INTERNATIONAL HIGHER SCHOOL OF MEDICINE

Department of Fundamental disciplines

SYLLABUS

Biochemistry
2025-2026 academic year
for students of medical faculty
1 course 1 semester, groups 1- 42
3 credits (90 h, including auditorial - 54 h, independent work – 36 h)

Lecturer: Zhaparalieva Cholpon Omorbekovna
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Groups: 1-42

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Groups: 37-42

Venue: Educational and Morphological Center
Lev Tolstoy street 114/1
Room № 301,303,304,102,003

The Syllabus is considered
at the meeting of Fundamental Disciplines Department
Protocol № 1 dated 30.08.2025
Head of the department _____ A.M. Satarkulova

Course objective: The purpose of mastering the academic discipline "Biochemistry" is to master the fundamentals of classical and modern biochemistry; formation of skills and abilities to work with biochemical equipment, setting up a biochemical experiment and analyzing clinical biochemical parameters for making a preliminary diagnosis based on it.
After study of the discipline the student must:
Knowledge: Students should understand the structure and metabolic pathways of key biomolecules in health and disease, the integration and regulation of these pathways, diagnostically important metabolites in tissues and fluids, as well as the principles of laboratory equipment and the basics of modeling biochemical experiments.
Skill: Students should be able to search, analyze, evaluate, and apply knowledge to solve professional tasks while effectively using key laboratory equipment in biomedical research.
Attitude: Students should possess a solid medical and biological conceptual framework, along with biochemical thinking skills, and be proficient in basic biochemical laboratory methods applied in clinical practice.
Pre-requisites: Chemical and biological disciplines of the school educational program.
Post-requisites: Pathology, pharmacology, internal medicine, pediatric diseases and medical genetics.

THEMATIC PLAN OF LECTURES

№	Theme of lecture	Hours	Date
1	Introduction to biochemistry. Organization of the cell. Biomolecules. Transport of substances across membranes into extracellular fluid.	2	29.09.25 - 04.10.25 06.10.25 - 11.10.25
2	Amyloidosis. Neurodegenerative dementias due to amyloids.	2	13.10.25 - 18.10.25 20.10.25 - 25.10.25
3	Structure, functions and disorders of Immunoglobulins. HIV and AIDS.	2	27.10.25 - 01.11.25 03.11.25 - 08.11.25
4	General characteristics and classification of enzymes. Regulation of enzymatic activity.	2	10.11.25 - 15.11.25 17.11.25 - 22.11.25
5	Clinical enzymology.	2	24.11.25 - 29.11.25 01.12.25 - 06.12.25
6	Impact of overweight, obesity and metabolic syndrome on health across life stages and pregnancy: causes, risks and macronutrient roles.	2	08.12.25 - 13.12.25 15.12.25 - 20.12.25
7	Vitamins in human nutrition. Biological role of dietary fibre.	2	22.12.25 - 27.12.25 29.12.25 - 03.01.26
8	Minerals in human nutrition: functions, sources, metabolism, and disorders. pH, water, and electrolyte balance.	2	05.01.26 - 10.01.26 12.01.26 - 17.01.26
9	Metabolism and hormonal control. Mechanism of hormone's action.	2	19.01.26 - 24.01.26 26.01.26 - 31.01.26
10	Clinical training		
Total		**18**	

THEMATIC PLAN OF THE PRACTICAL CLASSES

№	Theme of practical class	Hours	Date
1	Amino acids and proteins: structural organization, classification. Nutritional and metabolic significance.	2	29.09.25-04.10.25
2	Clinical aspects of proteins. Protein energy malnutrition (PEM).	2	06.10.25-11.10.25
3	Introduction to biochemical laboratory. Quantitative reactions for amino acids and proteins. Precipitation & denaturation of proteins.	2	13.10.25-18.10.25
4	Methods of laboratory manual techniques: paper chromatography, colorimetry, spectrometry. Determination of plasma proteins.	2	20.10.25-25.10.25
5	Characteristics of individual plasma proteins.	2	27.10.25-01.11.25
6	Components of adaptive immune system.	2	03.11.25-08.11.25
7	Extracellular matrix (ECM) functions in health and disease; protein targeting, sorting, and related disorders.	2	10.11.25-15.11.25
8	Hemoglobin and hemoglobinopathy.	2	17.11.25-22.11.25

