

## Subject card

|                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                          |                                             |                                     |         |                                                                                                                                                |     |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|---------------------------------------------|-------------------------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Subject name and code                       | Basis of genetic engineering, PG_00207444                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                          |                                             |                                     |         |                                                                                                                                                |     |
| Field of study                              | Biology                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          |                                             |                                     |         |                                                                                                                                                |     |
| Date of commencement of studies             | October 2026                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                          | Academic year of realisation of subject     |                                     |         | 2028/2029                                                                                                                                      |     |
| Education level                             | Bachelor's studies                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                          | Subject group                               |                                     |         | Obligatory subject group in the field of study<br>Optional subject group<br>Subject group related to scientific research in the field of study |     |
| Mode of study                               | full-time studies                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                          | Mode of delivery                            |                                     |         | at the university                                                                                                                              |     |
| Year of study                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                          | Language of instruction                     |                                     |         | Polish                                                                                                                                         |     |
| Semester of study                           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                          | ECTS credits                                |                                     |         | 1.0                                                                                                                                            |     |
| Learning profile                            | academic                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                          | Assessment form                             |                                     |         | credit                                                                                                                                         |     |
| Conducting unit                             | Laboratory of Microbial Biochemistry -> Department of General and Medical Biochemistry -> Faculty of Biology -> Rector                                                                                                                                                                                                                                                                                                                                                          |                                                          |                                             |                                     |         |                                                                                                                                                |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                          | prof. dr hab. Sabina Kędzierska-Mieszkowska |                                     |         |                                                                                                                                                |     |
|                                             | Teachers                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                          |                                             |                                     |         |                                                                                                                                                |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Lecture                                                  | Tutorial                                    | Laboratory                          | Project | Seminar                                                                                                                                        | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 15.0                                                     | 0.0                                         | 0.0                                 | 0.0     | 0.0                                                                                                                                            | 15  |
|                                             | E-learning hours included: 0.0                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                          |                                             |                                     |         |                                                                                                                                                |     |
| Learning activity and number of study hours | Learning activity                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Participation in didactic classes included in study plan |                                             | Participation in consultation hours |         | Self-study                                                                                                                                     | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 15                                                       |                                             | 1.0                                 |         | 9.0                                                                                                                                            | 25  |
| Subject objectives                          | The main goal of the course is to familiarize students with the basic concepts and techniques of genetic engineering and its practical application in various areas of our lives. Class participants have the opportunity to acquire skills in: (1) designing experiments related to cloning genes, examining their expression and identifying their protein products; (2) use of publicly available sequence and structure databases; (3) preparing a multimedia presentation. |                                                          |                                             |                                     |         |                                                                                                                                                |     |

| Learning outcomes   | Course outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Subject outcome   | Method of verification        |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------------------|
|                     | [BIOLL3_W07] knows the development of biology as a science, its connections with other disciplines and the principles of using biological knowledge in the economy and social life, including ways that are entrepreneurial                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |                               |
|                     | [BIOLL3_W05] has advanced knowledge of experimental methods, laboratory and field techniques, and the principles of planning and conducting biological research                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |                               |
|                     | [BIOLL3_U09] is able to learn independently and plan her/his own development in an organized and controlled manner                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |                               |
|                     | [BIOLL3_U05] is able to prepare written papers and oral presentations on biological issues, using specialized terminology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                   |                               |
|                     | [BIOLL3_U03] is able to search for, select and critically analyze information from various sources, including scientific literature and electronic databases, as well as read and understand scientific texts in Polish and English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                               |
|                     | [BIOLL3_K04] is ready to apply the principles of bioethics, scientific integrity and honesty, including the proper handling of biological material and respect for intellectual property                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                   |                               |
| Subject contents    | [BIOLL3_K01] is ready to critically evaluate her/his biological knowledge and continuously update and develop it, taking into account scientific advances and the needs of practice                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                               |
|                     | The main topic of the lecture is the process of cloning genes of both prokaryotic and eukaryotic origin in various expression systems. During the classes, the following topics are discussed: selected prokaryotic vectors (plasmids, phages, cosmids) and eukaryotic vectors; enzymology of genetic engineering; stages of the gene cloning process (including mRNA purification, cDNA synthesis, identification of the cloned gene); basic methods used in genetic engineering (DNA sequencing, PCR, RT-PCR, nucleic acid hybridization techniques: Southern blot, Northern blot); popular expression systems such as the bacterial expression system involving T7 phage RNA polymerase; identification of protein products of cloned genes (immunodetection and protein microsequencing). The lecture topics are selected to cover a coherent thematic and experimental sequence from the process of gene cloning to obtaining a purified protein, i.e. the product of the cloned gene. |                   |                               |
|                     | Completed courses: Biochemistry, Molecular biology with biotechnology. Knowledge of the structure and properties of basic types of biological macromolecules, molecular mechanisms of the flow of genetic information and the regulation of its expression.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |                               |
|                     | Subject passing criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Passing threshold | Percentage of the final grade |
|                     | completion of final work - preparation of a project for cloning a selected gene or written assessment with test questions and open tasks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 51.0%             | 100.0%                        |
|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |                               |
|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |                               |
| Recommended reading | Basic literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |                               |
|                     | <p><b>A.1.</b> Used during classes</p> <p>The course is an original study based on many years of study of source materials and my own research work.</p> <p><b>A.2.</b> studied independently by the student</p> <p>Original experimental and review works provided by the lecturer and source materials selected by the student. Lecture materials provided by the lecturer. Buchnowicz J. (ed.). 2012. Molecular biotechnology. Genetic modifications, progress, problems. PWN, Warszawa. Brown T. A. 2009. Genomes. PWN, Warsaw.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                   |                               |

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|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                | Supplementary literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p><b>Additional literature:</b> Ledakowicz S (ed.) 2014. Biochemical engineering. WNT, Warsaw.</p> <p>Berg J. M., Tymoczko J. L., Stryer L. 2009. Biochemistry. PWN, Warsaw.</p> <p>Watson J. D. et al. 2006. Recombinant DNA: Genes and Genomes- A Short Course. Baskerville Beucher.</p> <p>Węgleński P. (ed.). 2007. Molecular genetics. PWN, Warszawa.</p> <p>Hanych, B. Kędzierska, S., Walderich B., Uznański, B. and Taylor A (1993) Expression of the Rz gene and the overlapping Rz1 reading frame present at the right end of the bacteriophage lambda genome. Gene, 129: 1-8.</p> <p>Kędzierska, S., Wawrzynów, A. and Taylor A. (1996) The Rz1 gene product of bacteriophage lambda is a lipoprotein localized in the outer membrane of <i>Escherichia coli</i>. Gene, 168: 1-8</p> |
|                                                                | eResources addresses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Example issues/<br>example questions/<br>tasks being completed | <p><b>Sample problem tasks:</b> 1. Propose a bacterial expression system that could be used for efficient overproduction of a protein well tolerated by host cells (full sequence of experiments from cloning to obtaining a purified protein). 2. Propose a bacterial expression system that could be used for efficient overproduction of a protein poorly tolerated by host cells (full sequence of experiments from cloning to obtaining a purified protein). 3. Suggest experiments that would enable testing the activity of a potential promoter of the selected gene.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Work placement                                                 | Not applicable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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