



Subject card

Subject name and code	Inventions inspired by nature, PG_00062142						
Field of study	Technical Physics						
Date of commencement of studies	February 2023	Academic year of realisation of subject			2023/2024		
Education level	second-cycle studies	Subject group					
Mode of study	Full-time studies	Mode of delivery			e-learning		
Year of study	1	Language of instruction			Polish		
Semester of study	2	ECTS credits			2.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Energy Conversion and Storage -> Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Katarzyna Januszewicz					
	Teachers	dr inż. Katarzyna Januszewicz					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	0.0	30
	E-learning hours included: 30.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours		Self-study		SUM
	Number of study hours	30	2.0		18.0		50
Subject objectives	Introducing students to the concept of bionics, which involves drawing inspiration from nature in the creation of inventions. Exploring the structure, mechanisms of motion, and functioning of plants, animals, and humans that have served as inspiration for the development of inventions and practical biotechnical solutions. The objective of this course is to acquaint students with the process of creating innovative solutions based on observations and understanding the structure and principles of living organisms.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K7_K71] is able to explain the need to apply knowledge from humanistic, social, economic or legal sciences in order to function in a social environment	the student has knowledge in the field of bioengineering, is able to connect the cause and effect of natural phenomena to science			[SK5] Assessment of ability to solve problems that arise in practice		
	[K7_U71] is able to apply knowledge from humanistic, social, economic or legal sciences in order to solve problems	the student is able to use tools for creative work "design thinking"			[SU3] Assessment of ability to use knowledge gained from the subject		
	[K7_W71] has general knowledge in humanistic, social, economic or legal sciences, including their fundamentals and applications	the student is able to observe the relationships between the natural environment and modern technologies			[SW1] Assessment of factual knowledge		

<p>Subject contents</p>	<p>Biomimetics. Historical overview. Contemporary centers and research conducted in the field of biomimetics. Biomimetics, as an interdisciplinary science, utilizes knowledge of the structure and principles of organisms to create technological devices employing these recognized mechanisms, laws, and relationships.</p> <p>Case study. Examples of technological solutions inspired by nature, such as the lotus effect for hydrophobic surfaces, the elbow joint as a hinge, burdock inspiring synthetic burrs, gecko-inspired adhesion solutions like adhesives.</p> <p>Biomimetic construction. Utilizing nature-inspired ideas in the creation of building structures (e.g., mimicking plant stems in the design of pipes).</p> <p>Biomaterials. Materials obtained by analyzing solutions available in nature. Aircraft skin constructions, spider silk as inspiration for innovative materials.</p> <p>Bioinformatics. Biocybernetics. Development of devices based on the movements of cats, flamingos, cows. Nano-sensors inspired by butterflies. Walking robots mimicking animal movements.</p> <p>Bioprosthetics. Examples of solutions with a case analysis. Discussion of biological aspects: structure, functioning principles, and the application of this knowledge in specific technological solutions and inventions. Materials and prosthetic designs (e.g., foot prostheses, hip prostheses).</p> <p>Biooptics. Examples of solutions with a case analysis. Discussion of biological aspects: structure, functioning principles, and the application of this knowledge in specific technological solutions and inventions. Chameleons as an inspiration for camouflage techniques.</p> <p>Biodynamics. Examples of solutions with a case analysis. Discussion of biological aspects: structure, functioning principles, and the application of this knowledge in specific technological solutions and inventions. Rehabilitation-assisting actuators.</p> <p>Biohydraulics. The phenomenon of cavitation, illustrated using the example of the Alpheus shrimp.</p> <p>Methods used in integrating biological research into new technologies.</p> <p>Opportunities and prospects for future inventors in the context of being a student.</p>								
<p>Prerequisites and co-requisites</p>									
<p>Assessment methods and criteria</p>	<table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Test</td> <td>60.0%</td> <td>100.0%</td> </tr> </tbody> </table>	Subject passing criteria	Passing threshold	Percentage of the final grade	Test	60.0%	100.0%		
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Recommended reading	Basic literature	<p>Johan Gielis: A generic geometric transformation that unifies a wide range of natural an abstract shapes. 2003. American Journal of Botany 90(3): 333338.</p> <p>Bioinformatics. W: Robert Nisbet, John Elder IV, Gary Miner: Handbook of Statistical Analysis and Data Mining Applications. Academic Press, 2009, s. 321334. ISBN 978-0-08-091203-5.</p> <p>Paul G. Higgs Teresa K. Attwood. Bioinformatyka i ewolucja molekularna.</p> <p>Eisner T., Aneshansley D.J.Spray aiming in the bombardier beetle: Photographic evidence , Proc. Natl. Acad. Sci. USA, 1999, Vol. 96, pp. 97059709,</p> <p>Kasprzak M. (2013) Wybrane algorytmy i modele grafowe w bioinformatyce wydawnictwo: Politechnika Poznańska ISBN 978-83-7775-233-3</p> <p>M.Kossobudzka, Żywa latarka, Wiedza i Życie, 2004, 6, 32-33</p> <p>M.Fischetti, Błysk w oku laserowa korekcja wad wzroku, Świat Nauki, 2004, 6, 82-84</p> <p>Ślesak, S. Karpiński. Biologiczne bazy danych i ich zastosowanie w funkcjonalnej analizie porównawczej organizmów wybrane zagadnienia. Biotechnologia, s. 3952, 2010.</p> <p>Vincent, J. F. V.; Bogatyreva, O. A.; Bogatyrev, N. R.; Bowyer, A. & Pahl, A.-K. (2006). "Biomimeticsits practice and theory". Journal of the Royal Society Interface. 3 (9): 471482. doi:10.1098/rsif.2006.0127. PMC 1664643. PMID 16849244.</p> <p>Nanosensors inspired by butterfly wings (Wired UK) Archived 17 October 2010 at the Wayback Machine. Wired.co.uk. Retrieved on 23 April 201</p>
	Supplementary literature	<p>Clark, O. G.; Kok, R.; Lacroix, R. (1999). "Mind and autonomy in engineered biosystems" (PDF). Engineering Applications of Artificial Intelligence. 12 (3): 389399. CiteSeerX 10.1.1.54.635. doi:10.1016/S0952-1976(99)00010-X. Archived from the original (PDF) on 18 August 2011</p> <p>Design inspired by nature Archived 21 September 2009 at the Wayback Machine, ESA</p>
	eResources addresses	<p>Adresy na platformie eNauczanie: Wynalazki inspirowane naturą - Moodle ID: 33055 https://enauzanie.pg.edu.pl/moodle/course/view.php?id=33055</p>
Example issues/ example questions/ tasks being completed	<p>Explain the concept of bionics.Show us some inspirations for everyday items from the natural environment.</p>	
Work placement	<p>Not applicable</p>	