**description of the course of study**

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| **Course code** | **0912-7LEK-B2.4-Bch** | |
| **Name of the course in** | Polish | **Biochemia** |
| English | **Biochemistry** |

1. **LOCATION OF THE course OF STUDY within the system of studies**

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| **1.1. Field of study** | Medicine |
| **1.2. Mode of study** | Full-time |
| **1.3. Level of study** | Uniform Master’s studies |
| **1.4. Profile of study\*** | General academic |
| **1.5. Person preparing the course description** | dr hab. Jan Pałyga. |
| **1.6. Contact** |  |

1. **General characteristicS of the course of study**

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| **2.1. Language of instruction** | English |
| **2.2. Prerequisites\*** | General and organic chemistry |

1. **DETAILED CHARACTERISTICS OF THE COURSE OF STUDY**

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| * 1. **Form of classes** | | Lectures – 35 hours (including 5 of e-learning), Laboratories– 20 hours |
| * 1. **Place of classes** | | Courses in the teaching rooms of the UJK |
| * 1. **Form of assessment** | | Lecture – Exam, Laboratory – Credit with grade |
| * 1. **Teaching methods** | | Problem-based lecture, laboratory classes |
| * 1. **Bibliography** | **Required reading** | 1. Rodwell Victor, Weil P. Anthony, Bender David, Botham Kathleen M., Kennelly Peter J., Harper's Illustrated Biochemistry, 31th Edition, McGraw-Hill Education 2018;  2. Nelson D. L., Cox M. M., Lehninger Principles of Biochemistry, 7thEdition. Macmillan Higher Education 2017. |
| **Further reading** | 3. Berg J. M. Tymoczko J. L., Gatto Jr. G. J., Stryer L. Biochemistry, 8th ed., W.H. Freeman Publishers, 2015;  4. Ferrier D.R. Lippincott Illustrated Reviews Biochemistry 7th ed, Wolters Kluwer 2017.  5. Salway J.G. Medical Biochemistry at a Glance, 3rd Edition, Wiley 2012. ISBN 978-0-47-065451-4. |