9	**Assessment #1**	2	24.11.25-29.11.25
10	Enzymes: Factors affecting enzyme activity.	2	01.12.25-06.12.25
11	Inhibitors and activators of enzymes in clinical use.	2	08.12.25-13.12.25
12	Investigation of oxidoreductase and hydrolase action & factors affecting enzyme's activities.	2	15.12.25-20.12.25
13	**Assessment #2**	2	22.12.25-27.12.25
14	Fat-soluble vitamins.	2	29.12.25-03.01.26
15	Water-soluble vitamins: hematopoietic vitamins.	2	05.01.26-10.01.26
16	Water- soluble vitamins: energy-releasing vitamins.	2	11.01.26-17.01.26
17	Methods of laboratory manual technique: Titration (direct; reverse): Determination of vitamin C in food.	2	19.01.26-24.01.26
18	**Assessment #3**	2	26.01.26-31.01.26
19	Clinical training		
Total		**36**	

THEMATIC PLAN OF INDEPENDENT WORK OF STUDENTS

Unit №	Theme of independent work	Hours	Date
Organization of the cell. Proteins	1) work with educational literature;	2	29.09.25-29.11.25
	2) individual assignments (PBL)	2	
	3) Lab.w. "Paper chromatography"	2	
	Total	6	
Enzyme. Clinical enzymology.	1) work with tasks on the platform "Proceum" on the topic "Enzymes. Clinical enzymology";	4	01.12.25 - 27.12.25
	2) work with educational literature;	10	
	3) individual assignments (PBL)	2	
	4) Lab.w. "Determination of blood aspartate aminotransferase"	2	
	Total	18	
Vitamins and minerals in human nutrition. Metabolism and hormonal control	1) work with tasks on the platform "Proceum" on the topic "Nutrition";	2	29.12.25–31.01.26
	2) work with educational literature;	6	
	3) individual assignments (PBL)	2	
	4) Lab.w. "Determination of iron in the blood"	2	
	Total	**12**	

Recommended reading for the discipline:

1. Basic:

1. Ferrier D.R. Lippincott's Iliustrated reviews: Biochemistry (7th ed) 2017
2. Champe P.C. Lippincott's Illustrated Reviews: Biochemistry. 2005
3. Satyanaryana U. Biochemistry (5th ed) 2017
4. Murray R.K Harper's Illustrated Biochemistry (26th ed) 2003
5. Satyanaryana U. Biochemistry (2nd ed) 2005
6. Satyanaryana U. Biochemistry (4th ed) 2011
7. Mukhamedova I. Biochemistry practical book 2010
8. DM Vasudevan. Textbook of Biochemistry (4th ed) 2016

2. Additional:

1. Satyanaryana U. Biochemistry (6th ed) 2021
2. Chatterjea M.N. Textbook of Medical Biochemistry (8th ed) 2012
3. V.W. Rodwell, D.A. Bender, K.M.Kennely Harper's Biochemistry. (30 ed) 2015

Grading policy and procedures for all types of work

For the period of studying the discipline, the student gains points for the relevant parameters (per unit):
current score - 40 points
independent work - 20 points
control score (final assessment of knowledge per unit)- 40 points
Maximum score: 100 = (40 + 20 + 40)

Assessment criteria:
Current academic performance and midterm assessment in the unit:

