COURSE DESCRIPTION CARD - SYLLABUS

Course name
Fundamentals of Biotechnology

Course

Field of study
Pharmaceutical Engineering

Year/Semester
1/1

Area of study (specialization)
-

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
prof. dr hab. Jaromir Budzianowski - lecture

Responsible for the course/lecturer:
prof. dr hab. Barbara Thiem - laboratory classes

Prerequisites

Students starting this subject should have basic knowledge in biology, chemistry, physics.

Course objective

Knowledge of various biotechnological processes useful in pharmacy and used to obtain bioactive substances, in particular low-molecular secondary metabolites, biopolymers, and recombinant therapeutic proteins and nucleic acids, such as biosynthesis or biotransformation using fermentation methods, recombinant DNA technology, hybridoma technology, biocatalyst technology immobilized, metabolic bioengineering. To acquaint students with the influence on the properties of therapeutic proteins in the way they are obtained in various expression systems and various modifications of their molecules. Understanding the concept of therapeutic cloning, xenotransplantation and gene therapy. Getting to know modern techniques used in plant biotechnology, expanding knowledge about the development and importance of cell and tissue cultures in scientific research and perspectives of their applications. Practical knowledge of the basic procedures used in plant in vitro cultures.

Course-related learning outcomes

Knowledge

1. has knowledge of the production potential of living cells and its regulation and use by appropriate technological methods (K_W4).

2. has knowledge of the ability to biosynthesis and biotransformation of specific cells and their parts and the possibility of use for various purposes, in particular for the preparation of drugs by biotechnology methods, which is within the scope of pharmaceutical engineering (K_W5).

3. knows the scheme of the biotechnological process, its stages, the impact of various factors determining the course of this process and the ways of their presentation (K_W9).

4. knows the methods of obtaining certain biologically active substances using various biotechnological methods and increasing their production. Knows how to improve the properties of medicinal substances produced by biotechnological methods (K_W14).

Skills

1. is able to choose the appropriate biotechnological method to produce a specific type of product that is used for medicinal purposes (K_U2).

2. uses correct chemical, pharmaceutical and biotechnological terminology and nomenclature of compounds obtained by biotechnological methods, also in a foreign language (K_U3).

3. is able to establish and conduct selected types of plant cultures using basic research tools specific to in vitro cultures (K_U12).

4. is able to develop documentation (protocol) of undertaken research and perform simple biological measurements (K_U5).

Social competences

1. is ready to critically assess his/her knowledge, understands the need for further education, supplementing disciplinary knowledge and raising his professional, personal and social competences, understands the importance of knowledge in solving problems and is ready to seek expert opinions (K_K1).

2. is aware of the importance of understanding non-technical aspects and effects of engineering activities, including its impact on the environment and the associated responsibility for decisions, correctly recognizes problems and makes the right choices related to the exercise of the profession, in accordance with the principles of professional ethics, care for achievements and traditions of the profession (K_K3).

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired during the lecture is verified by a test consisting of 30 questions. Final issues on the basis of which questions are prepared will be sent to students via the WISUS-AKSON portal. Assessment threshold: 60% of correct answers. Skills acquired in the laboratory are checked by passing short entry tests and / or oral answers, preparing documentation of research tasks carried out (protocols) and preparing a report from the analysis of scientific publications.

