

**MED 1001 – Molecular Basis of Cell**

Course Name	Code	Semester	Type of course	Theory (hours)	Group Work (hours)	ECTS
Molecular Basis of Cell	MED 1001	I	Mandatory	30	56	6
Faculty, the educational program and education level	Faculty of Medicine, one-cycle Educational Program “Medicine”					
Author (s)	<p><b>Sophiko Tskvitinidze</b> – Assistant Professor, Dr. of Biology            TEL: +995 593 744 133 /+ 995 599 122 633            E.MAIL: <a href="mailto:tskvitinidze.s@gmail.com">tskvitinidze.s@gmail.com</a></p> <p><b>Eka Ekaladze</b> – invited teacher            Mob.tel.: 595 633362 E.MAIL: <a href="mailto:ekaekaladze@hotmail.com">ekaekaladze@hotmail.com</a>            Consultation days and time individually</p>					
Educational course format	<p><b>Total:</b> 180 hours, that includes:  <b>Contact hours:</b> 102 h</p> <ol style="list-style-type: none"> <li>1. Lecture – 36 h</li> <li>2. Group work/seminars – 56 h</li> <li>3. Laboratory lesson– 6 h</li> <li>4. Midterms – 2 h</li> <li>5. Final exam -2 h</li> </ol> <p><b>Independent work</b> – 78 h</p>					
Prerequisites	No prerequisites					
The purpose (s) of tutorial course/modules	<p>The learning course aims to give the deep knowledge about the molecular bases of the cell; main organic and inorganic compounds; Importance of bio molecules for cell functioning and for the life generally; energy of the cell, as well as the basic source of the vital processes in the cellular space; the complex molecular mechanisms of vital processes in cells and the main aspects of the regulation processes.</p> <p>The course also aims to demonstrate the connection between biochemistry, as the fundamental medical discipline, and medicine and the importance of the medical practice/training on the base of clinical correlations.</p>					
Teaching and learning strategy	<p><b>Lectures</b> - Monologue, explanation, demonstration (video, Power-Point);</p> <p><b>Laboratory work</b> –introduction to biochemistry laboratory, its equipment, devices and methods of work;</p> <p><b>Group working</b> -The student performs the task, which is thematically derived from the course, but additionally requires independent working, searching of reading materials from the Internet and processing of information. Student's verbal activity will be assessed;</p>					

	<p><b>Project preparation and presentation</b> - Students choose material from provided topics or independently, working out sufficient material, will work with the books and presents in auditorium for estimation.</p> <p>In the process of abstract preparation student will <b>work with basic and additional literature</b>. Because of <b>abstract preparation and presentation</b>.</p>
<p><b>Assessment criteria</b></p>	<p><b>Maximum score- 100</b></p> <p><b>Midterm assessment -60 scores</b>, that includes:</p> <ul style="list-style-type: none"> <li>• Attendance on lectures -5 score (0,14X36=5scores);</li> <li>• Activity on Laboratory – 5 scores:</li> <li>• Activity on Group work -10 scores;</li> <li>• Project preparation and presentation -10 scores;</li> <li>• Abstract preparation and presentation – 10 score;</li> <li>• Midterm Exam – 20 score</li> </ul> <p>Final score for laboratory work and work in group will be calculated as the average arithmetical. (The calculation program - Appl.1)</p> <p><b>Laboratory Work is Assessed Based on the Following Criteria</b> (maximum 5score):</p> <p><b>5 scores:</b> Laboratory method is planned correctly, the usage of the laboratory equipment and devices by the student is accurate. The student is able to make method recording correctly, can easily identify the mistakes made and plan the way of correction. The student is able to analyze the method exercised and interpret the results. Laboratory work is carried out accurately and completely;</p> <p><b>4 scores:</b> Laboratory method is planned correctly. The student reveals the relevant knowledge when applying laboratory equipment and devices. The student is able to make method recording correctly, easily identify the mistakes made and plan the way of correction, however, has difficulties in analyzing the results. Laboratory work is performed with minor faults.</p> <p><b>3 scores:</b> Laboratory method is planned correctly. The student is not able to reveal the relevant knowledge when using the laboratory equipment since he/she makes minor mistakes when applying laboratory devices; The student can make method recording correctly but is not able to detect the mistakes made and experiences difficulties in looking for the ways of correction. Laboratory work is carried out with minor faults.</p> <p><b>2 scores:</b> Minor mistakes are made in planning of the laboratory method; the student is not able to reveal the relevant knowledge when using laboratory equipment and devices, is able to make method recording correctly but is not able to detect the mistakes made and relevantly has difficulties in finding the way of correction. Laboratory work is carried out with essential faults.</p> <p><b>1 score:</b> Essential mistakes are made in planning laboratory method; the student is hardly familiar with the rules of usage of laboratory equipment and devices; the student is able to make method recording but is unable to detect the mistakes made and relevantly has difficulties in finding the ways of correction. Laboratory work is carried out with essential faults.</p> <p><b>0 score:</b> Student is absolutely unaware of laboratory method and equipment and devices. The task is not fulfilled.</p> <p><b>Group Work Assessment Based on the Following Criteria</b> (maximum 10scores)</p> <p><b>10 scores-</b> Student has been able to present complete and thorough knowledge of the subject, a substantial amount of detailed and relevant information. Demonstrate considerable depth of understanding of the studied main and additional literature. Bring forward a balanced view of the</p>

