# 

**SYLLABUS of the MODULE (SUBJECT)**

**General Information**

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| **Module title:** | |
| Module type | Obligatory |
| Faculty PMU | Faculty of Medicine and Dentistry |
| Major | Medicine |
| Level of study | long-cycle (S2J) |
| Mode of study | full-time studies |
| Year of studies, semester | Year 2, semester III/IV |
| ECTS credits (incl. semester breakdown) | 20 |
| Type/s of training | lectures (20h) /seminars (40h)/ practical/ (110h) |
| Form of assessment[[1]](#footnote-1) | ☒graded assessment:  ☒descriptive  ☒test  ☐practical  ☐oral  ☐non-graded assessment  ☒final examination  ☒descriptive  ☒test  ☐practical  ☒oral |
| Head of the Department/ Clinic, Unit | Prof. dr hab. Dariusz Chlubek |
| Tutor responsible for the module | dr n. med. Patrycja Kupnicka; patrycja.kupnicka@pum.edu.pl |
| Department’s/ Clinic’s/ Unit’s website | https://www.pum.edu.pl/wydzialy/wydzial-medycyny-i-stomatologii/zaklad-biochemii |
| Language | English |

**Detailed information**

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| **Module objectives** | | The aim of biochemistry is to understand life processes at the molecular level and explanation of the relationship between structure and function of biomolecules in a living organism. This knowledge is fundamental to understanding the role of the various tissues and organs and consequently, the functioning of the whole body in health and disease. It also allows to purposefully respond to the appearance of pathological processes through the implementation of effective treatment. It allows to take preventive measures in relation to civilization diseases, eg. Diabetes. The aim of biochemistry is also to prepare students to study clinical subjects. |
| Prerequisite /essential  requirements | Knowledge | Student knows the basic models of chemical compounds. He explains the concept of: atom, molecule, chemical reagent, chemical reaction, the functional group. Identifies and defines the organic compounds: hydrocarbons, alcohols, aldehydes, ketones, acids, esters, ethers, amides, amines. Familiar with the term chemical bond, classifies types of chemical bonds. Defines the concepts of solubility, diffusion, osmosis, osmotic pressure, molarity. He knows the concepts of solution, molar concentration, percent concentration, equivalent concentration , electrolytic dissociation, ion, anion, cation. |
| Skills | Student can properly use basic laboratory equipment ( uses of the automatic pipette, measures the correct volume of solutions, prepares solutions in accordance with the prescribed concentration, can titrate). Performs chemical calculations based on the knowledge of chemistry and mathematics. Properly use the principles of functioning in the laboratory. Able to react properly in an emergency in a chemistry lab (action of the compounds corrosive, flammable, toxic, high temperature, etc.). |
| Competences | Student can work in a team and actually perform tasks requiring precision, by following strictly established procedure. He can behave responsibly in emergency situations. It has a habit of self-education. |

