Methodological recommendations for students independent work (SIW)

Discipline:	**«Methods and equipment for pharmaceutical analysis»**
Discipline code:	**MOFA 4201**
EP:	**6B07201 «Pharmaceutical manufacturing technology»**
Volume of educational hours / credits:	**120 hours (4 credits)**
Course:	**4**
Semestr:	**7**
Volume of independent work:	**10**

Shymkent, 2024

Methodological guidelines for independent work of students were developed in accordance with the working curriculum of the discipline (syllabus) "Methods and equipment for pharmaceutical analysis" and discussed at a meeting of the department.

Protocol №21, 10.06.2024 y.

Head of Department, Professor Ordabaeva S.K.

Introduction

Students independent work (SIW) is one of the most important elements of studying at a university. This is due to the fact that the teacher only organizes and directs the cognitive activity of students, being a kind of guide to the world of knowledge, but the effectiveness of learning new material depends on the students' own efforts. Independent work of students is a variety of individual and collective activities of students, carried out under the guidance, but without the direct participation of the teacher. This is a special form of training based on the teacher's assignments, the implementation of which requires active mental activity. Therefore, independent search for knowledge is a distinctive feature of studying at a university. Self-training contributes to the formation of a high culture of mental work, the acquisition of techniques and skills of independent work, the ability to wisely spend and distribute your time, accumulate and assimilate the information necessary for successful learning and professional development. It develops such qualities in students as organization, discipline, initiative, will, develops thinking skills and abilities, teaches independent thinking, allows you to form your own style of work that most fully corresponds to the personal inclinations and cognitive skills of the student.

When properly organized, self-training is of decisive importance for the development of independence as one of the leading personality traits of a specialist with higher education and acts as a means of ensuring for students:

- solid assimilation of knowledge on the subject;
- mastering the methods and techniques of self-education (abilities to process the source of information, generalize the information received);
- development of the need for independent replenishment of knowledge.

Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.

120 hours are allocated for studying the discipline "Methods and equipment for pharmaceutical analysis", including 12 hours for SIW.

1. Topic: State principles and regulations governing the quality of medicines.
2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.
3. Tasks: study the sections of the topic, including working with primary sources, dictionaries and regulatory documents, prepare for test questions on the topic, prepare an abstract, a review of the abstract with a subsequent presentation to the audience
4.Execution form: abstract, review of an abstract

5. **Execution criterion:** Appendix 1
6. **Evaluation criteria:** according to the assessment sheet (syllabus, item 10.2)
7. **Submission deadlines:** 1st week
8. **Literature:** Appendix 2
9. **Control:**

1. Regulatory legal acts in the field of standardization of medicines.
2. The standardization system in healthcare of the Republic of Kazakhstan. Regulatory documentation (RD) governing the quality of medicines: State Pharmacopoeia of the Republic of Kazakhstan, general pharmacopoeial article (GPA), pharmacopoeial articles (PM), temporary pharmacopoeial article (TPA), temporary analytical normative document (TARD), analytical normative document (AND), etc.
3. General characteristics of RD (requirements, standards and control methods).
4. International Pharmacopoeia of the World Health Organization, European Pharmacopoeia, Eurasian Economic Community Pharmacopoeia, other regional and national pharmacopoeias.
5. Quality assurance of medicines. Control and permit system.
6. Quality assurance system for medicines according to international standards. GMP, GLP, GCP, GPP - a unified system of requirements for organizing quality control of medicines.

1. Topic: General principles and methods of identification of medicinal products. Identification of medicinal products by physical properties and constants.
2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.
3. Tasks: study the sections of the topic, including working with primary sources, dictionaries and regulatory documents, prepare for test questions on the topic, prepare an abstract, a review of the abstract with a subsequent presentation to the audience
4. Execution form: preparation of test assignments, review of tests, checking in the «Antiplagiat University" system.
5. **Execution criterion:** Appendix 1
6. **Evaluation criteria:** according to the assessment sheet (syllabus, item 10.2)
7. **Submission deadlines:** 2nd week
8. **Literature:** Appendix 2
9. **Control**

1. General principles and methods of drug identification.

2. Physical properties and constants used to identify drugs: appearance, smell, taste, solubility, melting point, boiling point, solidification, relative density, optical rotation, viscosity, etc.
3. Instrumental methods of analysis used to identify drugs (polarimetry, UV and IR spectroscopy, GLC and HPLC, atomic absorption spectroscopy, mass spectroscopy).

1.Topic: Methods based on radiation emission: atomic absorption spectrometry, fluorimetry.

2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.

3. Tasks study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation with a subsequent speech to the audience.

4. Execution form preparation of test assignments, review of tests, checking in the «Antiplagiat University" system

5.Execution criterion: Appendix 1

6.Evaluation criteria: according to the assessment sheet (syllabus, item 10.2)

7.Submission deadlines: 1st week

8.Literature: Appendix 2

9.Control:

1. Sequence of operations when measuring optical density on a spectrophotometer in the visible and ultraviolet spectral ranges.
2. Rules for working on the SF-2000.
3. In what coordinates is the calibration graph plotted? What is its purpose?
4. The structure of the spectrophotometer and its operating principle.
5. List the main characteristics of spectral instruments.
6. How is a monochromatic light flux obtained in a spectrophotometer?
7. What material are cuvettes made of when working in the ultraviolet and visible spectral ranges? Why?
8. Basic rules for working with cuvettes.
9. What device in a spectrophotometer converts light energy into electrical energy?
10. Leading schools in the field of pharmaceutical analysis;

1.**Topic:** Methods based on the absorption of electromagnetic radiation: nephelometry.

2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.

3. Tasks study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation with a subsequent speech to the audience.
4. Execution form preparation of test assignments, review of tests, checking in the «Antiplagiat University" system
5. Execution criterion: Appendix 1
6. Evaluation criteria: according to the assessment sheet (syllabus, item 10.2)
7. Submission deadlines: 3rd week
8. Literature: Appendix 2
9. Control:

1. The essence of spectral methods in the UV, visible and IR regions. What wavelength ranges are characteristic of each region?
2. The differences in the terms "spectroscopy" and "spectrophotometry".
3. What is the absorption spectrum of a substance? What are absorption spectra in the UV and visible regions?
4. What are IR spectra?
5. What radiation sources are used for spectrophotometry when working in the UV, visible and IR regions of the spectrum?
6. The unit of measurement of wavelength in the UV and IR regions of the spectrum.
7. Definition of the following terms: transmission, transmittance, optical density, molar absorption coefficient.
8. Formulate the laws: Beer's law, Bouguer-Lambert's law and Bouguer-Lambert-Beer's law. Which of them underlies photometric methods of analysis?
9. What is the optical density of the solution if the basic law of light absorption is observed?
10. Pharmaceutical analysis, types, methods, equipment, features, scope of application.

