MEDICAL UNIVERSITY- PLOVDIV
FACULTY OF MEDICINE

SYLLABUS

IN

CLINICAL CHEMISTRY

Approved by the Department Council - Protocol №05/23.10.2024

Confirmed by the Faculty Council - Protocol № 09/13.11.2024

CLINICAL CHEMISTRY

Syllabus

Discipline	Final exam/ semester	According to the Faculty of Pharmacy curriculum of MU-Plovdiv Academic hours				ECTS	Academic hours in semester			
							V semester		…… semester	
		Aauditorium	Lectures	Practices	Non-auditorium		L	P	L	P
Clinical chemistry	**V**	**60**	**15**	**45**	**60**	**4,0**	**1**	**3**		

DISCIPLINE:
"Clinical Chemistry"

TYPE OF DISCIPLINE ACCORDING TO THE UNIFORM STATE REQUIREMENTS:
Mandatory

LEVEL OF QUALIFICATION:
Master's degree **/M/**

FORMS OF TRAINING:
Lectures, Practical Exercises

YEAR OF TRAINING:
3rd year

DURATION OF TRAINING:
One semester

ACADEMIC HOURS:
15 hours of lectures, 45 hours of practical exercises

TECHNICAL EQUIPMENT APPLIED IN THE TRAINING:
Multimedia, computers, tables, diagrams, charts, albums, prints of the analyzers and the laboratory information system (LIS), displaying the available modern equipment, specialized library; CD animation to illustrate the principles and methods, documented quality control data.

FORMS OF EVALUATION:
Semester exam

EVALUATION CRITERIA:

Current control: Written tests, tasks or presentation on a specific theme at least twice during the semester. Tests and tasks are prepared by the individual assistants for the various topics. The final semester grade is formed on the basis of all current tests and tasks.

Final exam: The theoretical exam is in a written form on two questions from the questionnaire of Clinical Chemistry, individually selected by each student. The time for completing the written exam is two academic hours. Oral examination is held at the discretion of the examiners.

The final grade is formed by the semester and exam grade, according to the academic standard of the discipline.

ASPECTS OF EVALUATION CRITERIA:

Participation in discussion, solving tests, clinical and laboratory tasks, presentations, written and oral answer.

SEMESTER EXAM: Yes

STATE EXAM: No

LECTURER:

Habilitated lecturer from the Department of Clinical Laboratory

DEPARTMENT:

Clinical laboratory

ANNOTATION

Clinical Chemistry is a field that combines analytics and instrumentation with information technology and management of workflow, staff efficiencies and high volume automation. The field is ever-changing and demands staff have skills in the methodologies and their limitations, technology and troubleshooting equipment, as well as management and ability to adapt operations to evolving clinical needs. As a part of the Clinical laboratory science, Clinical chemistry is in service to the physician providing test results that are critical to diagnosing and managing patients.

BASIC AIMS OF THE DISCIPLINE

1. Implementation and observing the requirements for preanalytical preparation of the patient and biological material, providing results with high reliability.
2. To know and eliminate errors in preanalytical stage and the possible interference (pharmaceutical, diagnostic and therapeutic procedures) on the results of clinical laboratory analysis.
3. Implementation the scientific methods of quality assurance in all phases of laboratory testing, knowledge of methods of clinical-chemical indicators and informative introduction to the content of the results.
4. Creating a critical attitude towards the individual analytical methods, knowing their advantages and disadvantages.

5. Implementation the closely practical skills to perform basic clinical laboratory activities.

EXPECTED RESULTS

Acquisition of theoretical knowledge and practical skills in clinical chemistry to meet the requirements of modern laboratory science of quality assurance in all phases of laboratory testing; absorption methods of clinical-chemical indicators to ensure results with a high analytical reliability.

LECTURES

LECTURE №1 – 2 hours: Subject and tasks of clinical chemistry. Organization of clinical laboratory activities. Biological variations and reference value. Reliability of laboratory results. Ensuring the quality of results.

LECTURE №2 – 3 hours: Principle and calibration measurements in clinical chemistry. Calibration curves. Methods for the determination of glucose in biological fluids. Methods for determination of proteins in biological fluids.

LECTURE №3 – 2 hours: Low molecular nitrogen-containing compounds. Lipids and lipoproteins. Methods for determination.

