Study program: Integrated academic studies in Pharmacy

Type and level of the study program: Integrated academic studies

Course title: General biochemistry (PhII-GBCH)

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Course status: Compulsory

ECTS Credits: 4

Condition: Organic chemistry I, Organic chemistry II

Course aim The aim of this course is to fit the studetns with biochemical knowledge necessary for further studies of pharmacy, and for better understanding of physiologic and pathologic processes in the body.

Expected outcome of the course: Knowledge about common biochemical pathways, bioenergetics, regulatory mechanisms and its importance for the normal metabolism. Knowledge about biological events on the molecular level and understanding of the essence of the diseases.

Course description

Theoretical education

1. Introduction to general biochemistry. Bioelements. Energy. Chemical reactions within the cell. 2. Water as biological solvent and biomolecule.
3. Aminoacids. Peptides. 4. Proteins – structure, characteristics, classification. 5. Fibrillary proteins – keratin and collagen, structure and function. Globular proteins. Haemoproteins – structure and function of haemoglobin and myoglobin, cytochromes. 6. Nucleic acids – general structure. Structure and properties of DNA. Structures, types and functions of RNA. 7. Carbohydrates – mono-, di- and oligosaccharides, polysaccharides, glycosaminoglycans. 8. Lipids – fatty acids, alcohols, simple and complex lipids, properties. 9. Glyco-, phospho-, and lipoproteins. 10. Eicosanoids. 11. Enzymes – structure, properties, mechanism of catalysis, classification. Enzymatic reaction kinetics. Affecting factors, activation and inhibition. Isoenzymes, diagnostic importance of enzymes in practical medicine. Coenzymes and vitamins. 12. Biological membranes, chemical composition, structure. Transport processes through membranes. 13. Bioenergetics – thermodynamics, exergonic and endergonic reactions. Energy rich chemical bonds. Biological oxidation. Structure of mitochondrial membrane. Electron transport system of mitochondria, ATP synthesis. 14. Metabolic pathways. Catabolism, anabolism. Regulation of metabolism. 15. Catabolism of carbohydrates – glycogen catabolism, glycogenolysis. Glycolysis: process, energy balance, regulation. Oxidative decarboxylation of pyruvate. The Krebs cycle of citric acid: process, energy balance, regulation. Pentose phosphate pathway – process and importance. Catabolism of other hexoses. Anabolism of carbohydrates – gluconeogenesis: process, energy balance, regulation. 16. Catabolism of lipids – beta-oxidation od fatty acids, regulation. Catabolism of triglycerides, phospho-, and sphingolipids, cholesterol. Ketogenesis. Anabolism of lipids – biosynthesis of fatty acids: process and regulation. Biosynthesis of triglycerides, phospho-, and sphingolipids. Biosynthesis of cholesterol. 17. Metabolism of amino acids. Deamination, transamination. Ureogenesis. 18. Biosynthesis of nucleotides. Breakdown of nucleic acids. Biosynthesis of heme. 19. Molecular basis of heredity – DNA. Synthesis of DNA – replication. Synthesis of RNA – transcription. Synthesis of proteins – translation and processing. 20. Intercellular signalling – types, first and second messengers, membranous and intracellular receptors. 21. Hormones: the mechnism of action, classification, receptors. Hormones of thyroid gland. Hormones of the adrenal medulla: adrenalin, noradrenalin, dopamine. Hormones of the pancreas. Hormones of the adrenal cortex: gluco-, and mineralocorticoids. Hormones of the gonads: oestrogens, progesterone, testosterone.

Practical education: exercises, other forms of education, research related activities

1. Goals of the practical lessons. Short overview of the lecture program. Assessing reliability of biochemical methods. Introduction to biochemistry laboratory practice. Glass dishes, instruments. Assessing volume. Pipetting, glass and automatic pipettes. 2. Measurements in medical biochemistry – review. Calculation of the reference values, precision and accuracy of measurement. Photometry – principles of the Lambert-Beer law. Absorbance (extinction) and molar extinction coefficient (ε). Blank and the standard solution. Colorimeter and spectrophotometer. The absorption spectrum of bromothymol blue (BTB). Application of photometry. Colorimetric determination of bromothymol blue concentration via molar extinction coefficient. 3. Photometry – standard and construction of the calibration curve. Determination of the proportionality factor. Colorimetric determination of BTB concentration via standard solution and calibration curve.
4. Amino acids – classification, physical and chemical properties. Coloured reactions of amino acids. 5. Chromatographic methods in biochemistry.Chromatographic separation of animo acids. Ion-exchange chromatography of amino acids. 6. Proteins – physico-chemical properties. Serum protein fractioning and isolation. Plasma fibrinogen isolation using salting out method. 7. DNA and RNA – the structure, function and properties. Quantitative determination of DNA using diphenylamine. Quantitative determination of RNA using orcinol. 8. Carbohydrates - the structure, function and properties. Coloured reactions of carbohydrates. Lipids – the classification, physico-chemical properties. 9. SEMINAR – enzymology. Qualitative assessment of enzymatic activity of α-amylase from saliva. 10. Principles of quantitative assessment of enzymatic activity. Determination of the initial reaction speed of p-nitrophenyl phosphate hydrolysis with alkaline phosphatase.
11. Determination of the Michaelis constant of alkaline phosphatase for p-nitrophenylphosphate. 12. Isoenzymes – definition, characteristics, diagnostic importance of isoenzyme profile. Demonstration of alkaline phosphatase isoenzymes. 13. Vitamins and coenzymes. Quantitative determination of vitamin C in urine.

Literature

Compulsory

1. Harvey R, Ferrier D. Lippincott's Illustrated Reviews: Biochemistry, 5th Edition. Wolters Kluwer Health, 2011.
2. Rodwell A, et al. Harper's Illustrated Biochemistry, 30th Edition. The McGraw-Hill Education, 2015.

Number of active classes				Other:
Lectures:	Practice:	Other types of teaching:	Research related activities:	-
45	30	-	-	

Teaching methods Oral presentations for small group of students using multimedial didactic tools. Control of knowledge by the use of tests with multiple choice questions.

Student activity assessment (maximally 100 points)

Pre-exam activities	**points**	**Final exam**	**points**
Lectures	8	Written	-
Practices	12	Practical	10
Colloquium	40	Oral	30
Essay	-		