

**FACULTY OF CIVIL ENGINEERING**

**SUBJECT CARD**

<b>Name in English:</b>	<b>Modern testing methods for non-destructive inspection of building structures</b>
<b>Name in Polish:</b>	<b>Nowoczesne metody badań nieniszczących konstrukcji budowlanych</b>
<b>Main field of study (if applicable):</b>	<b>Civil Engineering</b>
<b>Specialization (if applicable):</b>	<b>Civil Engineering</b>
<b>Level and form of studies:</b>	<b><del>1st</del> / 2nd level*, full-time / <del>part-time</del>*</b>
<b>Kind of subject:</b>	<b><del>obligatory</del> / optional / <del>university-wide</del>*</b>
<b>Subject code:</b>	<b>CEB006163</b>
<b>Group of courses:</b>	<b><del>YES</del> / NO*</b>

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	<b>15</b>		<b>15</b>		
Number of hours of total student workload (CNPS)	<b>30</b>		<b>60</b>		
Form of crediting	<del>Examination</del> / crediting with grade *	Examination / crediting with grade *	<del>Examination</del> crediting with grade *	Examination / crediting with grade *	Examination / crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	<b>1</b>		<b>2</b>		
including number of ECTS points for practical (P) classes			<b>2.0</b>		
including number of ECTS points for direct teacher-student contact (BK) classes	<b>0.6</b>		<b>0.6</b>		

\* delete as appropriate

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. The student possesses knowledge of the areas of basic aspects of building structures, building materials and concrete structures.
2. The student knows the principles of building materials and testing their strength parameters.

**SUBJECT OBJECTIVES**

- C1. Introduction of modern testing methods for quality control of building materials and structures during their erection.
- C2. Introduction of modern testing methods for quality control of existing building structures.
- C3. Learning modern testing systems for NDT examination of building structures.
- C4. Developing skills of basic and advanced testing procedures for building structures examination necessary for evaluation of their technical conditions.
- C5. Strengthening the ability to work in a team and making students aware of the need to constantly expand knowledge of modern testing methods for building structures examination.

<b>SUBJECT EDUCATIONAL EFFECTS</b>	
<b>Relating to knowledge:</b>	
PEK_W01	The student knows and understands the specific implementation of quality control of building materials and structures during their erection.
PEK_W02	The student knows and understands the specific implementation of quality control of existing building structures with particular attention focused on the evaluation of their technical conditions.
<b>Relating to skills:</b>	
PEK_U01	The student is able to plan and carry out test procedures components of building structures and interpret the results of the evaluation of their quality and mechanical properties.
PEK_U02	The student can evaluate the technical condition of building structures using modern non-destructive testing methods.
PEK_U03	The student has the skills necessary to use modern non-destructive testing systems.
<b>Relating to social competences:</b>	
PEK_K01	The student can work independently or in a team task.
PEK_K02	The student is aware of the need to constantly expand knowledge of both traditional and modern testing methods for building structures examination.

<b>PROGRAMME CONTENT</b>		
<b>Form of classes - lecture</b>		<b>Number of hours</b>
Lec1	Introduction, aims, scope and plan of the subject. Brief history review of the development of testing methods addressed for building structures.	<b>2</b>
Lec2	Characteristics of modern testing methods for non-destructive evaluation of “in-situ” concrete compressive strength (LOK-Test, CAPO-Test, COMA-Test).	<b>2</b>
Lec3	Nondestructive evaluation of concrete tensile strength using “pull-off” measurements.	<b>1</b>
Lec4	“In-situ” nondestructive evaluation of concrete water permeability by means of GWT method.	<b>1</b>
Lec5	Characteristics of modern testing methods for non-destructive evaluation of corrosion risk assessment of building structures (Rainbow-Test, Aquamerck Test, Rapie Chloride Test, Corrosion Mapping Systems – Bloodhound, Galva Pulse).	<b>2</b>
Lec6	Modern testing methods for non-destructive examination of structural integrity of building structures („Impact-Echo”).	<b>3</b>
Lec7	Modern testing methods for non-destructive examination of structural integrity of building structures (Impulse Response, infrared thermography, ultrasonic tomography)	<b>2</b>
Lec8	Modern methods for locating and identifying the reinforcing steel bars (Cover-Master, Profometer, Ground Penetrating Radar, radiography).	<b>1</b>
Lec9	Final examination test	<b>1</b>
<b>Total hours</b>		<b>15</b>

<b>Form of classes - class</b>		<b>Number of hours</b>
Cl1		
...		
<b>Total hours</b>		

