



Subject card

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|---|--|---|-------------------------------------|------------|--|---------|-----|
| Subject name and code | Inventions inspired by nature, PG_00066585 | | | | | | |
| Field of study | Mathematics | | | | | | |
| Date of commencement of studies | October 2024 | Academic year of realisation of subject | | | 2024/2025 | | |
| 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 -> Faculties of Gdańsk University of Technology | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Katarzyna Januszewicz | | | | | |
| | Teachers | dr hab. inż. Katarzyna Januszewicz | | | | | |
| Lesson types | 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 | | | | | | |
| | eNauczanie source addresses: Moodle ID: 43732 Wynalazki inspirowane naturą _2025 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=43732 | | | | | | |
| 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 | | |

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| Subject contents | <p>Course content – lecture 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>Bioprosthesis. 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> | | |
| Prerequisites and co-requisites | | | |
| Assessment methods and criteria | 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 | |
| Example issues/ example questions/ tasks being completed | Explain the concept of bionics.Show us some inspirations for everyday items from the natural environment. | |
| Practical activites within the subject | Not applicable | |

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