Criteria/ Score	Intervals			
	0 – 23	24 – 30	31 – 35	36 – 40
	«Unsatisfactory»	«Satisfactory»	«Good»	«Excellent»
Systematic and comprehensive knowledge regarding the objects of study	Possesses partial and disparate knowledge that is not logically interconnected	Possesses the minimum set of knowledge necessary for a systematic approach to the object of study	Possesses a set of knowledge sufficient for a systematic approach to the object of study	Possesses complete knowledge and a systematic view of the object of study
Criteria/ Score	**Intervals**			
	0 – 23	24 – 30	31 – 35	36 – 40
	«Unsatisfactory»	«Satisfactory»	«Good»	«Excellent»
Working with information	Unable to find necessary information, or only find fragments of it, within the context of the task.	Can find necessary information within the context of the task.	Can interpret and organize necessary information within the context of the task.	Can find and organize necessary information, as well as identify additional sources of information within the context of the task.
Scientific understanding of the phenomenon, process, or object being studied.	Unable to draw scientifically correct conclusions from available information.	Able to analyze some available information.	Able to conduct a systematic and scientifically correct analysis of the information provided.	Includes new data relevant to the task in the analysis, offers new perspectives on the task.
Mastering standard algorithms for solving professional problems	Able to solve only fragments of a given problem in accordance with a given algorithm	Able to solve a given problem in accordance with a given algorithm	Understands the basics of the proposed algorithm and solves the given problem in accordance with it	Understands the basics of the proposed algorithm and proposes new solutions within the framework of the given problem
Mastering laboratory experiment techniques	Has not mastered the proposed laboratory experiment algorithm and its design.	Conducts the experiment in accordance with the proposed algorithm, but makes errors in presenting the results.	Conducts the experiment in accordance with the proposed algorithm, but makes some errors in presenting the results.	Conducts the experiment in accordance with the proposed algorithm, presents and correctly interprets the results.

Results of independent work

Criteria/ Score	Intervals			
	0-11	12-14	15-17	18-20
	«Unsatisfactory»	«Satisfactory»	«Good»	«Excellent»
Solution to the assigned problem (Clinical case)	Not independent (rewritten work)	The assigned problem is defined correctly, but the proposed explanation is incorrect.	The solution to the assigned problem is provided correctly and a brief interpretation is given.	The correct solution to the assigned problem is provided, and the analysis and interpretation of the obtained results are presented fully and systematically.
Criteria/ Score	**Intervals**			
	0-11	12-14	15-17	18-20
	«Unsatisfactory»	«Satisfactory»	«Good»	«Excellent»
Working with information	Unable to find necessary information, or to find individual fragments of it, within the context of the assigned task.	Can find necessary information within the context of the assigned task.	Can interpret and organize necessary information within the context of the assigned task.	Can find and organize necessary information, as well as identify additional sources of information within the context of the assigned task.
Conducting a laboratory experi-	Does not participate in the laboratory ex-	Conducts the experiment with the assis-	Conducts the experiment independently	Conducts the experiment independently

ment	periment, but presents its results.	tance of laboratory assistants.	and only documents the results without interpreting the results.	in accordance with the proposed algorithm, documents and accurately interprets the results.

Conduct Policy: (lateness, absence, behavior in the auditorium, late submission of work).
- Punctuality and completion of tasks.
- Mandatory attendance of classes.
- Attending class in a clean medical uniform.
- Eliminating conversations on a cell phone in the classroom.
- Active participation in the learning process.
- Doing homework on time.
- Academic detention at the time specified by the teacher.

For violations of the Conduct Policy, the total points for discipline might be reduced to1-10 points.

Academic Ethics Policy.
- Be tolerant, respect the opinions of others.
- Formulate objections in the correct form.
- Constructively support feedback in all classes.
- Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the following: the absence of references when using printed and electronic materials, quotes, thoughts and works of other authors or students.
- For violations of the Academic Ethics Policy, the total points for the discipline may be reduced to 1-10 points.