Programme content

Lectures. 1. Basic principles of biotechnology: living cells and organisms as bioreactors, biochemical basis, possibilities of regulation by technological methods. 2. Characteristics of organisms used in traditional biotechnology. General principles of conducting microbial (bacterial and fungal) cultures to carry out biosynthesis and biotransformation processes in them. 3. General principles of conducting biotechnological production processes - cell culture conditions - biological and technological aspects, the scheme of the biotechnological process (the concept of trophophase and idiophase as well as upstream processing and downstream processing). 4. Immobilized biocatalysts and their applications. 5. Protoplast fusion and its applications. 6. Molecular biotechnology: preparation of therapeutic proteins using recombinant DNA technology, expression systems, glycosylated proteins and non-glycosylated proteins. 7. Improving the properties of recombinant therapeutic proteins (amino acid sequence change, PEG-ylation, protein fusion, N-glycosylation). 8. Therapeutic nucleic acids - obtaining, improving properties (changes in the chemical structure - introduction of S, F and PEG-ylation atoms) 9. Animal biotechnology in the production of therapeutic proteins. 10. Plant biotechnology in the preparation of recombinant therapeutic proteins, stable and transient expression. 11. Comparison of the effectiveness of producing the same therapeutic protein in different expression systems (bacteria, fungi, insects, mammals, plants). 12. Plant biotechnology in the preparation of therapeutic secondary metabolites. 13. Metabolic bioengineering - transfer of secondary metabolism genes between different organisms. 14. Concepts of therapeutic cloning, xenotransplantation and gene therapy.
Labolatory classes. Practical knowledge of laboratory equipment and principles of working under sterile conditions in a laminar chamber. Preparation of solutions of selected plant growth and development regulators as well as specific medium. Methods for sterilizing vessels, tools and media. Practical knowledge of the method of surface sterilization of various plant explants. Establishment of sterile primary culture. Induction and passage of callus and cell culture in suspension. Microscopic assessment of cell viability. Plant micropropagation using methods of apical and nodal shoot fragments, and induction of adventitious shoots (direct and indirect organogenesis) and organ culture. Roots transformed by inoculation with Agrobacterium rhizogenes. Production of somatic seeds (= artificial seeds) - pelleting of sterile plant material with calcium alginate.

Teaching methods

Lecture: multimedia presentation. Laboratory classes: experimental work in the laboratory of plant in vitro cultures and preparation of a record of conducted experiments in the form of a protocol.

Bibliography

Basic

1. Chmiel A. Biotechnologia – podstawy mikrobiologiczne i biochemiczne, PWN, Warszawa, 1994.

2. Malepszy St. (red.) Biotechnologia roślin, Wydawnictwo Naukowe PWN, Warszawa, 2009.

3. Ratledge C, Kristiansen B (red.): Podstawy biotechnologii., Wyd. Nauk. PWN, Warszawa, 2011.

Additional

1. Bednarski W., Fiedurek J. (red.) Podstawy biotechnologii przemysłowej , WNT, 2009.

2. Buchowicz J. Biotechnologia molekularna , Wyd. Nauk. PWN, Warszawa, 2012.

3. Crommelin DJA, Sindelar RD, Meibohm B (eds) Pharmaceutical biotechnology: fundamentals and applications (Third Edition), Informa, New York, 2008.

4. Fiedurek J. (red.) Podstawy wybranych procesów biotechnologicznych , WNT, 2014.

5. Fiedurek J., Bednarski W. Podstawy biotechnologii przemysłowej , WNT, 2012.

6. Gad Sh. C. (ed.) Handbook of pharmaceutical biotechnology , Wiley, New Jersey, 2007.

7. Kayser O. Podstawy Biotechnologii Farmaceutycznej , Wydawnictwo Uniwersytetu Jagiellońskiego, Kraków, 2006.

8. Kayser O., Müller R. (red.) Biotechnologia farmaceutyczna , PZWL, Warszawa,, 2003.

9. Legocki Andrzej (red.) Transformowanie i regeneracja roślin. Poradnik laboratoryjny, Instytut Chemii Bioorganicznej, Poznań, 1990.

10. Walsh G. Biopharmaceuticals. Concepts and Applications , John Wiley&Sons, 2007.

11. Woźny A., Przybył K. (red.) Komórki roślinne w warunkach stresu. Tom II. Komórki in vitro. , Wyd. Naukowe UAM, Poznań, 2004.

12. Journal published by the Biotechnology Committee at the Polish Academy of Sciences. BioTechnology - information review; www.biotechnologia.pl; www.e-biotechnologia.pl.

13. Other journals with the word "biotechnologia" or "biotechnology" in their title.

Breakdown of average student's workload

	Hours	ECTS
Total workload	60	2,0
Classes requiring direct contact with the teacher	35	1,2
Student's own work (literature studies, preparation for laboratory classes, preparation for tests) [1]	25	0,8

[1] delete or add other activities as appropriate