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| **Description of the learning out**c**omes for the subject /module** | | | |
| **No. of learning outcome** | **Student, who has passed the (subject)**  **knows /is able to /can:** | **SYMBOL**  **(referring the standards)** | **Method of verification of learning outcomes\*** | |
| W01 | knows and understands the water and electrolyte balance in biological systems | B.W1 | S, RZĆ, W, ET, EP, EU | |
| W02 | knows and understands the acid-base balance and the mechanism of action of buffers and their importance in systemic homeostasis; | B.W2 | S, RZĆ, W, ET, EP, EU | |
| W03 | knows and understands the structure of simple organic compounds that are part of macromolecules present in cells, the extracellular matrix and body fluids | B.W10 | S, RZĆ, W, ET, EP, EU | |
| W04 | knows and understands the structure of lipids and polysaccharides and their functions in cellular and extracellular structures | B.W11 | S, RZĆ, W, ET, EP, EU | |
| W05 | knows and understands the 1st, 2nd, 3rd and 4th order structures of proteins; knows the post-translational and functional modifications of proteins and their importance | B.W12 | S, RZĆ, W, ET, EP, EU | |
| W06 | knows and understands the functions of nucleotides in the cell, the primary and secondary structures of DNA and RNA and the structure of chromatin | B.W13 | S, RZĆ, W, ET, EP, EU | |
| W07 | knows and understands the functions of the human genome, transcriptome and proteome and the basic methods used in their study, the processes of DNA replication, repair and recombination, transcription and translation, and degradation of DNA, RNA and proteins, as well as the concepts of gene expression regulation | B.W14 | S, RZĆ, W, ET, EP, EU | |
| W08 | knows and understands the basic catabolic and anabolic pathways, methods of their regulation and the influence of genetic and environmental factors | B.W15 | S, RZĆ, W, ET, EP, EU | |
| W09 | knows and understands the metabolic profiles of basic organs and systems | B.W16 | S, RZĆ, W, ET, EP, EU | |
| U01 | can predict the direction of biochemical processes depending on the energy state of cells; | B.U6 | RZĆ, S, PS | |
| U02 | can use basic laboratory techniques such as qualitative analysis, titration, colorimetry, pHmetry, chromatography, electrophoresis of proteins and nucleic acids | B.U8 | RZĆ, S, PS | |
| U03 | can use simple measuring instruments and assess the accuracy of measurements | B.U9 | RZĆ, S, PS | |
| U04 | can use databases, including the Internet, and search for the necessary information using the available tools | B.U10 | RZĆ, S, PS | |
| U05 | can plan and perform simple scientific research and interpret their results and draw conclusions | B.U13 | RZĆ, S, PS | |

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| **Table presenting LEARNING OUTCOMES in relation to the form of classes** | | | | | | | | |
| **No. of learning outcome** | **Learning outcomes** | **Type of training** | | | | | | |
| **Lecture** | **Seminar** | **Practical classes** | **Clinical classes** | **Simulations** | **E-learning** | **Other…** |
| W01 | B.W1 | x | x | x |  |  |  |  |
| W02 | B.W2 | x | x | x |  |  |  |  |
| W03 | B.W10 | x | x | x |  |  |  |  |
| W04 | B.W11 | x | x | x |  |  |  |  |
| W05 | B.W12 | x | x | x |  |  |  |  |
| W06 | B.W13 | x | x | x |  |  |  |  |
| W07 | B.W14 | x | x | x |  |  |  |  |
| W08 | B.W15 | x | x | x |  |  |  |  |
| W09 | B.W16 | x | x | x |  |  |  |  |
| U01 | B.U6 | x | x | x |  |  |  |  |
| U02 | B.U8 | x | x | x |  |  |  |  |
| U03 | B.U9 | x | x | x |  |  |  |  |
| U04 | B.U10 | x | x | x |  |  |  |  |
| U05 | B.U13 | x | x | x |  |  |  |  |

