

## COURSE UNIT DESCRIPTION - STRUCTURAL CELL BIOLOGY

| Course unit title       | Code |
|-------------------------|------|
| STRUCTURAL CELL BIOLOGY |      |

| Lecturer(s)                                                                             | Department(s)                                                                                                 |
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| <b>Coordinator:</b> Assoc. Prof. dr. Juozas RAUGALAS<br>Other(s): dr. Eglė Lastauskienė | Department of Microbiology and Biotechnology<br>Faculty of Natural Sciences, Čiurlionio 21, LT 03101, Vilnius |

| Cycle                                     | Level of the course unit | Type of the course unit |
|-------------------------------------------|--------------------------|-------------------------|
| Full-time studies (1 <sup>st</sup> stage) | 1 out of 1               | Compulsory              |

| Mode of delivery | Period of delivered  | Language(s) of instruction |
|------------------|----------------------|----------------------------|
| Face to face     | 3th semester, autumn | Lithuanian                 |

| Prerequisites and corequisites                            |                                       |
|-----------------------------------------------------------|---------------------------------------|
| <b>Prerequisites:</b><br>General and bioorganic chemistry | <b>Corequisites (if any):</b><br>None |

| Number of credits allocated to the course unit | Student's total workload | Contact hours | Self-study and research hours |
|------------------------------------------------|--------------------------|---------------|-------------------------------|
| 5                                              | 133                      | 64            | 69                            |

| Purpose of the course unit: programme competences to be developed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                            |                                                                                                                                                                                  |
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| The course unit aims to develop:<br><i>Subject-specific competences:</i> <ul style="list-style-type: none"> <li>knowledge of the structure and functions of components of eukaryotic and prokaryotic cells, achievements of structural cell biology, and general methods of cell investigation;</li> <li>skills to perform reliable measurements, document and analyse the results of the measurements</li> </ul> <i>General competences:</i> <ul style="list-style-type: none"> <li>analytical and critical thinking;</li> <li>skills for self-development, learning skills in order to study general science resources;</li> <li>ability to organize and plan their work and time</li> </ul> |                                                                                                                                            |                                                                                                                                                                                  |
| Learning outcomes of the course unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Teaching and learning methods                                                                                                              | Assessment methods                                                                                                                                                               |
| Upon completion of the course students will be able to: <ul style="list-style-type: none"> <li>Explain prokaryotic and eukaryotic cell structure regularities and principles.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | The course material is provided in the lectures and laboratory works.                                                                      | Upon completion of the first part of the course (lectures 1-5) accounted for the first intermediate written exam.                                                                |
| <ul style="list-style-type: none"> <li>Explain basic principles of the fluorescence and electron microscopy methods and their application possibilities.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                            | Upon completion of the second part of the course (lectures 6-10) accounted for the second intermediate written exam.                                                             |
| <ul style="list-style-type: none"> <li>Use light microscopy and apply light microscopy methods to study cells and tissues.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Knowledge perpetuating cytology laboratory sessions, where under the guidance of the teacher, students carry out specific practical tasks. | After the laboratory work reported for each job separately. The final assessment from 0 to 5 points. For the remaining five classes accounted for the final written examination. |
| <ul style="list-style-type: none"> <li>Use theoretical and practical knowledge in other disciplines (genetics, molecular biology, biochemistry) and apply them in experiments.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                            |                                                                                                                                                                                  |

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|  |  | After the laboratory works are finished students report for each work (task) separately. Final assessment is from 0 to 4 points. |
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| Content: breakdown of the topics                                                                                                                                                                                   | Contact hours |           |          |           |                 |                           | Self-study work: time and assignments |                  |                                                                                                                                                             |
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|                                                                                                                                                                                                                    | Lectures      | Tutorials | Seminars | Exercises | Laboratory work | Internship/work placement | Contact hours                         | Self-study hours | Assignments                                                                                                                                                 |
| 1. Introductions to cells. Chemical components of cells.                                                                                                                                                           | 3             |           |          |           |                 |                           | 3                                     | 2                | Analyses of needed lecture material. Studying of literature and other sources of information, learning through practical tasks during the laboratory works. |
| 2. Biological membranes. Plasma membrane. Passive and active membrane transport. Carrier proteins, channels, and pumps. Endocytosis and exocytosis. Glycocalyx. The cell walls of plant, fungi and bacteria cells. | 3             |           |          |           |                 |                           | 3                                     | 2                | Analyses of needed lecture material. Studying of literature and other sources of information, learning through practical tasks during the laboratory works. |
| 3. Ribosomes, their structure and functions. Endoplasmic reticulum. Golgi apparatus. Lysosomes. Peroxisomes. Plant vacuole and other vacuoles.                                                                     | 3             |           |          |           |                 |                           | 3                                     | 2                | Analyses of needed lecture material. Studying of literature and other sources of information, learning through practical tasks during the laboratory works. |
| 4. Mitochondria. Plastid types. Chloroplasts and their functions.                                                                                                                                                  | 3             |           |          |           |                 |                           | 3                                     | 2                | Analyses of needed lecture material. Studying of literature and other sources of information, learning through practical tasks during the laboratory works. |
| 5. Cytosol. Cytoskeleton. Actin filaments, microtubules and intermediate filaments. Centrioles, basal bodies, mitotic spindle.                                                                                     | 3             |           |          |           |                 |                           | 3                                     | 2                | Analyses of needed lecture material. Studying of                                                                                                            |

