

**MINISTRY OF HEALTH OF UKRAINE**  
**ODESSA NATIONAL MEDICAL UNIVERSITY**

**Faculty of Pharmacy**

**Department of Pharmaceutical Chemistry and Drug Technology**

**APPROVED by**

Vice-rector for scientific and pedagogical work

\_\_\_\_\_ Eduard BURYACHKIVSKY

\_\_\_\_\_, 202\_

**METHODOLOGICAL DEVELOPMENT**

**TO PRACTICAL LESSONS FROM THE EDUCATIONAL DISCIPLINE**

Faculty, course \_\_\_\_\_ Pharmaceutical, V course

Educational discipline \_\_\_\_\_ Pharmaceutical chemistry

*(the name of the educational discipline)*

**Approved:**

The meeting of the department Pharmaceutical chemistry

Odesa National Medical University

Minutes № \_ dated \_\_\_\_\_

Head of Department (\_\_\_\_\_) Volodymyr GELMBOLDT  
(signature) (Name, last name)

**Developers:**

senior Lecturer Nikitin O.V., as. Lytvynchuk I.V., as. Shyshkin I.O.

## ***Practical lesson No. 1***

**Topic:** Medicines for thyroid hormones, antithyroid drugs. Thyroid hormone preparations: thyroxine, triiodothyronine, thyroidin. Drugs used in hypofunction of the thyroid gland: potassium iodide. Antithyroid drugs: iodine, diiodotyrosine, mercazolil (thiamazole).

**Goal:** to acquaint students with the pharmaceutical analysis of medicines: thyroid hormones, antithyroid drugs.

**Basic concepts:** State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:** visual material, multimedia projector.

### **Plan:**

- 1. Organizational moment (greetings, checking those present, announcing the topic, the purpose of the lesson, motivating students to study the topic).**
- 2. Control of basic knowledge (written work, written test, frontal survey, etc.):**
  - Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General characteristics of means that stimulate receptors of afferent nerve fibers;
- ✓ Peculiarities of pharmaceutical analysis of substances that protect sensitive nerve endings from external irritations;
- ✓ Peculiarities of pharmaceutical analysis of substances that irritate sensitive nerve endings.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;

- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Use general methods of drug analysis and determination of the good quality of drugs based on their appearance, solubility, and reaction to the environment in accordance with the requirements of the Federal Drug Administration.

List of didactic units:

- ✓ the text of textbooks;
  - ✓ a bank of test tasks.
- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Levothyroxine sodium salt is a synthetic drug, which in its structure and action corresponds to the natural hormone of the thyroid gland - thyroxine. What active metabolite forms levothyroxine in the body?

- A. triiodothyronine
- B. glycine
- C. serotonin
- D. phenylalanine
- E. tryptophan

2. The pharmacist-analyst, during the identification of levothyroxine sodium salt, measures the angle of rotation of the investigated solution. What device does he use?

- A. \* polarimeter
- B. refractometer
- C. spectrophotometer
- D. potentiometer
- E. photoelectrocolorimeter

3. In the laboratory for quality control of medicinal products, analysis of the substance levothyroxine sodium salt is carried out. To identify the sodium cation is used solution:

A. \* potassium pyroantimonate

B. potassium iodide

C. calcium chloride

D. iron (III) chloride

E. magnesium sulfate

4. At a chemical and pharmaceutical enterprise, a medicinal substance with antithyroid action is obtained - thiamazole (mercazolyl). One of the starting compounds in the synthesis is:

A. \* methyl isothiocyanate

B. naphthoquinone

C. furfural

D. hydroxyquinoline

E. acridine

5. One of the stages of pharmaceutical analysis is the quantitative determination of the medicinal product. Thiamazole (merkazolil) is determined by the method:

A. \* alkalimetry by substitute

B. bromatometry

C. nitritometry

D. complexometry

E. of permanganometry

6. In the control and analytical laboratory, the antithyroid drug thiamazole (mercazolil) is identified. The reaction of mercaptide formation is carried out with a solution:

A. \* copper (II) sulfate

B. sodium chloride

C. sulfuric acid

D. potassium iodide

E. of formaldehyde

7. On the basis of thiourea, effective drugs with antithyroid effect, for example, thiamazole (mercazolil), have been obtained. Name the heterocycle that is the basis of the substance molecule.

- A. \*imidazole
- B. furan
- C. pyridine
- D. pyrimidine
- E. quinoline

8. Thiamazole (mercazolil) is an effective means of correcting the increased function of the thyroid gland. The mechanism of antithyroid action of this medicinal product is associated with inhibition of the enzyme:

- A. \*thyroperoxidase
- B. hyaluronidase
- C. cyclooxygenase
- D. carbonic anhydrases
- E. phosphodiesterase

### 3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

1. Calculate the volume of a 0.1 M solution of silver nitrate ( $KP=1.0008$ ), which will be spent on the titration of 0.3145 g of potassium iodide (M.m. 166.01), if its percentage content in the substance is 99.7% .

2. Calculate the percentage content of potassium iodide (M.m. 166.01) in a 5% alcoholic solution of iodine, if 8.04 ml of a 0.1M solution of argentum nitrate ( $KP = 1.0000$ ) was spent on the titration of 2.00 ml of the drug; volume of 0.1 M sodium thiosulfate solution ( $CP = 1.0000$ ), spent on iodine titration - 5.68 ml.

3. Calculate the volume of 0.1 M iodine solution ( $KP = 1.0006$ ), which will be spent on the titration of 0.4890 g of sodium thiosulfate (M.m. 248.18), if its percentage content in the substance is 101.0%.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicinal products.	Pharmaceutical chemistry: textbook for students. of higher pharmacology education institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of accreditation. / for general ed. Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.
2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	

– Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

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#### **4. Summary:**

As a result of the class, the students of higher education acquired the skills to propose and implement the selection of methods for determining the quality of medicinal products in accordance with the requirements of the State Medical University of Ukraine and the Ministry of Health, according to the methods used in pharmaceutical analysis.

#### **5. List of recommended literature:**

##### **Main:**

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.

2. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 2. - 724 p.
3. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 3. - 732 p.5.
4. Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 456 p.
5. Nizhnyk H.P. Pharmaceutical chemistry: a textbook (University I-III years) H.P. Nizhnyk — 2nd ed., ed. - All-Ukrainian specialized publishing house "Medytsina", 2015. - 352 p.
6. Pharmaceutical chemistry. Analysis of medicinal substances by functional groups: study guide / O.O. Tsurkan, I.V. Nizhenkovska, O.O. Glushachenko. - 3rd edition - All-Ukrainian specialized publishing house "Medytsina", 2019. - 152 p.
7. Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.
8. Medicinal chemistry: education. manual for students of higher educational institutions / I.S. Hrytsenko, S.G. Taran, L.O. Transition, etc.; for general I.S. Hrytsenko - Kharkiv: NFaU: Golden Pages, 2017. - 552p.
9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

**Additional:**

1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.
2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.



3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.

4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.

### ***Practical lesson No. 2***

**Topic:** Pancreatic hormone drugs. Insulin.

Insulin preparations: Insulin for injection, Suinsulin, Zinc-insulin suspension for injection.

**Goal:** to acquaint students with the pharmaceutical analysis of medicinespancreatic hormones.

**Basic concepts:** State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:** visual material, multimedia projector.

#### **Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

**2. Control of basic knowledge (written work, written test, frontal survey, etc.):**

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General characteristics of means that stimulate receptors of afferent nerve fibers;
- ✓ Peculiarities of pharmaceutical analysis of substances that protect sensitive nerve endings from external irritations;
- ✓ Peculiarities of pharmaceutical analysis of substances that irritate sensitive nerve endings.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;

- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Use general methods of drug analysis and determination of the good quality of drugs based on their appearance, solubility, and reaction to the environment in accordance with the requirements of the Federal Drug Administration.

List of didactic units:

- ✓ the text of textbooks;
  - ✓ a bank of test tasks.
- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Drug metabolism is one of the stages of pharmacokinetics. Means that are metabolically transformed into biologically active substances are called:

- A. enzymes
- B. vitamins
- C. hormones
- D. \*prodrugs
- E. conjugate

2. Medicines are metabolized in several stages. The phase of drug metabolism, during which the biochemical conjugation of functional groups of the molecule with acid residues, such as glucuronic and sulfate, or glycine, occurs, is called:

- A. \*conjugation phase
- B. functionalization phase
- C. secretion phase
- D. phase of mitosis
- E. depolarization phase

3. Medicines are metabolized in several stages. The phase of metabolism, during which the functional groups in the molecule of the medicinal substance undergo biochemical transformation, is called:

- A. secretion phase
- B. conjugation phase
- C. \* functionalization phase
- D. phase of mitosis
- E. depolarization phase

4.Lipophilicity is very important for the bioavailability of the substance. The numerical indicator that characterizes lipophilicity is called:

- A. surface tension coefficient
- B. stoichiometric coefficient
- C. correction factor
- D. viscosity coefficient
- E. \*distribution coefficient

5.Lipophilicity is one of the factors affecting the bioavailability of medicines. Experimentally, it can be determined by the nature of the substance distribution in the system:

- A. acetonitrile-water
- B. water-chloroform
- C. chloroform-glycerol
- D. \*n-octanol-water
- E. ethanol-paraffin

6.Lipophilicity affects the bioavailability of drugs. This indicator characterizes the ability of a substance to dissolve in:

- A. water
- B. \*lipids
- C. acetone
- D. acids
- E. basics

7.In medical practice, optically active medicinal compounds are used in the form of levorotatory, dextrorotatory isomers and their racemic mixtures. The study of the optical activity of substances is carried out by the method:

- A. conductometry
- B. refractometry
- C. \*polarimetry
- D. spectrometry
- E. amperometry

8. An important characteristic of the medicinal product is its lipophilicity. To experimentally determine the lipophilicity coefficient of substances, its distribution between:

- A. ethyl acetate and dichloroethane
- B. ethanol and acetone
- C. isopropanol and hexane
- D. methanol and benzene
- E. \*water and octanol

### **3. Formation of professional skills and abilities:**

- Content of tasks (tasks, clinical situations, etc.).

1. Comparative characteristics of pancreatic hormones. Characteristics, classification, relationship between structure and pharmacological action, mechanism of action, examples
2. Characterization, classification, pharmaceutical analysis of pancreatic hormone drugs.
3. Characterize the relationship between the structure and pharmacological action, the mechanism of action of drugs of pancreatic hormones.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicinal products.	Pharmaceutical chemistry: textbook for students. of higher pharmacology education institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of accreditation. / for general ed. Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.
2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	

– Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

#### **4. Summary:**

As a result of the class, the students of higher education acquired the skills to propose and implement the selection of methods for determining the quality of medicinal products in accordance with the requirements of the State Medical University of Ukraine and the Ministry of Health, according to the methods used in pharmaceutical analysis.

#### **5. List of recommended literature:**

##### **Main:**

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.

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**Additional:**

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4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.

### ***Practical lesson No. 3***

**Topic:** Antidiabetic drugs. Derivatives of sulfonylureas: Butamide, Chlorpropamide, Bucarban, Glibenclamide. Biguanides: Metformin hydrochloride, Buformin.

**Goal:** to acquaint students with pharmaceutical analysis antidiabetic drugs.

**Basic concepts:** State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:** visual material, multimedia projector.

#### **Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

**2. Control of basic knowledge (written work, written test, frontal survey, etc.):**

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General characteristics of means that stimulate receptors of afferent nerve fibers;
- ✓ Peculiarities of pharmaceutical analysis of substances that protect sensitive nerve endings from external irritations;
- ✓ Peculiarities of pharmaceutical analysis of substances that irritate sensitive nerve endings.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;
- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Use general methods of drug analysis and determination of the good quality of drugs based on their appearance, solubility, and reaction to the environment in accordance with the requirements of the Federal Drug Administration.

List of didactic units:

- ✓ the text of textbooks;
  - ✓ a bank of test tasks.
- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:
1. The specialist identifies glibenclamide by the method of spectrophotometry by the value of the specific absorption index. This indicator is calculated after measuring:
    - A. \*optical density
    - B. refractive index
    - C. viscosity
    - D. pH of the solution
    - E. angle of rotation
  2. The pharmacist-analyst conducts the reaction of identifying the substance of the medicinal substance with an alkaline solution of hydroxylamine hydrochloride and a solution of iron (III) chloride in hydrochloric acid. The appearance of a red color indicates that the substance belongs to:
    - A. \* Complex ethers (esters)
    - B. Simple ethers (ethers)
    - C. Heterocyclic compounds
    - D. Tertiary amines
    - E. Organic acids



3. To determine fluoride impurities in medicinal compounds, the pharmacist-analyst conducts steam distillation and then determines the presence of sodium fluoride by reacting with the reagent:

- A. \* Aminomethylalizaric acid
- B. Thioacetamide
- C. Methoxyphenylacetic acid
- D. Rhodanbromide
- E. is pure iodine

4. Indicate the reaction to medicinal preparations belonging to complex ethers, which is accepted by the DF of Ukraine:

- A. \* Formation of hydroxamates of iron
- B. Formation of azo dye
- C. Formation of indophenol
- D. Formation of tribromophenol
- E. Thaleiochin formation

5. To identify the substance of the medicinal product, the pharmacist-analyst conducts a reaction with a copper-tartrate reagent (Fehling's reagent). The presence of which of the following functional groups is indicated by the visible analytical effect?

- A. \*  $\alpha$ -ketol
- B. Carboxylic
- C. Complex and ethereal
- D. Amide
- E. Simple ethereal

6. Chloride ions are detected by a solution of argentum nitrate in an acidic medium in the presence of the following acid:

- A. \* Nitrate
- B. Sulfate
- C. Phosphate
- D. Vinegar

E. Sulfite

7. As the main reagent when testing for the limit content of aluminum impurities, the chemical analyst uses the solution:

A. \* Hydroxyquinoline

B. Resorcinol

C. Pyridine

D. Formaldehyde

E. Benzaldehyde

8. According to the SFU, as the main reagent when testing for the limit content of magnesium impurity, the chemical analyst uses the solution:

A. \* Hydroxyquinoline

B. Resorcinol

C. Pyridine

D. Formaldehyde

E. Benzaldehyde

### 3. Formation of professional skills and abilities:

– Content of tasks (tasks, clinical situations, etc.).

