11	Deformations of the truss. The principle of virtual work.	1
L12	Curved beams, trusses beams, three-hinged arches, three-hinged frame and three-hinged truss arches.	2
L13		
L14	Influence lines of displacements.	1
L15	Repetytorium.	1
	Total:	**15**
Type of classes – Classes		**Number of hours**
C1	Introduction to the course. Discussion of the conditions of gaining credit. Kinematic analysis of planar shield system.	1
C2	Preparation of the influence line for functions (reactions, cross-section forces). Static method for simple and continuous hinged beams.	2
C3		
C4	Preparation of the influence line for functions (reactions, cross-section forces). Kinematic method for simple and continuous hinged beams.	2
C5		
C6	Using the influence lines. Live loads on the influence line, determination of the worst case of load position on the structure.	1
C7	Test #1.	1
C8	Planar trusses, the general properties of the truss. Kinematic analysis of truss systems. Preparation of influence line for simple and complex plane trusses. Static method.	2
C9		
C10	Preparation of influence lines using kinematic method for trusses.	1
C11	The use of virtual work equation to calculate the trusses displacements caused by mechanical and nonmechanical load (uneven temperature rise, inaccurate assembly, non-elastic subsidence supports)	2
C12		
C13	Analytical solving of three-hinged arches. Preparation of the influence line using the static method for arches and three-hinged frames.	1
C14	Test #2.	1
C15	Repetytorium.	1
	Total:	**15**
Type of classes – Project		**Number of hours**
P1	Project No. I - statically determinate multi-span beam – assumptions. Immutability of beam system.	2
P2	Shear and bending moment diagrams. Preparation of influence lines using static method for reaction and cross-section forces. Kinematic method for influence lines.	4
P3		
P4	Checking using the influence lines the internal forces in cross-sections. Calculation of extreme values of shear and bending moment in a given cross-section under the moving load.	4
P5		
P6	Calculation of vertical displacement and rotation angle under the	4

P7	mechanical load.	
P8	Defense of project No. I. Project No. II - statically determinate truss – assumptions	2
P9	Immutability of truss system. Cremona method and load balancing method. Ritter method (method of sections).	4
P10		
P11	Preparation of influence lines for reactions and forces of cross-section using static method. Checking using the influence lines the reactions and internal forces in cross-section.	4
P12		
P13	Calculation of extreme values of forces in the cross-section under the moving load with a specific schema on the lower (upper) truss belt. Calculation of horizontal or vertical displacement and change the distance between the nodes under mechanical loads.	4
P14		
P15	Defense of project No. I.	2
	Total:	**30**

TEACHING TOOLS	
1.	Lectures with audiovisual aids.
2.	Exercises with the use of audiovisual resources and board and chalk.
3.	Author's teaching aids
4.	Literature.

METHODS OF ASSESSMENT (F – FORMATIVE, P – SUMMARY)	
F1	Assessment to prepare for classes
F2	Rating advance of the projects carried out independently by the student in accordance with the approved schedule
F3	Evaluation of activity during the course
P1	Rating colloquia of credits
P2	Evaluation of the implementation of projects
P3	Evaluation of practical knowledge in the field of design
P4	Rating final exam in writing and orally.

STUDENT'S WORKLOAD

L.p.	**Activity**	**ECTS activity**	
		hours	**[ECTS]**
1.	Classes – **lecture**	**15**	6
2.	Contact hours with the teacher-related lectures.	10	
3.	Getting acquainted with the indicated literature.	15	
4.	**Classes – practice.**	**15**	
5.	Contact hours with the teacher-related practice.	10	
6.	Preparing for exercise.	10	
7.	Preparation for test #1.	10	
8.	Preparation for test #2.	10	
9.	**Classes – project.**	**30**	
10.	Contact hours with teacher-related project.	10	
11.	Preparing for classes in design, execution of projects.	10	
12.	Preparing for the exam.	15	
	Total:	**160**	

BASIC AND SUPLEMENTARY LITERATURE	
1.	R. C. Coates,M. G. Coutie,F. K. Kong, Structural Analysis, CRC Press, 1990
2.	Igor A. Karnovsky, Olga Lebed, Advance method of structural analysis book, Springer, 2010

3.	Russell C. Hibbeler, Structural Analysis, Ninth Edition, Prentice-Hall, 2015
4.	Williams, A. Structural analysis in theory and practice. Butterworth-Heinemann is an imprint of Elsevier , 2009
5.	HIBBELER, R.C. Structural analysis. Prentice-Hall, Inc., Singapore, 2006

MATRIX OF LEARNING OUTCOME CARRYING OUT

Learning outcome for the course	Reference to the effect defined for the field of study	Objectives of the course	Contents of study	Teaching tools	Methods of assessment
S-1	K_W05 K_W06	O1, O3	L1÷L14, C1	1, 2, 3, 4	F1, F3, P1, P4
S-2	K_U22, K_U02	O1, O2, O3	L1÷L14, C1÷C6, C8÷C13, P1÷P15	1, 2, 3, 4	F1÷F3, P1÷P4
S-3	K_U09	O2, O3	L3, L5÷L7, L9, L10, L12÷L14, C2, C3, C8, C9, C12, C13, P11, P12	1, 2, 3, 4	F1÷F3, P1÷P4
S-4	K_U09	O2, O3	L4÷L7, L9, L10, L12÷L14, C4, C5, C10, P2, P3	1, 2, 3, 4	F1÷F3, P1÷P4
S-5	K_U09	O2, O3	L7, L9, L10, L12÷L14, C6,C8÷C10, P4, P5, P13, P14	1, 2, 3, 4	F1÷F3, P1÷P4
S-6	K_U09	O2, O3	L11, L14, C10÷C12, P6, P7, P13, P14	1, 2, 3, 4	F1÷F3, P1÷P4
S-7	K_K01, K_K02	O1, O2, O3	C1÷C15, P1÷P15	4	F1÷F3, P1÷P4

