Study program: Integrated academic studies in Pharmacy

Course title: General Biochemistry

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Course status: Compulsory

ECTS Credits: 5

Condition: Biology and Human Genetics, Organic Chemistry I; Organic Chemistry II

Course aim:

To enable pharmacy students to gain knowledge of the biochemical basis of physiological processes in the human organism..Students will be introduced to the structures of basic biomolecules and the most important biochemical reactions and metabolic pathways. Particular attention will be paid to the biochemical part of molecular biology and its application in medicine and pharmacy.

Expected outcome of the course:

Knowledge of the basic constituents of the human body. Knowledge of general metabolic pathways, bioenergetics, regulatory mechanisms and their importance for normal metabolism. Knowledge of biological phenomena at the molecular level and understanding of the essence of many diseases.

Contents of the course:

Theoretical education

1. Introduction. Bioelements / biomolecules. Energy. Chemical reactions in the cell. 2. Water as a biological solvent and biomolecule. 3. Amino acids. Peptides. 4. Proteins - structure, properties, classification. 5. Fibrillar proteins, keratin and collagen, properties and function. Globular proteins. Hemoproteins - structure and function of hemoglobin and myoglobin, cytochromes. 6. Nucleic acids - general structure, structure and properties of DNA. RNA - structure, types and function. 7. Carbohydrates - mono-, di-, oligo- and polysaccharides. Glycosaminoglycans. 8. Lipids - fatty acids, simple and complex lipids, properties. 9. Glyco-, phospho- and lipoproteins. 10. Prostaglandins, leucotriens, thromboxanes. 11. Enzymes - structure, properties, classification, mechanism of catalysis. Enzyme reaction kinetics, influence factors, activation, inhibition. Isoenzymes, diagnostic significance. Coenzymes and vitamins. 12. Biological membranes - structure. Transport processes through biological membranes. 13. Bioenergetics - thermodynamics, exergons and endergonic reactions. Energy-rich chemical bonds, biological oxidation. ETS mitochondria: components - cytochromes, coenzyme Q, electron transport, ATP synthesis. 14. Oxidative stress biochemistry. Mechanisms of antioxidant protection 15. Metabolic pathways. Catabolism, anabolism, regulation. 16. Glycogen catabolism, glycogenolysis. Glycolysis - flow, energy balance, regulation. Oxidative decarboxylation of pyruvate. Krebs citric acid cycle - flow, energy balance, regulation. Phosphate pentose cycle - flow and significance. Catabolism of other hexoses. Carbohydrate Anabolism - Gluconeogenesis, Flow, Energy Balance, Regulation. 17. Lipid Catabolism - Beta Oxidation of Fatty Acids, Regulation. Catabolism of triglycerides, phospho and sphingolipids, cholesterol. Ketogenesis. Lipid Anabolism - Fatty Acid Biosynthesis, Flow and Regulation. Biosynthesis of triacylglycerol, phospho- and sphingolipids. Cholesterol biosynthesis. 18. Metabolism of amino acids. Oxidative deamination, transamination, decarboxylation. Ureogenesis. Creatine synthesis. Amino acids as precursors. Glutathione synthesis. 18. Metabolism of Nitrogen Compounds. Nucleotide biosynthesis. Nucleic acid degradation. Biosynthesis of heme. 19. Molecular basis of inheritance - DNA. DNA Synthesis - Replication. RNA synthesis - transcription. Protein synthesis - translation, processing. 20. Intercellular signaling - types, first and second messengers. Membrane and intracellular receptors. 21. Cell cycle, oncogenes, growth factors, carcinogenesis. 22. Molecular Biology and Genetic Engineering Methods and Techniques. 23. Application of molecular biology methodology in medicine and pharmacy. Pharmacogenetics.

Practical education

1. Introduction to work in the biochemical laboratory. Glassware, instruments. Volume measurement. Pipetting, glass and automatic pipettes. 2.Photometry - Principles of Lambert-Beer Law. Extinction and molar extinction coefficient. Blind probe. Standard solution. Colorimeter and spectrophotometer. The sbsorption spectrum. Application of photometry. Colorimetric determination of concentration using the molar extinction coefficient, standard solution and using a calibration curve. 3. Amino acids - classification, physico-chemical properties. Colored reactions of amino acids. 4. Chromatographic methods in biochemistry. Amino acid ion exchange chromatography. 5. Proteins - physicochemical properties. Serum protein fractionation and isolation. Isolation of fibrinogen from blood plasma 6. DNA and RNA - structure and function, properties. Quantification of DNA and RNA. 7. Carbohydrates - structure, function, properties. Colored reactions of carbohydrates. 8. Lipids - types, classification, physico-chemical properties. 9. SEMINAR - enzymology. Qualitative demonstration of enzymatic activity of α-amylase in saliva. 10. Principles

of quantitative measurement of enzyme activity. Determination of the initial velocity rate of enzymatic reaction. 11. Determination of Michaelis constat. 12. Isoenzymes: definition, properties, importance of knowing the isoenzyme profile in diagnostics. 13. Vitamins and coenzymes. Quantification of vitamin C in Urine.14. Ureagenesis. Determination of the urea serum concentration. 15. Determination of the concentration of the uric acid in serum.

Literature

Compulsory

1. Rifai N, Horwath R A, Wittwer C. Tietz Textbook of Clinical chemistry and molecular diagnostics, Elsevier, St. Louis, Missouri, 2018.
2. Kovačević Z, Milošević Tošić M. Practical Biochemistry and Molecular Biology, Novi Sad, 2001.

Number of active classes	**Teoretical classes:** 45	**Practical classes:** 30

Teaching methods

Lectures for small groups with the use of multimedia didactic materials. Practical work: work in medical laboratories.

Student activity assessment (maximally 100 points)

Pre-exam activities	**points**	**Final exam**	**points**
Lectures	8	Written	
Practices	12	Practical	15
Colloquium	25	Oral	40
Essay			