**ACADEMIC DISCIPLINE OVERVIEW**

1. **Program data**

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| 1.1. Higher education institution | Grigore T. Popa University of Medicine and Pharmacy Iasi |
| 1.2. Faculty | Medical Bioengineering |
| 1.3. Department | Biomedical Sciences |
| 1.4. Field of study | Health |
| 1.5. The cycle of studies | Bachelor |
| 1.6. Study program / qualification | Balneo-physiokinetotherapy and rehabilitation – english language / Physiokinetotherapist |

**2. Discipline data**

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| 2.1. Name of the discipline / Code | **Biophysics** | **RE1111** |
| 2.2. Teaching staff in charge with lectures | **Associate Professor Andrei Năstuță, PhD** |
| 2.3. Teaching staff in charge with practical activities | **Associate Professor Andrei Năstuță, PhD** |
| 2.4. Year of study | **I** | 2.5. Semester | **2** | 2.6. The type of assessment | **Exam, E2** |
| 2.7. Discipline type | **Mandatory** | **Fundamental discipline** |

**3. Estimated total time (hours/semester of didactic activity)**

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| 3.1. Number of hours / week: | 3.2. Courses number of hours / week | 3.3. Seminars / practical classes number of hours / week |
| Semester 1 |  |  |  |
| Semester 2 | **2** | **1** | **1** |
| 3.4. Total number of learning hours: | **28** | 3.5. Of which: Courses | **14** | 3.6. Of which: Seminars / practical classes: | **14** |
| 3.7. Distribution of individual study time: | Hours sem. 1 | Hours sem. 2 |
| Study time using course book materials, bibliography and hand notes |  | 10 |
| Supplementary documentation in the library, using specialised platforms via internet and by field work |  | 6 |
| Preparation time for seminars / practical classes, study themes, reviews, portfolio and essays |  | 6 |
| Tutorship |  | 2 |
| Examinations |  | 4 |
| Other activities |  | - |
| Total hours of individual study (*without examinations*) |  | **22** |
| 3.8. Total hours per semester |  | **50** |
| 3.9. Number of credits |  | **2** |

**4. Preconditions (where applicable)**

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| 4.1. of curriculum | - |
| 4.2. of competences | - |

5. **Conditions (where applicable)**

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| 5.1. for lectures | Logistic video support |
| 5.2. for seminars / practical classes | Students will wear protective clothing (white coats) |

**6. Specific competences acquired**

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| **Professional competencies** | **C 4.2** | The accumulation of knowledge about the physical phenomena that are the basis of the organization and functioning of the living world; Establishing physical principles of operation of medical devices. The measurement process, parameters and normal measurement values of the organism viewed as a biosystem. Measurement and interpretation of functional parameters at the molecular, tissue, systemic and whole organism levels. Using basic knowledge to explain and interpret electrotherapy procedures. |
| **C 5.2** | Development of students' ability to work with laboratory equipment. Acquisition of domain-specific experimental techniques and correlations with results from related domains (e.g. biology, biochemistry).Realization of specific experimental arrangements, data acquisition, analysis and interpretation.The development of the capacity to extrapolate the presented experimental techniques and their application in research and development projects.Using basic knowledge to choose the means and methods of functional assessment in different pathological situations. |

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| **Transversal****competencies** | **CT3** | Developing the ability to work in a team, encouraging interdependencies and the use of specific competencies of each team member.Increasing the ability to understand and process experimental data in teams.Effective use of information sources and communication resources and assisted professional training (Internet portals, specialized software applications, databases, on-line courses, etc.) |

7**.** **Objectives of the study discipline (according to the grid of specific competences acquired)**

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| 7.1. General objective | The accumulation of knowledge about physical phenomena underlying the organization and functioning of the living world; |
| 7.2. Specific objectives | Developing the working capacity of students with laboratory equipment. Acquiring specific experimental techniques and correlations with outcomes from related fields (e.g. biology, biochemistry). |