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| **Table presenting TEACHING PROGRAMME** | | | |
| **No. of a teaching programme** | **Teaching programme** | **No. of hours** | **References to learning outcomes** |
| **Winter semester** | | | |
| **Lectures** | | | |
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| TK01 | The importance of biochemistry in medicine. Proteins - structure and functions | 2 | B.W10, W12; B.U10 |
| TK02 | Enzymes | 2 | B. W10 ; B. U10 |
| TK03 | Protein digestion | 2 | B. W15, W16; B. U10 |
| K04 | Catabolism of amino groups of amino acids | 2 | B. W15, W16; B. U10 |
| TK05 | The Krebs cycle and the mitochondrial respiratory chain | 2 | B. W015; B. U6,U10 |
| TK06 | Acid-base balance | 2 | B W02, W16; B. U10 |
| TK07 | Magnesium metabolism | 2 | B. W10, W15; B. U10 |
| TK08 | Ethyl alcohol metabolism | 2 | B. W1, W4; W15; B. U10 |
| TK09 | Overall carbohydrate metabolism. Digestion of carbohydrates | 2 | B. W11, W15; W16; B. U10 |
| TK10 | Glycogen metabolism | 2 | B. W11, W15, W16;  B. U10 |
| **Seminars** | | | |
| TK01 | *Amino acids and protein structure*  *Biomedical importance of amino acids and proteins. Classification and properties of amino acids. Protein structures: primary, secondary, tertiary and quaternary. Bonds stabilizing protein structures. Properties of proteins. Functions of proteins in the body. The isoelectric point of a protein. Improper protein folding.* | 1,5 | B.W10, W12  B.U10 |
| TK02 | *Fibrillar proteins*  *Structure and types of collagen. Collagen biosynthesis. Collagenopathies. The structure of elastin. Protective role of α1-antitrypsin in elastin metabolism and the development of emphysema* | 1,5 | B.W10, W12  B.U10 |
| TK03 | *Nucleotide metabolism*  *Nucleosides and nucleotides - structure and functions. Synthesis and catabolism of purine nucleotides. Synthesis and catabolism of pyrimidines. Diseases related to purine catabolism* | 1,5 | B.W10, W13  B. U10 |
| TK04 | *DNA and RNA: Structure replication and repair*  *Structure of DNA. DNA replication. Organization of eukaryotic DNA. DNA repair. Telomeres. Reverse transcriptases. . RNA structure. Types of RNA and their functions. Transcription. Post-transcriptional modification of RNA. Alternative splicing* | 1,5 | B.W10, W13, W14  B.U10 |
| TK05 | *Enzymes I*  *Biomedical importance of enzymes. Classification and nomenclature of enzymes. Specificity of enzymatic reactions. Factors influencing the rate of enzymatic reaction. Kinetics of enzymatic catalysis. Active site and allosteric site.* | 1,5 | B. W10  B. U10 |
| TK06 | *Enzymes II: regulation. Regulation of gene expression*  *Inhibition of enzymatic reactions: competitive and non-competitive inhibition. Enzymes in clinical diagnosis.*  *Regulation of enzyme activity. Regulatory sequences and molecules. The operon theory. Regulation of gene expression in Eukaryotes. Hormonal regulation. Alternative splicing and mRNA editing. Regulation by changes in DNA*. | 1,5 | B.W10, W13, W14  B.U10 |
| TK07 | *Protein biosynthesis*  *Properties of the genetic code. Types of mutations and their effects. Types of tRNA. Functions of the tRNA arms. Stages of protein biosynthesis: initiation, elongation and termination. Post-translational modifications of proteins. Effect of antibiotics on protein synthesis.* | 1,5 | B. W14, W15  B. U10 |
| TK08 | *Removal of amino acid nitrogen.*  *Protein metabolic turnover. Digestion of food proteins. Reactions of deamination, deamidation and transamination: course and organ localization. Reactions releasing ammonia. Cellular mechanisms of ammonia binding and detoxification.* Urea cycle. The role of the liver and muscles in the nitrogen balance of the organism: the alanine cycle. Ammonia metabolism. | 1,5 | B. W15, W16  B. U10 |