Guidelines for the lecture:

Key questions covered in lecture #1: *Introduction to biochemistry. Organization of the cell. Biomolecules. Transport of substances across membranes into extracellular fluid*

1.1. Biochemistry as since.
1.2. Biochemical organization of the cells
1.3. Biological membrane organization & membrane transport
1.4. Biomolecules: short characteristics
1.5. Transport of substances in the ECF

Recommended reading for the lecture #1:

1. Ferrier D.R. Lippincott's Illustrated reviews: Biochemistry. (7th ed. 2017) pp. 1 – 52;
2. Champe P.C., Richard A. Harvey Lippincott's Illustrated reviews of Biochemistry 2004 pp. 1-38;
3. Satyanaryana U. Biochemistry (5th education) 2017 pp. 1-7; 45-73
4. Murray R.K Harper's Illustrated Biochemistry 26th ed. 2003 pp. 14-30
5. Satyanaryana U. Biochemistry (2nd education) 2005 pp. 45-72, pp 165
6. Satyanaryana U., Chakrapani U. Biochemistry (4theducation) 2013-pp 43-68;

Key questions covered in lecture #2: *Amyloidosis. Neurodegenerative dementias due to amyloids*

2.1. Chaperon & chaperonin system: functions
2.2. Misfolding of proteins and genetic missing. Amyloidosis
2.3. Neurodegenerative disorders due to amyloidosis: Alzheimer disease, Prion diseases

Recommended reading for the lecture #2:

1. Ferrier D.R. Lippincott's Illustrated reviews: Biochemistry. (7th ed 2017) pp. 1-52;
2. Champe P.C., Richard A. Harvey Lippincott's Illustrated reviews of Biochemistry 2004 pp. 1-38;
3. Satyanaryana U. Biochemistry (5th education) 2017 pp. 45-70, pp 167.

Key questions covered in lecture #3: *Structure, functions and disorders of Immunoglobulins. HIV and AIDS*

3.1. Principles of innate immune response: Complement system response: opsonization, MAC formation, chemotaxis, inflammation.
3.2. Cytokines
3.3. Diseases due to altered innate immune response (chronic hemolytic anemia, susceptibility to infections).

Recommended reading for the lecture #3:

1. Satyanaryana U.Biochemistry (5th education) 2017 pp. 697-701
2. Murray R.K Harper's Illustrated Biochemistry 26th ed 2003 pp. 580-597.
3. Satyanaryana U. Biochemistry (2nd education) 2005 pp. 615-620
4.DM Vasudevan. Textbook of Biochemistry. 4th ed. 2016 pp. 18-25;230;

Key questions covered in lecture #4 *General characteristics and classification of enzymes. Regulation of enzymatic activity*

4.1. Chemical nature of the enzymes: prosthetic group and cofactors. Cofactor function of vitamins. Monomeric and oligomeric enzymes, multienzyme complex.
4.2. Mechanism of enzyme action: energy of activation, influence of enzyme on energy of activation. Steps of enzymatic reaction: sequential and "ping-pong" mechanisms.
4.3. Allosteric modulation (non-covalent modification): conformational changes of allosteric enzymes, feedback regulation. Classes of all ostericenzymes.
4.4. Activation of latent enzymes by covalent modification (partial proteolysis: zymogen of digestive enzymes, autocatalysis; association-dissociation; phosphorylation-dephosphorylation, oxidation/reduction)
4.5. Neurohumoral control of enzyme synthesis

Recommended reading for the lecture #4:

1. Ferrier D.R. Lippincott's Illustrated reviews: Biochemistry. (7th ed 2017) pp.53-67
2. Champe P.C., Richard A. Harvey Lippincott's Illustrated reviews of Biochemistry 2004 pp. 47-58;
3. Satyanaryana U. Biochemistry (5th education) 2017 pp. 87- 119
4. Murray R.K Harper's Illustrated Biochemistry 26th ed 2003 pp. 49-60, 61-72.
5. Mukhamedova I. Biochemistry practical book 2010 pp. 81-96

Key questions covered in lecture #5: *Clinical enzymology*

5.1. Plasma Enzymes. Possible mechanisms responsible for abnormal levels of plasma enzymes.
5.2. Isoenzymes. Definition. Determination in the plasma.
5.3. Short characteristics of CPK, LDH, AST, ALT, ALP, ACP in diagnosis

Recommended reading for the lecture #5:

1. Murray R.K Harper's Illustrated Biochemistry 26th ed. 2003 pp. 49-60, 61-72.
2. Satyanaryana U. Biochemistry (2nd education) 2005 pp. 85-112
3. Satyanaryana U., Chakrapani U. Biochemistry (4theducation) 2013 pp. 85-115

