Annex No. 9
to the Rector's Decision No. 35/19
of 12 June 2019.

COURSE SPECIFICATION

Course code	**B2-2-KB-006a**
Course title in Polish	**Diagnostyka i wzmacnianie konstrukcji betonowych**
Course title in English	**Diagnostics and strengthening of concretes structures**
Valid from academic year	**2019/2020**

CURRICULAR ALIGNMENT

Programme	**CIVIL ENGINEERING**
Level	**second-cycle**
Programme profile	**academic**
Mode of attendance	**full-time**
Specialism	**Building Structures**
Academic unit responsible for the course	**Department of Strength of Materials, Concrete Structures and Bridges**
Course coordinator	**dr hab. inż. Barbara Goszczyńska, prof. PŚk**
Approved by	**prof. dr hab. inż. Marek Iwański**

COURSE DESCRIPTION

Teaching block	**specialism**
Course status	**required**
Language of instruction	**Polish**
Semester of delivery	**semester II**
Prerequisites	**-**
Exam (YES/NO)	**YES**
ECTS	**4**

Mode of teaching	lecture	class	lab	project	seminar
Number of hours per semester	**30**		**15**	**15**	

LEARNING OUTCOMES

Category	Code	Learning outcomes	Corresponding programme outcome code
Knowledge	W01	Students demonstrate a comprehensive understanding of the principles governing the analysis, design, and dimensioning of various reinforced concrete elements and building structures.	B2_W02

	W02	Students possess a thorough understanding of the principles underlying the analysis of static problems in reinforced concrete frame structures.	B2_W04
	W03	Students are knowledgeable of the design and maintenance guidelines for building structures and their components.	B2_W14
Skills	U01	Students can identify and compile the loads acting on building structures.	B2_U01
	U02	Students can visually assess simple building structures.	B2_U02
	U03	Students can design reinforcements for basic reinforced concrete elements.	B2_U03
	U04	Students can conduct static analysis of frame structures.	B2_U04
Competence	K01	Students can work independently and in a team.	B2_K01
	K02	Students recognize the necessity of continuous professional and personal development.	B2_K06
	K03	Students can formulate opinions on construction-related matters and understand the importance of disseminating knowledge about construction to the public.	B2_K07

COURSE CONTENT

Teaching mode*	Topics covered
lecture	1. Overview of the subject matter and related literature, with a specific focus on the formal and legal foundations for ensuring the quality and safety of building structures, and legal acts concerning the safe operation of building structures.
	2. Conducting inspections of concrete structures, including the reasons for inspections; types, methods, and scope of inspections; principles for assessing the safety of reinforced concrete structures.
	3. Crack morphology: causes of cracking in reinforced concrete structures, the appearance of cracking in terms of deformations, diagnosing the causes of cracking based on the location and time of crack formation, and the crack pattern.
	4. Investigations of reinforced concrete structures: scope of investigations including inventory, location and assessment of reinforcing bars, concrete strength, internal defects, protective properties, crack morphology, deformations, and displacements - diagnostic methods, measuring equipment, test execution.
	5. Safety assessment of structures: structural modeling, reliability and stress levels of the structure, evaluation of the global safety factor, conditional approval for operation – structural monitoring.
	6. Assessment of the stress state of reinforced concrete elements (plastic hinge method – beams; yield line method – slabs).
	7. Principles of structural strengthening and the conditions that must be ensured for effective strengthening.
	8. Design of strengthening: methods for strengthening reinforced concrete beams, slabs, columns, frames, and walls.
	9. Examples of strengthened flexural and shear elements, including short cantilevers and slabs subjected to punching shear.
	10. Technology for the execution of repairs and strengthening, including modern techniques for strengthening in flexure, shear, and compression using composites.
lab	1. Conducting a technical condition inspection of the agreed-upon building structure, including the preparation of an inspection report.
	2. Participation in a demonstration of testing equipment, including a presentation of the operating principles and the processing of results from tests performed on reinforced concrete beams using a 3D optical system and a scanning electron microscope.
	3. Performing an investigation for the identification and location of reinforcement, as well as the measurement of crack widths - report.

project	Technical design for strengthening a given reinforced concrete beam for increased loading: — assessment of the beam's current load-bearing capacity. — selection of the strengthening method. — static and strength calculations for the strengthening. — detailed execution drawing of the strengthening. — description of the strengthening execution technology.