| TK09 | *Breakdown and synthesis of amino acids*  *Glucogenic and ketogenic amino acids. Catabolism of the carbon backbones of amino acids. Biosynthesis of non-essential amino acids. Diseases related to the metabolism of amino acids.* | 1,5 | B. W15  B. U10 |
| TK10 | *Conversion of amino acids into specialized products*  *Porphyrin metabolism. Porphyries. Heme catabolism. Jaundice. Iron metabolism. Catecholamines: synthesis, catabolism. Histamine. Serotonin. Creatine. Melanin.* | 1,5 | B. W10, W15, W16  B. U10 |
| **Practical** **classes** | | | |
| TK01 | *Amino acids and protein structure*  *Biomedical importance of amino acids and proteins. Properties of amino acids and proteins. Functions of proteins in the body. The isoelectric point of a protein.* | 4 | B.W10, W12  B.U08, U09, U10, U13 |
| TK02 | *Fibrillar proteins*  *Structure and types of collagen. The structure of elastin. Properties of amino acids and proteins. Protein denaturation. Protective properties of colloids.* | 4 | B.W10, W12  B.U08, U09, U10, U13 |
| TK03 | *Nucleotide metabolism*  *Nucleosides and nucleotides - structure and functions. Synthesis and catabolism of purine and pyrimidine nucleotides. Diseases related to purine catabolism. Determination of serum transaminases activity.* | 4 | B.W10, W13  B.U08, U09, U10, U13 |
| TK04 | *DNA and RNA: structure replication and repair*  *Structure of DNA. DNA replication. Organization of eukaryotic DNA. DNA repair. Telomeres. Reverse transcriptases. DNA isolation. RNA structure. Types of RNA and their functions. Transcription. Post-transcriptional modification of RNA. Alternative splicing*  *Properties of nucleic acids.* | 4 | B.W10, W13, W14  B.U08, U09, U10, U13 |
| TK05 | *Enzymes I:*  *Biomedical importance of enzymes. Specificity of enzymatic reactions. Factors influencing the rate of enzymatic reaction. Kinetics of enzymatic catalysis.*  *Determination of amylase activity in saliva* | 4 | B. W10  B.U08, U09, U10, U13 |
| TK06 | *Enzymes II: regulation. Regulation of gene expression*  *Inhibition of enzymatic reactions: competitive and non-competitive inhibition. Enzymes in clinical diagnosis.Regulatory sequences and molecules. The operon theory. Regulation of gene expression in Eukaryotes. Hormonal regulation. Alternative splicing and mRNA editing. Regulation by changes in DNA. Determination of amylase activity in serum and urine* | 4 | B.W10, W13, W14  B.U08, U09, U10, U13 |
| TK07 | *Protein biosynthesis*  *Properties of the genetic code. Types of mutations and their effects. Types of tRNA. Functions of the tRNA arms. Stages of protein biosynthesis: initiation, elongation and termination.*  *Post-translational modifications of proteins. Effect of antibiotics on protein synthesis. Determination of protein concentration* | 4 | B. W14, W15  B.U08, U09, U10, U13 |
| TK08 | *Removal of amino acid nitrogen.*  *Protein metabolic turnover. Digestion of food proteins. Reactions releasing ammonia. Cellular mechanisms of ammonia binding and detoxification. Urea cycle. The share of liver and muscles in the nitrogen balance of the organism. Ammonia metabolism. Kay's test.* | 4 | B. W15, W16  B.U08, U09, U10, U13 |
| TK09 | *Breakdown and synthesis of amino acids*  *Glucogenic and ketogenic amino acids. Catabolism of the carbon backbones of amino acids. Biosynthesis of non-essential amino acids. Diseases related to the metabolism of amino acids. Determination of urea in serum and urine* | 4 | B. W15  B.U08, U09, U10, U13 |
| TK10 | *Conversion of amino acids into specialized products*  *Porphyrin metabolism. Porphyries. Heme catabolism. Jaundice. Iron metabolism. Catecholamines: synthesis, catabolism. Histamine. Serotonin. Creatine. Melanin. . Determination of iron and TIBC concentration in the serum. Detection of urobilinogen in urine* | 4 | B. W10, W15, W16  B. U08, U09, U10, U13 |
| **Simulation** | | | |