Key questions covered in lecture #6: *Impact of overweight, obesity and metabolic syndrome on health across life stages and pregnancy: causes, risks and macronutrient roles*

6.1. Sources and supply pattern of vitamins. Functions of vitamins.
6.2. Alimentary and secondary avitaminosis, hypovitaminosis. Hypervitaminosis, toxic effect.
6.3. Vitamin D: sources, metabolism, mechanism of action.
6.4. Vit.D deficiency diseases octeomalacia, rickets. Overdose of Vit D/PTH and renal osteodystrophy.
6.5. Functions of minerals in the human body.
6.6. Major intracellular cations: Mg^{2+}; Ca^{2+}: distribution, biological role, mechanism of balance regulation.
6.7. Clinical aspects: Hypo-, hypermagnesemia & hypo-, hypercalcemia

Recommended reading for the lecture #6:

1. Ferrier D.R. Lippincott's Illustrated reviews: Biochemistry. (7th ed 2017) pp. 357-399
2. Murray R.K Harper's Illustrated Biochemistry 26th ed. 2003 pp. 481- 497.
3. Satyanaryana U. Biochemistry (2nd education) 2005 pp. 113-162
4. DM Vasudevan. Textbook of Biochemistry. 4th ed. 2016. pp. 271; 290;

Key questions covered in lecture #7: *Vitamins in human nutrition. Biological role of dietary fibre*

7.1. Hematopoietic vitamins: **B9, B12:** metabolic role; biochemical screening tests for vitamins B9 and B12 deficiency
7.2. Transition metal ions in the human nutrition: Zn^{2+}, Se^{2+}, Fe^{2+}, biological role; homeostasis regulation, diseases due to deficiency; recommended intake

Recommended reading for the lecture #7:

1. Ferrier D.R. Lippincott's Illustrated reviews: Biochemistry. (7th ed 2017) pp. 357-399
2. Champe P.C., Richard A. Harvey Lippincott's Illustrated reviews of Biochemistry 2004 pp. 319-330;
4. Murray R.K Harper's Illustrated Biochemistry 26th ed 2003 pp. 481- 497
6. Satyanaryana U., Chakrapani U. Biochemistry (4theducation) 2013 pp. 116- 164

Key questions covered in lecture #8: *Minerals in human nutrition: functions, sources, metabolism, and disorders. pH, water, and electrolyte balance*

8.1. Metabolism definition. Regulation of metabolism
8.2. Endocrine system and hormonal effect, signaling effects in local communication
8.3. Regulation of hormone synthesis and release
8.4. Chemical nature of hormones

Recommended reading for the lecture #8:

1. Ferrier D.R. Lippincott's Illustrated reviews: Biochemistry. (7th ed 2017) pp. 357-399
2. Champe P.C., Richard A. Harvey Lippincott's Illustrated reviews of Biochemistry 2004 pp. 319-330;
3. Satyanaryana U. Biochemistry (5th education) 2017 pp. 119-165.
4. Murray R.K Harper's Illustrated Biochemistry 26th ed 2003 pp. 481- 497

Key questions covered in lecture #9: *Metabolism and hormonal control. Mechanism of hormone's action*

9.1. Hormonal action through membrane receptors
9.2. Hormonal action through the nuclear receptors.
9.3. Pathological mechanisms of endocrine diseases
Recommended reading for the lecture #9:
1. Mukhamedova I.P. Biochemistry practical book, pp. 102 – 123
2. Murray R.K Harper's Illustrated Biochemistry 26th ed 2003 pp. 49-60, 61-72.

