# COURSE UNIT DESCRIPTION

| Course unit title | |
|---|---|
| Biotechnology | |

| Lecturer(s) | Department |
|---|---|
| Coordinator: lect. dr. Audrius Gegeckas | Vilnius University, Life Sciences Center, Institute of Biosciences, Sauletekio Ave. 7, Vilnius |

| Cycle | | Type of the course unit |
|---|---|---|
| First | | Compulsory |

| Mode of delivery | Period of delivery | Language of instruction |
|---|---|---|
| Face to face | Autumn semestre | English |

| Prerequisites and co-requisites |
|---|
| Biology, Biochemistry, Genetics, Chemistry |

| Number of credits | Student's total workload | Contact hours | Self-study hours |
|---|---|---|---|
| 5 | 133 | 64 | 69 |

| Programme competences to be developed. |
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| A.4. ability to explain structural and functional properties as well as transformations of organic and essential biological molecules.<br>A.5. ability to explain and apply principles of biotechnology, molecular biology and genetic engineering in practical work.<br>C.1. ability to apply theoretical knowledge in solving quantitative and qualitative problems of both familiar and unfamiliar nature.<br>C.2. ability to identify problems and propose problem-solving approaches.<br>C.3. ability to draw science-based conclusions.<br>D.1. ability to communicate in written and oral forms.<br>D.3. ability to present scientific information to specialist and non-specialist audiences. |

| Learning outcomes of the course unit | Teaching and learning methods | Assessment methods |
|---|---|---|
| After successful completion of this course student should be able to:<br>• Develop and apply modern life sciences research-based knowledge about biotechnological processes.<br>• Combine, integrate and apply knowledge in biology, chemistry, cell biology, genetics and biochemistry for analysis and development of biotechnological processes.<br>• Carry out basic biotechnological procedures.<br>• Select appropriate biotechnological methods for the investigation of biological molecules and biological processes.<br>• Interpret the data obtained and draw science-based | Problem-oriented teaching during lectures. Textbook reading and analysis of literature. Discussions during the lectures. Problem solving classes (tutorials) | Two intermediate achievement tests (written) - for the correct answer of the question students have to propose the solution of the problem. Presentation of biotechnological-based problem solving. Final exam (written) - for the |

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| conclusions.<br>• Read biotechnological text. | | correct answer of the question students have to propose the solution of the problem. |

| Topics | Contact work hours | | | | | | Time and tasks of self-study | |
|---|---|---|---|---|---|---|---|---|
| | Lectures | Consultations | Seminars | Tutorials | Laboratory work | Total contact hours | Self-study | Tasks |
| **1.** Conception of the biotechnology, main concepts, trends and development. | 3 | | 1 | | | **4** | **2** | Analysis of scientific and methodological literature. The discussion at the lectures. |
| **2.** Construction and development of the microorganism for production of target product; problems and possible solutions. | 6 | | 3 | | | **9** | **6** | Analysis of scientific and methodological literature. The discussion at the lectures. |
| **3.** Vectors, diversity of the bacterial and yeast strains, applications possibilities. DNA transfer into cells. | 4 | | 1 | | | **5** | **2** | Analysis of scientific and methodological literature. The discussion at the lectures. |
| **4.** Expression and optimization of the target product, process monitoring. | 3 | | 1 | | | **4** | **2** | Analysis of scientific and methodological literature. The discussion at the lectures. |
| **5.** Cell disruption methods. Protein purification. Development and optimization of a purification strategy. | 4 | | 1 | | | **5** | **10** | Analysis of scientific and methodological literature. The discussion at the lectures. Preparation for I intermediate achievement test. |
| **6.** The growth of the microorganisms – exponential and stationary phases biochemistry. | 2 | | 1 | | | **3** | **2** | Analysis of scientific and methodological literature. The discussion at the lectures. |
| **7.** Types of fermenters: properties and application. | 3 | | 1 | | | **4** | **2** | Analysis of scientific and methodological literature. The discussion at the lectures. |
| **8.** Use of enzymes in biotechnology, new enzyme search and application prospect. | 4 | | 1 | | | **5** | **2** | Analysis of scientific and methodological literature. The discussion at the lectures. |
| **9.** Protein engineering and development of new products. | 4 | | 1 | | | **5** | **2** | Analysis of scientific and methodological literature. The discussion at the lectures. |
| **10.** Abzymes; modelling, engineering and manufacturing of antibody with catalytic activity. | 4 | | 1 | | | **5** | **2** | Analysis of scientific and methodological literature. The discussion at the lectures. |