<b>Form of classes - laboratory</b>		<b>Number of hours</b>
Lab1	Introduction. Safety regulations. General description of non-destructive testing methods. Introduction to laboratory exercises with ultrasonic measurements	2
Lab2	Short test nr 1. Exercises no 1 - ultrasonic measurements. Determination of ultrasonic pulse velocity in different building materials.	2
Lab3	Short test nr 2. Principles of the concrete compressive strength evaluation by means of rebound measurements. Introduction to laboratory exercises. Overview of available testing systems and measurement techniques. Interpretation of obtained results.	2
Lab4	Short test nr 3. Exercises no 2 - rebound measurements.	2
Lab5	Exercises no 3 – Evaluation of the concrete compressive and tension strength by means of “pull-out” and “pull-off” measurements.	2
Lab6	Exercises no 4 - Localization and identification of the reinforcing steel bars in concrete structures. Non-destructive cover layer measurements.	2
Lab7	Exercises no 5 - Non-destructive moisture measurements of different materials.	2
Lab8	Short test nr 4. Summary and final recognition.	1
	<b>Total hours</b>	<b>15</b>

<b>Form of classes - project</b>		<b>Number of hours</b>
Proj1		
...		
	<b>Total hours</b>	

<b>Form of classes - seminar</b>		<b>Number of hours</b>
Sem1		
...		
	<b>Total hours</b>	

<b>TEACHING TOOLS USED</b>	
N1. LECTURE: classic lecture, multimedia presentations, educational films.	
N2. LABORATORY: practical laboratory tests, preparation of test reports, discussion of the results obtained	
N3. Consultation	

<b>EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT</b>		
<b>Evaluation</b> (F – forming (during semester), P –concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1 (L1-L2)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Short test no 1
F2 (L2-L3)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Short test no 2, Assessment of the Exercises no 1 Discussion of the results obtained
F3 (L4-L5)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Short test no 3, Assessment of the Exercises no 2 Discussion of the results obtained
F4 (L5-L8)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Short test no 4, Assessment of the Exercises no 3, 4 and 5 Discussion of the results obtained
P (laboratory) = 0,60 x average rating of short tests results+ 0.4 x average rating of test reports evaluation		
P (lecture)	PEK_W01 PEK_W02 PEK_U01 PEK_U02 PEK_K02	Crediting with grade basing on the final examination test

<b>PRIMARY AND SECONDARY LITERATURE</b>
<p><b><u>PRIMARY LITERATURE:</u></b></p> <p>[1] Sansalone M.J., W.B. Streett W.B., Impact-Echo Nondestructive Evaluation of Concrete and Mansory, Buullbrier Press, 1977.</p> <p>[2] Schickert G., Wiggerhauser H., Non-Destructive Testing in Civil Engineering. Berlin, 1995.</p> <p>[3] Bungey J.H., Millard S.G., M.G., Testing of Concrete in Structures, 4<sup>th</sup> Edition, Taylor&amp;Francis, London and New York, 2006.</p> <p>[4] Breyse D., Non-Destructive Assessment of Concrete Structures: Reliability and Limits of Single and Combinated Techniques, State of the Art, Report of the RILEM Technical Committee 207-INR, Springer Dordrecht Heidelberg London New York, 2012</p> <p><b><u>SECONDARY LITERATURE:</u></b></p>

<b>SUBJECT SUPERVISOR (NAME AND SURNAME, DIVISION, E-MAIL ADDRESS)</b>
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT  
**Modern testing methods for non-destructive  
inspection of building structures**  
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY *Civil Engineering*  
AND SPECIALIZATION **Civil Engineering**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)**	Subject objectives ***	Programme content ***	Teaching tool number ***
<b>Knowledge</b>				
<b>PEK_W01</b>	K_W06, K_W14, KS_CEB_W22,	C1÷C2 + C5	Lec1÷Lec8	N1, N3
<b>PEK_W02</b>	K_W06, K_W14, KS_CEB_W22,	C1÷C2 + C5	Lec1÷Lec8	N1, N3
<b>Skills</b>				
<b>PEK_U01</b>	K_U02, K_U15, KS_CEB_U21, KS_CEB_U23	C3÷C4	Lab1÷Lab7	N2 N3
<b>PEK_U02</b>	K_U02, K_U15 KS_CEB_U21, KS_CEB_U23	C3÷C4	Lab1÷Lab7	N2 N3
<b>PEK_U03</b>	K_U02, K_U15 KS_CEB_U21	C3÷C4	Lab1÷Lab7	N2, N3
<b>Social competences</b>				
<b>PEK_K01</b>	K_K03, K_K05, K_K06	C5	Lec1÷Lec8 Lab1÷Lab7	N1, N2
<b>PEK_K02</b>	K_K01, K_K05, K_K06	C5	Lec1÷Lec8 Lab1÷Lab7	N1, N2

\*\* - enter symbols for main-field-of-study/specialization educational effects

\*\*\* - from table above