1. **Objectives, syllabus CONTENT and intended LEARNING outcomes**

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| * 1. **Course objectives *(including form of classes)***   C1- Acquaintance with the structure and properties of basic classes of biological compounds found in living organisms.  C2- Acquaintance with the basics of enzymatic catalysis and processes of capture as well as processing of energy in metabolism.  C3- Presentation of basic catabolic and anabolic processes in the cells as well as the integration and regulation of metabolic processes.  C4- Developing the ability to use knowledge of biochemistry, especially about basic metabolism as well as nucleic acids and proteins, to explore the pathological processes and treatments of biochemical disturbances in the body |
| * 1. **Detailed syllabus *(including form of classes)***   Lecture  Part I.  Cells and biomolecules. Amino acids – structure and stereoisomers, classification by R groups, acid-base properties. Formation and properties of peptide bond. Biologically active peptides.  Proteins. Overview of protein structure (primary, secondary, tertiary, and quaternary protein structure). The relationship between structure and function using the example of globular proteins (myoglobin and haemoglobin) and fibrous proteins (collagen and elastin). Protein denaturation. Protein function.  Carbohydrates: structure, properties and biological function. Monosaccharides, disaccharides and polysaccharides, Glycoproteins and proteoglycans. Biologically active glycosides – cardiac glycosides.  Nucleic acids: nitrogen bases, nucleosides, nucleotides and polynucleotides. The structure and biological functions of DNA and basic classes of ribonucleic acids.  Fatty acids and lipids. Triacylglycerols - high-energy reserve material. Membrane lipids: phospholipids, glycolipids and cholesterol. Eicosanoids. Steroids, carotenoids and other polyprenyl compounds.  Part II.  Enzymes and biocatalysis. How enzymes work? Catalytic power and specificity of enzymes. Classification of enzymes. Co-enzymes and prosthetic groups and their relationship with vitamins and the role of the most important co-enzymes and metals in enzymatic catalysis. Enzyme kinetics and mechanism of enzymatic reactions. Regulation of enzyme activity: inhibitors and activators. Allosteric regulation of enzyme activity.  Biochemical reaction types in metabolism. Energy relationships between catabolic and anabolic pathways. ATP and transfer of high-energy phosphoryl groups. Principles of metabolic regulation.  Glycolysis and gluconeogenesis. Glycogenesis and glycogenolysis. Pentose phosphate pathway of glucose oxidation.  Tricarboxylic acid cycle. Production of acetyl-CoA (activated acetate). Reactions and regulation of the citric acid cycle.  Energy conversion in specialized biological membranes. The chain of electron transport, proton gradient generation, oxidative phosphorylation and mitochondrial ATP synthesis.  Lipid and fatty acid metabolism. Digestion, mobilization, and transport of fats. Oxidation of saturated and unsaturated fatty acids. Ketone bodies. Glycerol metabolism. Biosynthesis of saturated and unsaturated fatty acids. Biosynthesis of triacylglycerols. Biosynthesis of biological membrane lipids. Biosynthesis of eicosanoids. Biosynthesis of cholesterol, steroids and other isoprenoids.  Metabolism of proteins and amino acids. Transamination and deamination of amino acids. Urea cycle.  Biosynthesis of nonessential amino acids. Conversion of amino acids to biogenic amines and other compounds.  The metabolic profiles of tissues under the normal condition of the body. Metabolism during starvation and diabetes. The basic ingredients of the food and the nutritional requirements of a human. Hormonal regulation and integration of mammalian metabolism.  Part III.  Biosynthesis of purine and pyrimidine rings. Biosynthesis of ribonucleotides and deoxyribonucleotides.  DNA replication and repair. DNA-dependent synthesis of RNA. RNA processing. RNA-dependent synthesis of DNA and RNA. Protein synthesis, targeting and degradation. Principles of gene regulation. Chromatin and eukaryotic gene expression.  **Topics for e-learning:**  Lecture 1. Weak interactions in an aqueous environment.  Lecture 2. Principles of bioenergetics.  Lecture 3. Transport across membranes; Excitable membranes, action potential and propagation of the pulse  Lecture 4. Biochemical and molecular foundations of sensory organ function.  Lecture 5. Oxidative stress and cellular free radicals. Metabolism of xenobiotics.  Checking knowledge (lecture) – Mandatory three periodic one-time written tests verifying knowledge of the above parts of material and a written final exam. Taking the final exam is possible after obtaining the positive results from all intermediate tests and obtaining credit from the laboratory.  Laboratory classes  Safety rules in the biochemical laboratory. Basic biochemical calculations.  Spectrophotometric determination of natural compound (cardiac glycoside) based on the standard curve. The properties of amino acids and proteins. Quantitative determination of the protein. Protein electrophoresis in polyacrylamide gel slab.  Properties of simple and complex sugars. Investigation of reducing properties of the hydrolysis products of sucrose and starch. Quantitative determination of glucose.  General properties of fats and steroids. Saponification of fats to obtain soaps; insoluble soaps. Quantitative determination of the cholesterol.  Chemical characterization of nucleic acids - detection of the products of DNA hydrolysis. DNA isolation by the method of protein desalting. Electrophoresis of the products of DNA digestion with a restriction enzyme in an agarose gel.  Quantitative determination of nucleic acids by spectrophotometric methods. Quantitative determination of DNA by diphenylamine method.  Determination of enzyme activity. The effects of pH, temperature, activators and inhibitors on enzyme activity. Enzymes in clinical diagnosis.  Nutrition and the gastrointestinal tract. Biochemistry of blood and urine. Metabolic defects.  Checking knowledge – regularly during classes as well as mandatory periodic tests. Final test. |

**4.3 Intended learning outcomes**

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| **Code** | **A student, who passed the course** | **Relation to learning outcomes** |
| within the scope of **knowledge**the graduate knows and understands: | | |
| W01 | basic reactions of organic and non-organic compounds in water solutions; | B.W4. |
| W02 | the structure of simple organic compounds included in the macromolecules present in the cells, extracellular matrix and body fluids; | B.W10. |
| W03 | the structure of lipids and polysaccharides and their functions in the cellular and extracellular structures; | B.W11. |
| W04 | the protein primary, secondary, tertiary and quaternary structures; knows the post-translational and functional protein modifications and their significance; | B.W12. |
| W05 | the functions of nucleotides in the cell, RNA and DNA primary structure as well as chromatin structure; | B.W13. |
| W06 | basic catabolic and anabolic pathways, methods of their regulation and the influence of genetic and environmental factors; | B.W15. |
| W07 | the metabolic profiles of basic organs and systems; | B.W16. |
| W08 | the influence of the oxidative stress on cells and its importance in the pathogenesis of diseases and in aging processes; | C.W47. |
| within the scope of **ABILITIES**the graduate knows how to**:** | | |
| U01 | determine molar and percentage concentration of compounds and the concentration of substances in isoosmotic solutions, both mono- and multi-component; | B.U3. |
| U02 | determine the solubility of inorganic compounds, chemical substrate for the solubility of organic compounds, or lack thereof, and practical significance for nutrition and therapy; | B.U4. |
| U03 | determine the pH of the solution and the effect of changes in the pH on the inorganic and organic compounds; | B.U5. |
| U04 | envisage the development of biochemical processes depending on the state of the cells’ energy; | B.U6. |