Guidelines for the lessons (practical class) of the discipline
Key questions covered in lesson #1: *Amino acids and proteins: structural organization, classification. Nutritional and metabolic significance*
1.1. Biochemical laboratory role in the clinical medicine
1.2. Amino acids: structure; properties; biologically important peptides: Glutathione, Renin-Angiotensin system, brady-kinin, oxytocin and ADH
1.3. Proteins: biological role; properties, structural organization
Recommended reading for the lesson #1:
1. Ferrier D.R. Lippincott's Illustrated reviews: Biochemistry. (7th ed 2017) pp. 1 – 52;
2. Champe P.C., Richard A. Harvey Lippincott's Illustrated reviews of Biochemistry 2004 pp. 1-38;
3. Satyanaryana U. Biochemistry (5th education) 2017 pp. 1-7; 45-73
4. Murray R.K Harper's Illustrated Biochemistry 26th ed 2003 pp. 14-30
5. Satyanaryana U. Biochemistry (2nd education) 2005 pp. 45-72, pp 165
6. Mukhamedova I. Biochemistry practical book 2010 pp. 22-40; 61-78
7. DM Vasudevan. Textbook of Biochemistry. 4th ed. 2016 pp. 18-25;

Key questions covered in lesson #2: *Clinical aspects of proteins. Protein energy malnutrition (PEM)*
2.1. Plasma proteins: biological role
2.2. Important biochemical techniques for protein separation: Chromatography. Principles. Types: Thin-layer chroma-tography (TLC), absorption column chromatography, gel filtration chromatography. Electrophoresis. Principles. Types: Carrier electrophoresis, SDS gel electrophoresis. Dialysis. Principles. Biological ultrafiltration (glomerular filtration). Compensative dialysis in artificial kidney. Peritoneal dialysis.
2.3. Electrophoretic pattern in the normal and pathology.
3.4. Determination of serum total protein by colorimetric method.
Recommended reading for the lesson #2:
1. Satyanaryana U. Biochemistry (5th education) 2017 pp. 45-70; 167.
2. Murray R.K Harper's Illustrated Biochemistry 26th ed 2003 pp. 33-39.
3. Satyanaryana U. Biochemistry (2nd education) 2005 pp. 54-72

Key questions covered in lesson #3: *Characteristics of individual plasma proteins*
3.1. Albumin, biological role, functions. Hypoalbuminemia and pathogenesis of edema.
3.2. Haptoglobin and transferrin. Biological role. Wilson disease.
3.3. α_1-Antytrypsin.Biological role. Deficiency of Γ_1-Antytrypsin.Pulmonary Emphysema and one type of liver disease.
3.4. α_2-Macroglobulin. Biological role.
3.5. AFP (α_1-Fetoprotein).
Recommended reading for the lesson #3:
1. Ferrier D.R. Lippincott's Illustrated reviews: Biochemistry. (7th ed 2017) pp. 1-52;
2. Champe P.C., Richard A. Harvey Lippincott's Illustrated reviews of Biochemistry 2004 pp. 25-34;
3. Satyanaryana U. Biochemistry (5th education) 2017 pp. 182-195.
4. Murray R.K Harper's Illustrated Biochemistry 26th ed 2003 pp. 40-48.

Key questions covered in lesson #4: *Components of adaptive immune system*
4.1. Adaptive immune response: T- and B-lymphocytes activation (overview). Production of immunoglobulins.
4.2. Structure of immunoglobulins. Isotypes.
4.3. Mechanism of antibody action: neutralization, agglutination, activation of complement, and effector cells.
4.4. Immunochemical techniques: primary binding tests (radioimmunoassay - RIA and enzyme-. linked immunosorbent assay - ELISA); secondary binding tests (agglutination).
Recommended reading for the lesson #4:
1. Murray R.K Harper's Illustrated Biochemistry 26th ed 2003 pp. 580-597.
2. Satyanaryana U. Biochemistry (2nd education) 2005 pp. 615-620
pp. 15-36; 51-60; 668;

Key questions covered in lesson #5: *Extracellular matrix (ECM) functions in health and disease; protein targeting, sorting, and related disorders*
5.1. Elastin. Structure. Desmosine Cross-links
5.2. Fibrillin. Biological role. Diseases due to abnormal formation of elastin: Morfan syndrome
5.3. Collagen. Types. Structure. Biogenesis.
5.4. Diseases due to abnormal formation of collagen: osteogenesis imperfecta, Ehlers-Danlos syndrome

