***Course name:***
***Genetic engineering***

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|---|---|
| ECTS | 4 |
| Course status | *facultative* |
| Course final assessment /evaluation of outcomes | *exam* |
| Prerequisite | *knowledge of molecular biology and biochemistry on the level of undergraduate agricultural/natural studies* |

***Main field of study****:*
Agriculture and Horticulture, Biology and Biotechnology (Erasmus+)

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|---|---|
| Educational profile | general academic |
| Code of studies and education level | bachelor/engineer (SI) or master of science (SM) |
| Semester of studies | Winter or summer |
| Language of instruction | English |

**Course offered by**:

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|---|---|
| Name of faculty offering the course | Faculty of Biotechnology and Horticulture |
| Name of department offering the course | Department of Plant Biology and Biotechnology |
| Course coordinator | Dr hab. Marek Szklarczyk, prof. UAK |

**Learning outcomes**:

| Symbol of outcome | Description of the learning outcome | Reference to main field of study outcomes | Area symbol* |
|---|---|---|---|
| KNOWLEDGE – student knows and understands | | | |
| GEN_W1 | biochemical manipulations on DNA molecules and enzymes used for these purposes | EPB2_W01<br>EPB2_W04 | R, P |
| GEN_W2 | issues of recombinant protein production and in vitro mutagenesis | EPB2_W01<br>EPB2_W04 | R, P |
| GEN_W3 | basic methods of genome analysis | EPB2_W01<br>EPB2_W04 | R, P |
| GEN_W4 | transgenics in selected groups of organisms | EPB2_W01<br>EPB2_W04 | R, P |
| GEN_W5 | selected methods of gene cloning | EPB2_W01<br>EPB2_W04 | R, P |
| GEN_W6 | perspectives of recombinant DNA technology and associated social concerns | EPB2_W03<br>EPB2_W08 | R, P |
| SKILLS – student is able to | | | |
| GEN_U1 | prepare competent cells and assess their quality | EPB2_U01<br>EPB2_U05 | R, P |
| GEN_U2 | perform molecular cloning in a plasmid vector | EPB2_U01<br>EPB2_U05 | R, P |
| GEN_U3 | interpret results of DNA sequencing | EPB2_U01<br>EPB2_U05 | R, P |

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|---|---|---|---|
| GEN_U4 | operate laboratory instruments – centrifuges, spectrophotometers, electrophoresis equipment, gel documentation systems, thermocyclers and incubators | EPB2_U01<br>EPB2_U05 | R, P |
| SOCIAL COMPETENCIES – student is ready to: | | | |
| GEN_K1 | team work | EPB2_K02 | R, P |
| GEN_K2 | prevent threats associated with recombinant DNA technology | EPB2_K04<br>EPB2_K05 | R, P |
| GEN_K3 | influence social perception of genetic manipulations | EPB2_K03 | R, P |

**Teaching contents**

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|---|---|
| Lectures | 30 hours |
| Topics | Techniques for manipulation of DNA molecules<br>Methods of gene delivery<br>Production of recombinant proteins<br>In vitro mutagenesis<br>Genome editing and genome-scale reverse genetics<br>Genetically modified microorganisms and plants<br>Strategies of molecular cloning<br>High-throughput DNA sequencing<br>Socioethical aspects of genetic engineering |
| Accomplished learning outcomes | *GEN_W1, GEN_W2, GEN_W3, GEN_W4, GEN_W5, GEN_W6* |
| Means of verification, rules and criteria of assessment | *Evaluation is based on test questions, in order to earn a positive mark at least 51% of answers must be correct. Contribution to the final grade from the course – 65%.* |
| Classes: | 30 hours |
| Topics | Production of *Escherichia coli* competent cells. Control of cell competence through transformation with plasmid DNA.<br>Assessment of transformation efficiency. Isolation of plasmid vector DNA. Isolation of DNA to be cloned. Assessment of concentration and purity of the obtained DNA preparations. Control electrophoresis of the obtained DNA preparations. Restriction digest of the vector and DNA for cloning. Vector dephosphorylation.<br>Preparative electrophoresis of the digested DNA preparations – gel isolation of the linearized vector and restriction fragments (selected fraction) of DNA to be cloned. Control electrophoresis of the gel-isolated DNA fragments. Ligation of the vector and restriction fragments being cloned. Transformation of the ligation mixture into *E. coli* cells. Analysis of transformation results. Analysis of sequence chromatograms. Isolation of the recombinant protein. |
| Accomplished learning outcomes | *GEN_U1, GEN_U2, GEN_U3, GEN_U4, GEN_K1, GEN_K2, GEN_K3* |
| Means of verification, rules and criteria of assessment | *Evaluation is based on:*<br>*- individual reports from laboratory activities, contribution to the final grade from the course – 15%;*<br>*- two tests from the laboratory topics (at least 51% of correct answers to earn a positive mark), contribution to the final grade from the course – 20%.* |

**References**:

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|---|---|
| Basic | *Brown TA (2016) Gene cloning and DNA analysis: an introduction, 7th edn. Wiley-Blackwell*<br>*Howe C (2007) Gene cloning and manipulation, 2nd edn. Cambridge University Press*<br>*Nicholl DST (2008) An introduction to genetic engineering, 3rd edn. Cambridge University Press* |
| Supplementary | *Brown TA (2017) Genomes 4, 4th edn. Garland Science*<br>*Green MR, Sambrook J, MacCallum P (2012) Molecular cloning: a laboratory manual, 4th edn. Cold Spring Harbor Laboratory Press*<br>*Genetic Engineering & Biotechnology News (GEN) – Mary Ann Liebert, Inc. (journal)* |

**Structure of learning outcomes**

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|---|---|
| Area of academic study: R – agricultural, forestry and veterinary sciences | 2 ECTS** |
| Area of academic study: P – biological sciences | 2 ECTS** |

**Structure of student activity**

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|---|---|---|---|---|
| Contact hours | | 68 | hrs. | 2.7 ECTS** |
| Including: | lectures | 30 | hrs. | |
| | classes and seminars | 30 | hrs. | |
| | consultations | 4 | hrs. | |
| | participation in research | 0 | hrs. | |
| | obligatory traineeships | 0 | hrs. | |
| | participation in examination | 4 | hrs. | |
| e-learning | | 0 | hrs. | 0 ECTS** |
| student own work | | 32 | hrs. | 1.3 ECTS** |

*Areas of academic study in the fields of: H- humanities; S - social studies; P – biological sciences; T – technological sciences; M- medical, sport and health sciences; R – Agricultural, forestry and veterinary sciences; A – the arts
** stated with an accuracy to 0.1 ECTS, where 1 ECTS = 25 - 30 hours of classes