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| within the scope of **SOCIAL COMPETENCE**, the graduate is able to: | | |
| K01 | recognize his/her own limitations and self-evaluate educational deficiencies and needs; | H.S5 |
| K02 | use reliable information sources; | H.S7 |
| K03 | conclude on the basis of own surveys and observations; | H.S8 |
| K04 | introduce rules of social conduct and teamwork to the group of specialists, including specialists form other medical professions also in the multicultural and multinational environment; | H.S9 |
| K05 | give opinions concerning various aspects of professional activity; | H.S10 |
| K06 | take responsibility for own decisions made during professional activities including own safety and safety of other people; | H.S11 |

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| * 1. **Methods of assessment of the intended learning outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **Teaching**  **outcomes**  ***(code)*** | **Method of assessment (+/-)** | | | | | | | | | | | | | | | | | | | | |
| **Exam oral/written\*** | | | **Test\*** | | | **Project\*** | | | **Effort**  **in class\*** | | | **Self-study\*** | | | **Group work\*** | | | **Others\***  **Observation** | | |
| ***Form of classes*** | | | ***Form of classes*** | | | ***Form of classes*** | | | ***Form of classes*** | | | ***Form of classes*** | | | ***Form of classes*** | | | ***Form of classes*** | | |
| *L* | *C* | *...* | *L* | *C* | *...* | *L* | *C* | *...* | *L* | *C* | *...* | *L* | *C* | *...* | *L* | *C* | *...* | *L* | *C* | *...* |
| W01 – W09 | ***X*** |  |  | ***X*** |  |  |  |  |  |  | ***X*** |  |  |  |  |  |  |  |  |  |  |
| U01 – U04 | ***X*** |  |  | ***X*** |  |  |  |  |  |  | ***X*** |  |  |  |  |  |  |  |  |  |  |
| K01-K06 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ***X*** |  |  |

***\*delete as appropriate***

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| * 1. **Criteria of assessment of the intended learning outcomes** | | |
| **Form of classes** | **Grade** | **Criterion of assessment** |
| **lecture (L)** | **3** | achievement 61-68% of the total number of points possible to obtain |
| **3,5** | Achievement 69-76% of the total number of points possible to obtain |
| **4** | Achievement 77-84% of the total number of points possible to obtain |
| **4,5** | Achievement 85-92% of the total number of points possible to obtain |
| **5** | Achievement 93-100% and more of the total number of points possible to obtain |
| **classes (C)\*** | **3** | Achievement 61-68% of the total number of points possible to obtain (practice and theory) |
| **3,5** | Achievement69-76% of the total number of points possible to obtain (practice and theory) |
| **4** | Achievement 69-77% of the total number of points possible to obtain (practice and theory) |
| **4,5** | Achievement 78-87% of the total number of points possible to obtain (practice and theory) |
| **5** | Achievement 88% and more of the total number of points possible to obtain (practice and theory) |

1. **BALANCE OF ECTS CREDITS – STUDENT’S WORK INPUT**

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| **Category** | **Student's workload** |
| **Full-time**  **studies** |
| *NUMBER OF HOURS WITH THE DIRECT PARTICIPATION OF THE TEACHER /CONTACT HOURS/* | ***55*** |
| *Participation in lectures\** | ***30*** |
| *Participation in classes, seminars, laboratories\** | ***20*** |
| *Preparation in the exam/ final test\** |  |
| *Others\** | ***51*** |
| *INDEPENDENT WORK OF THE STUDENT/NON-CONTACT HOURS/* | ***70*** |
| *Preparation for the lecture\** | ***70*** |
| *Preparation for the classes, seminars, laboratories\** |  |
| *Preparation for the exam/test\** |  |
| *Gathering materials for the project/Internet query\** |  |
| *Preparation of multimedia presentation* |  |
| *Others (please specify e.g. e-learning)\** |  |
| *TOTAL NUMBER OF HOURS* |  |
| ECTS credits for the course of study | ***125*** |
|  | **5** |

***\*delete as appropriate***

1 e-learning (without participation of the lecturer)

***Accepted for execution*** *(date and legible signatures of the teachers running the course in the given academic year)*

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