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| **11**. New drug development. Gene therapy. | 3 | | 2 | | | **5** | **10** | Analysis of scientific and methodological literature. The discussion at the lectures. Preparation for II intermediate achievement test. |
| **12**. Nanoparticles. Nanotechnology based by biological objects and their uses in biotechnology. | 4 | | 1 | | | **5** | **2** | Analysis of scientific and methodological literature. The discussion at the lectures. |
| **13**. Systems and synthetic biology. | 4 | | 1 | | | **5** | **25** | Analysis of scientific and methodological literature. The discussion at the lectures. Preparation for exam. |
| **Total** | **48** | | **16** | | | **64** | **69** | |

| **Assesment strategy** | **Weight %** | **Assessment period** | **Assessment criteria** |
|---|---|---|---|
| I intermediate achievement test (written) | 25 | $7^{th}$ week | An intermediate achievement test (written) is consisted of 15 question test and 2 open type questions. Answers of the test are assessed according the complication of questions. The test is assessed in max. **4 points**. Every open type question is assessed in max. **3 points**. For the correct answer of the question students have to propose the solution of the problem, an assessment criteria:<br>**3 points** – a problem was analized excellent and properly, deductions were logical and reasonable;<br>**1.5 points** – a problem was analized improperly, deductions were incomplete, a lack of clearity and concreteness;<br>**0 points** – answers of questions were not delivered or a problem was analized improperly, conclusions and a reasoning were not written, a student understood the essence of a problem improperly.<br>Passed:<br>10 (excellent)<br>9 (very good)<br>8 (good)<br>7 (average)<br>6 (sufficient)<br>5 (weak)<br>Not passed:<br><5 (insufficient). |
| II intermediate achievement test (written) | 25 | $13^{th}$ week | An intermediate achievement test (written) is consisted of 15 question test and 2 open type questions. Answers of the test are assessed according the complication of questions. The test is assessed in max. **4 points**. Every open type question is assessed in max. **3 points**. For the correct answer of the question students have to propose the solution of the problem, an assessment criteria:<br>**3 points** – a problem was analized excellent and properly, deductions were logical and reasonable; |

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| | | | **1.5 points** – a problem was analized improperly, deductions were incomplete, a lack of clearity and concreteness;<br>**0 points** – answers of questions were not delivered or a problem was analized improperly, conclusions and a reasoning were not written, a student understood the essence of a problem improperly.<br>Passed:<br>10 (excellent)<br>9 (very good)<br>8 (good)<br>7 (average)<br>6 (sufficient)<br>5 (weak)<br>Not passed:<br><5 (insufficient). |
| Seminars | 10 | $9^{th}$ to $16^{th}$ week of the course | The maximum score that could be achieved is 10.<br>Passed:<br>10 (excellent)<br>9 (very good)<br>8 (good)<br>7 (average)<br>6 (sufficient)<br>5 (weak)<br>Not passed:<br><5 (insufficient). |
| Exam (written) | 40 | After the course, during the session. | An exam is required. The exam (written) is allowed only after positive assessments of the I and II intermediate achievement tests and seminars. Exam (written) is consisted of 15 question test and 2 open type questions. Answers of the test are assessed according the complication of questions. The test is assessed in max. **4 points**. Every open type question is assessed in max. **3 points**. For the correct answer of the question students have to propose the solution of the problem, an assessment criteria:<br>**3 points** – a problem was analized excellent and properly, deductions were logical and reasonable;<br>**1.5 points** – a problem was analized improperly, deductions were incomplete, a lack of clearity and concreteness;<br>**0 points** – answers of questions were not delivered or a problem was analized improperly, conclusions and a reasoning were not written, a student understood the essence of a problem improperly.<br>Passed:<br>10 (excellent)<br>9 (very good)<br>8 (good)<br>7 (average)<br>6 (sufficient)<br>5 (weak)<br>Not passed: |

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| | | | <5 (insufficient); the failed exam is assesed 0 points. The final grade is based on a sum of points received from assessments of written intermediate achievement tests, seminars and an exam. |

**Reading list**

| Author | Year of publ. | Title | Publisher | Number of volumes in the library of faculty |
|---|---|---|---|---|
| **Main reading list** | | | | |
| Michael Wink | 2011 | An Introduction to Molecular Biotechnology: Fundamentals, Methods and Applications; 2 edition | Wiley-Blackwell | 1 |
| C. Ratledge, B. Kristiansen. | 2006 | Basic Biotechnology; 3 edition | Cambridge University Press | 1 |
| A. S. Bommarius, B. R. Riebel | 2004 | Biocatalysis. Fundamentals and Applications; 1 edition | Wiley-VCH Verlag GmbH & Co. KgaA, Weinheim | 1 |
| **Additional reading list** | | | | |
| Jan-Christer Janson | 2011 | Protein Purification: Principles, High Resolution Methods, and Applications (Methods of Biochemical Analysis); 3 edition | Wiley | |
| Sheldon J. Park, Jennifer R. Cochran | 2009 | Protein Engineering and Design; 1 edition | CRC Press | |
| Markus Schmidt, Alexander Kelle, Agomoni Ganguli-Mitra, Huib de Vriend | 2009 | Synthetic Biology: the technoscience and its societal consequences | Springer | |
| | | Trends in Biotechnology | http://www.cell.com/trends/biotechnology/ | |
| | | Current Opinion in Biotechnology | http://www.sciencedirect.com/science/journal/09581669 | |
| | | Biotechnology and Bioengineering | http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1097-0290 | http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1097-0290 |