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| Motor proteins. Pseudopodia, flagella and cilia.                                                                                                                                                         |   |  |  |  |  |  |   |   | literature and other sources of information, learning through practical tasks during the laboratory works.                                                  |
| 6. Cell nucleus. Nucleoplasma and chromatin. Nuclear envelope. Nuclear lamina.                                                                                                                           | 3 |  |  |  |  |  | 3 | 2 | Analyses of needed lecture material. Studying of literature and other sources of information, learning through practical tasks during the laboratory works. |
| 7. Cell division and cell cycle. DNA replication. Prokaryotic cell division. Mitosis and their phases. Cytokinesis in animal and plant cells. Meiosis. Crossing-over. Comparison of meiosis and mitosis. | 3 |  |  |  |  |  | 3 | 2 | Analyses of needed lecture material. Studying of literature and other sources of information, learning through practical tasks during the laboratory works. |
| 8. Gametes and their formation. Gametogenesis. Plant gametes and spores. Sporogenesis and gametogenesis. Fertilization. Cell differentiation.                                                            | 3 |  |  |  |  |  | 3 | 2 | Analyses of needed lecture material. Studying of literature and other sources of information, learning through practical tasks during the laboratory works. |
| 9. Cell death from injury and apoptosis.                                                                                                                                                                 | 2 |  |  |  |  |  | 2 | 2 | Analyses of needed lecture material. Studying of literature and other sources of information, learning through practical tasks during the laboratory works. |
| 10. Cell origin and evolution. Endosymbiosis: the origin of mitochondria and chloroplasts. The main methods of cell investigation.                                                                       | 3 |  |  |  |  |  | 3 | 2 | Analyses of needed lecture material. Studying of literature and other sources of information, learning through practical tasks during the laboratory works. |
| 11. The main cytological and histological methods.                                                                                                                                                       | 3 |  |  |  |  |  | 3 | 2 | Analyses of needed lecture material. Studying of                                                                                                            |

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|                                                                                                                                                                                        |           |  |  |  |           |  |           |           | literature and other sources of information, learning through practical tasks during the laboratory works. |
| 12. The main methods of microscopy. Simple and complex microscopes. Structure of the light microscope, principles of light microscopy. Principles of preparation of microscopy slides. |           |  |  |  | 4         |  | 4         |           |                                                                                                            |
| 13. Morphology of the cells. Plant cells. Prosenchyma and parenchyma cells. Animal cells and their diversity. Fungi cells.                                                             |           |  |  |  | 4         |  | 4         |           |                                                                                                            |
| 14. Diversity of microorganisms. Morphology of the bacterial cell. Analysis of the permanent preparations. Spores of bacteria.                                                         |           |  |  |  | 4         |  | 4         |           |                                                                                                            |
| 15. Bacterial cell wall. Gram staining. Yeast cells. Cellular and hyphae form of the cell. Peculiarity of yeast division.                                                              |           |  |  |  | 4         |  | 4         |           |                                                                                                            |
| 16. Measurement of the size of microscopy objects. Determination of the cell number in cell suspensions. Determination of the size of cellular organelles by using ocular micrometre.  |           |  |  |  | 4         |  | 4         |           |                                                                                                            |
| 17. Mitosis. Preparation of the microscopy slide. Analysis of the mitosis stages in peace/onion root cells. Calculation of the mitotic index.                                          |           |  |  |  | 4         |  | 4         |           |                                                                                                            |
| 18. Cell differentiation. Analysis of the mammalian blood slides. Analysis of red and white blood cells. Gametes. Morphology of the mammalian spermatozooids. Mammalian oocytes.       |           |  |  |  | 4         |  | 4         |           |                                                                                                            |
| 19. Fluorescent microscopy. Principles of the fluorescent microscopy. Common fluorochromes. Preparation of slides for fluorescent microscopy and their analysis.                       |           |  |  |  | 4         |  | 4         |           |                                                                                                            |
| 20. Preparation for two middle exams.                                                                                                                                                  |           |  |  |  |           |  |           | 11        | Prepare for the exams                                                                                      |
| 21. Preparation for laboratory exercises.                                                                                                                                              |           |  |  |  |           |  |           | 24        | Prepare for the laboratory works                                                                           |
| 22. Preparation for final exam.                                                                                                                                                        |           |  |  |  |           |  |           | 12        | Prepare for the final exam                                                                                 |
| <b>Total</b>                                                                                                                                                                           | <b>32</b> |  |  |  | <b>32</b> |  | <b>64</b> | <b>69</b> |                                                                                                            |