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| **E-learning** | | | |
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| **Summer semester** | | | |
| **Lectures** | | | |
| TK01 | Glycolysis and gluconeogenesis | 2 | B. W10; W15; W16; B. U10 |
| TK02 | The pentose cycle. Fructose and galactose metabolism | 2 | B. W10; W15; W16;W25; B. U10 |
| TK03 | Digestion and absorption of lipids | 2 | B. W10; W11;W15; W16; B. U10 |
| TK04 | Lipoprotein metabolism | 2 | B. W10; W11;W15; W16;W25; B. U10 |
| TK05 | Cholesterol and steroid hormones metabolism | 2 | B. W10; W11;W15; W16;W25; B. U10 |
| TK06 | Bilirubin and iron metabolism | 2 | B. W10; W11;W15; W16;W25; B. U10 |
| TK07 | Biochemistry of liver | 2 | B. W10; W11;W15; W16;W25; B. U10 |
| TK08 | Water and mineral management | 2 | B. W1; W15; W16; B. U10 |
| TK09 | Kidney and urine | 2 | B. W1; W2;W16;W25; B. U10 |
| TK10 | Presentation of examination tests | 2 |  |
| **Seminars** | | | |
| TK11 | *Acid -base balance - pulmonary regulation*  *Physiologically important blood and tissue buffer systems. Henderson-Hasselbalch equation. Contribution of the respiratory system to the maintenance of acid-base homeostasis. Carbon dioxide partial pressure.* | 1,5 | B W02, W16  B. U10 |
| TK12 | *Acid -base balance - renal regulation*  *The role of the kidneys in maintaining acid-base homeostasis. Mechanisms of reabsorption and regeneration of bicarbonates in renal tubules. Renal ammonogenesis. The production of titratable acidity and urine pH.* | 1,5 | B. W02, W16  B. U10 |
| TK13 | *Classification and structure of carbohydrates. Digestion and absorption of carbohydrates. Glycogen metabolism*  *Classification and structure of carbohydrates. Digestion of food carbohydrates. Disturbances in digestion and absorption of carbohydrates. Structure and function of glycogen. Glycogen synthesis. Glycogen degradation. Metabolic and hormonal regulation of the processes of glycogenogenesis and glycogenolysis. Differences in the regulation of glycogen metabolism in muscles and liver. Glycogen storage diseases.* | 1,5 | B. W10, W11, W15, W16  B. U6, U10 |
| TK14 | *Glycolysis and gluconeogenesis*  *Transport of glucose to cells. Glucose synthesis. Substrates of gluconeogenesis. Metabolic and hormonal regulation of gluconeogenesis. The lactic acid cycle. The role of gluconeogenesis in controlling blood glucose levels. Glycolysis reactions. Metabolic and hormonal regulation of glycolysis. Importance of glycolysis in aerobic and anaerobic conditions. Energy balance of glycolysis and oxygen combustion of glucose.* | 1,5 | B. W15, W16  B. U6,U10 |
| TK15 | *Pentose phosphate trail. Fructose and galactose metabolism*  *The physiological role and tissue localization of the pentose phosphate pathway. Characteristics of the pentose phosphate pathway reaction. Importance of NADPH in metabolic processes. Effects of G6PD deficiency. Fructose metabolism. Galactose metabolism. Defects of fructose and galactose metabolism. Lactose synthesis.* | 1,5 | B. W15, W16  B. U6,U10 |
| TK16 | *Dietary lipid metabolism and fatty acid structure*  *Presence of lipids in the diet. Digestion of lipids in the digestive tract: the importance of individual enzymes. Absorption of lipid digestion products. Processes of emulsification and micellization. Monoacylglycerol pathway. Lipids of physiological importance.* | 1,5 | B. W10, W11, W15, W16  B. U6,U10 |
| TK17 | *Synthesis of fatty acids and triacylglycerols. Fatty acid oxidation*  *Biosynthesis of fatty acids. Localization and regulation of lipogenesis. Fatty acid catabolism: -oxidation. Localization and regulation of -oxidation. Energy balance of fatty acid oxidation. Biosynthesis of acylglycerols. Metabolism of ketone bodies.* | 1,5 | B. W15  B. U6,U10 |
