

## GDAŃSK UNIVERSITY

## Subject card

|   | learning incrimed by a dama DO 20202440  |  |  |                                     |  |            |         |     |
|---|--|--|--|-------------------------------------|--|------------|---------|-----|
| 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                            | Subject supervisor dr inż. Katarzyna Januszewicz   |  |  |                                     |  |            |         |     |
| of lecturer (lecturers)                     | Teachers   |  | dr inż. Katarzyna Januszewicz  |                                     |  |            |         |     |
| Lesson types and methods                    | Lesson type  | Lecture  | Tutorial   | Laboratory                          | Projec   | t          | Seminar | SUM |
| of instruction                              | Number of study hours  | 30.0   | 0.0  | 0.0                                 | 0.0  |            | 0.0     | 30  |
|   | E-learning hours inclu   | uded: 30.0   |  |                                     |  |            | •       |     |
| Learning activity and number of study hours | Learning activity  | Participation in didactic<br>classes included in study<br>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<br>need to apply knowledge from<br>humanistic, social, economic or<br>legal sciences in order to function<br>in a social environment   |  | the student has knowledge in the<br>field of bioengineering, is able to<br>connect the cause and effect of<br>natural phenomena to science |                                     | [SK5] Assessment of ability to solve problems that arise in practice       |            |         |     |
|   | [K7_U71] is able to apply<br>knowledge from humanistic,<br>social, economic or legal sciences<br>in order to solve problems  |  | the student is able to use tools for<br>creative work "design thinking   |                                     | [SU3] Assessment of ability to<br>use knowledge gained from the<br>subject |            |         |     |
|   | [K7_W71] has general knowledge<br>in humanistic, social, economic or<br>legal sciences, including their<br>fundamentals and applications   |  | the student is able to observe the<br>relationships between the natural<br>environment and modern<br>technologies                          |                                     | [SW1] Assessment of factual knowledge                                      |            |         |     |

| Subject contents                   | Biomimetics. Historical overview. Co<br>Biomimetics, as an interdisciplinary s<br>to create technological devices empl<br>Case study. Examples of technologic<br>surfaces, the elbow joint as a hinge,<br>adhesives.<br>Biomimetic construction. Utilizing nal<br>plant stems in the design of pipes).<br>Biomaterials. Materials obtained by a<br>silk as inspiration for innovative mate<br>Bioinformatics. Biocybernetics. Deve<br>Nano-sensors inspired by butterflies.<br>Bioprosthetics. Examples of solutions<br>functioning principles, and the applic<br>inventions. Materials and prosthetic of<br>Biooptics. Examples of solutions with<br>principles, and the application of this<br>Chameleons as an inspiration for car<br>Biodynamics. Examples of solutions<br>functioning principles, and the applic<br>inventions. Rehabilitation-assisting a<br>Biohydraulics. The phenomenon of c<br>Methods used in integrating biologica | ntemporary centers and research co<br>science, utilizes knowledge of the stri<br>oying these recognized mechanisms<br>cal solutions inspired by nature, such<br>burdock inspiring synthetic burrs, ge<br>ture-inspired ideas in the creation of<br>analyzing solutions available in nature<br>rials.