University of Medicine and Pharmacy Carol Davila Bucharest

DISCIPLINE FILE

1. Data about the program

1.1	UNIVERSITY OF MEDICINE AND PHARMACY CAROL DAVILA BUCHAREST
1.2	FACULTY OF MEDICINE / DEPT. 1 FUNCTIONAL SCIENCES
1.3	BIOCHEMISTRY DISCIPLINE
1.4	STUDY FIELD HEALTH – sectorial regulated inside UE
1.5	CYCLE OF STUDY - MD
1.6	STUDY PROGRAMME - MEDICINE

2. Data about the discipline

2.1	DISCIPLINE NAME – BIOCHEMISTRY						
2.2	COURSE HOLDER –						
2.3	SEMINARY HOLDER -						
2.4 Year of study	I	2.5 semester	I and II	2.6 Evaluation type	Exam	2.7 Discipline regime	DF (fundamental discipline)

3. Total estimated time (hours/semester didactic activity)

3.1 Hours / week	5 hrs./week Sem I	Course .	2	Seminary / laboratory	3 hrs.
3.3 Total hours from education plan	140	Course	56	Seminary / laboratory	84
Distribution of time					
Manual, course, bibliography, notes study (hrs./week)					
Supplementary documentation (library, online, field)					
Preparing for seminary/lab, homework, reports, portfolio, essays					
Tutoring					
Examination					
Other activities					
3.7 Total hrs. individual study					
3.9 total hrs. per semester					
3.10 Credits					10

4. Preconditions (where needed)

4.1 curriculum	Chemistry knowledge
4.2 competence	-

5. Conditions (where needed)

5.1 course organization	Providing classroom, VP, table, markers
5.2 seminary/lab organization	Providing lab space, equipment, reactive according to 6.2

6. Specific accumulated competences

Professional skills (as knowledge and abilities)	• Fundamental biochemistry concepts • Ability to perform experiments in the lab • Capacity to correlate functional and structural biochemistry aspects • Knowledge of basic biochemistry in a medical lab • Practical ability of using laboratory equipment • Capacity to process and interpret experimental data obtained in the lab
Transversal competences (role, professional and personal development)	• Teamwork abilities, flexibility, adaptability in different circumstances and roles • Development of preclinical medical thinking • Capacity to identify a purpose and modes of attaining it, coherent planning, timeline organization, capacity to extract conclusions from experiments • Basic scientific biomedical vocabulary

7. Discipline objectives (from the specific competences grid)

5.1 General objective	Familiarize students with the principal concepts of medical biochemistry, biochemistry lab techniques used in medical practice and scientific research
5.2 Specific objectives	The Medical Biochemistry Course wants to familiarize the students with fundamental notions of medical biochemistry, structural biochemistry, principal metabolic pathways, techniques used in medical practice. Laboratory practice explains the underlying principles of laboratory equipment and creates the practical abilities of using it along with the understanding of biochemical determinations in medical practice. The students will also develop the capacity of processing and interpreting experimental data from the perspective of molecular mechanisms implicated.

8. Contents

6.1 Course	Teaching methods	Observations
SEM I		

The subject of biochemistry – the correlation with the other biomedical sciences. Natural amino acids –structure, classification, physical and chemical properties, ionization and isoelectric point. Peptides – definition, structure, properties, important natural peptides. Techniques of investigation. Proteins – primary, secondary, tertiary and quaternary structure, conformations. Protein properties, ionization, pI, denaturation etc. Protein classification – plasma proteins, fractions obtained by electrophoresis - roles and characteristics. Immunoglobulins and fibrinogen – structure and role. Myoglobin – structure and role. Collagen and elastin, fibronectins – structure and role. Allosteric regulation of hemoglobin function. Enzymes – structure, activity, nomenclature and classification. Enzymes characteristics – decreasing of the activation energy of catalyzed reactions, catalytic capacity. Enzyme specificity – reaction, substrate, stereo chemical. Enzymes action mode (active center, cofactors, izoenzymes, multienzymatic complexes). Enzymatic kinetics (Michaelis-Menten and Lineweaver-Burk equations, Michaelis-Menten constant significance, factors influencing reaction speed, competitive, non-competitive and un-competitive inhibitors). Allosteric and covalent regulation of enzymatic activity. Coenzymes and	- Lecture, systematic exposure - Electronic teaching materials (PowerPoint, VP, web materials etc.) - Interactive methods - Exemplification - Problematization Courses will be taught in amphitheaters and classrooms featuring laptop and retro projector. All courses will be updated according to university programs from our country and abroad, and according to the latest scientific discoveries.	Course content according to the analytic program.

