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

COURSE SPECIFICATION

Course code	**B2-1-KB-207, B2-1-BIM-208**
Course title in Polish	**Materiały Kompozytowe 2**
Course title in English	**Composite Materials 2**
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, BIM**
Academic unit responsible for the course	**Department of Strength of Materials of Concrete Structures and Bridges**
Course coordinator	**dr inż. Aleksandra Krampikowska**
Approved by	**prof. dr hab. inż. Marek Iwański**

COURSE DESCRIPTION

Teaching block	**specialism**
Course status	**required**
Language of instruction	**Polish**
Semester of delivery	**semester I**
Prerequisites	**-**
Exam (YES/NO)	**NO**
ECTS	**1**

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

LEARNING OUTCOMES

Category	**Code**	**Learning outcomes**	**Corresponding programme outcome code**

Knowledge	W01	Students have advanced knowledge of mathematics, physics, chemistry, which is the basis for subjects in the theory of materials, civil structures, and technological processes.	B2_W01
	W02	Students have knowledge of advanced issues of strength of materials, material modelling, structures.	B2_W03
	W03	Students are familiar with currently used building materials, their manufacturing technologies and construction technologies.	B2_W07
Skills	U01	Students able to classify simple and complex building structures made of composites.	B2_U02
	U02	Students can correctly define a computational model and carry out advanced analysis in the linear range of complex engineering structures and apply non-linear computation techniques at a basic level.	B2_U06
	U03	Students can select tools (analytical or numerical) to solve engineering problems.	B2_U13
Competence	K01	Students can work independently and in teams.	B2_K01
	K02	Students independently complete and extend knowledge of modern construction processes and technologies.	B2_K03

COURSE CONTENT

Teaching mode*	Topics covered
lecture	1. Basic information about composite materials; composites reinforced with particulates, chopped fibre, and continuous fibre. Composite vs laminate.
	2. Basic Types of Layered Laminates. Quasi-isotropic composites. Strength of layered composites.
	3. Stresses and strains in laminates – a classical lamination theory. Compliance in laminates. Lamination theory with temperature effect.
	4. Critical stress-strain state criteria for composite laminates. Micromechanics of composites. Material characteristics of composites – semi-empirical solution by Halpin and Tsai. Elasticity coefficient of composites.
	5. Composite joints. Bonded and bolted joints. Application of composites in bridge engineering (tie rods for prestressed concrete structures and cable-stayed bridges made of carbon, glass, and aramid fibres.
	6. Composite structures. Reinforcement of building structures with composite materials (material, technology, and reinforcement techniques using composite polymers). Selection of composites.
	7.Stress corrosion cracking of composites. Strength testing of composites and diagnostics of composite structures.
	8. Geocomposites.
	9. Modern material recycling technologies.
	10. Polymer composite production technology.

METHODS OF LEARNING OUTCOMES VERIFICATION

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

ASSESSMENT

Teaching mode*	Assessment type	Criteria
lecture	mark-based	*Scoring at least 50% on the in-class test or delivering a multimedia presentation for a public audience.*

STUDENT WORKLOAD

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

READING LIST

1. Królikowski W.: Polimerowe kompozyty konstrukcyjne, PWN, Warszawa 2018
2. Ochelski S.: Metody doświadczalne mechaniki kompozytów konstrukcyjnych, PWN, Warszawa 2018
3. Boczkowska A., Krzesiński G.: Kompozyty i techniki ich wytwarzania, Oficyna Wydawnicza PW, Warszawa 2016

4. Klugmann-Radziemska E., Haponiuk J.T., Datta J., Formela K., Sienkiewicz M., Włoch M.: Nowoczesne technologie recyklingu materiałowego, Wyd. PG, Gdańsk 2017
5. Rabek J.F.: Polimery, PWN, Warszawa 2017
6. Siwowski T.: Mosty z kompozytów FRP, PWN, Warszawa 2018
7. Dąbrowski H.: Wytrzymałość polimerowych materiałów włóknistych, Wyd. Politechniki Wrocławskiej, Wrocław 2002
8. German J.: Podstawy mechaniki materiałów włóknistych, Skrypt Politechniki Krakowskiej, Kraków 1996
9. Wilczyński A.P.: Polimerowe kompozyty włókniste, WNT, Warszawa 1996