main arguments on the issues.

**9 scores** - Student has been able to bring forward a consistent number of deductions on most of the topics tackled. make very good comments on the different perspectives on most of the issues. Demonstrates knowledge of the main readers.

**8 scores** - Student has been able to bring forward a consistent knowledge, Has properly developed terminology. Demonstrates knowledge of the main readers.

**7 scores** - Student has been able to present some factual information sufficiently linked with the topic. Demonstrate a good understanding of the topics selected. make a good attempt to bring forward a balanced view of some arguments on the issues. Terminology is partially developed.

**6 scores** - Student has been able to make some good comments on the different perspectives on some of the issues. Make poor deductions on most of the topics tackled. analyse some causes and results of human interactivity related to the issues.

**5 scores** - Student has been able to demonstrate inconsistent comments on the different perspectives on some of the issues. Terminology is partially developed. Present mediocre level of knowledge. Make poor deductions.

**4 scores** - Student demonstrates general overview of the topics. Terminology is not developed. Information sufficiently linked with the topic. Demonstrate irrelevant understanding of the literature.

**3 scores** - Student demonstrates general/superficial and inconsistent knowledge of the subject. No sufficient knowledge of the literature.

**2 scores** - Student demonstrates general comments, no knowledge of the terminology, no consistency.

**1 score** - Student demonstrates insufficient answer, not terminology awareness, chronologic manner of the answer, mostly wrong, no knowledge of literature.

**0 score:** Student demonstrates not even elementary knowledge of the topics.

#### **Project Preparation and presentation - Grading criteria – Maximum 10 scores**

1. Actuality of the problem – 2 sc;
2. Academic content – 2 sc;
3. Review of the literature on the issue -2 sc;
4. Visual and technical side of the material – 2sc;
5. Culture of the discussion and listening to the opponent- 1 sc.
6. Proper language and speaking style – 1 score.

#### **Abstract preparation and presentation's criteria (10 scores - max.):**

1. Actuality of appointed problem – 2 score;
2. Research observation in the wrate of topic -2 sc.
3. Correctness of conclusion and the connection with the main text - 2 score
4. Writing culture – 2 sc.
5. Visual and technical side of the material – 1sc;
6. Accuracy and reliability of indicated references and literature sources – 1 score;

#### **1.3. Midterm Exam – 20 scores**

Written test -40 close multiple-choice questions 0,5 score for each – max. 20 scores;