1.Topic: Magnetic field based methods: NMR spectroscopy.
2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.
3. Tasks study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation with a subsequent speech to the audience.
4. Execution form preparation of test assignments, review of tests, checking in the «Antiplagiat University" system
5. Execution criterion: Appendix 1
6. Evaluation criteria: according to the assessment sheet (syllabus, item 10.2)

7. Submission deadlines: 4th week
8. Literature: Appendix 2
9. Control:

1. How is a monochromatic light flux obtained in a spectrophotometer?
2. What are light filters used for?
3. How to choose the right working light filter?
4. What material are cuvettes made of when working in the ultraviolet and visible regions of the spectrum? Why?
5. Basic rules for working with cuvettes.
6. What device in a spectrophotometer converts light energy into electrical energy?
7. The sequence of operations when measuring optical density on a spectrophotometer in the visible and ultraviolet regions of the spectrum.
8. Rules for working on the SF-2000.
9. How are the working light filters and cuvettes selected?
10. What causes the selective absorption of light by molecules?
11. The unit of measurement of wavelength in the UV and IR regions of the spectrum.
12. Definition of the following terms: transmission, transmission coefficient, optical density, molar absorption coefficient.
13. Formulate the laws: Beer's law, Bouguer-Lambert's law and Bouguer-Lambert-Beer's law. Which of them is the basis of photometric methods of analysis?
14. What is the optical density of a solution if the basic law of light absorption is observed?
15. What is the absorption spectrum of a substance?
16. Define the following concepts: chromophore, bathochromic, hypsochromic, hyperchromic, hypochromic effects.
17. What is the basis for determining the concentration of solutions using photometric methods of analysis?
18. The main stages of determining the concentration of the test solution using the graduated graph method.
19. How is the concentration range of standard solutions selected when constructing a calibration curve?
20. In what cases is it unacceptable to use a calibration curve when determining the concentration of the test solution?

1.Topic: Methods based on the use of a magnetic field: NMR spectroscopy.

2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.
3. Tasks study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation with a subsequent speech to the audience.
4. Execution form preparation of test assignments, review of tests, checking in the «Antiplagiat University" system
5. Execution criterion: Appendix 1
6. Evaluation criteria: according to the assessment sheet (syllabus, item 10.2)
7. Submission deadlines: 5th week
8. Literature: Appendix 2
9. Control:
1. What is the absorption spectrum of a substance? What are absorption spectra in the visible range?
2. What radiation sources are used for spectrophotometry when working in the visible range of the spectrum?
3. The unit of measurement of wavelength in the visible range of the spectrum.
4. The basic law of light absorption.
5. What is the optical density of a solution if the basic law of light absorption is observed?
6. What causes the selective absorption of light by molecules?
7. What is the role of chromophore and auxochromic groups in a molecule when recording absorption spectra?
8. Definition of the following concepts: chromophore, bathochromic, hypsochromic, hyperchromic, hypochromic effects.
9. What is the basis for the use of spectra in qualitative and quantitative analysis?
10. What is the basis for determining the concentration of solutions using photometric methods of analysis?

1.Topic: Magnetic field based methods: PMR spectroscopy.
2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.
3. Tasks study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation with a subsequent speech to the audience.
4. Execution form preparation of test assignments, review of tests, checking in the «Antiplagiat University" system
5. Execution criterion: Appendix 1

6. Evaluation criteria: according to the assessment sheet (syllabus, item 10.2)**7. Submission deadlines:** 6th week
8. Literature: Appendix 2
9. Control:

1. The main stages of determining the concentration of the test solution using the graduated graph method
2. How is the concentration range of standard solutions selected when constructing a calibration curve?
3. In what cases is it unacceptable to use a calibration curve when determining the concentration of the test solution?
4. Advantages of the calibration graph method in comparison with other photometric methods of analysis?
5. What is the basis for determining the concentration using the method of comparing the optical densities of the standard and test solutions? Advantages and disadvantages of this method.
6. What requirements are followed when choosing a cuvette for analysis?
7. In what coordinates is the calibration graph plotted? What is its purpose?
8. The design of a spectrophotometer and its operating principle.
9. List the main characteristics of spectral devices.
10. How is a monochromatic light flux obtained in a spectrophotometer?
11. What material are cuvettes made of when working in the ultraviolet and visible regions of the spectrum? Why?

1.Topic: Magnetic field based methods: mass spectroscopy.
2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.
3. Tasks study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation with a subsequent speech to the audience.
4. Execution form preparation of test assignments, review of tests, checking in the «Antiplagiat University" system
5. Execution criterion: Appendix 1
6. Evaluation criteria: according to the assessment sheet (syllabus, item 10.2)
7. Submission deadlines: 7th week
8. Literature: Appendix 2
9. Control:
1. The photoelectrocolorimetry method is used to analyze … .
a. colored solutions

b. suspensions
c. turbid solutions
d. fluorescent solutions
e. colorless solutions
2. Qualitative and quantitative spectral analysis is determined using … .
a. spectral curves
b. chromatograms
c. thermograms
d. X-ray diffraction patterns
e. polarization curves
3. Physicochemical methods of analysis based on the study of emission, absorption and Raman spectra of electromagnetic radiation by atoms and molecules of the substance under study are called … .
a. chromatographic
b. X-ray
c. polarographic
d. spectral
e. thermal
4. Emission methods based on measuring the intensity of radiation emitted by a substance during its transition from an excited to a stationary state are called … .
a. optical-acoustic spectroscopy
b. spectral atomic absorption
c. nephelometry
d. nuclear magnetic resonance spectroscopy
e. spectral atomic emission
5. Absorption methods based on measuring the intensity of absorption of electromagnetic radiation by atoms and molecules of a substance are called … .
a. spectral atomic absorption
b. spectral atomic emission
c. nephelometry
d. nuclear magnetic resonance spectroscopy
e. optical-acoustic spectroscopy
6. Methods based on the scattering of monochromatic radiation by atoms or molecules of a substance and the measurement of additional bands of electromagnetic radiation are called … .
a. Raman spectroscopy
b. photocolorimetry
c. nephelometry
d. nuclear magnetic resonance spectroscopy
e. optical-acoustic spectroscopy