1. Give a scheme for the synthesis of butamide, indicating the chemical names of the initial, intermediate and final products; its pharmacological action.

2. Suggest possible methods of identification of butamide, chlorpropamide. Where possible, give equations for chemical reactions.

3. Describe the alkalimetric method of quantitative determination of butamide. Give the reaction equations, the formula for calculating the quantitative content, indicate the molar mass of the equivalent.

– Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the	Give identification reactions of ions	Pharmaceutical chemistry: textbook for students. of higher

	analysis of medicinal products.	that are part of medicinal products.	pharmacology education institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of accreditation. / for general ed.
2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.

-Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

#### **4. Summary:**

As a result of the class, the students of higher education acquired the skills to propose and implement the selection of methods for determining the quality of medicinal products in accordance with the requirements of the State Medical University of Ukraine and the Ministry of Health, according to the methods used in pharmaceutical analysis.

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- Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 3. - 732 p.5.
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- 9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

**Additional:**

- 1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.
- 2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.
- 3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.
- 4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.

### ***Practical lesson No. 4***

**Topic:** Solving calculation problems and test problems.

**Goal:** analysis and consolidation of the studied material with the help of solutions calculation tasks and test tasks.

**Basic concepts:** State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:** visual material, multimedia projector.

#### **Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

**2. Control of basic knowledge (written work, written test, frontal survey, etc.):**

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General characteristics of means that stimulate receptors of afferent nerve fibers;
- ✓ Peculiarities of pharmaceutical analysis of substances that protect sensitive nerve endings from external irritations;
- ✓ Peculiarities of pharmaceutical analysis of substances that irritate sensitive nerve endings.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;
- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Use general methods of drug analysis and determination of the good quality of drugs based on their appearance, solubility, and reaction to the environment in accordance with the requirements of the Federal Drug Administration.

List of didactic units:

- ✓ the text of textbooks;
  - ✓ a bank of test tasks.
- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:
1. The laboratory for quality control of medicinal products received a mucolytic drug containing ambroxol hydrochloride. To detect chloride ions, it is necessary to use a solution for its identification:
    - A. \*silver nitrate
    - B. barium sulfate
    - C. glyoxalhydroxyanil
    - D. potassium ferrocyanide
    - E. diphenylamine
  2. Dexamethasone is a hormonal agent, the structure of which contains covalently bound fluorine. This allows, after mineralization of the substance, to identify fluoride ions using a solution:
    - A. \*Calcium chloride
    - B. Sodium chloride
    - C. Ammonium oxalate
    - D. Silver nitrate
    - E. Sodium acetate
  3. The pharmacist-analyst identifies the antimicrobial agent "Ciprofloxacin hydrochloride". To detect the chloride ion, he conducts a reaction in the presence of concentrated sulfuric acid with the following reagent:
    - A. \*Potassium dichromate
    - B. Sodium hydroxide
    - C. Magnesium sulfate
    - D. Potassium chloride
    - E. Zinc oxide

4. The quality control of 0.1% injection solution of atropine sulfate is carried out in the central analytical laboratory of the pharmaceutical enterprise. Due to sulfate ions, the active substance can be identified when interacting with the following reagent:

- A. \*Barium chloride
- B. Copper (II) sulfate
- C. Potassium iodide
- D. Sodium bicarbonate
- E. Ammonium chloride

5. An antihypertensive drug containing clonidine hydrochloride (Clofelin) was received by the laboratory for quality control of medicinal products. For its identification, chloride ions are determined by the reaction of silver with nitrate in the medium:

- A. \*Dilute nitric acid
- B. Concentrated sulfuric acid
- C. Sodium hydroxide
- D. Diethyl ether
- E. Formaldehyde

6. During the pharmaceutical analysis of the medicinal substance, a reaction with antipyrine was carried out (phenazone) in the presence of dilute hydrochloric acid. The appearance of green color allows you to identify:

- A.\*Nitrite
- B. Sulfates
- C. Fluorides
- D. Bromides
- E. Iodides

7. Under the action of acetic acid diluted as a medicinal substance, a violent release of gas bubbles is observed, which causes cloudiness of the barium hydroxide solution. This test allows you to identify:

- A. \*Carbonates
- B. Fluorides

C. Nitrites

D. Sulfates

E. Chlorides

8. An anti-ulcer drug containing bismuth subcitrate has arrived at the drug quality control laboratory. During the reaction on the bismuth cation, the formation of a yellowish-orange color was observed. What reagent was used in this test?

A. \* Thiourea

B. Glyoxalhydroxanil

C. Hydrochloric acid

D. Sodium hydroxide

E. Potassium acetate

9. The substance of the antibiotic "Ampicillin sodium" arrived at the laboratory for quality control of medicinal products. The sodium ion was identified by reaction with a solution of potassium pyroantimonate by the formation of a precipitate of the following color:

A. \*White

B. Blue

C. Yellow

D. Chervony

E. Green

10. As a result of the reaction of the analgesic "Metamisole sodium monohydrate" with a solution of potassium pyroantimonate, a white precipitate was formed. This confirms the presence of a medicinal substance in the structure:

A. \*Sodium ions

B. Covalently bound sulfur

C. Methyl groups

D. Phenyl radical

E. Keto groups

11. When conducting a pharmaceutical analysis of a medicinal substance, a reaction was performed with sodium hydroxide solution when heated. As a result of this



reaction, a gas with a characteristic smell was released, under the influence of which a wet red litmus paper turned blue. What cations were identified in the composition of the medicinal substance?

- A. \*Ammonia
- B. Magnesium
- C. Calcium
- D. Sodium
- E. Potassium

12. When conducting a pharmaceutical analysis, a sample of a medicinal substance moistened with diluted hydrochloric acid was introduced into a colorless flame. The appearance of an orange-red color allows you to identify the following cation:

- A. \*Calcium
- B. Sodium
- C. Potassium
- D. Ammonia
- E. Barium

13. Iron (II) ion was identified in the composition of the anti-anemic agent "Iron sulfate heptahydrate" by the formation of a blue precipitate in the medium of dilute hydrochloric acid. What reagent was used in this experiment?

- A. \*Potassium ferricyanide
- B. Silver nitrate
- C. Tartaric acid
- D. Antipyrine
- E. Glyoxalhydroxyanil

14. A laboratory specialist of the pharmaceutical product certification center prepares reagents. To identify medicines containing potassium ions, use a solution:

- A. \*Sodium cobaltinitrite
- B. Ammonium oxalate
- C. Barium chloride
- D. Sodium hydroxide

## E. Magnesium sulfate

### 3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

1. Calculate the percentage content of potassium chloride (M.m. 74.56) in the substance, if 13.02 ml of 0.1 M silver nitrate solution (KP=1.0100) was spent on the titration of a weight of 0.9850 g; the volume of the measuring flask is 50 ml, the volume of the pipette is 5 ml.

2. Calculate the weight of sodium bromide (M.m. 102.90), if 19.23 ml of 0.1 M silver nitrate solution (KP=0.9870) was spent on its titration; its percentage content in the substance is 99.4%.

3. Calculate the volume of a 0.1 M solution of silver nitrate (KP=1.0008), which will be spent on the titration of 0.3145 g of potassium iodide (M.m. 166.01), if its percentage content in the substance is 99.7% .

4. Calculate the percentage content of active chlorine (atm. 35.46) in perchloric lime, if 22.20 ml of 0.1 M sodium thiosulfate solution (KP=1.0200) was spent on the titration of 2.4870 g of the drug; the volume of the measuring flask is 250 ml, the volume of the pipette is 25 ml.

5. Calculate the weight of potassium permanganate (M.m. 158.04), if 23.68 ml of 0.1 M sodium thiosulfate solution (KP=1.0000) was spent on its titration by the method of indirect iodometry; its percentage content in the substance is 99.8%; the volume of the measuring flask is 100 ml, the volume of the pipette is 25 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicinal products.	Pharmaceutical chemistry: textbook for students. of higher pharmacology education institutions and pharmacies. f-tiv higher med. education

			institutions of III-IV levels of accreditation. / for general ed. Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.
2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	

– Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

#### **4. Summary:**

As a result of the class, the students of higher education acquired the skills to propose and implement the selection of methods for determining the quality of medicinal products in accordance with the requirements of the State Medical University of Ukraine and the Ministry of Health, according to the methods used in pharmaceutical analysis.

#### **5. List of recommended literature:**

##### **Main:**

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.
2. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 2. - 724 p.
3. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 3. - 732 p.5.

4. Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 456 p.
5. Nizhnyk H.P. Pharmaceutical chemistry: a textbook (University I-III years) H.P. Nizhnyk — 2nd ed., ed. - All-Ukrainian specialized publishing house "Medytsina", 2015. - 352 p.
6. Pharmaceutical chemistry. Analysis of medicinal substances by functional groups: study guide / O.O. Tsurkan, I.V. Nizhenkovska, O.O. Glushachenko. - 3rd edition - All-Ukrainian specialized publishing house "Medytsina", 2019. - 152 p.
7. Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.
8. Medicinal chemistry: education. manual for students of higher educational institutions / I.S. Hrytsenko, S.G. Taran, L.O. Transition, etc.; for general I.S. Hrytsenko - Kharkiv: NFaU: Golden Pages, 2017. - 552p.
9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

**Additional:**

1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.
2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.
3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.
4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.

***Practical lesson No. 5***

**Topic:**Thematic control work on the topic:"Medicines for thyroid hormones, antithyroid drugs. Pancreatic hormone drugs. Antidiabetic drugs."

*Methodical development of practical classes, OPP "Pharmacy, Industrial Pharmacy", 5th year, Faculty of Pharmacy, Discipline: "Pharmaceutical Chemistry" page 28*

**Goal:**check the assimilation of knowledge of higher education students by topics: "Medicines for thyroid hormones, antithyroid drugs. Pancreatic hormone drugs. Antidiabetic drugs."

**Basic concepts:**State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:**visual material, multimedia projector.

**Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

**2. Control of basic knowledge (written work, written test, frontal survey, etc.):**

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ Subject and tasks of pharmaceutical chemistry;
- ✓ General methods of analysis of medicinal products and determination of the benign quality of medicinal products by appearance, solubility and reaction of the environment in accordance with the requirements of the Federal Drug Administration;
- ✓ The structure and main provisions of the State Pharmacopoeia of Ukraine regarding the quality of substances and medicinal forms of industrial production.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;
- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Environments according to the requirements of the SFU.

List of didactic units:

- ✓ the text of textbooks;
- ✓ a bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Levothyroxine sodium salt is a synthetic drug, which in its structure and action corresponds to the natural hormone of the thyroid gland - thyroxine. What active metabolite forms levothyroxine in the body?

- A. \*triiodothyronine
- B. glycine
- C. serotonin
- D. phenylalanine
- E. tryptophan

2. The pharmacist-analyst, during the identification of levothyroxine sodium salt, measures the angle of rotation of the investigated solution. What device does he use?

- A. \* polarimeter
- B. refractometer
- C. spectrophotometer
- D. potentiometer
- E. photoelectrocolorimeter

3. In the laboratory for quality control of medicinal products, analysis of the substance levothyroxine sodium salt is carried out. To identify the sodium cation is used solution:

- A. \* potassium pyroantimonate
- B. potassium iodide
- C. calcium chloride
- D. iron (III) chloride
- E. magnesium sulfate

4. At a chemical and pharmaceutical enterprise, a medicinal substance with antithyroid action is obtained - thiamazole (mercazoly). One of the starting compounds in the synthesis is:

- A. \* methyl isothiocyanate

- B. naphthoquinone
- C. furfural
- D. hydroxyquinoline
- E. acridine

5. One of the stages of pharmaceutical analysis is the quantitative determination of the medicinal product. Thiamazole (merkazolil) is determined by the method:

- A. \* alkalimetry by substitute
- B. bromatometry
- C. nitritometry
- D. complexonometry
- E. of permanganatometry

6. In the control and analytical laboratory, the antithyroid drug thiamazole (mercazolil) is identified. The reaction of mercaptide formation is carried out with a solution:

- A. \*copper (II) sulfate
- B. sodium chloride
- C. sulfuric acid
- D. potassium iodide
- E. of formaldehyde

7. On the basis of thiourea, effective drugs with antithyroid effect, for example, thiamazole (mercazolil), have been obtained. Name the heterocycle that is the basis of the substance molecule.