vitamins. Saccharides: monosaccharides, oligosaccharides, polysaccharides; structure and roles – amino saccharides and deoxisacchars. Glycoproteins – structure and roles. Proteoglycans – structure, roles, examples (hyaluronic acid, chondroitin sulfates, dermatan sulfate, heparin sulfate, keratan sulfate, and heparin). Lipids – fatty acids, acylglycerols, glycerophospholipids, and sphingolipids – structure, properties, roles. Cholesterol and biliary acids – structure and roles. Nucleic acids. Structural components – nitrogenous bases, nucleosides, nucleotides. DNA - covalent structure and conformation. Genetic material organization in eukaryotes and prokaryotes. Architecture of the eukaryotic genome. DNA biosynthesis (replication) Prokaryotic replication – stages, fidelity of the process. Eukaryotic replication. Particularities – DNA synthesis on RNA matrix. RNA – classification, structure, roles. Biosynthesis RNA on DNA matrix (transcription). Stages of transcription for eukaryotes and prokaryotes. Transcription inhibitors. Post transcription modifications – ARNm, ARNt and ARNr. Intron excision from primary transcripts of ARNm, ARNt and ARNr. ARN biosynthesis on ARN matrix.		

Protein biosynthesis – genetic code. Protein biosynthesis – stages, regulation, post-translation changes. DNA molecular lesions, mutations.		
SEM II		
Hormone biochemistry – definition, classification. Hormonal receptors. Action mechanism of hydrophilic hormones proteins, adenylcyclase and phosphodiesterase, protein kinases and phosphoprotein-phosphatases. Mechanisms of action for steroid and thyroid hormones. Thyroid, corticosuprarenal and sexual hormones – structure, biosynthesis, transport, metabolism, secretion regulation, biological action. Pancreatic, medulosuprarenal, hypothalamic and pituitary hormones. Calcium regulating hormones – parathormone, calcitonin, calcitriol – structure, biosynthesis, transport, metabolism, secretion regulation, biological action. Thermodynamic aspects of the reactions in living organisms, free energy, exergonic and endergonic reactions. Exergonic and endergonic reactions coupling. ATP – the common energetic intermediary. Other macroergic compounds. ATP synthesis by substrate phosphorylation. Mitochondrial respiratory chain and oxidative phosphorylation. Phosphorylation mechanisms – incompletely reduced oxygen species. Sugar metabolism I – digestion		

and absorption, metabolic pathways. Glycolysis – stages, regulation, energy balance. Sugar metabolism II – oxidative decarboxylation of pyruvate, Krebs cycle, pentosophosphate pathway. Glucuronic acid pathway – stages, role. Sugar metabolism III – gluconeogenesis – stages, role, regulation. Gluconeogenesis from proteins and lipids. Cori cycle. Glycogen metabolism – gluconeogenesis and glucogenolysis – stages, role, regulation. Galactose and fructose metabolism – clinical correlations. Lipid metabolism I – lipid digestion and absorption. Fatty acids metabolism. Clinical correlations. Lipid metabolism II – triacylglycerol metabolism. Ketone bodies metabolism. Ketogenesis regulation. Lipid metabolism III Glyco and sphyngo –lipids metabolism. Cholesterol metabolism. Clinical correlations. Lipid metabolism IV Plasmatic lipoprotein metabolism. Clinical correlations. Eicosanoids, prostaglandins, leukotrienes, tromboxanes – biosynthesis, roles. Clinical correlations. Amino acids and protein metabolism I - the dynamic state of proteins, the nitrogen balance. Deamination of amino acids and transport of resulting ammonia. Urea - biosynthesis and elimination – regulation, role. Amino acids and protein		

metabolism II Glutathione, creatinine – structure, role, properties. Hem biosynthesis and catabolism, regulation. Clinical correlations of protein, amino acids and hem proteins metabolism.		

References

- Biochemistry. H. Devlin. Ed. John Wiley & Sons, 2002.
- Biochemistry, 7th edition, Jeremy M Berg, John L Tymoczko, and Lubert Stryer.New York: W H Freeman; 2010

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- Biochemistry, 7th edition, Jeremy M Berg, John L Tymoczko, and Lubert Stryer.New York: W H Freeman; 2010

- Harper's Illustrated Biochemistry, 26th edition, Robert K. Murray, David A. Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil, Lange Medical books/McGraw-Hill Medical Publishing Division, 2003
- Biochemistry (Lippincott's Illustrated Reviews Series), Richard A. Harvey, Denise R. Ferrier, 2013

6.2 Seminary/laboratory	Teaching methods	Observations
SEM I		
1. Security in the laboratory. Presentation of the laboratory and the student's record sheet. Concentration of solutions. 2. Volumes. Titration of a strong acid with a strong base. 3. pH of solutions. pH indicators. 4. Buffer systems and physiological buffer systems. 5. Identification of amino acids and proteins. pI of casein. 6. Chromatography of a mixture of amino acids on a thin layer. Dialysis and protein salification. 7. Identification of monosaccharides and polysaccharides. Starch hydrolysis. 8. Electrophoresis-principle. Plasma	- Systematic exposure - Electronic teaching materials (PowerPoint, VP, web materials etc.) - Interactive methods - Exemplification - Problematization - Working with manuals - Didactic movies - Debate - Involving students in practical activities	During the laboratory practice the students will: - recapitulate some essential biochemistry notions necessary to understand the laboratory techniques - learn the principles of operating the instruments in the biochemistry laboratory, the concrete way of using them, the components of the device - learn the importance of the biochemical parameters - do the actual experiment - process mathematically and statistically the data obtained