7. Spectral methods based on the study of resonance effects when a substance is exposed to constant and alternating magnetic fields are called … .
a. nuclear magnetic resonance spectroscopy
b. photoelectrocolorimetry
c. phototurbidimetry
d. paramagnetic resonance spectroscopy
e. polarimetry
8. Spectral methods of analysis that characterize the interaction of the magnetic moment of an electron with a magnetic field are called … .
a. electron paramagnetic resonance spectroscopy
b. nuclear magnetic resonance spectroscopy
c. photoelectrocolorimetry
d. phototurbidimetry
e. photonephelometry
9. The wavelength of electromagnetic radiation ( ) in the UV and visible regions of the spectrum is measured in … .
a. nanometers (nm)
b. centimeters (cm)
c. kilometers (km)
d. millimeters (mm)
e. decimeters (dm)
10. The wavelength of electromagnetic radiation ( ) in the IR region of the spectrum is measured in … .
a. reciprocal centimeters (cm-1)
b. nanometers (nm)
c. kilometers (km)
d. millimeters (mm)
e. decimeters (dm)

1.Topic: Interim control: colloquium
2.Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.
3. Tasks: study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation followed by a speech in front of an audience/groups participating in the implementation of project work submit a full report
4. Execution form/оценивания: testing/full report on the project work and its defense
5. Execution criterion: table 1,2 and 3,4

6.Evaluation criteria: according to the assessment sheet (syllabus, item 10.2)
7.Submission deadlines: 8th week
8.Literature: Appendix 2
9.Control:
All questions of the topic from 1-5 lectures, laboratory classes and SIW

1.Topic: Optical methods of analysis: polarimetry.
2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.
3. Tasks study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation with a subsequent speech to the audience.
4. Execution form preparation of test assignments, review of tests, checking in the «Antiplagiat University" system
5.Execution criterion: Appendix 1
6.Evaluation criteria: according to the assessment sheet (syllabus, item 10.2)
7.Submission deadlines: 9th week
8.Literature: Appendix 2
9.Control:
1. To measure the optical rotation of a substance, use … .
a. polarimeter
b. refractometer
c. potentiometer
d. photometer
e. viscometer
2. To measure the refractive index of a substance, use … .
a. refractometer
b. polarimeter
c. potentiometer
d. photometer
e. viscometer
3. The ability of substances to rotate the plane of polarization when rectilinear polarized light passes through them is based on the presence in the molecule of … .
a. asymmetric carbon atom
b. primary nitrogen atom
c. secondary nitrogen atom
d. conjugated double bonds
e. heteroatoms of nitrogen, oxygen, sulfur

4. The ability of substances to rotate the plane of polarization when rectilinear polarized light passes through them is the basis of the method of … .
a. polarimetry
b. refractometry
c. photometry
d. polarography
e. potentiometry
5. The photoelectrocolorimetry method is used to analyze … .
a. colored solutions
b. suspensions
c. turbid solutions
d. fluorescent solutions
e. colorless solutions
6. Spectral methods based on the study of resonance effects when a substance is exposed to constant and alternating magnetic fields are called … .
a. nuclear magnetic resonance spectroscopy
b. photoelectrocolorimetry
c. phototurbidimetry
d. paramagnetic resonance spectroscopy
e. polarimetry
7. Spectral methods of analysis that characterize the interaction of the magnetic moment of an electron with a magnetic field are called … .
a. electron paramagnetic resonance spectroscopy
b. nuclear magnetic resonance spectroscopy
c. photoelectrocolorimetry
d. phototurbidimetry
e. photonephelometry
8. The wavelength of electromagnetic radiation ( ) in the UV and visible regions of the spectrum is measured in … .
a. nanometers (nm)
b. centimeters (cm)
c. kilometers (km)
d. millimeters (mm)
e. decimeters (dm)
9. The wavelength of electromagnetic radiation ( ) in the IR region of the spectrum is measured in … .
a. reciprocal centimeters (cm-1)
b. nanometers (nm)
c. kilometers (km)
d. millimeters (mm)

e. decimeters (dm)

1.Topic: Theoretical foundations of gas chromatography. Application of gas chromatography in drug analysis.
2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.
3. Tasks study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation with a subsequent speech to the audience.
4. Execution form preparation of test assignments, review of tests, checking in the «Antiplagiat University" system
5.Execution criterion: Appendix 1
6.Evaluation criteria: according to the assessment sheet (syllabus, item 10.2)
7.Submission deadlines: 10th week
8.Literature: Appendix 2
9.Control:
1. Quantitative analysis includes…
a) sample injection, retention time calculation;
b) separation, mixture composition calculation;
c) instrument calibration, separation, peak area measurement;
d) sample injection, separation, retention index calculation.
2. The most frequently used chromatographic peak parameter in quantitative analysis is…
a) peak height;
b) peak width at baseline;
c) peak width at half-height;
d) peak area.
3. The main advantage of a UV detector is…
a) selectivity;
b) ability to detect a large number of organic compounds;
c) low detection limit;
d) baseline stability.
4. The most frequently used retention parameter is…
a) absolute time;
b) relative time;
c) relative volume;
d) absolute volume.

5. For automatic calculation of peak area, a liquid chromatograph unit is used - ...
a) electronic amplifier;
b) chart recorder;
c) integrator;
d) electrometer.
6. The parameter characterizing a chromatographic column is ...
a) length;
b) column material;
c) chemical composition of the solid support;
d) nature of the stationary phase.
7. Retention time is the time elapsed from the start of sample injection to ...
a) appearance of the zone of the corresponding component with maximum concentration at the column outlet;
b) start of the detector signal;
c) end of the detector signal;
d) last maximum detector signal.
8. The detector is designed for ...
a) uniform movement of the analyzed sample in the column;
b) recording of the components of the analyzed mixture;
c) sample introduction into the chromatograph;
d) complete separation of the components of the analyzed sample.
9. The basis of qualitative analysis in gas chromatography is the value of …
a) retention time;
b) peak height;
c) peak area;
d) peak width.
10. The area of the chromatographic peak characterizes …
a) the qualitative composition of the sample;
b) the quantitative content of individual components in the sample;
c) the content of the liquid phase in the solid carrier;
d) the completeness of separation.

