Name of course						Course code	Semester
Structural Mechanics II						**ISCED: 0732**	**spring**
Type of class						**Level of studies**	**ECTS**
Lecture	**Classes**	**Laboratory**	**Project**	**Seminar**	**Exam**	BSc programme	
1	**1**	**-**	**2**	**-**	**E**	full-time studies	**6**
Speciality						**Type of subject**	
without division						facultative	
Unit:				Department of Construction Process Engineering			
				Room 94		Phone / fax: +48 (34) 325 0904	
Teacher				Maksym GRZYWIŃSKI, Ph.D.		maksym.grzywinski@pcz.pl	

I. CARD OF COURSE

SUBJECT OBJECTIVES	
O1	To understand the concept of static and kinematic indeterminacy (degrees of freedom) of the structures such as trusses, beams, and rigid pin jointed frames.
O2	Skills of solving systems of statically indeterminate by the Force Method (FM) and the Displacement Method (DM).
O3	To apply various methods for analyzing the indeterminate structures to evaluate the response of such structures in the form of bending moment, shear force, axial force etc.

PREREQUISITE & ADDITIONAL REQUIREMENTS	
R1	Knowledge of Mathematics in the field of mathematical analysis.
R2	Knowledge of Mechanics and Strength of Material.
R3	Completed course Structural Mechanics I.

LEARNING OUTCOMES	
S1	Knowledge of Structural Mechanics II and the ability to use the conceptual apparatus of mechanics in the formulation of practical engineering construction.
General skills	
S2	Can use literature sources and other materials relating to the engineering problem to be solved. Can make a classification of buildings, construction of supporting structures.
Basic engineering skills	
S3	Able to solve statically indeterminate systems by the Force Method (FM).
S4	Able to solve statically indeterminate systems by the Displacement Method (DM).
Personal and social competences	
S5	Take responsibility for the reliability of working results and their interpretation. Can ability to work on the given task autonomically and cooperate in a team.

CONTENTS OF STUDY		
Type of classes – Lecture		**Number of hours**
L01	Type of structures and loads	1
L02	Degree of indeterminate static systems. Introduction to the Force Method.	1
L03	The Force Method for trusses. Displacements for statically indeterminate systems.	1
L04	The Force Method for beams.	1
L05	Equation of Three Moment (3M) for continuous beams.	2
L06		
L07	The Force Method for plane frame.	2
L08		
L09	Degree of indeterminate kinematic systems (rotations and displacement).	1

	Introduction to the Displacement Method.	
L10	The equations of transformation and the canonical equations of Displacement Method.	1
L11	Slope-Deflection Method - continuous beams, frames.	2
L12		
L13	Moment Distribution Method - continuous beams, frames.	2
L14		
L15	Repertory before written exam	1
	Total:	**15**

Type of classes – Classes		**Number of hours**
C01	Determination of the degree of static indeterminate systems. Solving beams and frames statically indeterminate using the Force Method of canonical equations, calculation of load displacement unit and the external loads to the core systems.	2
C02		
C03	Solve statically indeterminate 2D trusses using the Force Method.	1
C04	Solve statically indeterminate beams, and 2D frames using the Force Method.	2
C05		
C06	Solving multi-span beams by the equation of Three Moment (3M).	2
C07		
C08	**Test #1 (Force Method)**	2
C09		
C10	Determination of the degree of kinematic indeterminate systems. Displacement Method.	1
C11	Solving continuous beams and 2D frames of statically indeterminate.	2
C12		
C13	**Test #2 (Displacement Method)**	2
C14		
C15	The use of symmetry and asymmetry in the structure calculations.	1
	Total:	**15**

Type of classes – Project		**Number of hours**
P01	Application guidelines for the **project #1** - statically indeterminate **continuous beam**.	2
P02	Discussion of the Force Method (FM). Adoption of the basic system, saving the canonical system of equations. Determination of internal forces in beam. Calculation of displacements for the basic system.	2
P03	The solution of the canonical equations. The calculation of the forces in the beam of the real. Execution control calculations by checking the compatibility of deformations.	2
P04	Discussion of the equation Three Moments (3M).	2
P05	Adoption of the basic system. Writing equations and calculating overtime bending moments. Plotting the internal forces of the beam statically indeterminate.	4
P06		
P07	Comparison of the results of project #1 using the Method of Displacements (DM). Calculation of the actual bending moments in principle of superposition.	2
P08	Determination of the degree of kinematic indeterminate, the adoption of the basic system, the calculation of the actual displacement of the system. Defense of the **project #1**.	2
P09	Application guidelines for the **project #2** - statically indeterminate **frame**. Displacement Method for sliding frames. Determination of the degree of kinematic indeterminate frame, the adoption of the basic system.	4
P10		

P11	Determination of the actual movements of the canonical system of equations Displacement Method (DM). The calculation of bending moments in principle of superposition.	4
P12		
P13	Calculation of displacements for the basic frame. The solution of the canonical equations. Comparison of the results with the Force Method (FM).	2
P14	Plotting the internal forces statically indeterminate frame using the principle of superposition. Design validation calculations.	2
P15	Defense of the **project #2**.	2
	Total:	**30**

TEACHING TOOLS	
1.	Lectures with audiovisual aids.
2.	Exercises using audiovisual means and the blackboard and chalk.
3.	Author's teaching aids
4.	Literature.

