

MEDICAL BIOCHEMISTRY II.

Department of Medical Biochemistry Molecular Biology

Credits: 5

Number of lessons per week 70; lectures 42; practical course/seminar: 28

Type of the course: obligatory

Academic year: 2021/2022

Code of the course AOKBMT794_2A

Name of Head of the Department: Professor László Csanády M.D. Ph.D. D.Sc.

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Position: Temporary Head of Department

Date of Habilitation: 2013 Its number: 341

Objectives of the subject, its place in the medical curriculum:

The aim of this course is to provide a comprehensive description of the metabolic processes in the human body, with particular emphasis on the medical aspects of these processes. The main focus of the semester is on intermediate metabolism, i.e. the amino acid and nucleotide metabolism following carbohydrate and lipid metabolism as described in Medical Biochemistry I and the integration of these processes in the individual organs and the human body as a whole. Furthermore, the course aims to develop the skills of medical students to understand the complex physiological processes in the human body at the molecular level. Medical students will learn clinical biochemical methods in case-oriented studies, and in addition, particularly promising and rapidly developing areas („medicine of tomorrow”) will be addressed. The medical biochemistry orientation of the course is the molecular basis of diseases that are of major public health concern (cardiovascular, neurodegenerative, cancer), with particular emphasis on potential molecular targets for therapy.

Place where the subject is taught (address of the auditorium, seminar room, etc.):

Premises located in the Basic Medical Sciences building (laboratory rooms located on the first floor and lecture halls located on the ground floor).

Successful completion of the subject results in the acquisition of the following competencies:

The knowledge of the structure, interactions and reactions of biological molecules and the interactions between organs of the higher integrated regulatory functions of the human body, is of paramount importance from a medical point of view and is essential for understanding physiological and pathological processes and, as a consequence, for making informed medical decisions.

Prerequisite (s) for admission to the course: Medical Biochemistry I.

Number of students required for the course (minimum, maximum) and method of selecting students:

Not applicable to compulsory subjects

How to apply for the course: Application is through the Neptun online system.

Detailed curriculum:

Lectures: 2x70 minutes per week (3 hours)

Lecturers: Prof. Csanády László (CSL), Prof. Kolev Kraszimir (KK), *Dr. Komorowicz Erzsébet (KE)*, Dr. Törőcsik Beáta (TB), Prof. Tretter László (TL)

Practices (P): 2 hours each week

Week	Lectures	Practices: 2 hours every week
1	Nitrogen balance. Protein digestion. Function and regulation of proteases. Amino acid absorption, amino acid transporters. (KK) Amino acid degradation. Ammonia removal. Reactions and regulation of the ornithine cycle.	Determination of transaminase and creatine kinase activity, medical implications
2	Amino acid degradation: the fate of the carbon skeleton. The role of vitamins in amino acid metabolism. Biosynthesis and degradation of heme. Iron homeostasis (KK)	Elimination of ammonia in the human body.
3	Nucleotide structure/functions. Fate of nucleotides of nutrient origin. Formation and	Metabolic role and medical significance

Week	Lectures	Practices: 2 hours every week
	elimination of uric acid, its biological role in the human body. Molecular background of gout (KK). Synthesis and degradation of purine and pyrimidine nucleotides. Effects of cytostatic drugs on nucleotide metabolism. (KK)	of vitamin B12 and tetrahydrofolic acid
4	Organ biochemistry. Red blood cell metabolism and enzymopathies. Intermediate metabolism of the kidney. Metabolic properties of the renal cortex and marrow. Renal metabolism in starvation and acidosis. Comparison of gluconeogenesis in kidney and liver. The metabolism of striated muscle and myocardium. Metabolic adaptation to exercise. (TL)	Biochemical-bioenergetic aspects of muscle work.
5	Metabolic characteristics of brain and adipose tissue. Metabolism of intestinal epithelial cells and lymphocytes. (TL) Starvation-fatigue cycle and its regulation, processes in the liver. Inter-organ communication during satiety and starvation. Regulation of biochemical processes in the satiated liver. (TL)	The role of the liver in metabolism. Metabolic rearrangements in liver diseases.
6	Membrane transporters. Na,K-ATPase isoforms. Secondary active transporters. Na ⁺ /H ⁺ exchange transporter (TB) Molecular basis of nerve transmission. Acetylcholine synthesis, receptors, acetylcholinesterase. Properties of synaptic vesicles; key proteins involved in exocytosis of synaptic vesicles (TB)	Metabolic characteristics of rapidly dividing cells and tumours.
7	Synthesis and metabolism of adrenaline and noradrenaline. Transporters in neurons (TB) Adrenergic receptors. Adrenaline and molecular mechanisms of the action of adrenaline and noradrenaline in different organs (TB)	Extracellular matrix: transformations in physiological and pathological states.
8	The synthesis and production of dopamine and serotonin and their metabolism. Molecular properties of transporters and receptors. Biochemical basis of Parkinson's disease. (TB) Synthesis, metabolism, transporters and molecular properties of glutamate and GABA. (TB)	The relationship between metabolism and nervous system function I
9	General characteristics of ion channels. Methods for the study of ion channels. Molecular mechanisms of gating and permeation. Spatial structure of the K ⁺ channel. (CSL) Ion channel families. Voltage dependent, Ca ²⁺ activated, and ATP-sensitive K ⁺ channels. Voltage-dependent Cl ⁻ channels. CFTR Cl ⁻ channel. Nicotinic Ach receptor. (CSL)	The relationship between metabolism and nervous system function II
10	General overview of blood clot formation and dissolution. Fibrinogen and fibrin. Regulation of thrombin. Activation of prothrombin. Initiation of coagulation and amplification of the initiation signal. (KK) The coagulation inhibitor system and negative feedback mechanisms. (KK)	Molecular background of congenital thrombophilia. APTI, PTI tests
11	Fibrinolysis. Activation of plasminogen. The plasmin inhibitor system. (KK) Cellular factors in coagulum formation and dissolution. Platelets and von Willebrand factor. (KK)	Molecular background of acquired thrombophilia. Fibrin stabilization and the study of soluble fibrin monomers
12	The role of neutrophil leukocytes and endothelial cells in hemostasis. Hemodynamic and biochemical interactions in hemostasis. (KK) Function and role of pattern recognition receptors (TLR, scavenger receptors) in the vascular wall. Cholesterol-induced pyroptosis and its molecular basis. (KK)	Risk factors associated with cholesterol homeostasis in atherosclerosis (diabetes, hypertriglyceridemia). Biochemical basis of atherosclerosis prevention.
13	The role of gene expression level regulation by dietary components in the regulation of metabolism. (TL). Regulatory, adaptive signals driven by the current metabolic state of the cell and their mechanism of action. Biochemical effects of thyroid hormone and its role in complex metabolic regulation, thermogenesis. (TL).	Molecular basis of weight regulation in physiological and pathological states.
14	Central molecules and drug targets of proliferation, differentiation, survival, angiogenesis, metastasis I (TB) Focal molecules and drug targets of proliferation, differentiation, survival, angiogenesis, metastasis II (TB)	Molecular basis of energy expenditure and its dysregulation in metabolic syndrome