LECTURE №4 – 2 hours: Acid-base exchange. Electrolytes and trace elements. Methods for determination.

LECTURE №5 – 2 hours: Enzymes. Bile pigments. Drugs in biological fluids.

LECTURE №6 – 2 hours: Hemoglobin. Hemostasis. Chemical examination of urine.

LECTURE №7 – 2 hours: Hormones in biological fluids. Drug monitoring.

PRACTICES

EXERCISE № 1 – 3 hours: Quality Assurance in clinical laboratory. Internal end external laboratory quality control. Control cards.

EXERCISE № 2 - 3 hours: Carbohydrates - methods for the determination of glucose in blood and other biological fluids. Calibration curve.

EXERCISE № 3 – 3 hours: Total serum protein. Methods for protein fractioning. Individual proteins. Calibration curve

EXERCISE № 4 – 3 hours: Non-protein nitrogen containing substances – urea, creatinine, uric acid. Principle of the analytical methods.

EXERCISE № 5 – 3 hours: Lipids and lipoproteins. Methods for determination of cholesterol, triglycerides, HDL-cholesterol, apolipoproteins

EXERCISE № 6 – 3 hours: Serum enzymes and isoenzymes. ASAT, ALAT, LDH, CK, CHE, alkaline phosphatase, α-amylase, lipase. Methods. Results interpretation.

EXERCISE № 7 – 3 hours: Body water and its distribution in the human body. Osmolality - methods of investigation. Classification of bioelements – macro- and microelements . Essential and non-essential bioelements.

EXERCISE № 8 – 3 hours: Electrolytes – sodium, patassium, clorides, calcium, inorganic phosphorus, magnesium. Principle of the analytical methods. Results' interpretation.

EXERCISE № 9 – 3 hours: Alkaline acidic exchange. Basic parameters, principle of the analytical methods. Results' interpretation.

EXERCISE № 10 – 3 hours: Hemoglobin – types and methods for determination. Serum bilirubin and fraction. Principle of the analytical methods. Results' interpretation.

EXERCISE № 11 – 3 hours: Blood coagulation and fibrinolysis – factors and inhibitors, bleeding time, PT, aPTT, fibrinogen, TT, D-Dimers. Methods. Laboratory control of anticoagulant therapy.

EXERCISE № 12 – 3 hours: Urine - general characteristics and chemical tests – pH, glucose, proteins, ketones, bilirubin, urobilinogen, blood.

EXERCISE № 13 – 3 hours: Oligoelements in the biological fluids – serum iron and iron binding capacity, copper, zinc

EXERCISE № 14 – 3 hours: Hormones in blood and urine. Basic analytical methods – chromogenous, fluorometric, immunochemical – RIA, ECLIA.

EXERCISE № 15 – 3 hours: Drug monitoring.

BIBLIOGRAPHY

1. Guide to practical trainings in clinical chemistry for pharmacy students. ed. by K. Tzatchev. Plovdiv, Lax book, 2014.
2. Clinical laboratory interpretation of results. ed. by T. Deneva, Plovdiv, 2021
3. Devlin, T. M. (ed.). Textbook of Biochemistry with Clinical Correlation, Fifth Edition, New York, Wiley-Liss, 2002.
4. Marshall, William J. et al. Clinical chemistry / William J. Marshall, Andrew Day, Marta Lapsley. - 8th ed.- Edinburgh : Elsevier, 2017.
5. Clinical chemistry: Principles, techniques, and correlations / Ed. Michael L. Bishop, Edward P. Fody, Larry E. Schoeff. - 7th ed.- Philadelphia: Wolters Kluwer / Lippincott Williams & Wilkins, 2013

CONSPECTUS

1. Analytical reliability of clinical laboratory methods - criteria. Reference range - established population (definition, reference group, reference state, reference conditions, choice of statistical method, disadvantages), individual – advantages.
2. Permanent, long-term and short-term acting factors of biological variation of results - examples.