| Assessment strategy                | Weight, % | Assessment period            | Assessment criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------|-----------|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| First midterm exam (written test)  | 30        | After first 50 % of lectures | Task of the middle exam consists of problem-oriented selective or open type questions; correct answers are assessed in different number of points. It is possible to collect approximately 70-90 points if answers are correct.<br><b>Assessment criteria:</b><br>5: collected not less than 85 % of possible points.<br>4: collected not less than 75 % of possible points.<br>3: collected not less than 65 % of possible points.<br>2: collected not less than 55 % of possible points.<br>1: collected not less than 45 % of possible points.<br>0: collected less than 45 % of possible points. |
| Second midterm exam (written test) | 30        | After first 50 % of lectures | Task of the middle exam consists of problem-oriented selective or open type questions; correct answers are                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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|                           |    |                                                  | assessed in different number of points. It is possible to collect approximately 70-90 points if answers are correct.<br><b>Assessment criteria:</b><br>5: collected not less than 85 % of possible points.<br>4: collected not less than 75 % of possible points.<br>3: collected not less than 65 % of possible points.<br>2: collected not less than 55 % of possible points.<br>1: collected not less than 45 % of possible points.<br>0: collected less than 45 % of possible points.                                                                                                           |
| Laboratory works          | 10 | During laboratory works after each work was done | Laboratory works are required.<br>The final exam are not permitted if the laboratory works are not done or assessed.<br><b>Assessment criteria:</b><br>4: laboratory works are implemented and reported excellent or very well.<br>3: laboratory works are implemented and reported well.<br>2: laboratory works are implemented and reported moderately.<br>1: laboratory works are implemented and reported according minimal requirements.<br>0: laboratory works are not implemented and/or not reported.                                                                                       |
| Final exam (written test) | 30 | After the course, during the session.            | Task of the middle exam consists of problem-oriented elective or open type questions; correct answers are assessed in different number of points. It is possible to collect approximately 70-90 points if answers are correct.<br><b>Assessment criteria:</b><br>5: collected not less than 85 % of possible points.<br>4: collected not less than 75 % of possible points.<br>3: collected not less than 65 % of possible points.<br>2: collected not less than 55 % of possible points.<br>1: collected not less than 45 % of possible points.<br>0: collected less than 45 % of possible points. |
|                           |    |                                                  | The final grade is based on an overall assessment of the two middle exams, the assessment for laboratory works and assessment of the written final exam.                                                                                                                                                                                                                                                                                                                                                                                                                                            |

| Author                                                                               | Year of publication | Title                                                                                   | Issue of a periodical or volume of a publication | Publishing place and house or web link |
|--------------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------|----------------------------------------|
| <b>Compulsory reading</b>                                                            |                     |                                                                                         |                                                  |                                        |
| V. Mildažienė, S. Jarmalaitė, R. Daugelavičius.                                      | 2004                | Cell biology (in Lithuanian)                                                            |                                                  | Kaunas                                 |
| Cooper G. M., Hausman R. E.                                                          | 2013                | The Cell: A Molecular Approach (6th ed.),.                                              |                                                  | Sinauer Associates, Inc.               |
| <b>Optional reading</b>                                                              |                     |                                                                                         |                                                  |                                        |
| Alberts B., Johnson A., Lewis J., Raff M., Bray D., Hopkin K., Roberts K., Walter P. | 2010                | Essential cell biology: an introduction to the molecular biology of the cell (3rd ed.). |                                                  | Garland Publishing                     |
| Lodish H. et al.                                                                     | 2008                | Molecular Cell Biology, (6th ed.)                                                       |                                                  | Freeman, N.Y.                          |