| TK18 | *Metabolism of phospholipids, glycolipids and eicosanoids*  *Structure, synthesis, degradation and function of phospholipids. Structure, synthesis, degradation and function of glycosphingolipids. Prostaglandins, thromboxanes and leukotrienes - structure, synthesis, function.* | 1,5 | B. W10, W11, W15  B. U6,U10 |
| TK19 | *Cholesterol and lipoprotein metabolism*  *Food sources of cholesterol. Cholesterol biosynthesis and its regulation. The role of the liver in cholesterol metabolism. Cholesterol catabolism - synthesis of bile acids. Primary and secondary bile acids. Enterohepatic circulation of bile acids.*  *The role of lipoproteins in lipid transport and metabolism. Classes of apolipoproteins. Lipoprotein fractions and their metabolism. The role of receptors in lipoprotein metabolism. The role of liver and adipose tissue in lipoprotein metabolism. Intravascular lipolysis.* | 1,5 | B. W15, W16  B. U10 |
| TK20 | *The citric acid cycle.*  *Biomedical importance of the processes of obtaining and storing energy in the cell. Characteristics of the citric acid cycle reactions and their regulation. Energy balance of the citric acid cycle. The amphibolic nature of the citric acid cycle. Enzymes participating in oxidation and reduction reactions.* | 1,5 | B. W015  B. U6,U10 |
| TK21 | *Bioenergetics. Biological oxidation.*  *Components of the mitochondrial respiratory chain. Redox potential. Respiratory chain poisons and compounds decoupling oxidation and phosphorylation processes. Mitochondria and apoptosis.* |  |  |
| TK22 | *Steroid hormones*  *Cholesterol as a precursor to steroid hormones. Adrenal cortex hormones: mineralocorticosteroids and glucocorticosteroids. Gonadal hormones: gestagens, estrogens and androgens. Synthesis of steroid hormones. Metabolic activities of steroid hormones.* | 1,0 | B. W15, W16  B. U10 |
| TK23 | *Thyroid hormones*  *Thyroid hormone biosynthesis. Storage and*  *secretion of thyroid hormones. Metabolic action*  *thyroid hormones* | 1 | B. W15, W16  B. U10 |
| TK24 | *Insulin and glucagon*  *Insulin: molecular structure, synthesis, regulation of secretion, biodegradation. Metabolic and hormonal regulation of insulin secretion. Metabolic effects. Hypoglycemia. Glucagon: structure, synthesis, secretion. Metabolic effects* | 1,5 | B. W15, W16  B. U10 |
| TK25 | *State of satiety and state of starvation*  *Regulatory mechanisms of the resorptive state. The role of the liver in the distribution of nutrients. Adipose tissue as an energy reservoir. Skeletal muscles at rest. Energy consumption by the brain. Organ metabolism in a starving state: liver, adipose tissue, muscles, brain, kidneys.* | 1,5 | B. W15, W16  B. U10 |
| TK26 | *Diabetes and obesity*  *Type I diabetes mellitus: causes, diagnosis, metabolic changes, treatment. Type II - causes of insulin resistance, metabolic changes, treatment. Chronic sequelae and prevention.*  *The causes of obesity. Anatomical differences in the distribution of fat. Weight regulation. Molecular influences. Metabolic effects. The impact of obesity on health. Weight reduction.* | 1,5 | B. W15, W16  B. U10 |
| TK27 | *Vitamins*  *Vitamin classification: fat and water soluble vitamins. Vitamin metabolism. Metabolic disorders associated with hypo- or hypervitaminosis.* | 1,0 | B. W15  B. U10 |
| TK28 | *Macronutrients and trace elements*  *The importance of macronutrients in metabolism: calcium, phosphorus, magnesium, sodium, potassium, chloride and micronutrients: copper, manganese, zinc. Health effects of the deficiency of ultra-trace elements: iodine, selenium, molybdenum.* | 1,0 | B. W15  B. U10 |
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| **Practical** **classes** | | | |
| TK11 | *Acid-base balance - pulmonary regulation*  *Physiologically important blood and tissue buffer systems. Henderson-Hasselbalch equation. Contribution of the respiratory system to the maintenance of acid-base homeostasis. Carbon dioxide partial pressure. Properties of buffers* | 4 | B W02, W16  B. U08, U09, U10, U13 |