METHODS OF ASSESSMENT (F – FORMATIVE, P – SUMMARY)	
F1	Assessment to prepare for classes. Checking presence.
F2	Staging elements 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.

STUDENT'S WORKLOAD			
L.p.	**Activity**	**Averaged workload**	
		hours	**[ECTS]**
1.	**Classes – lecture.**	**15**	2
2.	Contact hours of teacher - related lectures.	5	
3.	Preparing for the exam.	5	
4.	**Classes – practice.**	**15**	2
5.	Contact hours of teacher - related practice.	5	
6.	Preparing for finish test.	5	
7.	**Classes – project.**	**30**	2
8.	Contact hours of teacher - related project.	5	
9.	Execution of projects.	5	
	Total:	**90**	**6**

Textbook	
1.	Hibbeler R.C.: *Structural Analysis*, 8 edition, Prentice Hall, 2012
References	
1.	Bhavikatti S.S.: *Structural Analysis-II*, 4 edition, Vikas , 2013
2.	Kassimali A.: *Structural Analysis*, 6 edition, Cengage, 2020
3.	Khalfallah S.: *Structural Analysis 2. Statically Indeterminate Structures*, Wiley, 2018
4.	Olsson K.G., Dahlblom O.: *Structural Mechanics*, Wiley, 2016
5.	Smith P.S.: *An Introduction to Structural Mechanics*, Palgrave Macmillan, 2001

MATRIX OF LEARNING OUTCOME CARRYING OUT					
Learning outcome for the	**Reference to the effect**	**Objectives of the course**	**Contents of study**	**Teaching tools**	**Methods of assessment**

course	defined for the field of study				
S1	K_W05, K_W06	O1÷O3	L02÷L07, L12, C02÷C06, C08, C09, P01÷P09	1, 2, 3, 4	F1÷F3, P1÷P4
S2	K_U01, K_U02 K_U22	O1÷O3	C01÷C06, C08÷C13, P01÷P15	1, 2, 3, 4	F1÷F3, P1÷P4
S3	K_U09	O1, O2	C02÷C06, C08, C09, P01÷P09	1, 2, 3, 4	F1÷F3, P1÷P4
S4	K_U09	O1, O3	C10÷C12, P10÷P14	1, 2, 3, 4	F1÷F3, P1÷P4
S5	K_K01, K_K02	O1÷O3	C01÷C15, P01÷P15	4	F1÷F3, P1÷P4

II. METHODS OF ASSESSMENT – DETAILS

MARKS	LEARNING OUTCOME
	S1
2 (F)	Student has not a basic knowledge of Structural Mechanics II and did not know how to use the basic conceptual apparatus and a simple construction solves engineering problems with errors.
3 (E)	Student has a basic knowledge of Structural Mechanics II, and knows how to use the basic conceptual apparatus and can solve simple problems of engineering construction
4 (C)	Student has a wide knowledge of Structural Mechanics II, knows how to use advanced conceptual apparatus and can perfectly solve simple and complex problems selected engineering construction
5 (A)	Student has a wide knowledge of Structural Mechanics II, knows how to use advanced conceptual apparatus and perfectly able to solve simple and complex problems of engineering construction
	S2
2 (F)	Student can not replace primary literature sources necessary to solve the tasks of Structural Mechanics systems statically indeterminate
3 (E)	Student is able to briefly mention primary literature sources and can not fully exploit their
4 (C)	Student knows the primary literature sources and can be used in a range of tasks to be solved
5 (A)	Student can fluently replaced by reference and can fluently use it in terms of tasks to be solved
	S3
2.0 (F)	Student understands what the solution to the problem by Force Method but it can not properly begin the task
3.0 (E)	Student is able to solve a simple example using the Force Method, but the solution contains errors
4.0 (C)	Student is able to correctly solve a simple example and selected complex systems
5.0 (A)	Student is able to correctly solve simple and complex example by the Force Method
	S4
2.0 (F)	Student understands what is the solution of the Displacement Method but it can not properly begin the task
3.0 (E)	Student is able to solve a simple example using the Displacement Method, but the solution contains errors
4.0 (C)	Student is able to correctly solve a simple example and selected complex systems
5.0 (A)	Student is able to correctly solve simple and complex example by the Displacement Method
	S5
2.0 (F)	Student is not able to work individually or in a team
3.0 (E)	Student can work individually with the help of the teacher, teamwork is conflicting and delayed the work team
4.0 (C)	Student can work individually and in a team, is systematic but not too creative
5.0 (A)	Student can work individually and in a team. It can be the most appropriate solution to the problem is creative and well organized, able to mitigate 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 Enginering 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):
	The timetable posted on the door of Room 75 at the Faculty of Civil Engineering st. Academic 3 (second floor).