- A. \*imidazole
- B. furan
- C. pyridine
- D. pyrimidine
- E. quinoline

8. Thiamazole (mercazolil) is an effective means of correcting the increased function of the thyroid gland. The mechanism of antithyroid action of this medicinal product is associated with inhibition of the enzyme:

- A. \*thyroperoxidase
- B. hyaluronidase
- C. cyclooxygenase
- D. carbonic anhydrases
- E. phosphodiesterase

9. Drug metabolism is one of the stages of pharmacokinetics. Means that are metabolically transformed into biologically active substances are called:

- A. enzymes
- B. vitamins
- C. hormones
- D. \*prodrugs
- E. conjugate

10. Medicines are metabolized in several stages. The phase of drug metabolism, during which the biochemical conjugation of functional groups of the molecule with acid residues, such as glucuronic and sulfate, or glycine, occurs, is called:

- A. \*conjugation phase
- B. functionalization phase
- C. secretion phase
- D. phase of mitosis
- E. depolarization phase

11. Medicines are metabolized in several stages. The phase of metabolism, during which the functional groups in the molecule of the medicinal substance undergo biochemical transformation, is called:

- A. secretion phase
- B. conjugation phase
- C. \* functionalization phase
- D. phase of mitosis
- E. depolarization phase

12. Lipophilicity is very important for the bioavailability of the substance. The numerical indicator that characterizes lipophilicity is called:



- A. surface tension coefficient
- B. stoichiometric coefficient
- C. correction factor
- D. viscosity coefficient
- E. \*distribution coefficient

13. Lipophilicity is one of the factors affecting the bioavailability of medicines. Experimentally, it can be determined by the nature of the substance distribution in the system:

- A. acetonitrile-water
- B. water-chloroform
- C. chloroform-glycerol
- D. \*n-octanol-water
- E. ethanol-paraffin

14. Lipophilicity affects the bioavailability of drugs. This indicator characterizes the ability of a substance to dissolve in:

- A. water
- B. \*lipids
- C. acetone
- D. acids
- E. basics

15. In medical practice, optically active medicinal compounds are used in the form of levorotatory, dextrorotatory isomers and their racemic mixtures. The study of the optical activity of substances is carried out by the method:

- A. conductometry
- B. refractometry
- C. \*polarimetry
- D. spectrometry
- E. amperometry

16. An important characteristic of the medicinal product is its lipophilicity. To experimentally determine the lipophilicity coefficient of substances, its distribution between:

- A. ethyl acetate and dichloroethane
- B. ethanol and acetone
- C. isopropanol and hexane
- D. methanol and benzene
- E. \*water and octanol

17. The specialist identifies glibenclamide by the method of spectrophotometry by the value of the specific absorption index. This indicator is calculated after measuring:

- A. \*optical density
- B. refractive index
- C. viscosity
- D. pH of the solution
- E. angle of rotation

18. The pharmacist-analyst conducts the reaction of identifying the substance of the medicinal substance with an alkaline solution of hydroxylamine hydrochloride and a solution of iron (III) chloride in hydrochloric acid. The appearance of a red color indicates that the substance belongs to:

- A.\* Complex ethers (esters)
- B. Simple ethers (ethers)
- C. Heterocyclic compounds
- D. Tertiary amines
- E. Organic acids

19. To determine fluoride impurities in medicinal compounds, the pharmacist-analyst conducts steam distillation and then determines the presence of sodium fluoride by reacting with the reagent:

- A. \* Aminomethylalizaric acid
- B. Thioacetamide

C. Methoxyphenylacetic acid

D. Rhodanbromide

E. is pure iodine

20. Indicate the reaction to medicinal preparations belonging to complex ethers, which is accepted by the DF of Ukraine:

A. \* Formation of hydroxamates of iron

B. Formation of azo dye

C. Formation of indophenol

D. Formation of tribromophenol

E. Thaleiochin formation

21. To identify the substance of the medicinal product, the pharmacist-analyst conducts a reaction with the copper-tartrate reagent (Fehling's reagent). The presence of which of the following functional groups is indicated by the visible analytical effect?

A. \* $\alpha$ -ketol

B. Carboxylic

C. Complex and ethereal

D. Amidna

E. Simple ethereal

22. Chloride ions are detected by a solution of argentum nitrate in an acidic medium in the presence of the following acid:

A. \* Nitrate

B. Sulfate

C. Phosphate

D. Vinegar

E. Sulfite

23. As the main reagent when testing for the limit content of aluminum impurities, the chemical analyst uses the solution:

A. \* Hydroxyquinoline

B. Resorcinol

- C. Pyridine
- D. Formaldehyde
- E. Benzaldehyde

24. According to the SFU, as the main reagent when testing for the limit content of magnesium impurity, the chemical analyst uses the solution:

- A. \* Hydroxyquinoline
- B. Resorcinol
- C. Pyridine
- D. Formaldehyde
- E. Benzaldehyde

### **3. Formation of professional skills and abilities:**

– Content of tasks (tasks, clinical situations, etc.).

1. Calculate the volume of a 0.1 M solution of silver nitrate ( $KP=1.0008$ ), which will be spent on the titration of 0.3145 g of potassium iodide (M.m. 166.01), if its percentage content in the substance is 99.7% .
2. Calculate the percentage content of potassium iodide (M.m. 166.01) in a 5% alcoholic solution of iodine, if 8.04 ml of a 0.1M solution of argentum nitrate ( $KP = 1.0000$ ) was spent on the titration of 2.00 ml of the drug; volume of 0.1 M sodium thiosulfate solution ( $CP = 1.0000$ ), spent on iodine titration - 5.68 ml.
3. Calculate the volume of 0.1 M iodine solution ( $KP = 1.0006$ ), which will be spent on the titration of 0.4890 g of sodium thiosulfate (M.m. 248.18), if its percentage content in the substance is 101.0%.
4. Calculate the percentage content of potassium chloride (M.m. 74.56) in the substance, if 13.02 ml of 0.1 M silver nitrate solution ( $KP=1.0100$ ) was spent on the titration of a weight of 0.9850 g; the volume of the measuring flask is 50 ml, the volume of the pipette is 5 ml.
5. Calculate the weight of sodium bromide (M.m. 102.90), if 19.23 ml of 0.1 M silver nitrate solution ( $KP=0.9870$ ) was spent on its titration; its percentage content in the substance is 99.4%.

6. Calculate the volume of a 0.1 M solution of silver nitrate (KP=1.0008), which will be spent on the titration of 0.3145 g of potassium iodide (M.m. 166.01), if its percentage content in the substance is 99.7% .
7. Calculate the percentage content of active chlorine (atm. 35.46) in perchloric lime, if 22.20 ml of 0.1 M sodium thiosulfate solution (KP=1.0200) was spent on the titration of 2.4870 g of the drug; the volume of the measuring flask is 250 ml, the volume of the pipette is 25 ml.
8. Calculate the weight of potassium permanganate (M.m. 158.04), if 23.68 ml of 0.1 M sodium thiosulfate solution (KP=1.0000) was spent on its titration by the method of indirect iodometry; its percentage content in the substance is 99.8%; the volume of the measuring flask is 100 ml, the volume of the pipette is 25 ml.
9. Calculate the percentage content of hydrogen peroxide (M.m. 34.01) in the solution, if 18.40 ml of 0.1 M potassium permanganate solution (KP=1.0018) was spent on the dilution of 10.00 ml of the drug; the volume of the measuring flask is 100 ml, the volume of the pipette is 10 ml.
10. Calculate the volume of a 0.1M solution of sodium thiosulfate (KP = 1.0012), which will be spent on the titration of 0.2016 g of iodine (Atm. 126.90), if its percentage content in the substance is 99.6 %.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicinal products.	Pharmaceutical chemistry: textbook for students. of higher pharmacology education institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of accreditation. / for general ed.
2.	Chemical methods for the	Give a quantitative analysis of	Prof. Bezuglio P. O. - Ed. 3rd

analysis of medicinal products.	of medicinal substances	edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.
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– Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

#### **4. Summary:**

As a result of the lesson, mastering of the studied topics, the ability to choose methods of determining the quality of medicinal products in accordance with the requirements of the Federal Medical University and the Ministry of Health according to the methods used in pharmaceutical analysis are checked.

#### **5. List of recommended literature:**

##### **Main:**

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.
2. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 2. - 724 p.
3. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 3. - 732 p.5.
4. Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 456 p.

5. Nizhnyk H.P. Pharmaceutical chemistry: a textbook (University I-III years) H.P. Nizhnyk — 2nd ed., ed. - All-Ukrainian specialized publishing house "Medytsina", 2015. - 352 p.
6. Pharmaceutical chemistry. Analysis of medicinal substances by functional groups: study guide / O.O. Tsurkan, I.V. Nizhenkovska, O.O. Glushachenko. - 3rd edition - All-Ukrainian specialized publishing house "Medytsina", 2019. - 152 p.
7. Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.
8. Medicinal chemistry: education. manual for students of higher educational institutions / I.S. Hrytsenko, S.G. Taran, L.O. Transition, etc.; for general I.S. Hrytsenko - Kharkiv: NFaU: Golden Pages, 2017. - 552p.
9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

**Additional:**

1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.
2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.
3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.
4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.

***Practical lesson No. 6***

**Topic:** Steroid hormones and their analogues.Characteristics, classification, relationship between structure and pharmacological action, mechanism of action, methods of preparation, methods of analysis, application in medicine.

**Goal:**to acquaint students with the pharmaceutical analysis of drugs from the group of steroid hormones and their analogues.

**Basic concepts:** State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:** visual material, multimedia projector.

**Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

**2. Control of basic knowledge (written work, written test, frontal survey, etc.):**

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General characteristics of means that stimulate receptors of afferent nerve fibers;
- ✓ Peculiarities of pharmaceutical analysis of substances that protect sensitive nerve endings from external irritations;
- ✓ Peculiarities of pharmaceutical analysis of substances that irritate sensitive nerve endings.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;
- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Use general methods of drug analysis and determination of the good quality of drugs based on their appearance, solubility, and reaction to the environment in accordance with the requirements of the Federal Drug Administration.

List of didactic units:

- ✓ the text of textbooks;
  - ✓ a bank of test tasks.
- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:



1. The structural basis of steroid hormones is the hydrocarbon-cyclopentanephenanthrene skeleton. Name a hormone that has a steroid structure.

- A. \* estrone
- B. adrenaline
- C. thyroxine
- D. sinestrol
- E. oxytocin

2. The structural basis of steroid hormones is the hydrocarbon skeleton - cyclopentanephenanthrene. What natural compound is used to make testosterone propionate?

- A.\* cholesterol
- B. Indole
- C. naphthalene
- D. phenanthrene
- E. anthracene

3. A pharmacist-analyst for the identification of deoxycorticosterone acetate performed a steroid cycle reaction that produced a cherry-red color with green fluorescence. What reagent was added?

- A.\* conc. sulfuric acid
- B. iodine solution
- C. ferrum (III) chloride
- D. chloroform
- E. potassium hydroxide solution

4. The presence of which functional group determines the positive reaction of alcohol solutions of corticosteroid preparations (prednisone, prednisolone) with copper-tartrate reagent (Fehling's reagent):

- A.\*  $\alpha$ -ketol group
- B. pregnane cycle
- C. unlimited hydrocarbon bond

- D. optically active carbon atom
- E. phenolic hydroxyl
5. To identify prednisolone, the pharmacist-analyst must prove the presence of an  $\alpha$ -ketol group. What reagent should he use for this?
- A.\* copper-tartrate reagent (Fehling's reagent)
- B. Mayer's reagent
- C. Dragendorff's reagent
- D. Fisher's reagent
- E. Wagner's reagent
6. To identify the drug substance, the pharmacist-analyst conducts a reaction with a copper-tartrate reagent (Fehling's reagent). The presence of which of the following functional groups is indicated by a visible analytical effect?
- A.\* Alpha-ketol
- B. Complex-ester
- C. amide
- D. simple ether
- E. carboxyl
7. The cortisone acetate molecule contains an ester group. To confirm the presence of this group in the medicinal substance, the analyst used the following reaction:
- A.\* hydroxam test
- B. Vitaly-Moren reaction
- C. reaction with ammonium oxalate
- D. murexide sample
- E. reaction with bromine water
8. When studying the testosterone propionate substance, a hydroxam reaction was carried out, which indicates the presence of groups in the molecule:
- A.\* ester
- B. hydroxyl
- C. aromatic amino group
- D. carbonyl

E. aldehyde

### 3. Formation of professional skills and abilities:

– Content of tasks (tasks, clinical situations, etc.).

1. Calculate the specific rotation of 1% pure testosterone propionate, the angle of rotation is  $+0.9^\circ$ . The thickness of the cuvette is 1 dm.

2. Calculate the specific rate of absorption of 0.005% alcoholic solution of ethinyl estradiol. The optical density is 0.36.

3. Calculate the percentage content of sinestrol (M. m. 270.37), if the so-called titration = 0.4700 g according to FH used 3.95 ml of 0.5 n. NaOH solution (Kp 1.0075). The volume of the titrant in the control experiment is 10.3 ml.

– Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicinal products.	Pharmaceutical chemistry: textbook for students. of higher pharmacology education institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of accreditation. / for general ed. Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.
2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	

– Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

### 4. Summary:

As a result of the class, the students of higher education acquired the skills to propose and implement the selection of methods for determining the quality of medicinal products in accordance with the requirements of the State Medical University of Ukraine and the Ministry of Health, according to the methods used in pharmaceutical analysis.

## **5. List of recommended literature:**

### **Main:**

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.
2. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 2. - 724 p.
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7. Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.
8. Medicinal chemistry: education. manual for students of higher educational institutions / I.S. Hrytsenko, S.G. Taran, L.O. Transition, etc.; for general I.S. Hrytsenko - Kharkiv: NFAU: Golden Pages, 2017. - 552p.
9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

**Additional:**

1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.
2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.
3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.
4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.

***Practical lesson No. 7***

**Topic:** Hormones of the adrenal cortex and their synthetic analogues. Corticosteroids. Mineralocorticosteroids: Deoxycorticosterone acetate. Glucocorticosteroids: Cortisone acetate, Hydrocortisone acetate. Synthetic analogues of glucocorticosteroids: Prednisone, Dexamethasone, Triamcinolone, Flumethasone pivalate.

**Goal:**to acquaint students with the pharmaceutical analysis of drugs from the groupadrenal cortex hormones and their synthetic analogues.

**Basic concepts:**State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:**visual material, multimedia projector.

**Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

**2. Control of basic knowledge (written work, written test, frontal survey, etc.):**

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General characteristics of means that stimulate receptors of afferent nerve fibers;
- ✓ Peculiarities of pharmaceutical analysis of substances that protect sensitive nerve endings from external irritations;
- ✓ Peculiarities of pharmaceutical analysis of substances that irritate sensitive nerve endings.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;
- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Use general methods of drug analysis and determination of the good quality of drugs based on their appearance, solubility, and reaction to the environment in accordance with the requirements of the Federal Drug Administration.