<br>dopment of devices based on the mo<br>. Walking robots mimicking animal m<br>s with a case analysis. Discussion of<br>ation of this knowledge in specific ten<br>designs (e.g., foot prostheses, hip pr<br>n a case analysis. Discussion of bioloc<br>knowledge in specific technological<br>mouflage techniques.<br>with a case analysis. Discussion of the<br>ation of this knowledge in specific technological<br>mouflage techniques.<br>with a case analysis. Discussion of the<br>ation of this knowledge in specific technological<br>mouflage techniques. | nducted in the field of biomimetics.<br>ucture and principles of organisms<br>a laws, and relationships.<br>a as the lotus effect for hydrophobic<br>cko-inspired adhesion solutions like<br>building structures (e.g., mimicking<br>e. Aircraft skin constructions, spider<br>wements of cats, flamingos, cows.<br>ovements.<br><sup>1</sup> biological aspects: structure,<br>chnological solutions and<br>ostheses).<br>bgical aspects: structure, functioning<br>solutions and inventions.<br>biological aspects: structure,<br>chnological aspects: structure,<br>biological aspects: structure,<br>chnological aspects: structure,<br>biological aspects: structure,<br>biological aspects: structure,<br>biological aspects: structure,<br>biological aspects: structure,<br>biological aspects: structure,<br>chnological solutions and<br>biological solutions and |  |  |
|------------------------------------|--|---|---|--|--|
|                                    | Methods used in integrating biological research into new technologies.<br>Opportunities and prospects for future inventors in the context of being a student.  |   |   |  |  |
| Prerequisites<br>and co-requisites |  |   |   |  |  |
| Assessment methods and criteria    | Subject passing criteria   | Passing threshold   | Percentage of the final grade   |  |  |
|                                    | Test   | 60.0%   | 100.0%  |  |  |

| Bioinformatics. W. Robert Masel, John Eller Y. Cary Miner, Handbook, 2009, s. 321334. ISBN 978-0-08-091203-5.     Paul G. Higgs Teresa K. Attwood. Bioinformatyka i evolucija motekularna.       Elsener T., Aneshansley D.J. Spray alming in the bombardier beetle: Photografic evidence , Proc. Natl. Acad. Sci. USA, 1999, Vol. 96, pp. 0706/076, W. Standard, Anoya C. M. Sci. Sci. Sci. Sci. Sci. Sci. Sci. Sci   | Recommended reading  | Basic literature   | Johan Gielis: A generic geometric transformation that unifies a wide<br>range of natural an abstract shapes. 2003. American Journal of Botany<br>90(3): 333338.   |  |
|--|--|--|---|--|
| Paul G. Higgs Teresa K. Attwood. Bioinformatyka i evolucja<br>molekulama.       Einer T., Aneshansley D.J.Spray aiming in the bombardier baselie:<br>Pr029708.       Einer T., Aneshansley D.J.Spray aiming in the bombardier baselie:<br>Pr029708.       Kasprzak M. (2013) Wybrane algorytmy i modele grafowe w<br>boinformatyce wydawnictwo: Politechnika Poznańska ISBN<br>978-83-7775-233-3       M.Kossobudzka. Żywa latarka. Wiedza i Życie. 2004, 6, 32-33       M.Fischett, Blysk w oku laserowa korekcja wad wzroku, Świat Nauki,<br>2004, 6, 82-84       Ślesak. S. Karpiński. Biologiczne bazy danych i ich zastosowanie w<br>funktjonałnej analizie porównawczej organizmów wybrane<br>zagadniemia. Stotechniogla. 2: 892, 2010.       Vincent, J. F. V.: Bogatyreva, O. A.: Bogatyreva, N. R.: Bowyer, A. &<br>Pahl, A. K. (2009). "Biomimetrize 3014 net theory". Journal of the<br>Royal Society Interface. 31(9): 471482. doi:10.1008/nsf.2006.0127.<br>PNC: 1604643. PMID 16849244.       Nanosensors inspired by butterfly wings (Wired UK) Archived 17<br>October 2010 at the Wayback Machine. Wired co.uk. Retrieved on 23<br>April 201       Supplementary literature     Clark, O. G.; Kok, R.; Lacroix, R. (1999). "Mind and autonomy in<br>engineered biosystems" (PD): Engineering Applications of Artificial<br>intelligence. 12(3): 39308.00. Closes/n 10.1.1.44-83.5 (ci.10.1016)"<br>Stop2: 1379(99)0010-X. Archived 21 September 2009 at the<br>Wyback Machine. ESA       Resources addresses     Adresy na platformie eNauczanie:<br>Wynalizak linepirowane natura - Model ID: 33055<br>http://enauczanie.gi.edu.plmodelecourse/wew.php?id=33055<br>http://enauczanie.gi.edu.plmodelecourse/wew.php?id=33055<br>http://enauczanie.gi.edu.plmodelecourse/wew.php?id=33055 |  |  | 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.  |  |
