SZKOŁA GŁÓWNA GOSPODARSTWA WIEJSKIEGO

# Genetic engineering I

Educational subject description sheet

## Basic information

| | |
|---|---|
| **Field of study**<br>Biotechnology<br>**Speciality**<br>-<br>**Organizational unit**<br>Faculty of Biology and Biotechnology<br>**Study level**<br>first cycle (engineering degree)<br>**Study form**<br>full-time studies<br>**Education profile**<br>General academic | **Didactic cycle**<br>2024/25<br>**Subject code**<br>BBTBTjS_D.310K.01603.24<br>**Lecture languages**<br>english<br>**Mandatory**<br>Obligatory subjects<br>**Block**<br>Major subjects<br>**Disciplines**<br>Biological sciences |

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|---|---|
| **Coordinator** | Magdalena Pawełkowicz |
| **Teacher** | Magdalena Pawełkowicz, Marcin Filipecki, Piotr Gawroński, Marek Koter, Grzegorz Bartoszewski, Agnieszka Skarzyńska-Łyżwa |

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|---|---|---|
| **Period**<br>Semester 5 | **Examination**<br>Exam<br><br>**Activities and hours**<br>Lecture: 15<br>Laboratory exercises: 45 | **Number of ECTS points**<br>6 |

## Goals

| Code | Goal |
|---|---|
| C1 | The lectures are aimed at presenting genetic engineering as an extremely dynamically developing engineering science, enabling the change of basic biological processes for research and application purposes. Genetic engineering is presented as not so much a set of advanced research methods, but also the ability to plan their sequence in the implementation of a specific task. Thus, both well-established information and the latest achievements are presented, but always in a combination with a high application potential in diagnostics, therapies and agriculture. The aim of the exercises in genetic engineering is to provide students with practical knowledge of the possibilities of genetic manipulation in accordance with the latest knowledge in this field. The topics of the exercises are selected to cover a logical thematic and experimental sequence from the knowledge and cloning of the gene from the source organism to obtaining a transgenic organism, a mutant or an edited genome. Participants of the exercises have a chance to gain laboratory skills and a holistic view of the issues of genetic engineering, with particular emphasis on their use in plant biotechnology. Students also learn to present issues / results in the form of science posters. |

## Entry requirements

knowledge of the biochemistry of genetics (especially molecular) is recommended

## Subject's learning outcomes

| Code | Outcomes in terms of | Effects | Examination methods |
|---|---|---|---|
| **Knowledge – Student knows and understands:** | | | |
| W1 | the genetic material analysis and manipulation | BTj_K3_W01_inz, BTj_K3_W05, BTj_K3_W15_inz | Written exam, Written credit, Project |
| W2 | the field of molecular research and molecular diagnostics | BTj_K3_W01_inz, BTj_K3_W02_inz, BTj_K3_W05 | Written exam, Written credit, Project |
| **Skills – Student can:** | | | |
| U1 | work with genetic material and can transform plants | BTj_K3_U01_inz, BTj_K3_U02_inz, BTj_K3_U10_inz, BTj_K3_U12_inz, BTj_K3_U13_inz | Written credit, Project |
| U2 | search for information from various sources and use it creatively | BTj_K3_U01_inz, BTj_K3_U02_inz | Written exam, Written credit, Project |
| U3 | prepare a scientific poster in the field of genetic engineering | BTj_K3_U01_inz, BTj_K3_U02_inz | Written credit, Project |
| **Social competences – Student is ready to:** | | | |
| K1 | understand the social importance of genetic manipulation | BTj_K3_K01, BTj_K3_K03 | Written exam, Written credit, Project |

## Study content

| No. | Course content | Subject's learning outcomes | Activities |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1. | Genetic engineering introduction and hitorical overview. Nobel News - discussion. Genetic engineering tools. Crisp/Cas9 technologies.  Vectors. Long fragment libraries. Library browsing methods. Use of libraries. Introduction to omics analysis. | W1, W2, U2, K1 | Lecture |
| 2. | Planning and creation of genetic constructs. Advanced use of PCR, colony PCR. DNA gel elution and AMPure XP purification. Recombinant cloning. Golden gate and TEDA, subcloning. Transformation of Arabidopsis with A.tumefaciens; discussion of major developments in Genetic Engineering (poster session) | W1, W2, U1, U2, U3, K1 | Laboratory exercises |