**8. Contents**

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| **8.1. Lectures** | **Teaching methods** | **Observations** |
| 1 | 1.Introduction to atomic and molecular physics1.1. Atomic models1.2. Physico-chemical organization of living mater | Statements, questioning, observation, dialogue, debate, explanation, demonstration | 2h |
| 2 | 2. Supramolecular assembly elements2.1. Polarizability of molecules2.2. Intermolecular forces2.3. Supramolecular assembly of living mater2.4. Supramolecular architecture of living mater | Statements, questioning, observation, dialogue, debate, explanation, demonstration | 2h |
| 3 | 3. Experimental techniques used for the analysis of biophysical systems3.1. Centrifugation, mass spectrometry, electrophoresis3.2. UV-Vis spectroscopy, FT-IR spectroscopy and fluorescence | Statements, questioning, observation, dialogue, debate, explanation, demonstration | 2h |
| 4 | 4. Elements of physics of transport phenomena in biological environments4.1. Particle diffusion4.2. Osmosis | Statements, questioning, observation, dialogue, debate, explanation, demonstration | 2h |
| 5 | 5. Architecture and properties of cell membranes5.1. The lipid bilayer model5.2. Organization of proteins and carbohydrates5.3. Electrical properties (resistance and capacitance) of the lipid bilayers | Statements, questioning, observation, dialogue, debate, explanation, demonstration | 2h |
| 6 | 6. Passive and active transport phenomena in biological membranes6.1. Membrane transport proteins6.2. Potential equilibrium6.3. Ionic channels, characteristic potential | Statements, questioning, observation, dialogue, debate, explanation, demonstration | 2h |
| 7 | 7. Neurophysics7.1. Action potential and Hodgkin-Huxley model7.2. Models for the electrical and chemical synapses | Statements, questioning, observation, dialogue, debate, explanation, demonstration | 2h |

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| **8.2. Practical activities - practical class**  | **Teaching methods** | **Observations** |
| 1 | 1. Safety. Presentation of specific elements of biophysics laboratories 1.1. Safety regulations1.2. Quantities and units of measure1.3. Analysis of experimental data1.4. Sources of errors1.5. Calculation of errors1.6. Carrying out a laboratory report | Practical work, experimental demonstrations. | 2h |
| 2 | 2. Emission spectra of atoms and molecules. Determination of Planck constant. | Preparing the experimental arrangement and work strategy. Experimental data processing. Interpretation and extrapolation. | 2h |
| 3 | 3. Highlighting the intermolecular forces by colorimetric methods. Determination of surface tension3.1. Classification of intermolecular forces3.2. Demonstration by means of a colorimetric method, of hydrogen bonds formed between the water molecules and alcohol molecules3.3. Determination of surface tension for different liquid via droplet method | Preparing the experimental arrangement and work strategy. Experimental data processing. Interpretation and extrapolation. | 2h |
| 4 | 4. The principles of UV-Vis absorption spectroscopy 4.1. Defining the phenomenon of light absorption in liquids4.2. Visualization of the phenomenon of light absorption for different substances4.3. Determination of coefficient of extinction | Preparing the experimental arrangement and work strategy. Experimental data processing. Interpretation and extrapolation. | 2h |
| 5 | 5. Determination of the permeability coefficient of an artificial membrane5.1. Definition of the diffusion phenomena5.2. Study of diffusion phenomenon through artificial membranes5.3. Calculation of permeability coefficient for an artificial membrane | Preparing the experimental arrangement and work strategy. Experimental data processing. Interpretation and extrapolation. | 2h |
| 6 | 6. Lipid bilayers. Study of modern experimental techniques in biophysics6.1. Obtaining lipid bilayers6.2. Determination of the electrical properties of the lipid bilayers6.3. Voltage-clamp technique for measuring transmembrane electric currents6.4. Patch-clamp technique for studying ion channels | Preparing the experimental arrangement and work strategy. Experimental data processing. Interpretation and extrapolation. | 2h |
| 7 | 7. Nerve excitability and propagation of action potentials. Evaluation activity.7.1. Testing practical skills acquired by students7.2. Evaluation of theoretical knowledge acquired during the biophysics laboratory | Preparing the experimental arrangement and work strategy. Experimental data processing. Interpretation and extrapolation. Evaluation. | 2h |