	<p><b>Minimal scores of midterm assessment (for final exam) – is 11.</b></p> <p><b>1. Final Exam -40 scores</b></p> <p>Is held in the written test form (test consists of 60 close multiple-choice questions questions, each question is rated as 0,5 score) and 10 open questions - 1 score for each – total max. – 40 scores.</p> <p>The final exam would accounted as passed in case of maximum 70% or more (<math>40 \times 70 / 100 = 28</math> scores).</p> <p>Credit will be given to the student if he has collected at minimum 51 scores out of 100.</p> <p>Student's assessment has to be done in the following way:</p> <p><b>Positive rate:</b></p> <ul style="list-style-type: none"> <li>• (A) Excellent- 91 or more scores;</li> <li>• (B) Very Good- 81-90 scores;</li> <li>• (C) Good- 71-80 scores;</li> <li>• (D) Satisfactory- 61-70 scores;</li> <li>• (E) Enough- 51-60 scores;</li> </ul> <p><b>Negative rate:</b></p> <ul style="list-style-type: none"> <li>• (FX) Failure - 41-50 scores, which means that a student needs to work more and an independent and considerable further work is required to pass the exam once again to be re-awarded;</li> <li>• (F) Fail – 40 scores or less, which means that the student's diligence is not sufficient and student has to learn the subject all over again.</li> </ul> <p>Student can pass the additional exam during the same semester. The time interval between the final and the additional exams should be not less than 10 days.</p>
<b>The basic literature</b>	<ol style="list-style-type: none"> <li>1. Jeremy M.Berg, John L. Timoczko, Libert Steyer. <b>Biochemistry</b>. W.H. Freeman and Company New York. VII ed. 2012</li> <li>2. <b>Textbook of Biochemistry with Clinical Correlations</b>, Devlin, 7th edition, John Wiley &amp; Sons, Inc. 2009.</li> </ol>
<b>The auxiliary literature</b>	<ol style="list-style-type: none"> <li>1. Biochemistry. Lippincott's Illustrated Reviews _ Pamela C. Champe, Richard A.Harvey., Denise R.Ferrier . 5rd edition, 2009;</li> <li>2. David L. Nelson and Michael M. Cox. Lehninger Principles of Biochemistry, Worth Publishers, New York, 5 ed., 2013.</li> </ol>

### The tutorial/training course content

№	Subjects	Lecture (hours)	Work in group (hours)	Laboratory (hours)
1	Main concept and review of cell molecular basics. Energy methabolism of cells.	3	4	
2	Water and inorganic substances, acids, bases, solvents. PH and solutions. PH constanta. Blood and intracellular buffer systems. Acidosis and alkalosis.	3	4	2

	(Laboratory work - introductions to biochemical laboratory, hardware, laboratory work rules; substances weighing, solution preparation: making buffer solutions).			
3	Structure and functions of bio-molecules. Amino acids and proteins, the general structure and classification of amino acids. Protein structural levels. The chemical connections involved in protein structures. Proteins, structural levels and characteristics. Proteins, structural organization and properties. Review of protein research methods. The structural and functional features of myoglobin and hemoglobin. Features of hemoglobin and oxygen binding affecting factors. Disorders of the primary structure of hemoglobin. Hereditary hemoglobinopathies. Fibrin proteins. Collagen, elastin, keratin, tropomyosin.	3	4	
4	Enzymes: structure, function, the basis of enzymatic catalyses; The general principles of enzymes' catalyses. Regulation of enzyme activity – allosteric activity and inhibition, covalent modification, protein-protein interactions. Regulation of metabolic pathway. Basis of medical enzymology. Importance of enzymodiagnosics. Enzymopathy. Enzymes and their inhibitors for healing. Laboratory work: amino acid titrations, titration curves designing.	3	4	2
	<b>Midterm</b>		2	
5	Signal transduction basis, cell signal system. Chemical messengers. Receptor classes and characteristics. The main principles and ways of signal transduction.	3	4	
6	The energy for activity. Energy balance. Citric acid or tricarboxylic (Krebs) cycle. Reactions of the Krebs cycle, coenzymes, energetics, regulation. Oxidative phosphorylation and mitochondrial functioning. Electron transport and ATP-synthesis.	3	4	
7	Carbohydrate metabolism. ATP- production from glucose. Glycolysis functions. Phases and reactions. Regulation of glycolysis. Aerobic conversion of glucose. Gluconeogenesis. Gluconeogenesis regulation.	3	6	
8	Glycogenolysis and glycogenesis. Glycogen structure, functioning in the muscles and liver. Regulation of glycogen metabolism. Pentose-phosphate pathway: purpose, meaning, fructose and galactose metabolism. Glycoprotein. Fructose and galactose metabolism. Fructose intolerance and essential fructosuria; Galactosemia. Changes in the blood glucose concentration after meals and malnutrition. Carbohydrate digestion, absorption, transport. Insulin, glucagon and other hormones role in glucose homeostasis. Diabetes mellitus. Laboratory work: determination of glucose in the blood and urine, glycosylated	3	6	2