List of didactic units:

- ✓ the text of textbooks;
  - ✓ a bank of test tasks.
- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. The main method of quantitative determination of corticosteroids is:

A.\* spectrophotometry

B. potentiometry

C. cerimetry

- D. argentometry
  - E. Acidimetry
2. Quantitative content of cortisone acetate is recommended by SFU to be determined by spectrophotometry. For this, it is necessary to measure:
- A.\* optical density
  - B. refractive index
  - C. rotation angle
  - D. melting point
  - E. viscosity
3. A reaction is carried out on the steroid system in steroid hormones:
- A.\* Boscota
  - B. Bilstein's test
  - C. thalleiochin test
  - D. reaction with Markey's reagent
  - E. with Fehling's reagent
4. Hormonal preparations are presented in the assortment of medicines of the pharmacy. Specify the drug that belongs to glucocorticosteroids.
- A. \*hydrocortisone acetate
  - B. diethylstilbestrol
  - C. testosterone propionate
  - D. adrenaline hydrotartrate
  - E. progesterone
5. To identify the hydrocortisone acetate substance, the pharmacist-analyst conducts a reaction with a solution of phenylhydrazine sulfate. What functional group determines the appearance of a yellow color or sediment?
- A. \*keto group
  - B. thiol group
  - C. hydroxyl group
  - D. sulfamide group
  - E. nitro group

6. The identification reaction of hydrocortisone acetate, which is due to the reducing properties of the  $\alpha$ -ketol group, is accompanied by the formation of a red precipitate.

What reagent is used to carry out the specified reaction?

- A. \*copper tartrate
- B. mercuric bromide
- C. cyanobromide
- D. thioacetamide
- E. rhodanbromide

7. In order to identify hydrocortisone acetate, the analyst conducts a reaction to form iron (III) hydroxamate. This reaction confirms the presence of:

- A. \*ester group
- B. alcohol hydroxyl
- C. aldehyde group
- D. phenolic hydroxyl
- E. keto groups

8. In the laboratory of a pharmaceutical enterprise, a medicinal substance from the group of corticosteroids - hydrocortisone acetate - is analyzed. The appearance of intense bright coloration when concentrated sulfuric acid is added is due to the presence in the molecule of:

- A. \*steroid cycle
- B. pyridine cycle
- C. xanthine cycle
- D. naphthalene cycle
- E. imidazole cycle

### **3. Formation of professional skills and abilities:**

- Content of tasks (tasks, clinical situations, etc.).

1. Calculate the content of cortisone acetate in a tablet taken for quantitative determination by FH, if the optical density of the test solution is 0.505, the average weight of the tablet is 0.195 g, and the exact weight of the tablet powder is 0.0990.



2. Calculate the exact weight of prednisolone tablets for quantitative determination by FH, if the optical density of the solution under study is 0.558, the average weight of the tablet is 0.2510 g.

3. Calculate the percentage content of retinyl acetate according to FC. The optical density of the investigated solution is 0.45, the exact weight is 0.0287 g.

– Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicinal products.	Pharmaceutical chemistry: textbook for students. of higher pharmacology education institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of accreditation. / for general ed. Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.
2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	

– Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

#### 4. Summary:

As a result of the class, the students of higher education acquired the skills to propose and implement the selection of methods for determining the quality of medicinal products in accordance with the requirements of the State Medical University of Ukraine and the Ministry of Health, according to the methods used in pharmaceutical analysis.

## 5. List of recommended literature:

### Main:

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.
2. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 2. - 724 p.
3. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 3. - 732 p.5.
4. Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 456 p.
5. Nizhnyk H.P. Pharmaceutical chemistry: a textbook (University I-III years) H.P. Nizhnyk — 2nd ed., ed. - All-Ukrainian specialized publishing house "Medytsina", 2015. - 352 p.
6. Pharmaceutical chemistry. Analysis of medicinal substances by functional groups: study guide / O.O. Tsurkan, I.V. Nizhenkovska, O.O. Glushachenko. - 3rd edition - All-Ukrainian specialized publishing house "Medytsina", 2019. - 152 p.
7. Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.
8. Medicinal chemistry: education. manual for students of higher educational institutions / I.S. Hrytsenko, S.G. Taran, L.O. Transition, etc.; for general I.S. Hrytsenko - Kharkiv: NFaU: Golden Pages, 2017. - 552p.

9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

**Additional:**

1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.
2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.
3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.
4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.

***Practical lesson No. 8***

**Topic:** Androgens, anabolic steroids and their analogues. Testosterone propionate, Methyltestosterone

Semi-synthetic and synthetic anabolic agents: Methandienone, Nandrolone phenylpropionate.

**Goal:** to acquaint students with the pharmaceutical analysis of drugs from the group androgens, anabolic steroids and their analogues.

**Basic concepts:** State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:** visual material, multimedia projector.

**Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

**2. Control of basic knowledge (written work, written test, frontal survey, etc.):**

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General characteristics of means that stimulate receptors of afferent nerve fibers;
- ✓ Peculiarities of pharmaceutical analysis of substances that protect sensitive nerve endings from external irritations;
- ✓ Peculiarities of pharmaceutical analysis of substances that irritate sensitive nerve endings.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;
- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Use general methods of drug analysis and determination of the good quality of drugs based on their appearance, solubility, and reaction to the environment in accordance with the requirements of the Federal Drug Administration.

List of didactic units:

- ✓ the text of textbooks;
  - ✓ a bank of test tasks.
- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:
1. Testosterone propionate ampoules were sent to the control and analytical laboratory for analysis. A pharmacist-analyst should perform quantitative determination according to the requirements of the ND by the following method:
    - A.\* UV spectrophotometric
    - B. IR-spectrophotometric
    - C. refractometric
    - D. potentiometric
    - E. Nitritometric
  2. When studying the testosterone propionate substance, a hydroxam reaction was carried out, which indicates the presence of groups in the molecule:

A.\* ester

B. hydroxyl

C. aromatic amino group

D. carbonyl

E. aldehyde

3. The laboratory for quality control of medicinal products carries out certification of preparations from the group of hormones. What reagent is used to determine the steroid cycle?

A. \*concentrated sulfuric acid

B. dilute nitric acid

C. sodium nitrite solution

D.diphenylamine solution

E. magnesium sulfate solution

4.Testosterone propionate is used as a means of androgenic action.During the biotransformation of testosterone propionate, an active metabolite is formed:

A. \*dihydrotestosterone

B. prednisone

C. urocortisol

D.orotidine-5-phosphate

E. estriol

5.When examining the substance testosterone propionate, the pharmacist-analyst conducts the hydroxam reaction. This reaction confirms the presencein a molecule:

A \*ester group

B. In the carboxyl group

C. From the aldehyde group

D. of phenolic hydroxyl

E. amino groups

6. A pharmacist-analyst conducts an analysis of the drug dexamethasone. When heating an alcoholic solution of a substance with phenylhydrazine sulfate, a yellow color appears, which indicates the presence of a medicinal product in the structure:

- A. \*keto groups
- B. amino groups
- C. nitro groups
- D. carboxyl group
- E. ester group

7. Betamethasone dipropionate is a synthetic glucocorticosteroid. The presence of which atoms in a molecule of a substance contributes to an increase in anti-inflammatory activity?

- A. \*fluorine
- B. hydrogen
- C. nitrogen
- D. carbon
- E. oxygen

8. A series of dexamethasone substance is being studied in the chemical laboratory for the purpose of certification. After mineralization of the substance, the pharmacist-analyst conducts a reaction to:

- A. \* fluorides
- B. sulfates
- C. iodides
- D. nitrates
- E. bromides

### **3. Formation of professional skills and abilities:**

- Content of tasks (tasks, clinical situations, etc.).

1. Calculate the specific rotation of 1% pure testosterone propionate, the angle of rotation is  $+0.9^\circ$ . The thickness of the cuvette is 1 dm.

2. Calculate the angle of rotation of a 1% methandrostenolone solution if the specific rotation is  $+4.5^\circ$ . The thickness of the cuvette is 19 mm.

3. Calculate the specific rotation of a 1% methylandrostenediol solution if the angle of rotation is  $-0.7$ . The thickness of the cuvette is 19 mm.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicinal products.	Pharmaceutical chemistry: textbook for students. of higher pharmacology education institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of accreditation. / for general ed. Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.
2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	

– Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

#### **4. Summary:**

As a result of the class, the students of higher education acquired the skills to propose and implement the selection of methods for determining the quality of medicinal products in accordance with the requirements of the State Medical University of Ukraine and the Ministry of Health, according to the methods used in pharmaceutical analysis.

#### **5. List of recommended literature:**

##### **Main:**

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.

2. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 2. - 724 p.
3. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 3. - 732 p.5.
4. Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 456 p.
5. Nizhnyk H.P. Pharmaceutical chemistry: a textbook (University I-III years) H.P. Nizhnyk — 2nd ed., ed. - All-Ukrainian specialized publishing house "Medytsina", 2015. - 352 p.
6. Pharmaceutical chemistry. Analysis of medicinal substances by functional groups: study guide / O.O. Tsurkan, I.V. Nizhenkovska, O.O. Glushachenko. - 3rd edition - All-Ukrainian specialized publishing house "Medytsina", 2019. - 152 p.
7. Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.
8. Medicinal chemistry: education. manual for students of higher educational institutions / I.S. Hrytsenko, S.G. Taran, L.O. Transition, etc.; for general I.S. Hrytsenko - Kharkiv: NFaU: Golden Pages, 2017. - 552p.
9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

**Additional:**

1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.
2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.



3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.

4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.

### ***Practical lesson No. 9***

**Topic:** Progestogens, estrogens. Birth control. Estrogens of nonsteroidal structure.

Estrogenic hormones: Estradiol dipropionate, Estradiol dipropionate

Estrogens of nonsteroidal structure: Sinestrol, Diethylstilbestrol.

Progestogenic hormones: Progesterone, Pregnin.

**Goal:** to acquaint students with the pharmaceutical analysis of drugs from the group progestogens, estrogens.

**Basic concepts:** State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:** visual material, multimedia projector.

#### **Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

**2. Control of basic knowledge (written work, written test, frontal survey, etc.):**

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General characteristics of means that stimulate receptors of afferent nerve fibers;
- ✓ Peculiarities of pharmaceutical analysis of substances that protect sensitive nerve endings from external irritations;
- ✓ Peculiarities of pharmaceutical analysis of substances that irritate sensitive nerve endings.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;
- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Use general methods of drug analysis and determination of the good quality of drugs based on their appearance, solubility, and reaction to the environment in accordance with the requirements of the Federal Drug Administration.

List of didactic units:

- ✓ the text of textbooks;
  - ✓ a bank of test tasks.
- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. The acetylation method is used for the quantitative determination of sinesterol.

What is this method based on:

- A.\* on obtaining complex esters
- B. on the production of acids
- C. on obtaining salts
- D. on receiving grounds
- E. on obtaining poorly soluble compounds

2. An analytical chemist performs a quantitative determination of the substance diethylstilbestrol by the method of alkalimetry after preliminary acetylation.

Acetylation is carried out using:

- A.\* of acetic anhydride
- B. benzene
- C. acetone
- D. dioxane
- E. chloroform

3. Determination of the mass fraction of sinestrol in the oil solution of the drug after extraction of the active substance with an aqueous solution of sodium

hydroxide is carried out by the method:

- A.\* bromatometry
- B. permanganometry
- C. complexometry
- D. nitritometry
- E. alkalimetry

4. The laboratory for quality control of medicinal products carries out certification of preparations from the group of hormones. What reagent is used to determine the steroid cycle?

- A. \*concentrated sulfuric acid
- B. dilute nitric acid
- C. sodium nitrite solution
- D. diphenylamine solution
- E. magnesium sulfate solution

5. The introduction of fluorine atoms into the glucocorticosteroid molecule leads to a significant increase in anti-inflammatory activity. Which of the following drugs belongs to fluoroderivative glucocorticoids?

- A. \*betamethasone dipropionate
- B. prednisone
- C. cortisone acetate
- D. prednisone
- E. hydrocortisone acetate

6. Betamethasone dipropionate is a synthetic glucocorticosteroid. The presence of which atoms in a molecule of a substance contributes to an increase in anti-inflammatory activity?

- A. \*fluorine
- B. hydrogen
- C. nitrogen
- D. carbon
- E. oxygen

7. The anti-inflammatory activity of glucocorticosteroids increases when fluorine atoms are introduced into the molecule. A representative of fluoroderivative glucocorticosteroids is:

- A. \* Dexamethasone
- B. adrenaline tartrate
- C. levothyroxine sodium salt
- D. norepinephrine tartrate
- E. phenylephrine hydrochloride

8. A series of dexamethasone substance is being studied in the chemical laboratory for the purpose of certification. After mineralization of the substance, the pharmacist-analyst conducts a reaction to:

- A. \* fluorides
- B. sulfates
- C. iodides
- D. nitrates
- E. bromides

### **3. Formation of professional skills and abilities:**

- Content of tasks (tasks, clinical situations, etc.).

1. Calculate the exact weight of pregnin tablets for quantitative determination by FH, if the optical density of the solution under study is 1.02, the average weight of the tablet is 0.1 g, and the exact weight of the powder of the tablets is 0.0986 g.

2. Calculate the percentage content of sinestrol (M. m. 270.37), if the so-called titration = 0.4700 g according to FH used 3.95 ml of 0.5 n. NaOH solution (Kp 1.0075). The volume of the titrant in the control experiment is 10.3 ml.

3. Calculate the volume of 0.5 n sodium hydroxide solution (Kp 0.9931), which will be used to titrate the excess of acetic acid in the quantitative determination of diethylstilbestrol by FH, if the exact weight is 0.4985 g. The content of diethylstilbestrol is 99.5%, vol. titrant volume in the control experiment — 15.1 ml.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicinal products.	Pharmaceutical chemistry: textbook for students. of higher pharmacology education institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of accreditation. / for general ed. Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.
2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	

- Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

#### 4. Summary:

As a result of the class, the students of higher education acquired the skills to propose and implement the selection of methods for determining the quality of medicinal products in accordance with the requirements of the State Medical University of Ukraine and the Ministry of Health, according to the methods used in pharmaceutical analysis.

#### 5. List of recommended literature:

##### Main:

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.

2. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 2. - 724 p.
3. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 3. - 732 p.5.
4. Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 456 p.
5. Nizhnyk H.P. Pharmaceutical chemistry: a textbook (University I-III years) H.P. Nizhnyk — 2nd ed., ed. - All-Ukrainian specialized publishing house "Medytsina", 2015. - 352 p.
6. Pharmaceutical chemistry. Analysis of medicinal substances by functional groups: study guide / O.O. Tsurkan, I.V. Nizhenkovska, O.O. Glushachenko. - 3rd edition - All-Ukrainian specialized publishing house "Medytsina", 2019. - 152 p.
7. Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.
8. Medicinal chemistry: education. manual for students of higher educational institutions / I.S. Hrytsenko, S.G. Taran, L.O. Transition, etc.; for general I.S. Hrytsenko - Kharkiv: NFaU: Golden Pages, 2017. - 552p.
9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

**Additional:**

1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.
2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.