1.Topic: Theoretical foundations of liquid chromatography. Application of liquid chromatography in drug analysis.

2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.

3. Tasks study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation with a subsequent speech to the audience.
4. Execution form preparation of test assignments, review of tests, checking in the «Antiplagiat University" system
5.Execution criterion: Appendix 1
6.Evaluation criteria: according to the assessment sheet (syllabus, item 10.2)
7.Submission deadlines: 11th week
8.Literature: Appendix 2
9.Control:
1. Chromatography in quantitative analysis of drugs. Classification. Types of column chromatography: gas and liquid. Features. Quantitative parameters of chromatography. Advantages and disadvantages.
2. How are components detected and identified on paper and thin-layer chromatograms?
3. What methods allow chromatographing several samples simultaneously?
4. Sorption mechanisms (adsorption, absorption), desorption.
5. Classification of chromatographic methods by the mechanism of separation of the substances under study.
6. Classification of chromatography by technique.
7. The main stages (steps) of chromatography in a thin layer of sorbent.
8. Factors affecting the reproducibility of thin-layer chromatography.
9. Characteristics of sorbents used in TLC.
10. Requirements for plates used in TLC for applying the sorbent.

1.Topic: Electrochemical methods of analysis: potentiometry. Potentiometric titration.
2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.
3. Tasks study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation with a subsequent speech to the audience.
4. Execution form preparation of test assignments, review of tests, checking in the «Antiplagiat University" system
5.Execution criterion: Appendix 1
6.Evaluation criteria: according to the assessment sheet (syllabus, item 10.2)
7.Submission deadlines: 12th week
8.Literature: Appendix 2
9.Control:

1. The pH value is a number that conventionally characterizes the concentration of ions … in aqueous solutions.
a. hydrogen
b. hydroxonium
c. oxygen
d. hydroxyl
e. ammonium
2. Voltmeters (potentiometers, pH meters) are calibrated using …
a. standard buffer solutions
b. organic polar solvents
c. organic non-polar solvents
d. purified water
e. indicator solutions
3. In potentiometric titration, the end point of the titration is found by measuring … of an electrode pair consisting of an indicator electrode and a reference electrode immersed in the test solution.
a. electromotive force
b. optical density
c. refractive index
d. optical rotation
e. dynamic viscosity
4. In potentiometric titration, the electromotive force (EMF) is measured using … .
a. pH meter
b. refractometer
c. polarimeter
d. photometer
e. viscometer
5. In potentiometric titration, the electromotive force (EMF) is measured using … .
a. ion meter
b. refractometer
c. polarimeter
d. photometer
e. viscometer
6. In order to measure the pH of the substance being analyzed, the … .
a. potentiometer
b. refractometer
c. colorimeter
d. photometer

e. viscometer

7. In order to measure the pH of the substance being analyzed, the … . a) ionometer

b) refractometer

c) colorimeter

d) photometer

e) viscometer

8. To measure the pH of the analyzed substance, use … .

a. voltmeter

b. refractometer

c. colorimeter

d. photometer

e. viscometer

9. In potentiometric titration for analysis based on neutralization reactions, use … .

a. glass

b. silver

c. mercury

d. platinum

e. calomel

10. In potentiometric titration for analysis based on precipitation reactions, use … .

a. silver and silver sulfide

b. glass and silver

c. mercury and glass

d. platinum and mercury

e. calomel and glass

Topic: Electrochemical methods of analysis: anodic and cathodic polarography.

2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.

3. Tasks study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation with a subsequent speech to the audience.

4. Execution form preparation of test assignments, review of tests, checking in the «Antiplagiat University" system

5.Execution criterion: Appendix 1

6.Evaluation criteria: according to the assessment sheet (syllabus, item 10.2)

7.Submission deadlines: 13th week
8.Literature: Appendix 2
9.Control:

1. Quantitative polarographic analysis is based on measuring … of the substance being analyzed.
a. wavelength
b. optical density
c. optical rotation
d. electromotive force
e. refractive index

2. Quantitative polarographic analysis is based on measuring … of the substance being analyzed.
a. limiting diffusion current
b. specific refractive index
c. specific optical rotation
d. electromotive force
e. specific absorption coefficient

3. In potentiometric titration for analysis based on complexation reactions, … are used as indicator electrodes.
a. mercury and ion-selective
b. glass and silver
c. mercury and glass
d. platinum and mercury
e. calomel and glass

4. In potentiometric titration for analysis based on oxidation-reduction reactions, the indicator electrode is … .
a. platinum
b. glass
c. mercury
d. silver
e. calomel

5. In potentiometric titration, the reference electrodes are … .
a. silver chloride, calomel, glass
b. glass, silver and silver sulfide
c. mercury, glass and silver
d. platinum, mercury and silver chloride
e. calomel, glass and platinum

6. An electrochemical method of analysis based on measuring the current strength that occurs during electrolysis of a solution of the substance being analyzed on a microelectrode is called … .
a. polarography
b. electrophoresis
c. potentiometry
d. refractometry
e. amperometry
7. The polarographic method is used to study substances capable of … .
a. electroreduction and electrooxidation +
b. complexation
c. nucleophilic substitution
d. hydrolytic cleavage
e. electrophilic substitution
8. In the polarographic method, the microelectrode used is …
a. mercury dripping
b. silver sulfide
c. platinum
d. silver chloride
e. calomel
9. In the polarographic method, the macroelectrode is … .
a. mercury layer at the bottom of the electrolyzer
b. silver sulfide
c. platinum
d. silver chloride
e. mercury dripping
10. In the polarographic method, the external standard electrode is … .
a. calomel
b. silver sulfide
c. platinum
d. ion-selective
e. glass

11. The criterion for qualitative identification of the analyzed substance by the polarographic method is … .
a. half-wave potential
b. optical density
c. optical rotation
d. electromotive force
e. refractive index

1.Topic: Electrochemical methods of analysis: anodic and cathodic polarography.

2. Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.

3. Tasks study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation with a subsequent speech to the audience.

4. Execution form preparation of test assignments, review of tests, checking in the «Antiplagiat University" system

5.Execution criterion: Appendix 1

6.Evaluation criteria: по оценочному листу (силлабус, пункт 10.2)

7.Submission deadlines: 14th week

8.Literature: Appendix 2

9.Control:

1. The criterion for qualitative identification of the substance being analyzed by the polarographic method is … .
a) half-wave potential
b) optical density
c) optical rotation
d) electromotive force
e) refractive index
2. In potentiometric titration for analysis based on complexation reactions, … are used as indicator electrodes.
a) mercury and ion-selective
b) glass and silver
c) mercury and glass
d) platinum and mercury
e) calomel and glass
3. In potentiometric titration for analysis based on oxidation-reduction reactions, … is used as an indicator electrode.
a) platinum
b) glass
c) mercury
d) silver
e) calomel
4. In potentiometric titration, … are used as reference electrodes.

a) silver chloride, calomel, glass

b) glass, silver and silver sulfide
c) mercury, glass and silver
d) platinum, mercury and silver chloride
e) calomel, glass and platinum

5. An electrochemical method of analysis based on measuring the current that occurs during the electrolysis of a solution of the substance being analyzed on a microelectrode is called … .
a) polarography
b) electrophoresis
c) potentiometry
d) refractometry
e) amperometry

6. The polarographic method is used to study substances capable of … .
a) electroreduction and electrooxidation +
b) complexation
c) nucleophilic substitution
d) hydrolytic cleavage
e) electrophilic substitution

7. In the polarographic method, the microelectrode used is …
a) mercury dropping
b) silver sulfide
c) platinum
d) silver chloride
e) calomel

8. In the polarographic method, the macroelectrode is … .
a) mercury layer at the bottom of the electrolyzer
b) silver sulfide
c) platinum
d) silver chloride
e) mercury dropping

9. In the polarographic method, the external standard electrode is … .
a) calomel
b) silver sulfide
c) platinum
d) ion-selective
e) glass

1.Topic: Interm control: colloquium

2.Goal: developing students' skills for independent creative work, mastering the techniques of cognitive activity for further use and application in solving scientific and practical problems.
3. Tasks study the sections of the topic, including working with primary sources, prepare for test questions on the topic, prepare a presentation followed by a speech in front of an audience/groups participating in the implementation of project work submit a full report
4. Execution form/оценивания: testing/full report on the project work and its defense
5. Execution criterion: table 1,2 and 3,4
6.Evaluation criteria: according to the assessment sheet (syllabus, item 10.2)
7.Submission deadlines: 15th week
8.Literature: Appendix 2
9.Control:
All questions on the topic from lectures 6-10, laboratory classes and SIW

4. Forms of SIW implementation:

- preparation and defense of the abstract,
- review of the abstract,
- presentation,
- review of the presentation,
- compilation of test assignments,
- compilation of crosswords,
- preparation of the project work and its defense

5. Criteria for the implementation of SIW (requirements for the implementation of tasks)

5.1 Information for the teacher

At the beginning of the academic period, as a rule, each student is assigned SIW topics based on three topics from the calendar-thematic plan.

The distribution of topics should be such that each student covers various forms of SIW implementation.

In addition, according to the distribution of the dean's office, some groups of the course participate in the implementation of project work. The topics of project work are given in the syllabus. At the beginning of the project work, a calendar plan for the implementation of project work for the entire semester is drawn up. In accordance with this, the teacher monitors the entire process of project work, and students report on the work done weekly. On the 8th week, students submit an interim report, and on the 15th week - a full report.

Preparation and defense of the abstract (presentation). Abstract topics are assigned to the student at the beginning of the academic period. The student prepares the abstract and presents it to the department according to the schedule one week before the defense. The abstract is submitted for review to the student-reviewer, who submits the review according to the schedule for the defense. The defense and opposition of the work is held in front of the academic group. The assessment for the completion and review of the abstract for the student-reporter and the student-reviewer is set in accordance with the assessment criteria.

Compilation of crosswords. The assessment of the compiled crossword is carried out in front of the academic group according to the schedule. The work is assessed in accordance with the assessment criteria.

Test assignments. Test assignments are compiled individually by the student and submitted to the department according to the schedule. The work is assessed in accordance with the assessment criteria.

5.2 Information for students

according to the form of implementation of SIW in the form:
Abstract
Approximate outline of the abstract:
– introduction (topic, goals and objectives, relevance);
– main content (list of specific issues studied on the topic);
– conclusions and proposals;
– list of references.

The volume of the abstract is 10-12 pages. The *introduction*, which takes up 1-2 pages, presents a brief justification of the topic (relevance), goals and objectives. *The main content is presented in the form of a literature review* (3-5 pages), which provides a systematic analysis of the published literature on the topic of the abstract, while the student gives a critical assessment of the issues presented by different authors. The reference in the text is indicated in brackets by a number corresponding to the serial number of the source in the list of references. *Conclusions* contain 2-5 points. *The list of references* is numbered in the order they are mentioned in the literature review.

Requirements for writing an abstract: literacy, clarity, concreteness and logical sequence of presentation of the material; persuasiveness of argumentation; brevity and accuracy of wording; A4 format, Times New Roman font, font size 14, margins at the top, right, bottom 2 cm, left 3 cm.

Criteria for assessing the abstract: validity of goals and objectives, ability to consistently, competently, clearly present the material, volume of literature used; quality of design, defense of the abstract (brevity, clarity, clarity, logicality, level

of mastery of the problem and professional speech, completeness of answers to questions, etc.).

Review of the abstract - The submitted abstract is sent by the teacher for review. The reviewers are students. Requirements: relevance of the topic, novelty and practical significance, conclusions, recommendations, degree of problem solving and completion of the work, correctness of its formulation, the author's familiarity with scientific literature, depth of discussion, literacy of presentation. Highlight comments and wishes. In conclusion, the reviewer evaluates the work and expresses his/her opinion.