METHODS OF LEARNING OUTCOMES VERIFICATION

Learning outcome	Learning outcome verification methods					
	Oral exam	Written exam	Test	Project	Report	Other
W01		X		X		X
W02		X		X		X
W03		X		X		X
U01				X		X
U02					X	X
U03		X		X		X
U04		X		X		X
K01				X	X	X
K02		X		X	X	X
K03					X	X

ASSESSMENT

Teaching mode*	Assessment type	Criteria
lecture	exam	*Achieving a minimum of 50% of the total points.*
lab	mark-based	*Submitting a satisfactory (at least a grade of 3.0 in the Polish grading system) inspection description and test report.*
project	mark-based	*Submitting a project design free of fundamental errors – achieving at least a satisfactory grade (3.0) – and successfully defending the project.*

STUDENT WORKLOAD

ECTS weighting								
	Activities	Student workload						Unit
1.	Scheduled contact hours	W	C	L	P	S		h
		30		15	15			
2.	Other (office hours, exams)	4						h
3.	**Total number of contact hours**	**64**						h
4.	**Number of ECTS credits for contact hours**	**2,56**						ECTS
5.	**Independent study hours**	**36**						h
6.	**Number of ECTS credits for independent study**	**1,44**						ECTS
7.	**Practical hours**	**50**						h
8.	**Number of ECTS credits for practical hours**	**2**						ECTS
9.	**Total workload**	**100**						h
10.	**ECTS credits for the course** *1 ECTS credit =25 student learning hours*	**4**						ECTS

READING LIST

1. Murzewski J.: Bezpieczeństwo konstrukcji budowlanych. Arkady Warszawa 1970 r.
2. Bukowski B.: Morfologia rys w konstrukcjach żelbetowych i betonowych. AIL 4/1959.
3. Godycki – Ćwirko T.: Mechanika betonu. Arkady Warszawa 1982 r.
4. Thierry J., Zaleski S.: Remonty budynków i wzmacnianie konstrukcji. Arkady, Warszawa 1982 r.
5. Murzewski J.: Niezawodność konstrukcji inżynierskich. Arkady 1989r.
6. Godycki – Ćwirko T.: Morfologia rys w konstrukcjach z betonu. Ropr. Nauk. Nr 13, Białystok 1992 r.
7. Runkiewicz L.: Diagnostyka i wzmacnianie konstrukcji żelbetowych. Materiały pomocnicze i informacyjne Nr 93/1998 Politechniki Świętokrzyskiej Kielce..
8. Instrukcja 361/99 ITB**:** Zasady oceny bezpieczeństwa konstrukcji żelbetowych, 1999r.
9. Masłowski E., Spiżewska D.: Wzmacnianie konstrukcji budowlanych. Arkady, Warszawa 2000 r.
10. Praca zbiorowa pod redakcją Kamińskiego M**.:** Trwałość i skuteczność napraw obiektów budowlanych *dWe* 2007r.
11. Drobiec Ł., Jasiński R., Piekarczyk A**.:** Diagnostyka konstrukcji żelbetowych PWN 2010r. Tom 1 – Metodologia, Badania polowe, Badania laboratoryjne betonu i stali
12. Zybura A., Jaśniok M., Jaśniok T**.:** Diagnostyka konstrukcji żelbetowych PWN 2011 Tom 2 - Badania korozji zbrojenia i właściwości ochronnych betonu
13. Materiały konferencyjne Konferencji Naukowo-Technicznej Awarie Budowlane (29 konferencji)
14. Materiały konferencyjne Konferencji Naukowo – Technicznej Warsztat Pracy Rzeczoznawcy Budowlanego. (15 Konferencji)
15. Praca zbiorowa pod redakcją L. Runkiewicz, B. Goszczyńska: Rzeczoznawstwo Budowlane, Diagnostyka i wzmacnianie obiektów budowlanych, Politechnika Świętokrzyska Kielce 2016
16. The currently applicable building codes in Poland related to the lecture topics, as well as the Building Law Act