| TK12 | *Acid economy - renal regulation*  *The role of the kidneys in maintaining acid-base homeostasis. Mechanisms of reabsorption and regeneration of bicarbonates in renal tubules. Renal ammonogenesis. The production of titratable acidity and urine pH. Urine titratable acidity.* | 4 | B. W02, W16  B. U08, U09, U10, U13 |
| TK13 | *Classification and structure of carbohydrates. Digestion and absorption of carbohydrates. Glycogen metabolism*  *Classification and structure of carbohydrates. Digestion of food carbohydrates. Disturbances in digestion and absorption of carbohydrates. Structure and function of glycogen. Metabolic and hormonal regulation of the processes of glycogenogenesis and glycogenolysis. Testing the content of sugars in food products* | 4 | B. W10, W11, W15, W16  B. U6, U08, U09, U10, U13 |
| TK14 | *Glycolysis and gluconeogenesis*  *Glucose synthesis. Substrates of gluconeogenesis. The lactic acid cycle. The role of gluconeogenesis in controlling blood glucose. Importance of glycolysis under aerobic and anaerobic conditions. Energy balance of glycolysis and oxygen combustion of glucose. Testing the properties of sugars* | 4 | B. W15, W16  B. U6, U08, U09, U10, U13 |
| TK15 | *Pentose phosphate trail. Fructose and galactose metabolism*  *The physiological role and tissue localization of the pentose phosphate pathway. Effects of G6PD deficiency. Fructose and galactose metabolism. Defects of fructose and galactose metabolism. Lactose synthesis. Perform a sucrose loading test* | 4 | B. W15, W16  B. U6, U08, U09, U10, U13 |
| TK16 | *Dietary lipid metabolism and fatty acid structure*  *Presence of lipids in the diet. Digestion of lipids in the digestive tract. Absorption of lipid digestion products. Processes of emulsification and micellization. Lipids of physiological importance. Study of the properties of fats* | 4 | B. W10, W11, W15, W16  B. U6, U08, U09, U10, U13 |
| TK17 | *Synthesis of fatty acids and triacylglycerols. Fatty acid oxidation*  *Biosynthesis of fatty acids. Localization and regulation of lipogenesis. Fatty acid catabolism: -oxidation. Localization and regulation of -oxidation. Energy balance of fatty acid oxidation. Biosynthesis of acylglycerols. Metabolism of ketone bodies. . Lipase activity test* | 4 | B. W15  B. U6, U08, U09, U10, U13 |
| TK18 | *Metabolism of phospholipids, glycolipids and eicosanoids*  *Structure, synthesis, degradation and function of phospholipids. Structure, synthesis, degradation and function of glycosphingolipids. Prostaglandins, thromboxanes and leukotrienes - structure, synthesis, function. Determination of the acid number.* | 4 |  |
| TK19 | *Cholesterol and lipoprotein metabolism*  *Food sources of cholesterol. Cholesterol biosynthesis and its regulation. The role of the liver in cholesterol metabolism. Synthesis of bile acids. Enterohepatic circulation of bile acids.*  *The role of lipoproteins in lipid transport and metabolism. Classes of apolipoproteins. The role of liver and adipose tissue in lipoprotein metabolism. Determination of cholesterol and triacylglycerol in serum.* | 4 | B. W15, W16  B. U08, U09, U10, U13 |
| TK20 | *The citric acid cycle.*  *Biomedical significance of the processes of obtaining and storing energy in the cell. Energy balance of the citric acid cycle. The amphibolic nature of the citric acid cycle*  *Determination of the activity of ceruloplasmin, CRP and ASO.* | 4 | B. W015  B. U6, U08, U09, U10, U13 |
| TK21 | *Bioenergetics. Biological oxidation.*  *Components of the mitochondrial respiratory chain. Redox potential. Respiratory chain poisons and compounds decoupling oxidation and phosphorylation processes. Investigation of cytochrome oxidase activity.* | 4 | B. W015  B. U6, U08, U09, U10, U13 |