Presentation

Table 1 - Requirements for the presentation

Slide design	
Style	• a uniform design style; • avoid styles that distract from the presentation itself; • auxiliary information (control buttons) should not prevail over text, images
Background	• choose cooler tones (blue, green)
Use of color	• It is recommended to use no more than three colors on one slide: for the background, title and text
Animation effects	• use computer animation, but it should not distract attention from the content of the information on the slide
Presentation of information	
Contents of information	• use short words and sentences; • headlines should grab the audience's attention.
Location of information	• horizontal arrangement of information is preferable; • the most important information should be located in the center of the screen; • the inscription should be located under the picture
Fonts	• for headings – not less than 24; • for information – not less than 18; • to highlight information, use bold and italic.
Methods of selection	• You should use frames, borders, fills. Different font colors, shading, arrows, pictures, diagrams, charts, etc.
Volume of information	• Avoid filling one slide with too much information; • Display key points one at a time on each individual slide
Types of slides	• To ensure variety, use slides with text, tables, and diagrams.
Supplements to	• addendums should be written for each lecture depending on

the lecture	the content, volume and number of subjects studied

Presentation Review - The submitted presentation is analyzed according to the criteria listed above. The reviewers are the students. The review reflects comments or suggestions on all criteria. In conclusion, the reviewer evaluates the work and expresses his/her opinion. The students evaluating the presentation should pay attention to the content, text, and design of the material..

Table 2 - Presentation Evaluation Criteria

Критерии оценки	
Content	• must reflect the goals of the SIW; • must reflect a detailed description of the signs, phenomena, analysis of the proposed problem, etc.
Text	• must be correct; • must not contain spelling or punctuation errors; • must use accurate, complete, useful, up-to-date information, scientific terminology.
Design	• must correspond to the content; • must be aesthetically pleasing, diagrams and drawings attractive, interesting, not overlapping the text; • text must be easy to read, color, background must match graphic elements, lists and tables are built and placed correctly, all links must work.
Supplements to the lecture	• additions to the lecture should reflect: • rational name, synonyms of drugs; • functional analysis with reaction chemistry; • justification for the choice of pharmacopoeial and non-pharmacopeial methods of quantitative analysis with reaction chemistry and necessary calculations of quantitative measurements; • justification for the purity parameters recommended by regulatory documentation; • description of new drugs (chemical formula, Latin, rational name, physical and chemical properties, methods of analysis, application, etc.).

Compilation of test tasks

One test, depending on the level of complexity, includes 10-20 test tasks. Requirements for test tasks: adequacy (validity) of the form and content of the task, logical form of the statement, conciseness and brevity of the text, correct arrangement of the elements of the task, simplicity - one test task should contain one task of one level of complexity, with one correct answer.

Review of the preparation of test tasks

The teacher sends the submitted tests to the students for review. The reviewers analyze the test tasks according to the criteria presented above. It is necessary to highlight the comments and wishes. In conclusion, the reviewer evaluates the work and expresses his/her opinion.

The form of SIW implementation is project work

At the beginning of the academic calendar, project participants receive topics from the teacher. Then, students conduct a literature review of international and domestic scientific databases. Next, they formulate the goal and objectives of the study, draw up a calendar plan, and determine the functions of the team members. According to the calendar plan drawn up for the semester, they conduct experimental work on the selected topic, report weekly to the teacher on the work completed, submit an interim report on the 8th week, and a full report on the 15th week.

3 ***Criteria for evaluation of project work***

Criteria **"Goal setting and project planning"**	Points
Goal is **not formulated**	unsatisf. 0-49%
The **goal** is **formulated**, but there is **no plan** to achieve it	satisf. 50-69%
The goal is formulated, **justified**, and a **schematic plan** for achieving it is given.	good 70-89%
The goal is formulated, clearly **justified**, and a detailed **plan** for achieving it is given.	excellent 90-100%
Criterion **"Statement and justification of the project problem"**	
The project problem is **not formulated**	unsatisf. 0-49%
The formulation of the project **problem is superficial**	satisf. 50-69%

The project problem is **clearly formulated and justified**	good 70-89%
The project problem is **clearly formulated, justified and deep in nature**.	excellent 90-100%
Criterion "Diversity of information sources used"	
Information that was **not relevant** to the topic and purpose of the project was used	unsatisf. 0-49%
Most of the information presented is **not relevant** to the topic of the work.	satisf. 50-69%
The work contains **a small amount** of relevant information from a **limited** number of **similar** sources	good 70-89%
The work contains fairly **complete** information from a **variety** of sources.	excellent 90-100%
***Criterion* "Depth of disclosure of the project topic"**	
Topic of the project is **not disclosed**	unsatisf. 0-49%
Topic of the project is disclosed in **fragments**	satisf. 50-69%
The topic of the project has been revealed, the author has demonstrated knowledge of the topic within the **framework of the work program in the discipline being studied**	good 70-89%
The topic of the project is fully disclosed; the author has demonstrated **deep knowledge that goes beyond the scope of the work program being studied.**	excellent 90-100%
***Criterion* "Analysis of the progress of work and the results obtained, conclusions"**	
No attempts have been made to analyze the progress and results of the work	unsatisf. 0-49%
The analysis is replaced by a **brief description** of the progress and order of work	satisf. 50-69%
A **detailed result** of the work to achieve the goals stated in the project is presented.	good 70-89%
An exhaustive analysis of the **obtained work** results is presented, the necessary **conclusions** are drawn, and work **prospects** are outlined.	excellent 90-100%
***Criterion* "Achieving the goal and compliance with the content of the project"**	

The goals stated in the project **were not achieved**	unsatisf. 0-49%
A significant part of the working methods used do **not correspond to** the theme and purpose of the project	satisf. 50-69%
The methods used **correspond** to the theme and purpose of the project, but are **insufficient**	Good 70-89%
The methods of work are **sufficient** and used appropriately and effectively, the **objectives of the project are achieved**	excellent 90-100%
***Criterion* "Personal participation, creative approach to work"**	
The work is **formulaic**, showing the **formal** attitude of the author	unsatisf. 0-49%
The author showed **little involvement** in the topic of the project, but did not demonstrate independence in work, did not use the possibilities of a creative approach	satisf 50-69%
The author showed **little involvement** in the topic of the project, but **did not demonstrate independence** in work, **did not use the possibilities of a creative approach**	good 70-89%
The work is distinguished by **a creative approach**, full participation and the author's own **original attitude** to the idea of the project	excellent 90-100%
***Criterion* "Compliance with the requirements for the written part"**	
The written part of the project does not meet the requirements, all sections of the work are not disclosed and the work is not submitted on time	unsatisf. 0-49%
In the written part of the work, all sections are partially disclosed,bfundamental mistakes	satisf. 50-69%
There are typos and incorrect expressions in the work.	good 70-89%
The work fully reflects: the relevance of the topic, novelty and practical significance, conclusions, recommendations, the degree of solution to the problem and completion of the work, the correctness of its formulation, the author's familiarity with the scientific literature, the depth of the discussion, the literacy of the presentation and the work was delivered on time according to schedule	excellent 90-100%
***Criterion* "Quality of presentation"**	
There are a large number of fundamental errors in the presentation and	unsatisf.