5.5. Biochemical markers of bone destruction- urinary Pyd & Dpd
5.6. Hemoglobin. Structure, isotypes, developmental biology of globin chain synthesis and gene families.
5.7. Transport gases by erythrocytes.
5.8. Hemoglobin buffer system. Myoglobinuria and hematuria. Nephrotoxic effect of heme on intrarenal vessels.
Recommended reading for the lesson #5:
1.Ferrier D.R. Lippincott's Illustrated reviews: Biochemistry. (7th ed 2017) pp. 1-52;
2. Champe P.C., Richard A. Harvey Lippincott's Illustrated reviews of Biochemistry 2004 pp. 25-38;
3. Satyanaryana U. Biochemistry (5th education) 2017 pp. 45-65.
4. Murray R.K Harper's Illustrated Biochemistry 26th ed 2003 pp. 48-50.

Key questions covered in lesson #6: *Hemoglobin and hemoglobinopathy*
6.1. Structural hemoglobinopathies*:* sickle cell trait/ disease. Pathogenesis of RBCs sickling.
6.2. Production all hemoglobinopathies: α- and β-Thal syndrome. Types. Porphirias (overview).
6.3. Functional hemoglobinopathies*:* Methemoglobinemia and carboxyhemoglobin. Toxic effect. Defense systems against excess production of methemoglobin. Treatment.
Recommended reading for the lesson #6:
1. Satyanaryana U. Biochemistry (2nd education) 2005 pp. 199-226;
2. Satyanaryana U., Chakrapani U. Biochemistry (4theducation) 2013 pp. 196-220
3. DM Vasudevan. Textbook of Biochemistry. 4th ed. 2016 pp. 18-25;230;258;

Key questions covered in lesson #7:
Assessment # 1
Module by unit: Organization of the cell. Proteins in the human body.
I. MCQs
II. Check laboratory and practical works
III. PBL and clinical cases

Key questions covered in lesson #8: *Enzymes: Factors affecting enzyme activity.*
8.1. Specificity of enzyme action
8.2. Various factors that affect the activity of enzyme: enzyme concentration, substrate concentration (Michaelis-Menthen kinetics), optimum pH and temperature, influence of inhibitors and activators.
8.3. Competitive & non-competitive inhibition
Recommended reading for the lesson #8:
1. Ferrier D.R. Lippincott's Illustrated reviews: Biochemistry. (7th ed 2017) pp.53-67
2. Champe P.C., Richard A. Harvey Lippincott's Illustrated reviews of Biochemistry 2004 pp. 47-58;
3. Satyanaryana U. Biochemistry (5th education) 2017 pp 87- 119
4. Murray R.K Harper's Illustrated Biochemistry 26th ed 2003 pp. 49-60, 61-72.

Key questions covered in lesson #9: *Inhibitors and activators of enzymes in clinical use*
9.4. Inhibitors: mechanism of action; kinetic equation
9.5. Activators: mechanism of action; kinetic equation
9.6. Clinical use of activators & inhibitors
Recommended reading for the lesson #9:
1. DM Vasudevan. Textbook of Biochemistry. 4th ed. 2016 pp. 36-54;
2. Satyanaryana U. Biochemistry. 6th ed. 2021. pp. 87;
3. Chatterjea M.N. Textbook of Medical Biochemistry. 8th ed. 2012 pp.114;
4. V.W. Rodwell, D.A. Bender, K.M.Kennely. Harper's Biochemistry. 30ed. 2015 pp. 51-87;

Key questions covered in lesson #10:
Assessment # 2
Module by unit: Enzymes. Clinical enzymology
IV. MCQs
V. Check laboratory and practical works
VI. PBL and clinical cases

Key questions covered in lesson #11: *Fat-soluble vitamins*
11.1. Sources and supply pattern of vitamin A. Functions of vitamin A and the indicators for vit.A deficiency.
11.2. Vitamin A deficiency diseases: ophthalmic, dermatologic. Toxicity effect of Vit A overdose.
11.3 Dietary sources and possible limitation of vitamin E supply. Role of vitamin E in human metabolic processes and deficiency manifestations.
11.4 Vitamin K metabolism: absorption, transport, tissue stores and distribution. Biological role. Deficiency diseases.
Recommended reading for the lesson #11:
1. Ferrier D.R. Lippincott's Illustrated reviews: Biochemistry. (7th ed 2017) pp. 357-399
2. Champe P.C., Richard A. Harvey Lippincott's Illustrated reviews of Biochemistry 2004 pp. 319-330;
3. Satyanaryana U. Biochemistry (5th education) 2017 pp. 119-165.