3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.

4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.

### ***Practical lesson No. 10***

**Topic:**Thematic control work on the topic: "Steroid hormones and their analogues.

**Goal:**check the assimilation of knowledge of higher education students by topics "Steroid hormones and their analogues.

**Basic concepts:**State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:**visual material, multimedia projector.

#### **Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

**2. Control of basic knowledge (written work, written test, frontal survey, etc.):**

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ Subject and tasks of pharmaceutical chemistry;
- ✓ General methods of analysis of medicinal products and determination of the benign quality of medicinal products by appearance, solubility and reaction of the environment in accordance with the requirements of the Federal Drug Administration;
- ✓ The structure and main provisions of the State Pharmacopoeia of Ukraine regarding the quality of substances and medicinal forms of industrial production.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;

- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Environments according to the requirements of the SFU.

List of didactic units:

- ✓ the text of textbooks;
- ✓ a bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1.1. The structural basis of steroid hormones is the hydrocarbon-cyclopentanephenanthrene skeleton. Name a hormone that has a steroid structure.

- A. \* estrone
- B. adrenaline
- C. thyroxine
- D. sinestrol
- E. oxytocin

2. The structural basis of steroid hormones is the hydrocarbon skeleton - cyclopentanephenanthrene. What natural compound is used to make testosterone propionate?

- A.\* cholesterol
- B. Indole
- C. naphthalene
- D. phenanthrene
- E. anthracene

3. A pharmacist-analyst for the identification of deoxycorticosterone acetate performed a steroid cycle reaction that produced a cherry-red color with green fluorescence. What reagent was added?

- A.\* conc. sulfuric acid



- B. iodine solution
  - C. ferrum (III) chloride
  - D. chloroform
  - E. potassium hydroxide solution
4. The presence of which functional group determines the positive reaction of alcohol solutions of corticosteroid preparations (prednisone, prednisolone) with copper-tartrate reagent (Fehling's reagent):
- A.\*  $\alpha$ -ketol group
  - B. pregnane cycle
  - C. unlimited hydrocarbon bond
  - D. optically active carbon atom
  - E. phenolic hydroxyl
5. To identify prednisolone, the pharmacist-analyst must prove the presence of an  $\alpha$ -ketol group. What reagent should he use for this?
- A.\* copper-tartrate reagent (Fehling's reagent)
  - B. Mayer's reagent
  - C. Dragendorff's reagent
  - D. Fisher's reagent
  - E. Wagner's reagent
6. To identify the drug substance, the pharmacist-analyst conducts a reaction with a copper-tartrate reagent (Fehling's reagent). The presence of which of the following functional groups is indicated by a visible analytical effect?
- A.\* Alpha-ketol
  - B. Complex-ester
  - C. amide
  - D. simple ether
  - E. carboxyl
7. The cortisone acetate molecule contains an ester group. To confirm the presence of this group in the medicinal substance, the analyst used the following reaction:
- A.\* hydroxam test

- B. Vitaly-Moren reaction
  - C. reaction with ammonium oxalate
  - D. murexide sample
  - E. reaction with bromine water
8. When studying the testosterone propionate substance, a hydroxam reaction was carried out, which indicates the presence of groups in the molecule:
- A.\* ester
  - B. hydroxyl
  - C. aromatic amino group
  - D. carbonyl
  - E. aldehyde
9. The main method of quantitative determination of corticosteroids is:
- A.\* spectrophotometry
  - B. potentiometry
  - C. cerimetry
  - D. argentometry
  - E. Acidimetry
10. The SFU recommends determining the quantitative content of cortisone acetate by spectrophotometry. For this, it is necessary to measure:
- A.\* optical density
  - B. refractive index
  - C. rotation angle
  - D. melting point
  - E. viscosity
11. A reaction is carried out on the steroid system in steroid hormones:
- A.\* Boscota
  - B. Bilstein's test
  - C. thalleiochin test
  - D. reaction with Markey's reagent
  - E. with Fehling's reagent

12. Hormonal preparations are presented in the assortment of medicines of the pharmacy. Specify the drug that belongs to glucocorticosteroids.

- A. \*hydrocortisone acetate
- B. diethylstilbestrol
- C. testosterone propionate
- D. adrenaline hydrotartrate
- E. progesterone

13. To identify the hydrocortisone acetate substance, the pharmacist-analyst conducts a reaction with a solution of phenylhydrazine sulfate. What functional group determines the appearance of a yellow color or sediment?

- A. \*keto group
- B. thiol group
- C. hydroxyl group
- D. sulfamide group
- E. nitro group

14. The identification reaction of hydrocortisone acetate, which is due to the reducing properties of the  $\alpha$ -ketol group, is accompanied by the formation of a red precipitate. What reagent is used to carry out the specified reaction?

- A. \*copper tartrate
- B. mercuric bromide
- C. cyanobromide
- D. thioacetamide
- E. rhodanbromide

15. In order to identify hydrocortisone acetate, the analyst conducts a reaction to form iron (III) hydroxamate. This reaction confirms the presence of:

- A. \*ester group
- B. alcohol hydroxyl
- C. aldehyde group
- D. phenolic hydroxyl
- E. keto groups

16. In the laboratory of a pharmaceutical enterprise, a medicinal substance from the group of corticosteroids - hydrocortisone acetate - is analyzed. The appearance of intense bright coloration when concentrated sulfuric acid is added is due to the presence in the molecule of:

- A. \*steroid cycle
- B. pyridine cycle
- C. xanthine cycle
- D. naphthalene cycle
- E. imidazole cycle

17. Testosterone propionate ampoules were sent to the control and analytical laboratory for analysis. A pharmacist-analyst should perform quantitative determination according to the requirements of the ND by the following method:

- A. \* UV spectrophotometric
- B. IR-spectrophotometric
- C. refractometric
- D. potentiometric
- E. Nitritometric

18. When studying the substance testosterone propionate, a hydroxam reaction was carried out, which indicates the presence of groups in the molecule:

- A. \* ester
- B. hydroxyl
- C. aromatic amino group
- D. carbonyl
- E. aldehyde

19. The laboratory for quality control of medicinal products carries out certification of preparations from the group of hormones. What reagent is used to determine the steroid cycle?

- A. \*concentrated sulfuric acid
- B. dilute nitric acid
- C. sodium nitrite solution

D. diphenylamine solution

E. magnesium sulfate solution

20. Testosterone propionate is used as a means of androgenic action. During the biotransformation of testosterone propionate, an active metabolite is formed:

A. \*dihydrotestosterone

B. prednisone

C. urocortisol

D. orotidine-5-phosphate

E. estriol

21. When examining the substance testosterone propionate, the pharmacist-analyst conducts the hydroxam reaction. This reaction confirms the presence in a molecule:

A. \*ester group

B. In the carboxyl group

C. From the aldehyde group

D. of phenolic hydroxyl

E. amino groups

22. A pharmacist-analyst analyzes the drug dexamethasone. When heating an alcoholic solution of a substance with phenylhydrazine sulfate, a yellow color appears, which indicates the presence of a medicinal product in the structure:

A. \*keto groups

B. amino groups

C. nitro groups

D. carboxyl group

E. ester group

23. Betamethasone dipropionate is a synthetic glucocorticosteroid. The presence of which atoms in a molecule of a substance contributes to an increase in anti-inflammatory activity?

A. \*fluorine

B. hydrogen

C. nitrogen

D. carbon

E. oxygen

24. A batch of dexamethasone substance is being studied in a chemical laboratory for the purpose of certification. After mineralization of the substance, the pharmacist-analyst conducts a reaction to:

A. \* fluorides

B. sulfates

C. iodides

D. nitrates

E. bromides

25. For the quantitative determination of sinestrol, the acetylation method is used.

What is this method based on:

A. \* on obtaining complex esters

B. on the production of acids

C. on obtaining salts

D. on receiving grounds

E. on obtaining poorly soluble compounds

26. An analytical chemist performs a quantitative determination of the substance diethylstilbestrol by the method of alkalimetry after preliminary acetylation.

Acetylation is carried out using:

A. \* of acetic anhydride

B. benzene

C. acetone

D. dioxane

E. chloroform

27. Determination of the mass fraction of sinestrol in an oil solution of the drug after extraction of the active substance with an aqueous solution of sodium hydroxide is carried out by the method:

A. \* bromatometry

B. permanganatometry

C. complexometry

D. nitritometry

E. alkalimetry

28. The laboratory for quality control of medicinal products carries out certification of preparations from the group of hormones. What reagent is used to determine the steroid cycle?

A. \*concentrated sulfuric acid

B. dilute nitric acid

C. sodium nitrite solution

D. diphenylamine solution

E. magnesium sulfate solution

29. The introduction of fluorine atoms into the glucocorticosteroid molecule leads to a significant increase in anti-inflammatory activity. Which of the following drugs belongs to fluoroderivative glucocorticoids?

A. \*betamethasone dipropionate

B. prednisone

C. cortisone acetate

D. prednisone

E. hydrocortisone acetate

30. Betamethasone dipropionate is a synthetic glucocorticosteroid. The presence of which atoms in a molecule of a substance contributes to an increase in anti-inflammatory activity?

A. \*fluorine

B. hydrogen

C. nitrogen

D. carbon

E. oxygen

### **3. Formation of professional skills and abilities:**

- Content of tasks (tasks, clinical situations, etc.).

1. Calculate the specific rotation of 1% testosterone propionate, the angle of rotation is  $+0.9^\circ$ . The thickness of the cuvette is 1 dm.
2. Calculate the specific rate of absorption of 0.005% alcoholic solution of ethinyl estradiol. The optical density is 0.36.
3. Calculate the percentage content of sinestrol (M. m. 270.37), if the so-called titration = 0.4700 g according to FH used 3.95 ml of 0.5 n. NaOH solution (Kp 1.0075). The volume of the titrant in the control experiment is 10.3 ml.
4. Calculate the content of cortisone acetate in a tablet taken for quantitative determination by FH, if the optical density of the test solution is 0.505, the average weight of the tablet is 0.195 g, and the exact weight of the tablet powder is 0.0990.
5. Calculate the exact weight of prednisolone tablets for quantitative determination by FH, if the optical density of the solution under study is 0.558, the average weight of the tablet is 0.2510 g.
6. Calculate the percentage content of retinyl acetate according to FC. The optical density of the investigated solution is 0.45, the exact weight is 0.0287 g.
7. Calculate the specific rotation of 1% pure testosterone propionate, the angle of rotation is  $+0.9^\circ$ . The thickness of the cuvette is 1 dm.
8. Calculate the angle of rotation of a 1% methandrostenolone solution if the specific rotation is  $+4.5^\circ$ . The thickness of the cuvette is 19 mm.
9. Calculate the specific rotation of a 1% methylandrostenediol solution if the angle of rotation is  $-0.7$ . The thickness of the cuvette is 19 mm.
10. Calculate the exact weight of pregnin tablets for quantitative determination by FH, if the optical density of the solution under study is 1.02, the average weight of the tablet is 0.1 g, and the exact weight of the powder of the tablets is 0.0986 g.
11. Calculate the percentage content of sinestrol (M. m. 270.37), if the so-called titration = 0.4700 g according to FH used 3.95 ml of 0.5 n. NaOH solution (Kp 1.0075). The volume of the titrant in the control experiment is 10.3 ml.
12. Calculate the volume of 0.5 n sodium hydroxide solution (Kp 0.9931), which will be used to titrate the excess of acetic acid in the quantitative determination of



diethylstilbestrol by FH, if the exact weight is 0.4985 g. The content of diethylstilbestrol is 99.5%, vol. titrant volume in the control experiment — 15.1 ml.

– Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicinal products.	Pharmaceutical chemistry: textbook for students. of higher pharmacology education institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of accreditation. / for general ed. Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.
2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	

– Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

#### 4. Summary:

As a result of the lesson, mastering of the studied topics, the ability to choose methods of determining the quality of medicinal products in accordance with the requirements of the Federal Medical University and the Ministry of Health according to the methods used in pharmaceutical analysis are checked.

#### 5. List of recommended literature:

##### Main:

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition.

- Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.
- 2. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 2. - 724 p.
- 3. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 3. - 732 p.5.
- 4. Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 456 p.
- 5. Nizhnyk H.P. Pharmaceutical chemistry: a textbook (University I-III years) H.P. Nizhnyk — 2nd ed., ed. - All-Ukrainian specialized publishing house "Medytsina", 2015. - 352 p.
- 6. Pharmaceutical chemistry. Analysis of medicinal substances by functional groups: study guide / O.O. Tsurkan, I.V. Nizhenkovska, O.O. Glushachenko. - 3rd edition - All-Ukrainian specialized publishing house "Medytsina", 2019. - 152 p.
- 7. Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.
- 8. Medicinal chemistry: education. manual for students of higher educational institutions / I.S. Hrytsenko, S.G. Taran, L.O. Transition, etc.; for general I.S. Hrytsenko - Kharkiv: NFaU: Golden Pages, 2017. - 552p.
- 9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

### **Additional:**

1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.
2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.
3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.
4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.

### ***Practical lesson No. 11***

**Topic:** Vitamins are water soluble. Ascorbic acid, Calcium pangamate, Calcium pantothenate, Nicotinic acid, Nicotinamide.

**Goal:** to acquaint students with the pharmaceutical analysis of drugs from the group water-soluble vitamins.

**Basic concepts:** State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:** visual material, multimedia projector.

#### **Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

**2. Control of basic knowledge (written work, written test, frontal survey, etc.):**

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General characteristics of means that stimulate receptors of afferent nerve fibers;
- ✓ Peculiarities of pharmaceutical analysis of substances that protect sensitive nerve endings from external irritations;
- ✓ Peculiarities of pharmaceutical analysis of substances that irritate sensitive nerve endings.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;
- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Use general methods of drug analysis and determination of the good quality of drugs based on their appearance, solubility, and reaction to the environment in accordance with the requirements of the Federal Drug Administration.