answer the questions.	0-49%
The presentation contains minor fundamental errors and inaccuracies; partial fundamental errors when answering questions	satisf. 50-69%
The presentation contains typos, incorrect expressions, some non-fundamental errors, and inaccuracies in answering questions.	good 70-89%
The presentation in terms of design style, presentation of information, content, text meets the general requirements for presentation design. The author confidently and accurately answers questions	excellent 90-100%
***Criterion* "Quality of the final product"**	
There is **no project** product	unsatisfactory 0-49%
The design product **does not meet quality requirements** (aesthetics, ease of use, compliance with stated goals)	satisfactory 50-69%
The product **does not fully meet** quality requirements	good 70-89%
The product **fully meets the quality requirements** (aesthetically pleasing, easy to use, meets the stated purposes).	excellent 90-100%

Control over the implementation of SIW

Control over the implementation of the SIW is carried out by the teacher leading the laboratory lesson, the grade is given as the SIW is completed in accordance with the due date.

Criteria for assessing the implementation of SIW

Table 3 - Criteria for assessing the implementation of SIW

№	points	Evaluation criteria
1	**excellent** A(4,0; 95-100%); A-(3,67; 90-94%);	***Preparation and defense of the abstract*** · the abstract fully complies with the requirements for writing abstracts set out in the guidelines for the SIW; · when defending an abstract, shows fluency in the material, presents it clearly, logically, competently, convincingly, and speaks professionally; · answers questions confidently and accurately; · submitted on time according to schedule.

Review of the abstract

- the review fully reflects: the relevance of the topic, novelty and practical significance, conclusions, recommendations, the degree to which the problem was solved and the work was completed, the correctness of its formulation, the author's familiarity with the scientific literature, the depth of the discussion, the literacy of the presentation;
- answers questions confidently and accurately;
- submitted on time according to schedule.

Presentation

1. General requirements:

- the design of the slides and the presentation of information fully complies with the requirements for the presentation set out in the methodological recommendations for SIW;
- when defending, demonstrates fluency in the material, presents it clearly, clearly, logically, competently, convincingly, and speaks professionally;
- answers questions confidently and accurately;
- submitted on time according to schedule.

2. Requirements for the presentation «Additions to the lecture».

Additions to the lecture should reflect:

- selection of a rational scheme for the production of a substance;
- functional analysis with reaction chemism;
- justification for the choice of chemical technological process with the chemism of reactions and the necessary calculations of quantitative measurements;
- justification of process parameters recommended by regulatory standards;

Review of the presentation

- the review fully reflects: compliance with the requirements for the presentation in terms of design style, presentation of information, content, text set out in the guidelines for the SIW;
- sensible, significant comments and suggestions;
- answers questions confidently and accurately;
- presented on time according to schedule.

Compilation of test tasks

- test tasks (at least 20 tasks) meet the following requirements: adequacy (validity), logic, conciseness and brevity of the text, correct arrangement of task elements, simplicity - one test task must contain one task of one level of difficulty, with one correct answer;

		· submitted on time according to the schedule. ***During midterm control*** *Testing* · 90-100% correct answers
2	**good** B+(3,33; 85-89%); B (3,0;80-84%); B-(2,67; 75-79%); C+ (2,33; 70-74%)	Meets the above evaluation criteria, but allows: ***Preparation and defense of the abstract*** · minor remarks on design; · not fundamental mistakes when answering questions. ***Review of the abstract*** · typos, incorrect expressions; · not fundamental mistakes, inaccuracies when answering questions. ***Presentation*** · minor remarks on design; · not fundamental mistakes when answering questions. ***Review of the presentation*** · typos, incorrect expressions; · not fundamental mistakes, inaccuracies in answering questions. ***Compilation of test tasks*** · test tasks (at least 20 tasks) have minor comments (no more than 2-3) according to the above criteria. ***During midterm control*** *Testing* · 70-89% correct answers
3	**satisfactory** C (2,0; 65-69%); C(1,67; 60-64%) Д+(1,33; 55-59%); Д (1,0;50-54%)	Meets the above evaluation criteria, but allows: ***Preparation and defense of the abstract*** · significant remarks on design; · fundamental mistakes when answering questions. ***Review of the abstract*** · insufficient disclosure of points in the abstract (no more than 2 points); · fundamental mistakes, inaccuracies when answering questions; comments and suggestions require correction. ***Presentation*** · significant remarksa on design; · fundamental mistakes when answering questions ***Review of the presentation*** · fundamental mistakes, inaccuracies when answering questions; comments and suggestions are not fundamental. ***Compilation of test tasks*** · test tasks have significant comments (no more than 2-3) according to the above criteria. ***during midterm control***

		Testing 50-69% correct answers
4	**unsatisf.** FX (0; 0-25%) F (0; 0-49%)	Partially meets the above assessment criteria and allows: ***Preparation and defense of the abstract*** · does not meet the design requirements; · does not know the material; · not submitted on time. ***Review of the abstract*** · does not meet the requirements, all points of the abstract are not sufficiently covered; · not submitted on time. ***Presentation*** · does not meet the design requirements; · does not know the material; · not submitted on time. ***Review of the presentation*** · does not meet the requirements, all points of the presentation are not sufficiently disclosed; · not submitted on time. ***Compilation of test tasks*** · test tasks have significant comments (more than 4-5) on the above criteria; · not submitted on time ***During midterm control*** *Testing* · less than 50% correct answers

7. Literature:
main:

in Russian

1. Анализ лекарственных препаратов, производных ароматических соединений: Ордабаева С.К.-Шымкент: Типография «Әлем».- 2012.-270 с.
2. Асильбекова, А. Д. Промышленные методы получения лекарственных средств: лабораторный практикум / А. Д. Асильбекова, С. К. Ордабаева. - Алматы : New book, 2022.-212 с.
3. Государственная фармакопея Республики Казахстан.-Алматы: Издательский дом «Жибек жолы».-2008.-Том 1.-592 с.
4. Государственная фармакопея Республики Казахстан.- Алматы: Издательский дом «Жибек жолы».-2009.-Том 2.-804 с.
5. Государственная фармакопея Республики Казахстан.-Алматы: Издательский дом «Жибек жолы».-2014.-Том 3.-864 с.