4. Murray R.K Harper's Illustrated Biochemistry 26th ed 2003 pp 481- 497.

Key questions covered in lesson #12: *Water-soluble vitamins: hematopoietic vitamins*
12.1. Energy releasing vitamins (B-complex): sources, structure, metabolic effect. Deficiency disorders.
12.2. Vitamins non-B-complex: sources, structure, metabolic effect. Deficiency disorders.
12.3. Hematopoetic vitamins: *Folic acid* metabolism: dietary sources, digestion, absorption, transport, tissue stores, distribution. Metabolic effect: DNA cycle, the methylation cycle. Causes that may lead folic acid deficiency.
Recommended reading for the lesson #12:
1. Ferrier D.R. Lippincott's Illustrated reviews: Biochemistry. (7th ed 2017) pp. 357-399
2. Champe P.C., Richard A. Harvey Lippincott's Illustrated reviews of Biochemistry 2004 pp. 319-330;
3. DM Vasudevan. Textbook of Biochemistry. 4th ed. 2016 pp. 271; 290;

Key questions covered in lesson #13: *Water- soluble vitamins: energy-releasing vitamins.*
13.1. Sources and Functions of vitamins B4, B6, B5 and vitamin-like substances
13.2. Deficiency diseases.
Recommended reading for the lesson #13:
1. Ferrier D.R. Lippincott's Illustrated reviews: Biochemistry. (7th ed 2017) pp. 357-399
2. Champe P.C., Richard A. Harvey Lippincott's Illustrated reviews of Biochemistry 2004 pp. 319-330;
3. Satyanaryana U. Biochemistry (5th education) 2017 pp. 119-165.
4. Murray R.K Harper's Illustrated Biochemistry 26th ed 2003 pp. 481- 497

Key questions covered in lesson #14:
Assessment # 2
Module by unit: Vitamins and minerals in human nutrition. Metabolism and hormonal control of cell organization.
VII. MCQs
VIII. Check laboratory and practical works
IX. PBL and clinical cases

Guidelines for the lessons (laboratory work) of the discipline
Laboratory work 1*: Introduction to biochemical laboratory. Quantitative reactions for amino acids and proteins. Precipitation & denaturation of proteins*
1.1. Precipitation of proteins by salting out
1.2. Denaturation of proteins
1.3. Neumann's test for phosphoproteins
1.4. Analysis of glycoproteins.
Recommended reading for the laboratory work #1
1. Printed laboratory material (Laboratory report)

Laboratory work 2: *Methods of laboratory manual techniques: paper chromatography, colorimetry, spectrometry. Determination of plasma proteins*
Recommended reading for the laboratory work #2
1. Printed laboratory material (Laboratory report)

Laboratory work 3: *Investigation of oxidoreductase and hydrolase action & factors affecting enzyme's activities*
Recommended reading for the laboratory work #3
1. Printed laboratory material (Laboratory report)

Laboratory work 4: *Methods of laboratory manual technique: Titration (direct; reverse): Determination of vitamin C in food*
Recommended reading for the laboratory work #4
1. Printed laboratory material (Laboratory report)

Methodological instructions for the implementation of independent work on the discipline
1. Experimental work is carried out in the group according to the instructions given in the laboratory work report (sample collection, analytic phase, post-analytic phase)

Independent work includes the following types of work:
- work with lecture material, providing for the study of lecture notes and educational literature;
- search and review of literature and electronic sources of information on an individually given course problem, writing a report on a given problem;
- doing homework for class;
– preparation for laboratory work, practical and seminar classes;
– independent laboratory work on a given topic;
– preparation for control work;
- preparation for the test.