| TK22 | *Steroid hormones*  *Cholesterol as a precursor to steroid hormones. Adrenal cortex hormones: mineralocorticosteroids and glucocorticosteroids. Gonadal hormones: gestagens, estrogens and androgens. Reactions to detect steroid compounds.* | 4 | B. W15, W16  B. U08, U09, U10, U13 |
| TK23 | *Thyroid hormones*  *Thyroid hormone biosynthesis. Storage and*  *secretion of thyroid hormones. Metabolic action*  *thyroid hormones. Arranging diets.* | 2 | B. W15, W16  B. U08, U09, U10, U13 |
| TK24 | *Insulin and glucagon*  *Insulin: molecular structure, synthesis, regulation of secretion, biodegradation. Metabolic and hormonal regulation of insulin secretion. Metabolic effects. Hypoglycemia. Glucagon: structure, synthesis, secretion. Metabolic effects. Sucrose hydrolysis.* | 4 | B. W15, W16  B. U08, U09, U10, U13 |
| TK25 | *State of satiety and state of starvation*  *Regulatory mechanisms of the resorptive state. The role of the liver in the distribution of nutrients. Adipose tissue as an energy reservoir. Skeletal muscles at rest. Energy consumption by the brain. Organ metabolism in a starving state: liver, adipose tissue, muscles, brain, kidneys. Carrying out the synthesis of starch. Detection of ketone bodies in urine.* | 4 | B. W15, W16  B. U08, U09, U10, U13 |
| TK26 | *Diabetes and obesity*  *Type I diabetes mellitus: causes, metabolic changes. Type II - causes of insulin resistance, metabolic changes. Chronic sequelae and prevention.*  *The causes of obesity. Anatomical differences in the distribution of fat. Weight regulation. Metabolic effects. The impact of obesity on health. Glucose tolerance test.* | 4 | B. W15, W16  B. U08, U09, U10, U13 |
| TK27 | *Vitamins*  *Vitamin classification: fat and water soluble vitamins. Vitamin metabolism. Metabolic disorders associated with hypo- or hypervitaminosis. Vitamin C determination* | 4 | B. W15  B. U08, U09, U10, U13 |
| TK28 | *Macronutrients and trace elements*  *The importance of macronutrients in metabolism. Health effects of deficiency of ultra-trace elements. Examination of mineral and organic components of the tooth, determination of serum phosphate concentration.* | 4 | B. W15  B. U08, U09, U10, U13 |
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| **Simulation** | | | |
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| **E-learning** | | | |
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| **Booklist** |
| Obligatory literature: |
| 1. Biochemistry. Denise R. Ferrier. Seventh eddition |
| 2. |
| Supplementary literature: |
| 1. Harper’s Biochemistry. Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly, Anthony P. Weil. 31st ed. |
| 2. |

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| **Student’s workload** | |
| Form of student’s activity  (in-class participation; activeness, produce a report, etc.) | Student’s workload [h] |
| Tutor |
| Contact hours with the tutor | 170 |
| Time spent on preparation to seminars/ practical classes | 224 |
| Time spent on reading recommended literature |  |
| Time spent on writing report/making project |  |
| Time spent on preparing to colloquium/entry test | 28 |
| Time spent on preparing to exam | 120 |
| Other ….. |  |
| Student’s workload in total | 542 |
| **ECTS credits for the subject (in total)** | 20 |
| **Remarks** | |
|  | |

\* Selected examples of methods of assessment:

EP – written examination

EU – oral examination

ET – test examination

EPR – practical examination

K – colloqium

R – report

S – practical skills assessment

RZĆ – practical classes report, incl. discussion on results

O – student’s active participation and attitude assessment

SL – lab report

SP – case study

PS - assessment of student’s ability to work independently

W – entry test

PM – multimedial presentation

other…

1. replace **☐** into **☒** where applicable [↑](#footnote-ref-1)