COURSE DESCRIPTION CARD - SYLLABUS

Course name
Aerosol bioengineering [S2IChiP1-IBiB>BA]

Course

Field of study
Chemical and Process Engineering

Year/Semester
1/2

Area of study (specialization)
Bioprocesses and Biomaterials Engineering

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other (e.g. online)
0

Tutorials
15

Projects/seminars
0

Number of credit points

2,00

Coordinators

dr inż. Magdalena Matuszak
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Lecturers

Prerequisites

Basic knowledge of chemical, process and bioprocess engineering is required from the student. He should also have the ability to analyze the obtained measurement data in the field of chemical engineering and technology and perform mathematical calculations.

Course objective

The aim of education is to learn and understand the importance of process engineering in biochemical issues. Discussion of the basic issues in the field of the engineering of aerosol therapy, the atomization process, medical inhalers, medical products used in pharmacy and inhalation, and also methods of increasing the effectiveness of nebulization. Acquisition by students of selected skills and/or knowledge in the areas of issues related to the development of pharmaceutical products and aerosol therapy and the problems in this area. Providing the basis for understanding modern methods of measuring aerosol properties (analysis of micro- and macro-parameters of the spraying process), modeling the flow in specific areas of the respiratory tract, quality testing of pharmaceutical products. Getting to know the operation and operation of interactive calculators for the deposition of aerosol particles.

Course-related learning outcomes

Knowledge:
1. has extended and deepened knowledge in the field of mathematics and computer science necessary for modeling, planning and characterization of aerosol generation processes. k_w01
2. has an extended knowledge of aerosol therapy, which allows to understand the physical processes related to the delivery of drugs to the patient"s respiratory tract. k_w02
3. has a well-established and expanded knowledge of the selected specialization. k_w12

Skills:
1. has the ability to obtain and critically evaluate information from literature, databases and other sources, and to formulate opinions and reports on this basis. k_u01
2. has the ability to present research results in the form of presentation on aerosol bioengineering. k_u06
3. the student is able to verify the concepts of engineering solutions in relation to the state of

Social competences:
1. he is able to interact and work in a group, assuming various roles in it. k_k03
2. student is able to think and act in a creative and enterprising. k_k06

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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The knowledge acquired during the lectures is verified by an exam in the form of a multiple-choice test covering the material presented in the lectures. The test consists of 20-25 questions (closed). Passing threshold: 50% of points. The same method of completing the course is used for both stationary and remote classes.
As part of the classes in the form of tutorials: Students are required to participate in classes, actively participate in the discussed issues and prepare and present their own presentation on a given topic. Assessment is also based on class activity, team spirit and creativity in solving scientific problems. Completion of the course requires a positive grade from the test scheduled at the end of the course. The knowledge gained during the lecture is verified by the final test. It takes place during the last class and includes solving three-word problems. Passing threshold: 50% of points. The same method of completing the course is used for both stationary and remote classes.
Program content
Material presented as part of the lecture:
a) theoretical basis in the field of aerosol therapy:
• aerosol therapy - basic issues and dynamics of development,
• factors affecting the effectiveness of treatment with inhalation methods,
• basic parameters related to the spraying process,
• influence of liquid properties on the atomization process in medical inhalers
• structure and functioning of the respiratory system,
• the respiratory system acting as a mass exchanger and solid particle separator,
• dynamics of inhaled drug in the form of an aerosol.
b) principle of operation and classification of medical inhalers:
• nebulizers:
- pneumatic,
- ultrasonic,
• inhalers:
- pressurized metered dose inhaler (pMDI),
- dry powder inhalers (DPI),
• new generation devices:
- vibrating mesh,
- electrohydrodynamic atomization (EHDA),
- soft mist inhaler (Respimat SMI),
- AERx technology, simple pressure atomization,
- therapeutic aerosols produced by the vapor condensation,
- electronically controlled adaptive systems.
c) methods to increase the efficiency of nebulization:
• modifications to the design of medical inhalers,
• modifications to the operating parameters of atomizers,

• modification of the properties of medical preparations.
d) engineering a pharmaceutical product intended for inhalation:
• ways of delivering drugs to the patient"s body
• individual stages of the product design process,
• designing the drug formulation process.
The material presented during the tutorials:
a) analysis of micro- and macro-parameters of the spraying process
b) transport processes in biological systems
c) air flow in the respiratory system
d) modeling the flow in selected elements of the respiratory tract
(e) methods of measuring aerosol properties and qualitative testing of pharmaceutical products intended for inhalation
f) quantifying the inhalation process to deliver the medicament to the respiratory tract
g) interactive aerosol deposition calculators
h) an engineer of solid and liquid pharmaceuticals in aerosol therapy.

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Teaching methods

The subject is carried out in the form of lectures with the use of multimedia presentations combined with discussion and elements of problem-based teaching.
In addition, the subject is carried out in the form of tutorials in the classroom, combined with theoretical introduction. As part of independent work during the classes, students work with source materials, participate in discussions, solve tasks, formulate their own opinions, prepare a presentation.

Bibliography

Basic
1. Sosnowski, T.R., 2012. Aerozole wziewne i inhalatory, Politechnika Warszawska, Warszawa.
2. Moskal, A., 2012. Przepływy w organizmie człowieka. Wstęp do biomechaniki płynów, Politechnika Warszawska, Warszawa.
3. Henczka, M., 2012. Inżynieria produktu farmaceutycznego, Politechnika Warszawska, Warszawa.
4. Moskal, A., 2017. Mechanika aerozoli, Politechnika Warszawska, Warszawa.
Additional
1. Shepherd, H.R., 1961. Aerosols: science and technology, Interscience, New York.

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