# 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. Specialization*** | Lack |
| **1.6. Unit running the course of study** | The Faculty of Mathematics and Natural Sciences |
| **1.7. Person/s preparing the course description** | Prof. zw. dr hab. Bogusław Wiłkomirski, dr hab. Przemysław Rybiński, prof. UJK |
| **1.8. Person responsible for the course of study** | Prof. zw. dr hab. Bogusław Wiłkomirski |
| **1.9. Contact** | boguslaw.wilkomirski@ujk.edu.pl |

## 2. GENERAL CHARACTERISTICS OF THE COURSE OF STUDY

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| **2.1. Affiliation with the module** | Scientific basis of medicine |
| **2.2. Language of instruction** | English |
| **2.3. Semesters in which the course of study is offered** | 3rd semester |
| **2.4. Prerequisites*** | General and organic chemistry |

## 3. DETAILED CHARACTERISTICS OF THE COURSE OF STUDY

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| **3.1. Form of classes** | | Lectures – 30 hours, Laboratories– 45 hours |
| **3.2. Place of classes** | | Courses in the teaching rooms of the UJK |
| **3.3. Form of assessment** | | Lecture – Exam, Laboratory – Credit with grade |
| **3.4. Teaching methods** | | Problem-based lecture, laboratory classes |
| **3.5. Bibliography** | **Required reading** | 1. Nelson D. L., Cox M. M., Lehninger Principles of Biochemistry, 6th Edition. ISBN-10: 1-4292-3414-8; ISBN-13: 978-1-4292-3414-6;<br>2. Rodwell Victor, Weil P. Anthony, Bender David, Botham Kathleen M., Kennelly Peter J., Harper's Illustrated Biochemistry, 30th Edition, McGraw-Hill Education 2015. ISBN 9781259252860 |
| | **Further reading** | 3. Tymoczko John L., Berg Jeremy M., Stryer Lubert, Biochemistry: A Short Course, 3rd ed, Macmillan Learning 2016.<br>4. Salway J.G. Medical Biochemistry at a Glance, 3rd Edition, Wiley 2012. ISBN 978-0-47-065451-4.<br>5. Allan Gaw, Michael J. Murphy , Rajeev Srivastava, Robert A. Cowan, Denis St. J. O'Reilly; Clinical Biochemistry: An Illustrated Colour Text, 5th Edition, Churchill Livingstone 2013; ISBN 978-0702051791 |

## 4. OBJECTIVES, SYLLABUS CONTENT AND INTENDED TEACHING OUTCOMES

**4.1. 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.

**4.2. Detailed syllabus** ***(including form of classes)***

Lecture

Part I.

What is biochemistry? Brief history and the place of biochemistry within natural sciences. Cells and biomolecules. Water, its properties and function in the organisms.
Amino acids – stereoisomers, classification by R groups, acid-base properties. Peptides. Formation, properties of peptide bond, characteristics of amino acid composition. Biologically active peptides.
Proteins. Overview of protein structure (the three-dimensional protein structure, primary, secondary, tertiary, quaternary). The relationship between structure and function on the example of globular proteins (myoglobin and haemoglobin) and fibrous proteins (collagen and elastin). Protein denaturation. Protein function. Toxic peptides and proteins.
Enzymes and biocatalysis. An introduction to enzymology. How enzymes work? Catalytic power and specificity of enzymes. Division and classification of enzymes. Co-enzymes and their relationship with vitamins and the role of the most important co-enzymes and metals in non-enzymatic catalysis. Regulation of enzymatic activity: inhibitors and activators of enzymes. Ribozymes.

Part II.
Carbohydrates: the structure, properties and biological function. Monosaccharides and disaccharides. Polysaccharides. Glycoconjugates: proteoglycans, glycoproteins, and glycolipids. Glycosidic bond. Biologically active glycosides – cardiac glycosides, cyanogenic glycosides.
Fatty acids and lipids. Triacylglycerols - high-energy reserve material. Membrane lipids: phospholipids, glycolipids and cholesterol. Eicosanoids. Isoprene lipids: steroids, carotenoids and other polyprenyl compounds.. Structure of biological membranes. Membrane proteins and the processes occurring in the membranes. Passive diffusion and active transport through the membranes. Ionic channels.
Bioenergetics and metabolism. Principles of bioenergetics. Energy relationships between catabolic and anabolic pathways. Phosphoryl Group Transfers and ATP. Glycolysis and gluconeogenesis. Pentose phosphate pathway of glucose oxidation. Principles of metabolic regulation.
Tricarboxylic acid cycle. Production of acetyl-CoA (Activated acetate). Reactions of the citric acid cycle. Regulation of the citric acid cycle. Energy conversion in specialized biological membranes. The chain of electron transport proton gradient, oxidative phosphorylation and mitochondrial ATP synthesis.
Lipid metabolism. Fatty acids catabolism. Digestion, mobilization, and transport of fats. Oxidation of fatty acids. Ketone bodies. Glycerol metabolism. Distribution and synthesis of fatty acids. Lipid biosynthesis of biological membranes.