| Elser T., Areshansley D.J.Spray aiming in the bombardier beetle:<br>Photographic evidence, Proc. Natl. Acad. Sci. USA, 1999, Vol. 96, pp.<br>97059709.       Kasprzak M. (2013) Wybrane algorytmy i modele grafowe w<br>bombomatyce wydawinciwo: Politechnika Poznańska ISBN<br>978-83-7775-233-3       M.Kossobudzka, Żywa latarka, Wiedza i Życie, 2004, 6, 32-33       M.Fischetti, Blysk w oku laserowa korekcja wad wzroku, Świat Nauki,<br>2004, 6, 62-84       Stesak, S. Karpiński, Biołogiczne bazy danych i ich zastosowanie w<br>furkcjonalnej analizie porównawczej organizmów wybrane<br>zagadnienia, Biotechnologia, s. 3952, 2010.       Vincent, J. F. V.: Bogatyreva, O. A: Bogatyrev, N. R.; Bowyer, A. &<br>Pahl, AK. (2006), "Bominusciesis practice and theory", Journal of the<br>Royal Society Interface. 3 (9): 471482. doi:10.1098/rsif.2006.0127.<br>PNC 1064643. PMID 16849244.       Vanosensors inspired by butterfly wings (Wired UK) Archived 17<br>October 2010 at the Wayback Machine, Wired.co.uk. Retrieved on 23<br>April 201       Supplementary Ilterature     Clark, O. C.; Kok, R; Lacrok, R. (1999), "Mind and autonomy in<br>engineering bosystems" (PDF); Engineering Applications of Artificial<br>intelligence. 12 (3):38939, ClasSeerX 10.1.1.54, 435, doi:10.1016/<br>S055.179(69)(0010-X. Archived from the original (PDF) on 18<br>August 2011       Example issues/<br>example justics/<br>saks being completed     Explain the concept of bionics. Show us some inspirations for everyday items from the natural environment.<br>Ray and patientions for everyday items from the natural environment.   |  |  | Paul G. Higgs Teresa K. Attwood. Bioinformatyka i ewolucja molekularna.   |  |
| Kasprzek M. (2013) Wybrane algorytmy i modele grafowe w<br>bioinformatyce wydawnictwo: Politechnika Poznańska ISBN<br>978-83-7775-23-3       M. Kossobudzka, Żywa latarka, Wiedza i Życie, 2004, 6, 32-33       M. Kossobudzka, Żywa latarka, Wiedza i Życie, 2004, 6, 32-33       M. Fischetti, Błysk w oku laserowa korekcja wad wzroku, Świat Nauki,<br>2004, 6, 82-84       Stesak, S. Karpiński, Biologiczne bazy danych i ich zastosowanie w<br>funkcjonalnej analizie porównawczej organizmów wybrane<br>zagadnienia. Biołoschorek, K. (2006). Piotechnicelostis practice and hencyr. Journal of the<br>Royal Society Interface. 3 (9) 471 1462. doi:10.1098/tsti.2006.0127.<br>PMC 1664643. PMID 16849244.       Vancen, J. F. V.: Bogatyreva, O. A: Bogatyrev, N. R.; Bowyer, A. &<br>Panh, A.K. (2006). PMID 16849244.       Nanosensors inspired by butterfly wings (Wired UK) Archived 17<br>October 2010 at the Wayback Machine. Wired co.uk. Retineved on 23<br>April 201       Supplementary literature     Clark, O. G.; Kok, R.; Lacroix, R. (1999). "Mind and autonomy in<br>engineered biosystems" (PDF). Engineering Applications of Artificial<br>Intelligence. 12 (3): 39399. OttoBeerX 10.1. 15.4635. doi:10.1016/<br>S0952-1976(99)0010-X. Archived 17 Socies X 10.1.016/<br>S0952-1976(99)0010-X. Archived 121 September 2009 at the<br>Wayback Machine, ESA       eResources addresses     Adresy na platformie eNauczanie:<br>Wynalazki inspirowane natura. 1 Moodel D: 33055<br>Wynalazki inspirowane natura. Moodel D: 33055       Example sissues/<br>xzample questions/<br>aaks being completed     Explain the concept of bionics. Show us some inspirations for everyday items from the natural environment.       Work placement     Not applicable <                  |  |  | Eisner T., Aneshansley D.J.Spray aiming in the bombardier beetle:<br>Photographic evidence , Proc. Natl. Acad. Sci. USA, 1999, Vol. 96, pp.<br>97059709,  |  |