6. Государственная Фармакопея Республики Казахстан. Т.1. – Алматы: Издательский дом «Жибек жолы», 2015. – 720 с.
7. Руководство по инструментальным методам исследований при разработке и экспертизе качества лекарственных препаратов./– М. Изд-во Перо, 2014. – 656с.
8. Харитонов, Ю. Я. Аналитическая химия. Количественный анализ, физико-химические методы анализа: практикум: учеб. пособие - М. : ГЭОТАР - Медиа, 2012. - 368 с.
9. Харитонов, Ю. Я. Аналитическая химия. Аналитика 2. Количественный анализ. Физико-химические (инструменталь-ные) методы анализа: учебник - М: ГЭОТАР - Медиа, 2014. - 656 с.
10. Адиходжаева, Б. Б. Аналитическая химия: учебное пособие / -Алматы: ЭСПИ, 2023. -220 с.
11. Бошкаева, А. К. Структурные исследования лекарственных веществ методами физико-химического анализа: учеб. пособие/ - Алматы : New book, 2022. - 276 с.
12. Халиуллин, Ф. А. Инфракрасная спектроскопия в фармацевтическом анализе: учебное пособие / - М.: ГЭОТАР - Медиа, 2017. - 160 с
13. Сейтембетова, А. Ж. Аналитическая химия: учебное пособие / - Алматы : New book, 2022. -124с.
14. Тюкавкина, Н. А. Биоорганикалық химия: оқулық / Қаз. тілінен ауд. жауапты ред. Т. С. Сейтембетов. - М. : ГЭОТАР - Медиа, 2014. - 400 бет. +эл. опт. диск (CD-ROM)
15. Тюкавкина, Н. А. Биоорганическая химия: учебник /- М.: ГЭОТАР -Медиа, 2011. -416с.

In Kazakh

1. Дәріс кешені- Фармацевтикалық талдаудың әдістері мен құралдары пәні бойынша : дәріс кешені / фармацевтикалық және токсикологиялық химия кафедрасы. - Шымкент : ОҚМФА, 2016. - 92 бет
2. Қазақстан Республикасының Мемлекеттік фармакопеясы.-Алматы: «Жібек жолы» баспа үйі.-2008.-1 Т.-592 б.
3. Қазақстан Республикасының Мемлекеттік фармакопеясы.-Алматы: «Жібек жолы» баспа үйі.-2008.-2 Т.-792 б.
4. Қазақстан Республикасының Мемлекеттік фармакопеясы.-Алматы: «Жібек жолы» баспа үйі.-2014.-3 Т.-864 б.
5. Қазақстан Республикасының Мемлекеттік фармакопеясы. Т. 1. – Алматы: «Жібек жолы» баспа үйі, 2015. – 720 бет

electronic resources:

1. Харитонов, Ю. Я. Аналитическая химия. Аналитика - 2. Количественный анализ. Физико-химические (инструментальные) методы анализа [Электронный ресурс] : учебник. - Электрон. текстовые дан. (43,1Мб). - М. : ГЭОТАР - Медиа, 2017
2. Харитонов, Ю. Я. Аналитическая химия. Аналитика - 1. Общие теоретические основы. Качественный анализ [Электронный ресурс] : учебник. - Электрон. текстовые дан. (44,3Мб). - М. : ГЭОТАР - Медиа, 2017
3. Харитонов, Ю. Я. Аналитическая химия. Качественный анализ. Титриметрия [Электронный ресурс] : учебник. - Электрон. текстовые дан. (39,9Мб). - М. : ГЭОТАР - Медиа, 2017
4. Ордабаева, С. К. Промышленные методы получения лекарственных средств [Электронный ресурс] : лабораторный практикум / С. К. Ордабаева, А. Д. Асильбекова. Шымкент : [б. и.], 2016. - 200 б. эл. опт. диск (CD-ROM).
5. Фармациядағы физикалық-химиялық әдістер. [Электронный ресурс] = Физико-химческие методы исследования. = Physicaland chemical impharmacy, on the absorption of electromagnetig Radiation :әдістемелік ұсыныс / С. К. Ордабаева [ж. б.] ; ОҚМФА; Фармацевтикалық және токсикологиялық химия каф. - Электрон. текстовые дан. (8,72 Мб). - Шымкент : Б. ж., 2013. - эл. опт. диск
6. Анализ лекарственных веществ. Ч.1. Общие реакции на подлинность: учеб. пособ. / В.А. Смирнов. - Самара. Самар. гос. техн. ун-т, 2008. - 55 с https://aknurpress.kz/reader/web/2637
7. Тюкавкина, Н. А. Биоорганическая химия [Электронный ресурс] : учебник / - Электрон. текстовые дан. (47,4 МБ). - М. : Издательская группа "ГЭОТАР- Медиа", 2011. - 416 с. эл. опт. диск (CD-ROM). - (Электронный учебник).

extra:

1. Арзамасцев, А. П. Фармацевтическая химия: учеб. пособие/-3-е изд., испр. . - М. : ГЭОТАР - Медиа, 2008. - 640 с
2. Арзамасцев, А. П. Руководство к лабораторным занятиям по фармацевтической химии: учебное пособие / М.: Медицина, 2004. - 384 с. - (Учеб. лит. для студ. фарм. вузов и фак.).
3. Беликов, В. Г. Фармацевтическая химия : учебное пособие/- 2-е изд. - М. : Медпресс-информ, 2008. - 616 с.
4. Практикум по физико-химическим методам анализа, под ред. О.М. Петрухина.- М., 1987.-248 с.