Part III.
Biosynthesis of fatty acids and eicosanoids. Biosynthesis of triacylglycerols. Biosynthesis of membrane phospholipids. Biosynthesis of cholesterol, steroids and isoprenoids.
Metabolism of proteins and amino acids. Deamination and transamination of amino acids. Urea cycle. Biosynthesis of amino acids. Conversion of amino acids to biogenic amines and other compounds.
The metabolic profiles of tissues in the normal condition of the body. Metabolism during starvation and diabetes as well as metabolic response to stress. The basic ingredients of the food and the nutritional requirements of a human. The basic ingredients of the food and the nutritional requirements of a human. Metabolism of xenobiotics. Errors of metabolism. Hormonal regulation and integration of mammalian metabolism.
Nucleic acids: nitrogen bases, nucleosides, nucleotides and polynucleotides. The structure and biological functions of DNA and basic classes of ribonucleic acids.
Copying and reading of genetic information (transcription and translation processes, genetic code).

Checking knowledge (lecture) – Three periodic single-choice written tests verifying knowledge of the above parts of material and a written final exam. Take an exam is possible after obtaining positive results from all intermediate tests and obtaining credit from the laboratory.

<u>Laboratory classes</u>

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 plate.
Properties of simple and complex sugars. Investigation of properties reducing the hydrolysis products of sucrose and starch. Quantitative determination of glucose.
General characteristics of fats and steroids. Saponification of fats and receiving soaps, insoluble soaps. Quantitative determination of the cholesterol.
Chemical characterization of nucleic acids - the detection of the hydrolysis products of DNA. DNA isolation by method of desalting proteins. Electrophoresis of DNA digests with a restriction enzyme in an agarose gel.
Quantitative determination of nucleic acids by spectrophotometric methods. Quantitative determination of DNA by diphenylamine method.
Enzymes- pH effect, temperature, activators and inhibitors on their activity. Determination of 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.

| Code | A student, who passed the course | Relation to teaching outcomes |
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| within the scope of **KNOWLEDGE:** | | |
| W01 | knows basic reactions of organic and non-organic compounds in water solutions; | B.W4. |
| W02 | knows the physical, chemical and molecular basis of how the organs of the senses function; | B.W7. |
| W03 | knows the structure of simple organic compounds included in the macromolecules present in the cells, extracellular matrix and body fluids; | B.W10. |
| W04 | describes the structure of lipids and polysaccharides and their functions in the cellular and extracellular structures; | B.W11. |
| W05 | characterizes the protein primary, secondary, tertiary and quaternary structures; knows the post-translational and functional protein modifications and their significance; | B.W12. |
| W06 | knows the functions of nucleotides in the cell, RNA and DNA primary structure as well as chromatin structure; | B.W13. |
| W07 | describes basic catabolic and anabolic pathways, methods of their regulation and the influence of genetic and environmental factors; | B.W15. |
| W08 | knows the metabolic profiles of basic organs and systems; | B.W16. |
| W09 | knows the concepts of oxidation potential of the organism and oxidative stress | B.W17. |
| within the scope of **ABILITIES:** | | |
| U01 | determines molar and percentage concentration of compounds and the concentration of substances in isoosmotic solutions, both mono- and multi-component; | B.U3. |
| U02 | determines 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 | determines the pH of the solution and the effect of changes in the pH on the inorganic and organic compounds; | B.U5. |
| U04 | envisages the development of biochemical processes depending on the state of the cells' energy; | B.U6. |

| 4.4. Methods of assessment of the intended teaching outcomes | | | | | | | | | | | | | | | | | | | | | | |
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| **Teaching outcomes** *(code)* | **Method of assessment (+/-)** | | | | | | | | | | | | | | | | | | | | | |
| | **Exam written*** | | | **Test*** | | | **Project*** | | | **Effort in class*** | | | **Self-study*** | | | **Group work*** | | | **Others*** | | |
| | ***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*** | | | | | | | | | | |

****delete as appropriate***

| 4.5. Criteria of assessment of the intended teaching outcomes | | |
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| **Form of classes** | **Grade** | **Criterion of assessment** |
| **lecture (L)** | **3** | achievement 61-68% of the total number of points possible to obtain (16-18 points from 30 points) |
| | **3,5** | Achievement 69-76% of the total number of points possible to obtain (19-21 points from 30 points) |
| | **4** | Achievement 77-84% of the total number of points possible to obtain (22-24 points from 30 points) |
| | **4,5** | Achievement 85-92% of the total number of points possible to obtain (25-27 points from 30 points) |
| | **5** | Achievement 93-100% and more of the total number of points possible to obtain (28-30 points from 30 points) |
| **Laboratory classes (C)*** | **3** | Achievement 61-68% of the total number of points possible to obtain (practice and theory) |
| | **3,5** | Achievement 69-76% 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) |

- **Thresholds are valid from 2018/ 2019 academic year**

## 5. BALANCE OF ECTS CREDITS – STUDENT'S WORK INPUT

| **Category** | **Student's workload** |
|---|---|
| | **Full-time studies** |
| *NUMBER OF HOURS WITH THE DIRECT PARTICIPATION OF THE TEACHER /CONTACT HOURS/* | **60** |
| *Participation in lectures** | **30** |
| *Participation in classes, seminars, laboratories** | **30** |
| *Preparation in the exam/ final test** | |
| *Others** | |
| *INDEPENDENT WORK OF THE STUDENT/NON-CONTACT HOURS/* | **65** |
| *Preparation for the lecture** | **15** |
| *Preparation for the classes, seminars, laboratories** | **35** |
| *Preparation for the exam/test** | **15** |
| *Gathering materials for the project/Internet query** | |
| *Preparation of multimedia presentation* | |
| *Others** | |
| *TOTAL NUMBER OF HOURS* | **125** |
| ECTS credits for the course of study | **5** |

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

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