Course code	Course group	Volume in ECTS credits	Course hours
BIO 2010	C	4	100

Course type (compulsory or optional)	**Compulsory**
Course level (study cycle)	**Bachelor**
Semester the course is delivered	**Spring**
Study form (face-to-face or distant)	**Face-to-face**

Course title in Lithuanian

BIONIKA IR BIOINŽINERIJA

Course title in English

BIONICS AND BIOENGINEERING

Short course annotation in Lithuanian

Kursas skirtas visiems, mėgstantiems gamtą ir neabejingiems šiuolaikinei technikai. Gamta tai didžiulis mokslininkų biuras, pateikiantis beveik visų inžinierinių problemų sprendimus. Daugelis gamtoje naudojamų įrankių, įrengimų ir konstrukcijų yra sukurta subtiliau bei veikia efektyviau nei žmonių sukonstruoti. Dalyko tikslas - supažindinti arba pagilinti jau turimas žinias apie biologinių organizmų funkcionavimo mechanizmus, padėti geriau suvokti negyvosios ir gyvosios gamtos vienovę, suprasti kur ir kaip konkretūs gamtos dėsniai veikia biologinėse sistemose, kaip gamtos idėjas, kuriant įrankius, konstrukcijas ir mechanizmus, žmonės taiko technikoje.

Short course annotation in English

With billions of years of experience, nature conducts research in every branch of engineering and science. Nature's designs and capabilities have always inspired technology, from the use of tongs and tweezers to genetic algorithms and autonomous legged robots. Taking a systems perspective, this field is examined from every angle. Approaches to biomimetics including a new perspective on the mechanization of cognition and intelligence, as well as defense and attack strategies in nature, their applications, and potential are discussed. The field from modeling to applications and from nano- to macro-scales, beginning with an introduction to principles of using biology to inspire designs as well as biological mechanisms as models for technology is reviewed. The following topics are discussed: evolutionary robotics; genetic algorithms; molecular machines; multifunctional, biological-, and nano- materials; nastic structures inspired by plants; and functional surfaces in biology. Looking inward at biological systems, the course covers the topics of biomimetic materials, structures, control, cognition, artificial muscles, biosensors that mimic senses, artificial organs, and interfaces between engineered and biological systems.

Prerequisites for entering the course

General Biology BIO1001, Calculus I MAT 1011, Physics I FIZ1007

Course aim

This course is an introduction to the field of bionics. “Bionics” (from Greek words bios, meaning life, and mimesis, meaning to imitate) is a new discipline that studies nature’s best ideas and then imitates these designs and processes to solve human problems. The aim of the course is to provide the basic knowledge about the functioning of biological organisms, understand where and how certain laws of nature are operating in biological systems and might be applied to technology.
Students are introduced to the basic knowledge of how to design bio-engineered systems, processes and elements and how to apply knowledge dealing problems in bioengineering.

Links between course outcomes and criteria of learning achievement evaluation

Course outcomes	Criteria of learning achievement evaluation
To provide specific knowledge and practical skills in the fields of engineering and biotechnology.	By the end of the course, student will have a solid understanding of history, basic terminology of bionics, biomimetics examples of how ideas of the nature might be used in technology for the instruments, constructions, mechanisms and processes development.
To be to able apply the knowledge dealing qualitative and quantitative known and	Understands where and how certain laws of nature are operating in biological systems.

unknown biotechnological tasks.	Assess lifelong engineering solutions that were implemented in biological systems.
To be able to model bio-engineering systems, processes and their elements and apply the knowledge dealing biotechnological problems.	Is capable to design bio-engineering systems, processes and elements and also to apply knowledge dealing problems in bioengineering.

Content (topics)

1. Instruments (pliers, tweezers, suckers, drills, folding tools, hinges, hooks, etc.).
2. Building in nature, architectural bionics.
3. Building materials (solid, elastic, soft, etc.).
4. Carcass buildings. Underground and underwater constructions.
5. Heating, air conditioning and ventilation in nature, heat insulation. Thermoregulation (radiators, recuperation).
6. Mechanical-electric engines, the smallest known natural mechanical-electrical rotary engine - F1-ATPase. Principles of the operation.
7. Circulating system (circulatory, respiratory and other systems).
8. Movement (walking, running, swimming, flying, etc.). Walking machines, robots and manipulators.
9. Reaction motion systems in nature and engineering.
10. Navigation in the environment: principles and mechanisms (night vision devices, echolocation, electroreception, magnetoreception, etc.).
11. Resonant systems.
12. The war in living nature: camouflage, defense and attack (armor, spines, teeth, poisons, acids).
13. Electrical generators in biology and their use.
14. Organisms control systems (nervous system, muscles).
15. Robots and the humans: similarities and differencies.
16. Brain and computers.
17. Bionanotechnologies in living nature and technology.
18. Production of energy in the nature, the future of energy.
19. Ecosystem as an example of waste-free production for industry.

Practical works

1. Analysis of the reaction systems.
2. Analysis of the circulating system.
3. Self-cleaning poperties of hydrophobic surface.
4. Omar claw structure, biomechanical properties and functions.
5. Dynamography of the animal jumping event.
6. Modeling of the bio-electric generator system.

Distribution of workload for students (contact and independent work hours)

Lectures – 45 hours, laboratory work – 15 hours, individual work – 35 hours, consultations, and exam – 5 hours. Total 100 h.

Structure of cumulative score and value of its constituent parts

Final assessment sums the assessments of written final examination (50%), written mid-term examination (27%) and assessment of laboratory works (23%).

Recommended reference materials

No.	Publication year	Authors of publication and title	Publishing house	Number of copies in		
				University library	*Self-study rooms*	*Other libraries*
Basic materials						
1.	2010	A. Mukherjee (Ed.)	In-Tech,		1	

		Biomimetics, Learning from Nature. ISBN 978-953-307-025-4, 534 p.	Vukovar			
2.	2005	Y. Bar-Cohen, Biomimetics: Biologically Inspired Technologies. ISBN: 978-0849331633, 552 p.	CRC Press, Boka Raton, NY		1	
3.	2010	A. Gleich, C. von Pade, U. Petschow, E. Pissarskoi, Potentials and Trends in Biomimetics. 200 p. ISBN: 978-3-642-05245-3 (Human Physiology)	CRC Press, Boka Raton, NY		1	
Supplementary materials						

Course programme designed by

Dr. Raminta Rodaitė–Riševičienė, Faculty of Natural Sciences, Department of Biology