II. METHODS OF ASSESSMENT – DETAILS

MARKS	LEARNING OUTCOME
	S1
2 (F)	The student does not understand the concept of statically determinate system and can not perform kinematic analysis.
3 (E)	The student has an elementary knowledge of the statically determinate system and attempts to perform the correct kinematic analysis of a simple system
3,5 (D)	The student has an elementary knowledge of statically determinate systems and can perform kinematic analysis of a simple system
4 (C)	The student has an elementary knowledge of statically determinate systems and is able to perform kinematic analysis of simple and selected complex systems
4,5 (B)	The student has an elementary knowledge of statically determinate systems and is able to perform kinematic analysis of simple and complex systems
5 (A)	The student has a very good knowledge of the statically determinate system and is able to flawlessly perform kinematic analysis of all sorts of complex systems
	S2
2 (F)	The student does not know the basic literature necessary for solving tasks in the field of structural mechanics statically determinate systems
3 (E)	The student knows superficially the basic literature but cannot take full advantage of it
3,5 (D)	The student knows the basic literature and attempts to use it correctly
4 (C)	The student knows the basic literature and can use it in solving the basic tasks
4,5 (B)	The student knows the basic literature and can use it in solving basic and complex tasks
5 (A)	Students is fluent in literature and can fluently use it for all tasks to be solved
	S3

2 (F)	The student understands how to prepare the influence line using a static method but he can not properly begin the task
3 (E)	The student can solve simple task consisting of preparing a influence line using a static method, however, the solution contains errors
3,5 (D)	The student can solve flawlessly simple task consisting of preparing a influence line using a static method
4 (C)	The student can solve flawlessly simple and selected complex task consisting of preparing a influence line using a static method
4,5 (B)	The student can solve simple and complex task consisting of preparing a influence line using a static method
5 (A)	The student can solve flawlessly simple and complex task consisting of preparing a influence line using a static method
S4	
2 (F)	The student understands how to prepare the influence line using a kinematic method but he can not properly begin the task
3 (E)	The student is able to solve simple task consisting of preparing a influence line using a kinematic method, however, the solution contains errors
3,5 (D)	The student is able to solve flawlessly simple task consisting of preparing a influence line using a kinematic method
4 (C)	The student is able to solve flawlessly simple and selected complex task consisting of preparing a influence line using a kinematic method
4,5 (B)	The student is able to solve simple and complex task consisting of preparing a influence line using a kinematic method
5 (A)	The student is able to solve flawlessly simple and complex task consisting of preparing a influence line using a kinematic method
S5	
2 (F)	The student understands how to calculate the extreme value of the function but he can not properly begin the task
3 (E)	The student is able to solve simple task however, the solution contains errors
3,5 (D)	The student is able to solve flawlessly simple task consisting of the calculation of the extreme value of function
4 (C)	The student is able to solve flawlessly simple and selected complex task consisting of the calculation of the extreme value of function
4,5 (B)	The student is able to solve simple and complex task consisting of the calculation of the extreme value of function
5 (A)	The student is able to solve flawlessly simple and complex task consisting of the calculation of the extreme value of function
S6	
2 (F)	The student understands how to calculate the displacement but he can not properly begin the task
3 (E)	The student is able to solve simple task however, the solution contains errors
3,5 (D)	The student is able to solve flawlessly simple task consisting of the calculation of displacement
4 (C)	The student is able to solve flawlessly simple and selected complex task consisting of the calculation of displacement
4,5 (B)	The student is able to solve simple and complex task consisting of the calculation of displacement
5 (A)	The student is able to solve flawlessly simple and complex task consisting of the calculation of displacement
S7	
2 (F)	The student is not able to work individually or in a team
3 (E)	Students is able to work individually with the teacher help, in the teamwork he is conflicting and he delays the work of the team
3,5 (D)	Students is able to work individually with the teacher help, in the teamwork he is conflicting but he is trying not to delay teamwork

4 (C)	The student is able to work individually or in a team, he is systematic but not too creative
4,5 (B)	The student is able to work individually or in a team, he is systematic and he is trying to be creative and well organized
5 (A)	The student is able to work individually or in a team. He can find the most appropriate solution of the problem, he is creative and well organized and he is able to alleviate conflicts

III. OTHER USEFUL INFORMATIONS ABOUT THE SUBJECT	
1.	Information, where and how students may acquaint with literature, author's teaching aids and others: according to the type of materials:
	According to the type of material – in the classroom, in the teacher's office and university or faculty library
2.	Information about the place of classes:
	Show-case in the Faculty of Civil Engineering and faculty www page.
3.	Information about time of classes (day and hour):
	Show-case in the Faculty of Civil Engineering and faculty www page.
4.	Information about consultations (place and hours):
	2 times a week in the teacher's office.