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| **8.3. Bibliography:** |
| ***Mandatory:*** |
| 1. A. V. Nastuta, General biophysics: laboratory experiments, Ed. "Gr.T.Popa", Iasi, 2022.
2. Nastuta A.V., Agheorghiesei C. Capitol: Monitoring Hand Gesture and Effort Using a Low-Cost Open-Source Microcontroller System Coupled with Force Sensitive Resistors and Electromyography Sensors. In: Luca D., Sirghi L., Costin C. (eds) Recent Advances in Technology Research and Education. INTER-ACADEMIA 2017.
3. P. Herman, Physics of the human body, Springer Berlin, 2016.
4. J. A. Tuszynski, Molecular and Cellular Biophysics, CRC Press, 2016.
5. A. W. Wood, Physiology, Biophysics, and Biomedical Engineering, CRC Press, 2012.
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| ***Elective:*** |
| 1. D. Goldfarb, Biophysics demystified, McGraw-Hill, New York, 2011.
2. J. Thomas, Handbook of Modern Biophysics, Biomedical Applications of Biophysics, Springer, 2010.
3. J. Thomas, Handbook of Modern Biophysics, Fundamental Concepts in Biophysics, Springer, 2009.
4. J. Thomas, Handbook of Modern Biophysics, Biomembrane Frontiers Nanostructures, Models, and the Design of Life, Springer, 2009.
5. C. Stefanescu, V. Rusu, Biophysics and medical physics: an introduction. Tehnopress, Iasi, 2008.
6. V. Raicu, A. Popescu, Integrated Molecular and Cellular Biophysics, Springer, 2008.
7. T. A. Waigh, Applied Biophysics A Molecular Approach for Physical Scientists, John Wiley & Sons, 2007.
8. M.B. Jackson, Molecular and Cellular Biophysics, Cambridge University Press, 2006.
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**9. *Correlation of the discipline contents with the expectations of the epistemic community, professional associations, and representative employers from the afferent program field***

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| Knowledge and abilities are established as didactic objectives and specified as such in the analytic programs that are revised yearly. After their analysis by the study discipline staff, these are discussed and approved in the Curricular Committee, towards curricular harmonization among the various study disciplines. Along this entire process systematic evaluation is performed, directly if possible, regarding the correspondence of the contents to the expectations of the academic community and of the representatives of the social community, professional associations, and employers. |

**10. Evaluation**

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| Type of activity | Assessment criteria | Evaluation methods | Contribution to the final grade |
| Lectures | Acquiring theoretical notions and presented in the course | Written exam. MCQ Examination | 80 % |
| Practical activities | Activities carried out in laboratory and conducted quality essays. | Colloquium practical activity | Admitted/ Rejected |
| Individual study | Preparation time for seminars / practical classes, study themes, reviews, portfolio and essays.Study time using coursebook materials, bibliography and hand notes, documentation in the library, using specialised platforms via internet and by field work. | Tests during the semester | 20 % |
| Minimal performance standard:* Knowledge of cell membrane and protein organization patterns.
* Knowledge of transport phenomena in biophysical systems: diffusion, active/passive transport.
* Knowledge and application of structural analysis methods of biological systems.
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| Date | Holder of course / signature, | Holder of practical activities / signature, |
| 11.09.2024 | Associate Professor Andrei Năstuță, PhD | Associate Professor Andrei Năstuță, PhD |

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| Date of approval in the Department Council/Teaching Council,  |
| 19.09.2024 |  | Department director / signature, |
|  |  | Associate Professor Daniela-Viorelia Matei, MD, PhD |