| M.Kossobudzka, Żywa latarka, Wiedza i Życie, 2004, 6, 32-33   M.Fischetti, Błysk w oku laserowa korekcja wad wzroku, Świat Nauki,<br>2004, 6, 82-64   Ślesak, S. Karpiński, Biologiczne bazy danych i ich zastosowanie w<br>funkcjonalnej analizie portwinawczej organizmów wybrane<br>zagadnienia. Biotechnologia, s. 3952, 2010.   Vincent, J. F. V.; Bogatyreva, O. A.; Bogatyrev, N. R.; Bowyer, A. &<br>Pahl, AK. (2006). "Biomimeticistis practices and theory". Journal of the<br>Royal Society Interface: 3 (9): 471482. doi:10.1098/rsif.2006.0127.<br>PMC 168463. PMD 16849244.   Nanosensors inspired by butterfly wings (Wired UK) Archived 17<br>October 2010 at the Wayback Machine. Wired.co.uk. Retrieved on 23<br>April 201   Supplementary literature Clark, O. G.; Kok, R.; Lacroix, R. (1999). "Mind and autonomy in<br>engineered biosystems" (PDF). Engineering Applications of Artificial<br>Intelligence. 12 (3): 393396. OrteSeerx 10: 1.1.54.635. doi:10.1010/<br>S0952-1976(99)00010-X. Archived from the original (PDF) on 18<br>August 2011   Design inspired by nature Archived 21 September 2009 at the<br>Wayback Machine, ESA   eResources addresses Adresy na platformic eNauczanie:<br>Wynalazki inspirovane nature ; Moodle ID: 33055<br>http://anauczanie.go.edu.pli/moodleicourse/view.php?id=33055   Example issues/<br>example questions/<br>aaks being completed Explain the concept of bionics.Show us some inspirations for everyday items from the natural environment.   Work placement Not applicable  |  |  | Kasprzak M. (2013) Wybrane algorytmy i modele grafowe w<br>bioinformatyce wydawnictwo: Politechnika Poznańska ISBN<br>978-83-7775-233-3   |  |
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| Slesak, S. Karpiński. Biologiczne bazy danych i ich zastosowanie w<br>funkcjonalnej analizie porównawczej organizmów wybrane<br>zagadnienia. Biotechnologia, s. 3952, 2010.       Vincent, J. F. V.; Bogatyreva, O. A.; Bogatyrev, N. R.; Bowyer, A. &<br>Pahl, AK. (2006). "Bioinmeticsits practice and theory". Journal of the<br>Royal Society Interface. 3 (9): 471482. doi:10.1098/rsif.2006.0127.       PMC 1664643. PMID 16649244.       Nanosensors inspired by butterfly wings (Wired UK) Archived 17<br>October 2010 at the Wayback Machine. Wired.couk. Retrieved on 23<br>April 201       Supplementary literature     Clark, O. G.; Kok, R.; Lacroix, R. (1999). "Mind and autonomy in<br>engineered biosystems" (PDF). Engineering Applications of Artificial<br>Intelligence. 12 (3): 389399. CiteSeerX 10.1.54.635. doi:10.1016/<br>S0952-1976(99)00010-X. Archived from the original (PDF) on 18<br>August 2011       Design inspired by nature Archived 21 September 2009 at the<br>Wayback Machine, ESA       eResources addresses     Adresy na platformie eNauczanie:<br>Wynalazki inspirowane naturą - Moodle ID: 33055<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?ld=33055       Example issues/<br>example questions/<br>asks being completed     Explain the concept of bionics.Show us some inspirations for everyday items from the natural environment.<br>example duestions/<br>asks being completed  |  |  | M.Fischetti, Błysk w oku laserowa korekcja wad wzroku, Świat Nauki,<br>2004, 6, 82-84   |  |
