

## Subject card

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| Subject name and code                       | Biophysics of biologically active compounds, PG_00153615                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                          |                                         |                                     |                                                                                              |            |     |
| Field of study                              | Biotechnology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          |                                         |                                     |                                                                                              |            |     |
| Date of commencement of studies             | October 2025                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                          | Academic year of realisation of subject |                                     | 2025/2026                                                                                    |            |     |
| Education level                             | Master's studies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                          | Subject group                           |                                     | Optional subject group<br>Subject group related to scientific research in the field of study |            |     |
| Mode of study                               | full-time studies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                          | Mode of delivery                        |                                     | at the university                                                                            |            |     |
| Year of study                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                          | Language of instruction                 |                                     | Polish                                                                                       |            |     |
| Semester of study                           | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                          | ECTS credits                            |                                     | 2.0                                                                                          |            |     |
| Learning profile                            | academic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                          | Assessment form                         |                                     | credit                                                                                       |            |     |
| Conducting unit                             | Laboratory of Biophysics -> UG Institute of Biotechnology -> Intercollegiate Faculty of Biotechnology UG-MUG -> Rector                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                          |                                         |                                     |                                                                                              |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                          | dr hab. Jacek Piosik                    |                                     |                                                                                              |            |     |
|                                             | Teachers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                          | dr hab. Jacek Piosik                    |                                     |                                                                                              |            |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Lecture                                                  | Tutorial                                | Laboratory                          | Project                                                                                      | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 30.0                                                     | 0.0                                     | 0.0                                 | 0.0                                                                                          | 0.0        | 30  |
|                                             | E-learning hours included: 0.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                          |                                         |                                     |                                                                                              |            |     |
| Learning activity and number of study hours | Learning activity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Participation in didactic classes included in study plan |                                         | Participation in consultation hours |                                                                                              | Self-study | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 30                                                       |                                         | 5.0                                 |                                                                                              | 15.0       | 50  |
| Subject objectives                          | The aim of the course is to relay knowledge about the basic physical laws and the possibility of applying them in examining biochemical processes and in broadly-understood biotechnology. Presentation of the basics of modeling complex research systems and biochemical processes and of applying these methods in biotechnology. Students will acquire current knowledge concerning qualitative and quantitative examination of interference between small molecule compounds and macromolecules (nucleic acids), nanoparticles, and with other small molecule compounds, get to know the mechanisms of action of anticancer drugs, toxins, and exogenic mutagens and cancerogens. They will acquire an ability to analyze and interpret experimental results, listen with understanding, solve tasks and think critically. In consequence, they will acquire an ability to relay the knowledge acquired during classes and its further use in subsequent course of studies and in raising their qualifications in the field of broadly-understood biotechnology. |                                                          |                                         |                                     |                                                                                              |            |     |

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| Learning outcomes                                        | Course outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Subject outcome                                                                                                                                                                                                                                                    | Method of verification            |
|                                                          | [BIOTECHMU2_W05] The graduate possesses in-depth knowledge of methods used in the field of exact and natural sciences, necessary to understand biological phenomena and processes at the molecular level.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | The student has knowledge of biophysical and computational methods and their practical use in understanding complex biotechnology issues.                                                                                                                          | [SW4] test/exam - oral or written |
|                                                          | [BIOTECHMU2_W01] The graduate has in-depth knowledge of complex biological phenomena at the molecular level and knows their importance for biotechnology.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | The student knows the basic physical laws and their application in biotechnology. The student knows the basic interactions of low molecular compounds and nanoparticles with macromolecules. The student knows the mechanisms of action of basic anticancer drugs. | [SW4] test/exam - oral or written |
|                                                          | [BIOTECHMU2_K01] The graduate consciously combines knowledge acquired in previous stages of education with knowledge acquired on an ongoing basis to solve problems in the field of biotechnology; consciously deepens and updates knowledge and improves qualifications related to biotechnology in the field of exact and natural sciences and medical and health sciences.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | The student can apply the basic laws of physics to solve research problems in biotechnology.                                                                                                                                                                       | [SK4] test/exam - oral or written |
| Subject contents                                         | Basic physical laws and physical units, elements of the structure of matter wave and corpuscular theory, phenomena arguing for wave and corpuscular theory, Louis de Broglie dualism of mass, radioactivity, electron shells, orbitals, chemical bonds covalent and ionic, van- der-Waals and hydrogen interactions. The structure and properties of water, water as an environment for biochemical reactions. The structure of the DNA double helix stabilization mechanisms, various kinds of bonds between complementary base pairs. DNA as a target of various small molecule compounds (ligands). Overview of the mechanisms of interaction between various ligands and DNA: covalent bonds of ligands with DNA (electrophiles, nucleophiles), physical-chemical interactions (intercalation, bis- and multi-intercalation, interactions in the major and minor groove of DNA). Thermodynamics of DNA and ligand association. Overview of models of ligand-DNA interactions (McGhee von Hippel model) and research methodology of such interactions. Overview of selected ligands (mutagenesis, toxins, anti-cancer drugs) and the mechanisms of their biological activity. Presentation of a selected methodology used in examining such substances (physical chemical methods, spectrophotometry, spectrofluorometry, circular dichroism, calorimetry, flow calorimetry and others) as well as computational methods. Overview of small molecule compounds interactions in aqueous solutions. Thermodynamic models of mixed association of ligands, with particular focus on the differences between the discussed models. Presentation of research methods of such interactions and computational techniques. Overview of possibilities of modulating ligands biological activity through interactions with other small molecule compounds (e.g. methylxantines). Thermodynamic modeling of such processes and overview of experimental and computational methods. Elements of chemoprevention. Overview of selected methods of examining ligands biological activity (mutagenesis tests, cytotoxicity tests, examination of cell cycle perturbation). |                                                                                                                                                                                                                                                                    |                                   |
| Prerequisites and co-requisites                          | Basic course of inorganic and organic chemistry, physics, biochemistry and biophysics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                    |                                   |
| Assessment methods and criteria                          | Subject passing criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Passing threshold                                                                                                                                                                                                                                                  | Percentage of the final grade     |
|                                                          | Final test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 51.0%                                                                                                                                                                                                                                                              | 100.0%                            |
| Recommended reading                                      | Basic literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Handbooks of chemistry, biochemistry, physics and biophysics.                                                                                                                                                                                                      |                                   |
|                                                          | Supplementary literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | None                                                                                                                                                                                                                                                               |                                   |
|                                                          | eResources addresses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                    |                                   |
| Example issues/ example questions/ tasks being completed |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                    |                                   |
| Work placement                                           | Not applicable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                    |                                   |

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