Other subjects concerning the border issues of the given subject (both compulsory and optional courses!). Possible overlaps of themes: None.

Special study work required to successfully complete the course: None.

Requirements for participation in classes and the possibility to make up for absences:

Practices and seminars are mandatory. It is not possible to make up for missed practices/seminars. In case of absences amounting to more than 3 occasions, the semester is not acknowledged. Arriving to a practice/seminar with a delay of more than 10 minutes is considered an absence

Methods to assess knowledge acquisition during term time:

Practice/seminar participation performance will be evaluated by the tutor: as such, maximum 10 points per semester can be obtained that may count towards the final grade, see under "Grading system".

Midterms: A midterm will take place in the 6th and another in the 11th week, during the practice/seminar (allocated time per midterm: 20 minutes). Each midterm will consist of multiple choice questions (MCQs) from which max 20 points can be obtained (10 points per midterm).

It is not obligatory to pass a midterm in order to be allowed to sit for the final exam. However, the midterm points will be added as "points" to the result of the final exam, as detailed in "Grading system".

Lectures: At the end of each lecture, there will be a Kahoot on the topic of the lecture, consisting of 5 questions. Maximum 1 point can be earned per lecture, as outlined by the lecturer. Through the Kahoots, students may obtain points that will be added to the points earned at the final exam, as detailed in "Grading system".

Competition: The competition is held on the last week and consists of 70 multiple choice questions (MCQs). Only students who amass 14 or more points from the midterms may participate in the competition. Points obtained from midterms, Kahoot quizzes, or practice/seminar performance (see below), do not count in the competition. Winners will be exempted from the final exam.

Requirements for signature: No credit will be given for absences exceeding 6 hours (3 occasions).

Type of examination: final; Form: written and oral test based on material of the official textbooks, lectures and practices/seminars published at the department's Moodle e-learning system (<https://itc.semmelweis.hu/moodle/>). See under "Grading system" for further details.

Requirements of the examination:

The material covered in the exam is the material of the lectures and practices/seminars in the topic, with the corresponding textbook chapters.

Method and type of evaluation:

Grading system: The grade of the final exam is based on the points obtained i) in Kahoot quizzes at the lectures, ii) during the seminars/practices, iii) at the two midterms, iv) at the written MCQ semifinal exam, and v) in an oral exam following the written MCQ exam. The written MCQ exam and the oral exam will take place on the same day of the examination period.

The grading system is as follows:

- (i) Kahoot: maximum 1 point per lecture.
- (ii) Seminar/practice points: maximum 10 points.

Total points from (i) and (ii) cannot exceed 20 points.

(iii) Two midterms: maximum 20 points.

(iv) Written MCQ exam: This test consists of multiple choice questions (MCQs) from which max 100 points can be obtained (allocated time: 100 minutes).

If the score of the MCQ exam is 49 or below, then the grade of the final exam is 'fail'.

If students reach 50 points on the MCQ exam, the midterm points, practice/seminar performance points and lecture Kahoot points (total max. 40 points) will be added to the MCQ score.

Grade calculation of the written part of the final exam from the total points (MCQ+semester):

95- 140: grade 5 (excellent)

85- 94: grade 4 (good)

70- 84: grade 3 (satisfactory)

55- 69: grade 2 (pass)

Only those students who obtained at least 50 points at the semifinal MCQ test will be invited for an oral exam. During the oral exam, the examiner will pick three questions from those MCQs that were correctly answered by

the student. The student will have to elaborate properly on these questions. The final grade will be given based on the written and oral part of the exam.

How to register for the examination?: The exam dates are announced on the 12th week of the semester. At least one exam date per week will be provided. Applications are made in the Neptun system in accordance with the University Study and Exam Rules.

Possibilities for exam retake: An exam can be retaken after two calendar days.

Printed, electronic and online notes, textbooks, guides and literature (URL address for online material) to aid the acquisition of the material: Harper's Biochemistry (30th edition, or latest)

Online material published at the department's Moodle e-learning system (<https://itc.semmelweis.hu/moodle/>)