List of didactic units:

- ✓ the text of textbooks;
  - ✓ a bank of test tasks.
- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. In the process of biotransformation, ascorbic acid is transformed into dehydroascorbic acid. In this reaction, the compound reveals:

- A. \*restorative properties
- B. oxidizing properties
- C. acidic properties
- D. basic properties
- E. complexing properties

2. Ascorbic acid is known for its antioxidant properties. In the human body, it undergoes oxidation with the formation of:

- A. \* dehydroascorbic acid
- B. pantothenic acid
- C. salicylic acid
- D. nicotinic acid
- E. benzoic acid

3. An analysis of the ascorbic acid substance is carried out in the control and analytical laboratory. To determine the specific optical rotation, you must use:

*Methodical development of practical classes, OPP "Pharmacy, Industrial Pharmacy", 5th year, Faculty of Pharmacy, Discipline: "Pharmaceutical Chemistry" page 76*

- A. \*polarimeter
  - B. spectrophotometer
  - C. refractometer
  - D. hydrometer
  - E. viscometer
4. Quantitative determination of the substance of ascorbic acid is carried out by the pharmacist-analyst using the method of iodometry. What indicator does he use to determine the endpoint of the titration?
- A. \*starch
  - B. phenolphthalein
  - C. murexid
  - D. thymol blue
  - E. tropeolin 00
5. One of the reactions for identifying the nicotinamide substance is the reaction of ammonia release when boiling with sodium hydroxide solution. Name the functional group involved in this reaction:
- A. \*amide
  - B. ketone
  - C. aldehyde
  - D. thiol
  - E. carboxylic
6. An analytical chemist identifies the substance nicotinamide by reacting with a boiling sodium hydroxide solution. What gaseous product is released as a result of the reaction?
- A. \*ammonia
  - B. carbon (IV) oxide
  - C. hydrogen sulfide
  - D. sulfur (VI) oxide
  - E. formaldehyde

7. An analytical chemist performs the identification of nicotinamide by reaction to the pyridine cycle. What reagents should he use?

- A. \*Cyan bromide and aniline solutions
- B. solutions of potassium bromide and potassium bromate
- C. solutions of iodine and potassium iodide
- D. solutions of potassium hydroxide and dimethylformamide
- E. sulfuric acid and formaldehyde solution

8. An analytical chemist performs quantitative determination of the nicotinamide substance by acidimetry in a non-aqueous environment. What titrated solution does he use?

- A. \*perchloric acid solution
- B. iodine solution
- C. sodium hydroxide solution
- D. sodium edetate solution
- E. silver nitrate solution

### **3. Formation of professional skills and abilities:**

- Content of tasks (tasks, clinical situations, etc.).

1. Calculate the volume of 0.1 M potassium iodate solution ( $KP = 1.0010$ ), which will be used for the titration of 0.4520 g of ascorbic acid (M.m. 176.13), if its percentage content in the substance is 98.7% ; the volume of the measuring flask is 50 ml, the volume of the pipette is 10 ml.

2. Calculate the volume of 0.1 M sodium hydroxide solution ( $KP = 1.0030$ ), which will be spent on the titration of 0.3010 g of nicotinic acid (M.m. 123.11), if its percentage content in the substance is 99.5 % and weight loss during drying - 0.4%.

3. Describe the quantitative determination of nicotinic acid amide by acidimetry in non-aqueous solvents. Give the corresponding reaction equations, the calculation formulas for the calculation of the quantitative content and indicate the molar masses of the equivalents.

- Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicinal products.	Pharmaceutical chemistry: textbook for students. of higher pharmacology education institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of accreditation. / for general ed. Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.
2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	

– Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

#### **4. Summary:**

As a result of the class, the students of higher education acquired the skills to propose and implement the selection of methods for determining the quality of medicinal products in accordance with the requirements of the State Medical University of Ukraine and the Ministry of Health, according to the methods used in pharmaceutical analysis.

#### **5. List of recommended literature:**

##### **Main:**

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.

2. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 2. - 724 p.
3. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 3. - 732 p.5.
4. Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 456 p.
5. Nizhnyk H.P. Pharmaceutical chemistry: a textbook (University I-III years) H.P. Nizhnyk — 2nd ed., ed. - All-Ukrainian specialized publishing house "Medytsina", 2015. - 352 p.
6. Pharmaceutical chemistry. Analysis of medicinal substances by functional groups: study guide / O.O. Tsurkan, I.V. Nizhenkovska, O.O. Glushachenko. - 3rd edition - All-Ukrainian specialized publishing house "Medytsina", 2019. - 152 p.
7. Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.
8. Medicinal chemistry: education. manual for students of higher educational institutions / I.S. Hrytsenko, S.G. Taran, L.O. Transition, etc.; for general I.S. Hrytsenko - Kharkiv: NFaU: Golden Pages, 2017. - 552p.
9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

**Additional:**

1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.
2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.



3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.

4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.

### ***Practical lesson No. 12***

**Topic:** Vitamins are water soluble. Pyridoxine hydrochloride, Thiamine hydrobromide and hydrochloride, Folic acid, Riboflavin, Rutin.

**Goal:** to acquaint students with the pharmaceutical analysis of drugs from the group water-soluble vitamins.

**Basic concepts:** State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:** visual material, multimedia projector.

#### **Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

**2. Control of basic knowledge (written work, written test, frontal survey, etc.):**

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General characteristics of means that stimulate receptors of afferent nerve fibers;
- ✓ Peculiarities of pharmaceutical analysis of substances that protect sensitive nerve endings from external irritations;
- ✓ Peculiarities of pharmaceutical analysis of substances that irritate sensitive nerve endings.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;

- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Use general methods of drug analysis and determination of the good quality of drugs based on their appearance, solubility, and reaction to the environment in accordance with the requirements of the Federal Drug Administration.

List of didactic units:

- ✓ the text of textbooks;
  - ✓ a bank of test tasks.
- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Pyridoxine hydrochloride and cyanocobalamin are not recommended to be administered in the same syringe due to their chemical incompatibility. What reaction occurs in this case?

- A. \*complex formation
- B. neutralization
- C. oxidation
- D. restoration
- E. hydrolysis

2. Under the influence of the specific enzyme pyridoxalkinase, pyridoxine in the human body forms a coenzyme form that takes part in metabolism. What reaction is at the heart of this transformation?

- A. \*phosphorylation
- B. hydrolysis
- C. restoration
- D. oxidation
- E. conjugation

3. An analytical chemist identifies the substance pyridoxine hydrochloride by thin-layer chromatography. As a specific developer, he uses a solution:

- A. \* of 2,6-dichloroquinone chloride

B. cyanobromide

C. ninhydrin

D. diphenylamine

E. 2,4-dinitrochlorobenzene

4. A pharmacist-analyst is testing the substance thiamine hydrobromide. What is the main reagent he uses when determining the admixture of sulfates?

A. \* barium chloride solution

B. sodium nitrite solution

C. ammonium oxalate solution

D. sodium benzoate solution

E. calcium chloride solution

5. The thiamine molecule consists of two heterocycles connected by a methylene group. Name these heterocycles.

A. \*pyrimidine and thiazole

B. oxazole and pyrazine

C. imidazole and pyrrole

D. isoxazole and pyridazine

E. pyran and morpholine

6. After hydrolysis of rutin in an acidic environment, the substance can be detected:

A. \* glucose

B. lactose

S. sucrose

D. starch

E. dextrin

7. The pharmacist-analyst determines the good quality of thiamin hydrobromide in accordance with the requirements of the Federal Drug Administration. What auxiliary reagent does he use when determining the admixture of sulfates in this preparation?

A \* Acetic acid

B Nitric acid

CSulfuric acid

DBenzoic acid

E Salicylic acid

8.The pharmacist-analyst, analyzing the vitamin eye drops, observed a bright greenish-yellow fluorescence while examining them in UV light. This indicates the presence of:

A \* Riboflavin

B Thiamine bromide

CFolic acids

DAscorbic acid

E Vikasol

### 3. Formation of professional skills and abilities:

– Content of tasks (tasks, clinical situations, etc.).

1.Describe the chemical structure of thiamine and give the formulas of its pharmacopoeial agents and phosphorylated derivatives. Write the reaction equation of the thiochrome sample.

2.Describe the chemical structureand the biological role of pho acidleft Give the reaction equationand in which folic acid is highsolders as a complexing agent.

3.Give the equations of the opposite reactionsrept when determining the admixture mepyridoxine tail ether at the doctorof pyridoxine hydrochloride

– Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicinal products.	Pharmaceutical chemistry: textbook for students. of higher pharmacology education institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of

2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	accreditation. / for general ed. Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.
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– Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

#### **4. Summary:**

As a result of the class, the students of higher education acquired the skills to propose and implement the selection of methods for determining the quality of medicinal products in accordance with the requirements of the State Medical University of Ukraine and the Ministry of Health, according to the methods used in pharmaceutical analysis.

#### **5. List of recommended literature:**

##### **Main:**

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.
2. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 2. - 724 p.
3. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 3. - 732 p.5.
4. Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy *Methodical development of practical classes, OPP "Pharmacy, Industrial Pharmacy", 5th year, Faculty of Pharmacy, Discipline: "Pharmaceutical Chemistry"* page 85

education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 456 p.

5. Nizhnyk H.P. Pharmaceutical chemistry: a textbook (University I-III years) H.P. Nizhnyk — 2nd ed., ed. - All-Ukrainian specialized publishing house "Medytsina", 2015. - 352 p.

6. Pharmaceutical chemistry. Analysis of medicinal substances by functional groups: study guide / O.O. Tsurkan, I.V. Nizhenkovska, O.O. Glushachenko. - 3rd edition - All-Ukrainian specialized publishing house "Medytsina", 2019. - 152 p.

7. Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.

8. Medicinal chemistry: education. manual for students of higher educational institutions / I.S. Hrytsenko, S.G. Taran, L.O. Transition, etc.; for general I.S. Hrytsenko - Kharkiv: NFaU: Golden Pages, 2017. - 552p.

9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

#### **Additional:**

1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.

2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.

3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.

4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.

### ***Practical lesson No. 13***

**Topic:** Solving calculation problems and test problems.

**Goal:** analysis and consolidation of the studied material with the help of solutions calculation tasks and test tasks.

**Basic concepts:** State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:** visual material, multimedia projector.

**Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

**2. Control of basic knowledge (written work, written test, frontal survey, etc.):**

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General characteristics of means that stimulate receptors of afferent nerve fibers;
- ✓ Peculiarities of pharmaceutical analysis of substances that protect sensitive nerve endings from external irritations;
- ✓ Peculiarities of pharmaceutical analysis of substances that irritate sensitive nerve endings.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;
- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Use general methods of drug analysis and determination of the good quality of drugs based on their appearance, solubility, and reaction to the environment in accordance with the requirements of the Federal Drug Administration.

List of didactic units:

- ✓ the text of textbooks;
  - ✓ a bank of test tasks.
- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. A pharmacist-analyst examines a medicinal substance from the group of vitamins. What substance is called vitamin C?
  - A. \*ascorbic acid
  - B. barbituric acid
  - C. nicotinic acid
  - D. folic acid
  - E. salicylic acid
2. One of the listed medicines does not belong to vitamins:
  - A. \* calcium gluconate
  - B. calcium pangamate
  - C. calcium pantothenate
  - D. ergocalciferol
  - E. nicotinic acid
3. The identification of ascorbic acid according to SFU is carried out by a pharmacist-analyst using the following reagent:
  - A. \*silver nitrate
  - B. zinc sulfate
  - C. ammonium oxalate
  - D. calcium chloride
  - E. barium nitrate
4. In the practice of control and analytical laboratories, a solution of 2,6-dichlorophenolindophenol is used, the blue color of which is discolored under the action of reducing agents. Name the medicinal product that can be identified by a solution of 2,6-dichlorophenolindophenol:
  - A. \*ascorbic acid
  - B. salicylic acid
  - C. nicotinic acid
  - D. benzoic acid
  - E. acetylsalicylic acid



5. The pharmacist-analyst performs the analysis of the substance of ascorbic acid in accordance with the requirements of HFC. To determine the admixture of oxalic acid, he uses a solution:

- A. \* Calcium chloride
- B. Sodium chloride
- C. Sodium bicarbonate
- D. Sodium sulfate
- E. Sodium thiosulfate

6. The substance of ascorbic acid was sent to the control and analytical laboratory for analysis. In accordance with the requirements of HFC, the quantitative content of ascorbic acid is determined by the method:

- A. \*iodometry
- B. nitritometry
- C. acidimetry
- D. acidimetry in non-aqueous environments
- E. complex econometrics

7. What reaction does the pharmacist-analyst use to confirm the presence of an ester group in the medicinal substance "Calcium pangamate"?

- A. \*formation of iron (III) hydroxamate
- B. formation of iodoform
- C. formation of azo dye
- D. formation of indophenol
- E. formation of auric dye

8. The control and analytical laboratory received the substance calcium pantothenate. For the quantitative determination of the drug, the pharmacist-analyst should use the following method:

- A. \*complexometry
- B. iodometry
- C. iodochlorimetry
- D. Mercurimetry

E. argentometry

9. Quantitative content of ergocalciferol [Ergocalciferolum] in medicinal products is determined by the method:

A. \*photocolorimetry

B. polarimetry

C. permanganatometry

D. conductometry

E. gravimetry

10. A solution of Vikasol for injections was sent to the control and analytical laboratory for analysis. One of the drug identification reactions is the reaction with sulfuric acid (conc.). What is observed at the same time:

A. \*the smell of sulfur (IV) oxide is felt

B. change in color of the solution

C. smells of ammonia

D. the smell of benzaldehyde is felt

E. the smell of acetaldehyde is felt

11. Which of the medicinal substances listed below can the pharmacist-analyst of the pharmacy quantitatively determine by the cerimetry method?