proteins. 9. Water-soluble vitamins. Liposoluble vitamins. 10. Spectrophotometry-principle. Qualitative and quantitative analysis of hemoglobin. 11. Dosage of plasma enzymes. 12. Enzymatic kinetics. Michaelis Menten equation. 13. Nucleic acids. Denaturation of nucleic acids. 14. Identification of purine and pyrimidine bases.		- discuss the results of the experiments with the interpretation of the biochemical mechanisms involved - do grid tests and calculus problems on the subject of the experiment - discuss medical applications of the studied parameter
SEM II	-	
1. Dosage of uric acid in serum 2. Urea and creatinine metabolism. Dosage in serum 3. Metabolism of bilirubin. Bilirubin dosing in serum 4. Hormones (seminary). Dosage of urinary vanillylmandelic acid 5. Dosage of Mg and phosphates in serum. 6. Dosage of Ca in the serum. Calciotrophic hormones. Reports. 7. Seminar on energy and carbohydrate metabolism. Dosage of lactic acid 8. Dosage Cl in serum. Test 9. Fe in serum 10. Glycemia. Hormones that regulate blood sugar. Glucose in serum 11. Metabolism of lipoproteins. Determining cholesterol	-	

12. Serum triglyceride dosing 13. Urine physiological compounds 14. Pathological urinary compounds		

References

- Stoian I (coordinator), authors: Gaman L, Gîlcă M, Hillebrand A, Panait E, Vîrgolici B: Practical Guide of Biochemistry-revised edition (ISBN:978-973-708-570-2), Carol Davila, University Press, Bucharest, 2011

9. Corroborating the contents of the discipline with the expectations of the epistemic community representatives, professional associations and representative employers in the field related to the program

The obligatory biochemistry course supports students in their future physician activity by helping them to set up sound, effective medical thinking to enable them to cope with the multiple challenges they will face after graduation, both in terms of direct quotient with patients and the labor market in the medical field. The course contains important theoretical milestones that are needed for students to become good professionals. The content of the subject is constantly updated, in accordance with the similar university programs in the country and abroad, with the actual requirements and priorities of the current medical practice, with the new discoveries in the field of fundamental biochemistry, an alluvial domain in an extraordinary dynamics. In order to better adapt to the requirements of the labor market the content of the discipline, it regularly consults active representatives at different levels in the field of medical and laboratory biochemistry in order to obtain feedback on the subjects taught and the ways of their continuous improvement.

10. Evaluation

Activity type	8.1 Evaluation criteria	8.2 Evaluation methods	8.3 Weight of the final grade
8.4 Lecture	- It will be noted: accuracy and completeness of knowledge; logical coherence; degree of assimilation of specialized terms; the ability to work with concepts taught at the course - Students can take the exam only if they have obtained the pass mark (note 5) at the practical exam. - The written exam	Written exam with questions Semester-based control of the theory taught at the course	80% (written exam) 10% (control of the theory taught at the course) 10% laboratory exam

	consists in solving a mixed test consisting of 10 open questions (5 simple questions and 5 questions with double complement), 1 point each for the lab exam and 10 open topics for 1 point each from the lecture. - The exam is considered to be promoted if the student has accumulated at least 5 points (the equivalent of Note 5). To get score 10 the student must accumulate at least 9.5 points		
	During each semester a control paper from the theory delivered in the lecture is given until the date of the control work. The control work contains 10 open questions. The note from the control work is between 1 and 10. The grade obtained does not condition the entrance to the theoretical examination, but contributes to the final grade by 10%.		
8.5 Seminary/laboratory	The practical examination will include: knowledge of the principles of experimental techniques performed during	Oral exam - practical laboratory exam	10%

	the year, the ability to use the equipment specific to the medical biochemistry laboratory, the ability to process the experimental data, the way of interpreting the obtained results. Students will be marked with grades from 1 to 10. For the exam to be considered past the minimum mark obtained must be 5.		

The final grade will be calculated by weighing the weighted average of the grades obtained over the semester, as follows:

FINAL GRADE = 80*ET+10*LC+10*EP/100

Where ET - written theoretical exam, LC - semestrial control work from the theory taught at the lecture, EP-practical exam

Minimal performance standard

• For the 5 grade in the practical examination, the student must: recognize the equipment used in the biochemistry laboratory, know how to use it, know the significance of a certain biochemical dosed parameter.

• For 5 in theoretical exam S I, the student must be able to identify the class of compounds of which a particular biochemical structure is a part, know the structural formulas of the main biochemical compounds in each class and their biological properties / roles,

• For 5 in the theoretical exam S II, the student must know the main metabolic pathways in the carbohydrate, lipid and protein metabolism, the basic notions of biochemical energy, the mechanisms of action and the biological roles of the main classes of hormones.