COURSE DESCRIPTION CARD - SYLLABUS

Course name
Thermal problems in biomedical engineering [S1IBio1E>ZT]

Course

Field of study
Biomedical Engineering

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
English

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of physics, mathematics and mechanics; skills of logical thinking; association of knowledge of many branches; geting and using information form library and internet; social expertise: needs of continuous learnig, geting new knowledge

Course objective

Getting knowledge about thermal phenomena with special treatment for biomedical engineering

Course-related learning outcomes

Knowledge:
1. Student He/she has detailed knowledge in the area of biophysics which allows him/her to describe thermodynamics of open systems, states of equilibrium exchange, streams, transport in biological systems, intermolecular forces, kinetics of enzymatic reactions, membrane and diffusion potential, propagation of nervous impulses, information transfer through cell membrane, intramolecular and intermolecular communication - hormones and neurotransmitters, impact of external fields on living organisms, biophysics of the senses, mechanics of muscle contractions, mechanics of biological fluids. [K2_W014].

Skills:
1. He/she knows how to retrieve information from literature, databases and other properly selected sources (also in English) in the area of biomedical engineering; in particular he/she knows how to describe issues in biochemistry and biophysics and how to combine this information with technical aspects and engineering design, how to interpret it and how to draw conclusions and formulate and justify opinions [K2_U01].
2. He/she has the skill of self-learning [K2_U05].
3. He/she knows how to apply analytical, simulation and experimental methods to formulate and solve engineering tasks. He/she knows how to formulate problems and how to use mathematical methods to analyze technical issues; he/she knows how to explain the role of chemical transformations in industrial processes. [K2_U10].

Social competences:
1. He/she is well aware of the necessity for continuous learning and knows how to inspire and organize the process of learning of other people [K2_K01].
2. He/she is aware of the importance and understanding of non-technical aspects and results of engineering activities including its influence on the environment involving responsibility for decisions taken [K2_K02].
3. He/she knows how to cooperate and work in teams assuming various roles within [K2_K03].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
Written test of 5 general questions (positive note for minimu 3 correct answers: <3 - ndst, 3 - dst, 3,5 - dst+, 4 - db, 4,5 - db+, 5 - bdb) done at theend of semester.
Laboratorium:
Written test of 5 excerises of subjects realised during semester (positive note for minimu 3 correct answers: <3 - ndst, 3 - dst, 3,5 - dst+, 4 - db, 4,5 - db+, 5 - bdb) done at theend of semester.

Programme content

Lecture:
1. Basic characteristics of thermal phenomena. Modern materials for medical equipment with demanded thermal properties. Materials with thermal conduction coefficient dependent on temperature. Composite materials, functionally graded materials.
2. Fundamentals of temperature distribution Stationary temperature field. Transient heat flow. Problem of natural convection.
3. Thermal stresses in medical equipment, in elements of medical instruments, implants.
4. Thermal problems in composite materials. Effective characteristics of materials (effecive themal conductivity coefficient).
5. Inverse problems of thermal conductivity in medical equipment construction.
6.Temperature field (flow of heat, steady field) in medical equipment (incubators for babies, laboratory dries, criotherapy boxes).
Laboratorium:
1. Basic thermal characteristics in modern materials (materials of heat conductivity coefficient dependent on temperature, composite material, functionally graded materials
2. Calculations of steady-state temperature field in material of constant thermal conductivity coefficients.
3. Computations of transient temperature field in material of constant thermal conductivity coefficients
4. Problem of natural convection - calculation of heat transfer.
5. Calculations of effective material characteristics related to the heat transfer..
6. Construction of medical equipment with demanded thermal characteristics- inverse problems.

Course topics

none

Teaching methods

Lecture:
Multimedia presentation (images, graphs, videos, simulations)
Laboratorium:
Numerical experiment - computer simulations; Presentation of obtained results; practical work of students - preparing of computer programs to perform simulation; discussion;

Bibliography

Basic:
1. S. Wiśniewski, Termodynamika techniczna, Wydawnictwa Naukowo-Techniczne, Warszawa 2005
2. Y. C. Fung, S. Chien, Introduction to bioengineering, World Scientific, London 2001

Additional:
1. M. Cerrolaza, M. Doblare, G Martinez, B. Calvo, Computational bioengineering: current trends and applications, Imperial College Press, London 2004

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00