A. \*Vikasol

B. acetylsalicylic acid

C. sodium benzoate

D. phenyl salicylate

E. phenobarbital

12. After hydrolysis of rutin in an acidic environment, the substance can be detected:

A. \*glucose

B. lactose

C. sucrose

D. starch

E. dextrin

13. The analyst conducts quality control of nicotinic acid in accordance with the requirements of the Federal State Administration of Ukraine. Which reagent can be used to confirm the presence of a pyridine ring in its structure?

- A. \*cyanobromide solution
- B. sodium nitroprusside solution
- C. solution of potassium ferrocyanide
- D. ninhydrin solution
- E. benzaldehyde solution

14. When boiling nicotinamide with a solution of sodium hydroxide, the smell is felt:

- A. \*ammonia
- B. pyridine
- C. benzaldehyde
- D. formaldehyde
- E. ethyl acetate

15. The quantitative content of nicotinic acid according to the SFU is determined by the method:

- A. \*alkalimetry
- B. Argentometry
- C. nitritometry
- D. permanganatometry
- E. bromatometry

16. The presence of phenolic hydroxyl hydrochloride in the structure of pyridoxine can be confirmed using a solution:

- A. \*iron (III) chloride
- B. potassium permanganate
- C. sodium sulfate
- D. silver nitrate
- E. sodium nitrite

17. Quantitative determination of the substance pyridoxine hydrochloride in accordance with the requirements of the Federal Drug Administration is carried out by the following method:

- A. \*Acidimetry in a non-aqueous medium
- B. Gravimetry
- C. Complexonometry
- D. Argentometry
- E. Nitritometry

18. To identify thiamine bromide, the pharmacist-analyst conducted a thiochrome formation reaction. What reagent should he use?

- A. \*potassium ferricyanide
- B. calcium chloride
- C. From potassium bromide
- D. sodium hydroxide
- E. iron (II) sulfate

19. A physicochemical method is used for the quantitative determination of the folic acid substance according to the SFU. Name this method.

- A. \* Liquid chromatography
- B. ion exchange chromatography
- C. ultraviolet spectrophotometry
- D. refractometry
- E. polarimetry

20. An aqueous solution of which of the listed substances has an intense yellowish-green fluorescence that disappears when mineral acids or alkalis are added?

- A. \*riboflavin
- B. ascorbic acid
- C. glibenclamide
- D. pyridoxine hydrochloride
- E. thymol

### 3. Formation of professional skills and abilities:

- Content of tasks (tasks, clinical situations, etc.).

1. Calculate the volume of 0.1 M potassium iodate solution (KP = 1.0010), which will be used for the titration of 0.4520 g of ascorbic acid (M.m. 176.13), if its percentage content in the substance is 98.7% ; the volume of the measuring flask is 50 ml, the volume of the pipette is 10 ml.

2. Calculate the volume of 0.1 M sodium hydroxide solution (KP = 1.0030), which will be spent on the titration of 0.3010 g of nicotinic acid (M.m. 123.11), if its percentage content in the substance is 99.5 % and weight loss during drying - 0.4%.

3. Calculate the volume of 0.1 M perchloric acid solution (KP = 1.0000), which will be spent on the titration of 0.1450 g of pyridoxine hydrochloride (M.m. 205.64), if its percentage content in the substance is 98.7%. weight loss during drying - 0.45% and titrant volume in the control experiment -0.3 ml.

4. Calculate the weight of the tocopherol acetate sample (M.m. 472.8), if 19.20 ml of 0.1 M cerium sulfate solution (KP = 1.0000) was spent on its titration, its percentage content in the substance is 94.9% and the titrant volume in the control experiment - 0.4 ml; the volume of the measuring flask is 50 ml, the volume of the pipette is 20 ml.

5. Calculate the percentage content of retinyl acetate according to FC. The optical density of the investigated solution is 0.45, the exact weight is 0.0287 g.

6. Calculate the percentage content of atropine sulfate (M.m. 676.8) in the substance, if the weight of the test piece is 0.4983 g, the volume of 0.1 M perchloric acid solution (KP = 0.9892) in the working experiment - 7.42 ml, in the control - 0.21 ml, and the weight loss during drying - 2.3%.

7. Calculate the volume of 0.1 M perchloric acid solution (KP = 1.0000), which is spent on the titration of 0.2014 g of scopolamine hydrobromide (M.m. 384.3), if the titrant volume in the control experiment is 0.12 ml, the weight loss during drying is 12.6%, and the content of the active substance in the substance is 98.7%.

8. Calculate the weight of a sample of homatropine hydrobromide (M.m. 356.27), if 5.74 ml of a 0.1 M solution of perchloric acid (KP = 1.0241) was spent on its

titration, the volume of the titrant in the control experiment is 0.21 ml, and the content of the active substance in the substance is 99.4%.

9. Calculate the percentage content of tropacin (M.m. 371.91) in the substance, if the mass of the test piece is 0.1976 g, the volume of 0.1 M perchloric acid solution (KP = 1.0014) in the working experiment is 5.43 ml, in the control - 0.18 ml, and the weight loss during drying is 0.4%.

10. Calculate the volume of a 0.1 M solution of perchloric acid (KP = 1.0000), which is spent on the titration of 0.2858 g of cocaine hydrochloride (M.m. 339.82), if the volume of the titrant in the control experiment is 0.15 ml, the weight loss during drying is 0.4%, and the content of the active substance in the substance is 99.6%.

11. Calculate the percentage content of quinine hydrochloride if, when determined by the gravimetric method, the weight of the test piece is 0.4973 g, the weight of the weighing form is 0.4034 g, the loss in weight during drying is 9.2%, and the gravimetric factor is 1.112.

12. Write the reaction equation, calculate the gravimetric factor and the percentage content of quinine sulfate (M.m. 746.92) in the substance when determined by the gravimetric method, if it is known that M.m. quinine basis - 324.42, weight of the sample - 0.4793, weight of the weight form - 0.3986 g, weight loss during drying - 3.8%.

13. Calculate the volume of 0.1 M sodium hydroxide solution (KP = 1.0000), which is used for the titration of 0.5018 g of quinine sulfate (M.m. 746.92), if the content of the active substance in the substance is 99.2 %, and the weight loss during drying is 4.6%.

– Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of	Give identification reactions of ions	Pharmaceutical chemistry: textbook for students. of higher pharmacology education

	medicinal products.	that are part of medicinal products.	institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of accreditation. / for general ed.
2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.

– Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

#### **4. Summary:**

As a result of the class, the students of higher education acquired the skills to propose and implement the selection of methods for determining the quality of medicinal products in accordance with the requirements of the State Medical University of Ukraine and the Ministry of Health, according to the methods used in pharmaceutical analysis.

#### **5. List of recommended literature:**

##### **Main:**

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.
2. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 2. - 724 p.
3. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition.

- Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 3. - 732 p.5.
- 4. Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 456 p.
- 5. Nizhnyk H.P. Pharmaceutical chemistry: a textbook (University I-III years) H.P. Nizhnyk — 2nd ed., ed. - All-Ukrainian specialized publishing house "Medytsina", 2015. - 352 p.
- 6. Pharmaceutical chemistry. Analysis of medicinal substances by functional groups: study guide / O.O. Tsurkan, I.V. Nizhenkovska, O.O. Glushachenko. - 3rd edition - All-Ukrainian specialized publishing house "Medytsina", 2019. - 152 p.
- 7. Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.
- 8. Medicinal chemistry: education. manual for students of higher educational institutions / I.S. Hrytsenko, S.G. Taran, L.O. Transition, etc.; for general I.S. Hrytsenko - Kharkiv: NFaU: Golden Pages, 2017. - 552p.
- 9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

**Additional:**

- 1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.
- 2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.
- 3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.
- 4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.



### ***Practical lesson No. 14***

**Topic:** Fat-soluble vitamins. Retinol acetate, Ergocalciferol, Tocopherol acetate, Vikasol.

**Goal:** to acquaint students with the pharmaceutical analysis of drugs from the group of fat-soluble vitamins.

**Basic concepts:** State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:** visual material, multimedia projector.

#### **Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

**2. Control of basic knowledge (written work, written test, frontal survey, etc.):**

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ General characteristics of means that stimulate receptors of afferent nerve fibers;
- ✓ Peculiarities of pharmaceutical analysis of substances that protect sensitive nerve endings from external irritations;
- ✓ Peculiarities of pharmaceutical analysis of substances that irritate sensitive nerve endings.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;
- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Use general methods of drug analysis and determination of the good quality of drugs based on their appearance, solubility, and reaction to the environment in accordance with the requirements of the Federal Drug Administration.

List of didactic units:

- ✓ the text of textbooks;
  - ✓ a bank of test tasks.
- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:
1. The quantitative content of ergocalciferol [Ergocalciferolum] in medicinal products is determined by the method:
    - A. \*photocolorimetry
    - B. polarimetry
    - C. permanganatometry
    - D. conductometry
    - E. gravimetry
  2. A solution of Vikasol for injections was sent to the control and analytical laboratory for analysis. One of the drug identification reactions is the reaction with sulfuric acid (conc.). What is observed at the same time:
    - A. \*the smell of sulfur (IV) oxide is felt
    - B. change in color of the solution
    - C. smells of ammonia
    - D. the smell of benzaldehyde is felt
    - E. the smell of acetaldehyde is felt
  3. Which of the medicinal substances listed below can the pharmacist-analyst of the pharmacy quantitatively determine by the cerimetry method?
    - A. \*Vikasol
    - B. acetylsalicylic acid
    - C. sodium benzoate
    - D. phenyl salicylate
    - E. phenobarbital
  4. Which of the medicinal substances listed below can the pharmacist-analyst of the pharmacy quantitatively determine by the cerimetry method?
    - A. \* Vikasol

B. Acetylsalicylic acid

C. Sodium benzoate

D. Phenyl salicylate

E. Phenobarbital

5. The quantitative content of ergocalciferol [Ergocalciferolum] in medicines is determined by the method:

A. \* photolorimetry

B. polarimetry

C. permanganometry

D. conductometry

E. gravimetry

6. A solution of Vikasol for injections was sent to the control and analytical laboratory for analysis. One of the drug identification reactions is the reaction with sulfuric acid (conc.). What is observed at the same time:

A. \* the smell of sulfur (IV) oxide is felt

B. change in the color of the solution

C. smells of ammonia

D. the smell of benzaldehyde is felt

E. the smell of acetaldehyde is felt

7. The pharmacist-analyst confirms the presence of an ester group in the medicinal substance "Calcium pangamate" by the formation reaction:

A \* Colored hydroxamate

B Iodoform

C. Oily sediment

D. Murexida

E. White sediment

8. The substance calcium pangamate is being studied in the control and analytical laboratory. With which reagent does the calcium cation form a white precipitate?

A. \* Ammonium oxalate

B. Sodium chloride

C. Potassium permanganate

D. Potassium bromide

E. Sodium cobalt nitrite

### 3. Formation of professional skills and abilities:

– Content of tasks (tasks, clinical situations, etc.).

1. Calculate the weight of the tocopherol acetate sample (M.m. 472.8), if 19.20 ml of a 0.1 M solution of cerium sulfate (CP = 1.0000) was spent on its titration, its percentage content in the substance is 94.9% and the titrant volume in the control experiment - 0.4 ml; the volume of the measuring flask is 50 ml, the volume of the pipette is 20 ml.

2. Calculate the percentage content of retinyl acetate according to FC. The optical density of the investigated solution is 0.45, the exact weight is 0.0287 g.

3. Calculate the specific rotation of 1% of the soilRetinol acetate, angle of rotation  $+0.9^\circ$ . The thickness of the cuvette is 1 dm.

– Recommendations (instructions) for performing tasks.

No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicinal products.	Pharmaceutical chemistry: textbook for students. of higher pharmacology education institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of accreditation. / for general ed.
2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.

– Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

#### **4. Summary:**

As a result of the class, the students of higher education acquired the skills to propose and implement the selection of methods for determining the quality of medicinal products in accordance with the requirements of the State Medical University of Ukraine and the Ministry of Health, according to the methods used in pharmaceutical analysis.

#### **5. List of recommended literature:**

##### **Main:**

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.
2. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 2. - 724 p.
3. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 3. - 732 p.5.
4. Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 456 p.
5. Nizhnyk H.P. Pharmaceutical chemistry: a textbook (University I-III years) H.P. Nizhnyk — 2nd ed., ed. - All-Ukrainian specialized publishing house "Medytsina", 2015. - 352 p.

6. Pharmaceutical chemistry. Analysis of medicinal substances by functional groups: study guide / O.O. Tsurkan, I.V. Nizhenkovska, O.O. Glushachenko. - 3rd edition - All-Ukrainian specialized publishing house "Medytsina", 2019. - 152 p.
7. Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.
8. Medicinal chemistry: education. manual for students of higher educational institutions / I.S. Hrytsenko, S.G. Taran, L.O. Transition, etc.; for general I.S. Hrytsenko - Kharkiv: NFaU: Golden Pages, 2017. - 552p.
9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

**Additional:**

1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.
2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.
3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.
4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.

***Practical lesson No. 15***

**Topic:**Thematic control work on the topic: "Vitamins."

**Goal:**check the assimilation of knowledge of higher education students by topics "Vitamins."

**Basic concepts:**State Pharmacopoeia of Ukraine, qualitative analysis, quantitative analysis, active substance, substance, monograph.

**Equipment:**visual material, multimedia projector.

**Plan:**

**1. Organizational moment (greetings, checking those present, announcing the topic, purpose of the lesson, motivating students to study the topic).**

## 2. Control of basic knowledge (written work, written test, frontal survey, etc.):

- Requirements for students' theoretical readiness to perform practical classes.

The student should know:

- ✓ Subject and tasks of pharmaceutical chemistry;
- ✓ General methods of analysis of medicinal products and determination of the benign quality of medicinal products by appearance, solubility and reaction of the environment in accordance with the requirements of the Federal Drug Administration;
- ✓ The structure and main provisions of the State Pharmacopoeia of Ukraine regarding the quality of substances and medicinal forms of industrial production.