3. Effects of the medical procedures and medication (chemical and pharmacological interference) on the laboratory results. Guidelines for control of drug effects on laboratory tests.
4. Biological material for clinical laboratory testing - basic rules and requirements. Venous or capillary blood for testing.
5. Closed system for biological material for the different groups of clinical-laboratory parameters. Advantages for the clinic, advantages for the clinical laboratory.
6. Storage of the biological samples for analysis and transport to the laboratory – requirements and sources of errors. Criteria for rejection of the specimen for laboratory analysis.
7. Urine for clinical laboratory investigation. Body fluids and stool. Basic rules and requirements for collection, storage and transport to the laboratory. Sources of errors
8. Methods in the clinical laboratory- characteristics.
9. Calibration curve - conditions for calibration. Rules for construction.
10. Quality control in clinical laboratory - internal quality control.
11. Quality control in clinical laboratory - external evaluation of the quality of laboratory results.
12. Body water and its distribution in the body. Osmolality - methods for determination – reference range, informative significance.
13. Disturbances of water electrolyte exchange - terminology. Clinical laboratory parameters for assessment of water electrolyte exchange
14. Sodium and chloride - common data, indications for testing, analytical methods, principles. Reference limits, interpretation of results.
15. Potassium - general data for the parameter, analytical methods - principles. Reference limits, interpretation of results.
16. Total and ionized calcium in serum - common data ,analytical methods - principles. Reference limits, results interpretation.
17. Inorganic phosphate - common data, analytical methods - principles. Reference limits, interpretation of results.
18. Acid-base exchange. Basic parameters. Methods for determination. Informative significance
19. Serum iron and TIBC – common data, analytical methods, interference, indications for testing. Reference limits and interpretation of results.
20. Glucose in the blood - principle of the analytical methods, interference, indications for testing, biological material, reference, border and pathological values. Hyperglycemia and hypoglycemia.
21. Glucose in the blood - overload tests: two-hour postprandial test and glucose tolerance test (GTT), indications and contraindications, sources of errors, reference ranges, interpretation of results.
22. Evaluation of glycemia for preceeded period of time: glycated proteins – glycated hemoglobin HbA1, HbA1c and fructosamine. Common data for the parameters, indications for investigation, patient preparation, specimen, reference ranges and results interpretation.
23. Total protein - common data for the parameters, principles of the analytical methods and interferences, indications for investigation, patient preparation, reference ranges, results interpretation.
24. Major protein fractions – electrophoreses: indications for investigation, result interpretation.
25. Individual proteins, proteins of the acute phase, immunoglobulins. Analytical methods for investigation, indications for investigation, patient preparation, reference ranges, results interpretation.
26. Urea - common data for the parameter, principles of the analytical methods, source of errors, indications for investigation, patient preparation, reference ranges, results interpretation.
27. Creatinine - common data for the parameter, principles of the analytical methods, source of errors and interference, indications for investigation, patient preparation, specimen, reference ranges, results interpretation.
28. Uric acid - common data for the parameter, principles of the analytical methods, source of errors and interference, indications for investigation, patient preparation, specimen, reference ranges, results interpretation.

29. Transaminases, alkaline phosphatase and gamma-glutamyltransferase in serum – general information, principles of analytical methods, sources of errors, indications for analysis, biological material, reference ranges, interpretation of results.
30. Lactatedehydrogenase and creatinephosphokinase in serum - general information, principles of analytical methods, sources of errors, indications for analysis, biological material, reference ranges, interpretation of results.
31. Amylase, lipase and cholinesterase - general information, principles of analytical methods, sources of errors, indications for analysis, biological material, reference ranges, interpretation of results.
32. Cholesterol in serum and its fractions - general information, analytical methods, interferences, risk limits, interpretation of results.
33. Triglycerides in serum general information, analytical methods, interferences, risk limits, interpretation of results.
34. Serum bilirubin and fractions – metabolism, methods, interferences, reference ranges, interpretation of results.
35. Hemostasis as a complex functional system – blood vessels, platelets, coagulation and fibrinolysis.
36. Blood coagulation and fibrinolysis – phases, factors and inhibitors.
37. Clinical laboratory parameters for evaluation of haemostasis - bleeding time, PT, aPTT, fibrinogen, TT, D-Dimers. Interpretation of the results.
38. Hemoglobin – types and methods for determination. Reference ranges. Informative content.
39. Urine - general properties, pH, protein. Principles of the methods, interferences, results interpretation.
40. Urine - glucose, ketones. Principles of the methods, interferences, results interpretation.
41. Urine - bile pigments. Principles of the methods, interferences, results interpretation.
42. Hormones in biological fluids - general data, basic groups. Methods for testing.
43. Drug monitoring.

Approved: Prof. Tanya Deneva, MD, PhD
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