| Vincent, J. F. V.: Bogatyreva, O. A.: Bogatyrev, N. R.: Bowyer, A. &<br>Pahi, AK. (2006), "Biomimeticsits practice and theory". Journal of the<br>Royal Society Interface. 3 (9): 471482. doi:10.1098/rsif.2006.0127.<br>PMC 1684643. PMID 16849244.       Nanosensors inspired by butterfly wings (Wired UK) Archived 17<br>October 2010 at the Wayback Machine. Wired.co.uk. Retrieved on 23<br>April 201       Supplementary literature     Clark, O. G.; Kok, R.; Lacroix, R. (1999). "Mind and autonomy in<br>engineered biosystems" (PDF). Engineering Applications of Artificial<br>Intelligence. 12 (3): 389399. CiteSeerX 10.1.1.54.635. doi:10.1016/<br>S0952-1976(99)00010-X. Archived from the original (PDF) on 18<br>August 2011       Design inspired by nature Archived 21 September 2009 at the<br>Wayback Machine, ESA       eResources addresses     Adresy na platformie eNauczanie:<br>Wynalazki inspirowane naturą - Moodle ID: 33055<br>https://enauczanie.ge.du.pl/moodle/course/view.php?id=33055       Example issues/<br>example questions/<br>aasks being completed     Explain the concept of bionics. Show us some inspirations for everyday items from the natural environment.       Nork placement     Not applicable   |  |  | Ślesak, S. Karpiński. Biologiczne bazy danych i ich zastosowanie w funkcjonalnej analizie porównawczej organizmów wybrane zagadnienia. Biotechnologia, s. 3952, 2010.   |  |
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| Supplementary literature     Clark, O. G.; Kok, R.; Lacroix, R. (1999). "Mind and autonomy in<br>engineered biosystems" (PDF). Engineering Applications of Artificial<br>Intelligence. 12 (3): 389399. CiteSeerX 10.1.1.54.635. doi:10.1016/<br>S0952-1976(99)00010-X. Archived from the original (PDF) on 18<br>August 2011       Design inspired by nature Archived 21 September 2009 at the<br>Wayback Machine, ESA       eResources addresses     Adresy na platformic eNauczanie:<br>Wynalazki inspirowane naturą - Moodle ID: 33055<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33055       Example issues/<br>example questions/<br>aasks being completed     Explain the concept of bionics.Show us some inspirations for everyday items from the natural environment.       Work placement     Not applicable   |  |  | Nanosensors inspired by butterfly wings (Wired UK) Archived 17<br>October 2010 at the Wayback Machine. Wired.co.uk. Retrieved on 23<br>April 201  |  |
| Design inspired by nature Archived 21 September 2009 at the Wayback Machine, ESA     eResources addresses   Adresy na platformie eNauczanie: Wynalazki inspirowane naturą - Moodle ID: 33055 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33055     Example issues/ example questions/ aasks being completed   Explain the concept of bionics.Show us some inspirations for everyday items from the natural environment.     Work placement   Not applicable   |  | Supplementary literature   | Clark, O. G.; Kok, R.; Lacroix, R. (1999). "Mind and autonomy in<br>engineered biosystems" (PDF). Engineering Applications of Artificial<br>Intelligence. 12 (3): 389399. CiteSeerX 10.1.1.54.635. doi:10.1016/<br>S0952-1976(99)00010-X. Archived from the original (PDF) on 18<br>August 2011 |  |
| eResources addresses   Adresy na platformie eNauczanie:<br>Wynalazki inspirowane naturą - Moodle ID: 33055<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33055     Example issues/<br>example questions/<br>asks being completed   Explain the concept of bionics.Show us some inspirations for everyday items from the natural environment.     Work placement   Not applicable   |  |  | Design inspired by nature Archived 21 September 2009 at the Wayback Machine, ESA  |  |
| Example issues/   Explain the concept of bionics. Show us some inspirations for everyday items from the natural environment.     example questions/   asks being completed     Work placement   Not applicable   |  | eResources addresses   | Adresy na platformie eNauczanie:<br>Wynalazki inspirowane naturą - Moodle ID: 33055<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33055   |  |
| Work placement     Not applicable  | Example issues/<br>example questions/<br>tasks being completed | Explain the concept of bionics. Show us some inspirations for everyday items from the natural environment. |   |  |
|  | Work placement   | Not applicable   |   |  |