	hemoglobin measurement methods.			
9	Lipid digestion, absorption. The fatty acids meaning for energy formation of - the beta-oxidation: its value, steps, energy value. Ketonous metabolism. Ketonous ketogenesis and utilization. Ketonous metabolism disorders. Lipogenesis: fatty acid biosynthesis. Regulation of the fatty acids metabolism. Triacylglycerols intracellular deposition and dissolution of fatty tissue.	3	6	
10	Lipoproteins. Fatty acids and other lipid components transport between organs Cholesterol absorption. Cholesterol metabolism. Cholesterol transport, synthesis and transforming ways. Lipoprotein receptors. Biochemical aspects of atherosclerosis. Integration of carbohydrate and lipid metabolism.	3	6	
11	Protein digestion and absorption. Amino acids transformation ways: amino acids transamination, desamination, decarboxylation. Ammonia excretion ways. Urea cycle. Transform ways of some amino acids.	3	4	
12	Nutrition principles. Micro and macronutrients. Fat and water soluble vitamins. Metabolic interactions between different physiological (hunger-satiety, exercise, pregnancy, etc.) and pathological (diabetes, cancer, etc.) conditions	3	4	
	<b>Final Exam</b>		2	

### Learning Outcomes

Criteria	Competences
Knowledge and understanding	<p>At the end of the learning course student will know:</p> <ul style="list-style-type: none"> <li>• basic molecular structure of the cell, molecular mechanisms and the main principles of vital processes in the body;</li> <li>• structural and functional connections of complex molecules (proteins, fats, carbohydrates);</li> <li>• energy production and utilization processes;</li> <li>• communication between cell and the signal transduction main ways;</li> <li>• the main aspects of regulation and dysregulation cases of carbohydrates, lipids, protein metabolism;</li> <li>• biochemical aspects of healthy nutrition and food nutrients;</li> <li>• importance of vital processes on cellular and molecular level in the body .</li> </ul>
Applying knowledge	<p>After completing the course the student will be able:</p> <ul style="list-style-type: none"> <li>• determine the structural and functional connection between macro- molecules to</li> </ul>

	<p>differentiate the diseases' mechanisms (sickle-cell anemia, prion-disease, etc.);</p> <ul style="list-style-type: none"> <li>• discuss the biochemical changes in cells during various diseases;</li> <li>• discuss the pathologic conditions on the base of enzymatic spectrum;</li> <li>• analyze the the cellular processes disorders on molecular level for pathological process (obesity, diabetes, atherosclerosis, cardiovascular disease, and others) and their violations.</li> <li>• discuss the metabolic pathways and their regulation principles</li> </ul>
Judgment Ability	<p>Student will be able to:</p> <ul style="list-style-type: none"> <li>• systematize, combine and analyse the information about macromolecules (proteins, lipids, carbohydrates, enzymes) and metabolism;</li> <li>• determine and integrate the metabolic pathways;</li> <li>• analyse the transmission of the structural and functional changes;</li> <li>• systematize, combine and analyse the received information about proteins, lipids, carbohydrates, enzymes, messengers, ATP-'s generation and utilising;</li> <li>• compare and analyze the ways of enzymatic therapy;</li> <li>• connect molecular, organic and systemic levels of the life</li> <li>• analyze the fundamentals and the involved substances of the vital importance process</li> </ul>
Communication skills	<p>Student will have the ability of free verbal and written communication with professionals, explain them the problem and debate around the issue of biochemistry and molecular basis of cell</p>