The student should be able to:

- ✓ Interpret the general requirements of the SFU regarding the identification of drugs;
- ✓ To propose and carry out a choice of physical, physico-chemical and chemical methods for determining the good quality of medicinal products in accordance with the requirements of the State Medical Center and the Ministry of Health;
- ✓ Environments according to the requirements of the SFU.

List of didactic units:

- ✓ the text of textbooks;
- ✓ a bank of test tasks.

- Questions (test tasks, tasks, clinical situations) to check basic knowledge on the subject of the lesson:

1. Quantitative determination of the substance of ascorbic acid is carried out by a pharmacist-analyst using the method of iodometry. What indicator does he use to determine the endpoint of the titration?

A. \*starch

B. phenolphthalein

C. murexid

D. thymol blue

E. tropeolin 00

2. An analysis of the substance ascorbic acid is carried out in the control and analytical laboratory. To determine the specific optical rotation, you must use:

A. \*polarimeter

B. spectrophotometer

C. refractometer

D. hydrometer

E. viscometer

3. Inbound control of nicotinamide is carried out at the CZL of the pharmaceutical enterprise. According to the SFU monograph, the aqueous solution of the substance must be transparent. The tested solution must be compared with:

A. \* with water

B. chloroform

C. methanol

D. ether

E. propanol-2

4. An analytical chemist identifies the substance pyridoxine hydrochloride by thin-layer chromatography. As a specific developer, he uses a solution:

A. \* of 2,6-dichloroquinone chloride

B. cyanobromide

C. ninhydrin

D. diphenylamine

E. 2,4-dinitrochlorobenzene

5. Under the influence of the specific enzyme pyridoxalkinase, pyridoxine in the human body forms a coenzyme form that takes part in metabolism. What reaction is at the heart of this transformation?

A. \*phosphorylation

B. hydrolysis



C. restoration

D. oxidation

E. conjugation

6. Pyridoxine hydrochloride and cyanocobalamin are not recommended to be administered in the same syringe due to their chemical incompatibility. What reaction occurs in this case?

A. \*complex formation

B. neutralization

C. oxidation

D. restoration

E. hydrolysis

7. The thiamine molecule consists of two heterocycles connected by a methylene group. Name these heterocycles.

A. \*pyrimidine and thiazole

B. oxazole and pyrazine

C. imidazole and pyrrole

D. isoxazole and pyridazine

E. pyran and morpholine

8. In the process of biotransformation in the body, nicotinamide forms a product of interaction with glycine. What type of reaction does this interaction belong to?

A. \* conjugations

B. restoration

C. oxidation

D. hydrolysis

E. dealkylation

9. Dehydroascorbic acid is a metabolite of ascorbic acid formed as a result of dehydrogenation. What reaction of metabolic transformations occurs?

A. \* oxidation

B. hydrolysis

C. demining

D. acetylation

E. glucuronidation

10. Ascorbic acid is known for its antioxidant properties. In the human body, it undergoes oxidation with the formation of:

A. \* dehydroascorbic acid

B. pantothenic acid

C. salicylic acid

D. nicotinic acid

E. benzoic acid

11. In the process of biotransformation, ascorbic acid is transformed into dehydroascorbic acid. In this reaction, the compound reveals:

A. \*restorative properties

B. oxidizing properties

C. acidic properties

D. basic properties

E. complexing properties

12. An analytical chemist performs the identification of nicotinamide by reaction to the pyridine cycle. What reagents should he use?

A. \*Cyan bromide and aniline solutions

B. solutions of potassium bromide and potassium bromate

C. solutions of iodine and potassium iodide

D. solutions of potassium hydroxide and dimethylformamide

E. sulfuric acid and formaldehyde solution

13. An analytical chemist identifies the substance nicotinamide by reacting with a boiling sodium hydroxide solution. What gaseous product is released as a result of the reaction?

A. \*ammonia

B. carbon (IV) oxide

C. hydrogen sulfide

D. sulfur (VI) oxide

E. formaldehyde

14. One of the reactions for the identification of the nicotinamide substance is the reaction of ammonia release when boiling with sodium hydroxide solution. Name the functional group involved in this reaction:

A. \*amide

B. ketone

C. aldehyde

D. thiol

E. carboxylic

15. A pharmacist-analyst examines a medicinal substance from the group of vitamins. What substance is called vitamin C?

A. \*ascorbic acid

B. barbituric acid

C. nicotinic acid

D. folic acid

E. salicylic acid

16. One of the listed medicines does not belong to vitamins:

A. \* calcium gluconate

B. calcium pangamate

C. calcium pantothenate

D. ergocalciferol

E. nicotinic acid

17. Identification of ascorbic acid according to SFU is carried out by a pharmacist-analyst using the following reagent:

A. \*silver nitrate

B. zinc sulfate

C. ammonium oxalate

D. calcium chloride

E. barium nitrate

18. In the practice of control and analytical laboratories, a solution of 2,6-dichlorophenolindophenol is used, the blue color of which is discolored under the action of reducing agents. Name the medicinal product that can be identified by a solution of 2,6-dichlorophenolindophenol:

- A. \*ascorbic acid
- B. salicylic acid
- C. nicotinic acid
- D. benzoic acid
- E. acetylsalicylic acid

19. The pharmacist-analyst performs the analysis of the substance of ascorbic acid in accordance with the requirements of HFC. To determine the admixture of oxalic acid, he uses a solution:

- A. \* Calcium chloride
- B. Sodium chloride
- C. Sodium bicarbonate
- D. Sodium sulfate
- E. Sodium thiosulfate

20. The substance of ascorbic acid was sent to the control and analytical laboratory for analysis. In accordance with the requirements of HFC, the quantitative content of ascorbic acid is determined by the method:

- A. \*iodometry
- B. nitritometry
- C. acidimetry
- D. acidimetry in non-aqueous environments
- E. complex econometrics

21. What reaction does the pharmacist-analyst use to confirm the presence of an ester group in the medicinal substance "Calcium pangamate"?

- A. \*formation of iron (III) hydroxamate
- B. formation of iodoform
- C. formation of azo dye

D. formation of indophenol

E. formation of auric dye

22. The control and analytical laboratory received the substance calcium pantothenate. For the quantitative determination of the drug, the pharmacist-analyst should use the following method:

A. \*complexometry

B. iodometry

C. iodochlorometry

D. Mercurimetry

E. argentometry

23. Quantitative content of ergocalciferol [Ergocalciferolum] in medicines is determined by the method:

A. \*photocolorimetry

B. polarimetry

C. permanganometry

D. conductometry

E. gravimetry

24. A solution of Vikasol for injections was sent to the control and analytical laboratory for analysis. One of the drug identification reactions is the reaction with sulfuric acid (conc.). What is observed at the same time:

A. \*the smell of sulfur (IV) oxide is felt

B. change in color of the solution

C. smells of ammonia

D. the smell of benzaldehyde is felt

E. the smell of acetaldehyde is felt

25. Which of the medicinal substances listed below can the pharmacist-analyst of the pharmacy quantitatively determine by the cerimetry method?

A. \*Vikasol

B. acetylsalicylic acid

C. sodium benzoate

D. phenyl salicylate

E. phenobarbital

26. After hydrolysis of rutin in an acidic environment, the substance can be detected:

A. \*glucose

B. lactose

C. sucrose

D. starch

E. dextrin

27. The analyst conducts quality control of nicotinic acid in accordance with the requirements of the Federal State Administration of Ukraine. Which reagent can be used to confirm the presence of a pyridine ring in its structure?

A. \*cyanobromide solution

B. sodium nitroprusside solution

C. solution of potassium ferrocyanide

D. ninhydrin solution

E. benzaldehyde solution

28. When boiling nicotinamide with a solution of sodium hydroxide, the smell is felt:

A. \*ammonia

B. pyridine

C. benzaldehyde

D. formaldehyde

E. ethyl acetate

29. Quantitative content of nicotinic acid according to SFU is determined by the method:

A. \*alkalimetry

B. Argentometry

C. nitritometry

D. permanganometry

E. bromatometry

30. The presence of phenolic hydroxyl hydrochloride in the structure of pyridoxine can be confirmed using a solution:

A. \*iron (III) chloride

B. potassium permanganate

C. sodium sulfate

D. silver nitrate

E. sodium nitrite

31. Quantitative determination of the substance pyridoxine hydrochloride in accordance with the requirements of the Federal Drug Administration is carried out by the following method:

A. \*Acidimetry in a non-aqueous medium

B. Gravimetry

C. Complexonometry

D. Argentometry

E. Nitritometry

32. To identify thiamine bromide, the pharmacist-analyst conducted a thiochrome formation reaction. What reagent should he use?

A. \*potassium ferricyanide

B. calcium chloride

C. From potassium bromide

D. sodium hydroxide

E. iron (II) sulfate

33. A physicochemical method is used for the quantitative determination of the folic acid substance according to the SFU. Name this method.

A. \* Liquid chromatography

B. ion exchange chromatography

C. ultraviolet spectrophotometry

D. refractometry

E. polarimetry

34. An aqueous solution of which of the listed substances has an intense yellowish-green fluorescence that disappears when mineral acids or alkalis are added?

- A. \*riboflavin
- B. ascorbic acid
- C. glibenclamide
- D. pyridoxine hydrochloride
- E. thymol

### **3. Formation of professional skills and abilities:**

– Content of tasks (tasks, clinical situations, etc.).

1. Calculate the percentage content of retinyl acetate according to FH. The optical density of the investigated solution is 0.45, the exact weight is 0.0287 g.
2. Calculate the volume of 0.1 M potassium iodate solution (CP = 1.0010), which will be used for the titration of 0.4520 g of ascorbic acid (M.m. 176.13), if its percentage content in the substance is 98, 7%; the volume of the measuring flask is 50 ml, the volume of the pipette is 10 ml.
3. Calculate the volume of 0.1 M sodium hydroxide solution (CP = 1.0030), which will be spent on the titration of 0.3010 g of nicotinic acid (M.m. 123.11), if its percentage content in the substance is 99 .5% and weight loss during drying - 0.4%.
4. Calculate the volume of a 0.1 M perchloric acid solution (KP = 1.0000) that will be spent on the titration of 0.1450 g of pyridoxine hydrochloride (Mm. 205.64), if its percentage content in the substance is 98.7 %, the weight loss during drying is 0.45%, and the titrant volume in the control experiment is 0.3 ml.
5. Calculate the weight of the tocopherol acetate sample (M.m. 472.8), if 19.20 ml of 0.1 M cerium sulfate solution (KP = 1.0000) was spent on its titration, its percentage content in the substance is 94.9% and the titrant volume in the control experiment - 0.4 ml; the volume of the measuring flask is 50 ml, the volume of the pipette is 20 ml.

– Recommendations (instructions) for performing tasks.



No	Main tasks	Instructions	Answers
1	2	3	4
1.	Chemical methods for the analysis of medicinal products.	Give identification reactions of ions that are part of medicinal products.	Pharmaceutical chemistry: textbook for students. of higher pharmacology education institutions and pharmacies. f-tiv higher med. education institutions of III-IV levels of accreditation. / for general ed. Prof. Bezuglio P. O. - Ed. 3rd edition, revised. – Vinnytsia: Nova Kniga, 2017. – 456 p.
2.	Chemical methods for the analysis of medicinal products.	Give a quantitative analysis of medicinal substances	

– Requirements for work results, including for registration: Individual form of answers to test tasks (the form is attached).

#### **4. Summary:**

As a result of the lesson, mastering of the studied topics, the ability to choose methods of determining the quality of medicinal products in accordance with the requirements of the Federal Medical University and the Ministry of Health according to the methods used in pharmaceutical analysis are checked.

#### **5. List of recommended literature:**

##### **Main:**

1. State Pharmacopoeia of Ukraine: in 3 volumes / Derz. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2015. - Vol. 1. - 1128 p.
2. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition.

- Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 2. - 724 p.
- 3. State Pharmacopoeia of Ukraine: in 3 volumes / Derzh. medical service of Ukraine funds, Ukr. of science pharmacopoeia medicine quality center means - 2nd edition. - Kh.: Ukr. of science pharmacopoeia medicine quality center means, 2014. - Vol. 3. - 732 p.5.
- 4. Pharmaceutical chemistry: Textbook for students. higher pharmacy education closing and pharmacy Faculty of Medical Sciences for students higher pharmacy education closing / In general ed. P.O. Bezuglio - Kind. 3rd edition, revised. – Vinnytsia, NOVA KNYGA, 2017. - 456 p.
- 5. Nizhnyk H.P. Pharmaceutical chemistry: a textbook (University I-III years) H.P. Nizhnyk — 2nd ed., ed. - All-Ukrainian specialized publishing house "Medytsina", 2015. - 352 p.
- 6. Pharmaceutical chemistry. Analysis of medicinal substances by functional groups: study guide / O.O. Tsurkan, I.V. Nizhenkovska, O.O. Glushachenko. - 3rd edition - All-Ukrainian specialized publishing house "Medytsina", 2019. - 152 p.
- 7. Hudoyarova O.S. Pharmaceutical chemistry. - Vinnytsia: "Nilan-LTD" LLC, 2018. - 194 p.
- 8. Medicinal chemistry: education. manual for students of higher educational institutions / I.S. Hrytsenko, S.G. Taran, L.O. Transition, etc.; for general I.S. Hrytsenko - Kharkiv: NFaU: Golden Pages, 2017. - 552p.
- 9. Pharmaceutical chemistry. General and special pharmaceutical chemistry. Medicines of an inorganic nature: laboratory-practical classes. Study guide / L.G. Mishina - Vinnytsia: PP "TD "Edelweiss and K"", 2010. - 384 p.

**Additional:**

- 1. Analytical chemistry and instrumental methods of analysis / A.I. Gab, D.B. Shakhnin, V.V. Malyshev -Ukraine University, 2018- 396 p.
- 2. British Pharmacopoeia, 2004. - CD-ROM, v. 3.0.
- 3. European Pharmacopoeia. Third Edition. Supplement, 2008. Council of Europe Strasbourg.

4. Clarke's Analysis of Drugs and Poisons, London: Pharmaceutical Press, Electronic version, 2005.