## Course advanced

| Activities | Methods of conducting classes |
|---|---|
| Lecture | Lecture |
| Laboratory exercises | Presentation, Teamwork, Interpreting the results, Laboratory (experiment), learning by experiment, Observation |

| Activities | Examination method | Percentage |
|---|---|---|
| Lecture | Written exam | 40% |
| Laboratory exercises | Written credit | 40% |
| Laboratory exercises | Project | 20% |

| Activities | Credit conditions |
|---|---|
| Lecture | A pass in the lecture requires a pass in the laboratory exercise part of the course. |
| Laboratory exercises | The assessment of the learning outcomes consists of:<br>1 - assessment of the tests on the material covered (4 partial tests) (40%),<br>2 - assessment of the lecture test (40%),<br>3 - project (20%), each element separately 1, 2, 3 min. 51%. The final grade ismcalculated as the sum of the points obtained for each item (including their weight).<br>In order to pass the course it is necessary to obtain (points: 1, 2, 3) 51%.<br>The following scale is used to calculate the final score:<br>100-91% points - 5.0<br>90-81% points - 4.5<br>80-71% points - 4.0<br>70-61% points - 3.5<br>60-51% points - 3.0 |

## Literature

**Obligatory**

1. Principles of Gene Manipulation and Genomics, S. B. Promrose and R. Twymann, Willey Blackwell
2. Introduction to Genetic Engineering, Desmond S. T. Nicholl, Cambridge University Press
3. Gene cloning and DNA Analysis, T.A. Brown, Willey Blackwell

**Optional**

1. Molecular Biotechnology: Principles and Applications of Recombinant DNA, B. R. Glick and C. L. Patten, ASM Press
2. Recombinant DNA Techniques: A Textbook, M. Jain, Alpha Science
3. Biochemistry, Stryer L et al., WH Freeman
4. Selected scientific articles
5. Additional interent sources indicated by the trainer

## Calculation of ECTS points

| **Activity form** | **Activity hours*** |
|---|---|
| Lecture | 15 |
| Laboratory exercises | 45 |
| Preparation for the exam | 30 |
| Preparation for remote work | 15 |
| Preparing a report | 15 |
| Preparation for exercises | 15 |
| Self-study on the content covered in class | 15 |
| | |
| **Student workload** | **Hours**<br>150 |
| **Number of ECTS points** | **ECTS**<br>6 |

* hour means 45 minutes

## Effects

| Code | Content |
|---|---|
| BTj_K3_K01 | The graduate is ready to proper storage of data, updating and extending knowledge on topics related to biotechnology and the related sciences; |
| BTj_K3_K03 | The graduate is ready to for safe work via the selection and application of a proper technique of handling, storing and disposing of laboratory materials (e.g. using proper techniques in terms of handling, storing and disposing of bacteria, chemical substances and dangerous bio-waste); |
| BTj_K3_U01_inz | The graduate can utilise proper techniques and knowledge related to biotechnology in practice, under the care of a supervisor; |
| BTj_K3_U02_inz | The graduate can perform and present an independent experiment (a final diploma thesis), which reflects features such as: e.g. competences associated with the ability of proper time management, solving a research problem as well as performing tasks and interpreting the quality of results; |
| BTj_K3_U10_inz | The graduate can critically assess the functionality and validity of technical and technological solutions used in a biotechnological process; |
| BTj_K3_U12_inz | The graduate can plan and perform experiments related to the preparation, creation and utilisation of biological material in a production process; |
| BTj_K3_U13_inz | The graduate can propose analytical methods and plan an experiment for solving engineering tasks related to various stages of creating a biotechnological product; |
| BTj_K3_W01_inz | The graduate knows and understands technologies of performing biotechnological processes |
| BTj_K3_W02_inz | The graduate knows and understands basics related to the life cycle of a biotechnological product, as well as devices and their instrumentation (measurement sensors) used in biotechnological production |
| BTj_K3_W05 | The graduate knows and understands the principles which define the three-dimensional structure of biological macromolecules, with the ability to explain and provide the examples of the relationship between structure and function |
| BTj_K3_W15_inz | The graduate knows and understands the systems currently recommended for managing quality and safety in the biotechnological industry; the principles of creating and developing the forms of individual entrepreneurship; |