Federal State Autonomous Educational Institution of Higher Education
«Peoples' Friendship University of Russia»

the Shared Research and Educational Center

WORKING PROGRAM OF THE DISCIPLINE /

Name of the discipline:

Pharmacopoeia Methods

Recommended for (field/ specialty):

33.06.01 Pharmacy

The direction of the program:

Pharmaceutical technology (in collaboration with the University of Basel)

2021

1. Goals and objectives of the discipline:

The purpose of studying the discipline is the formation and development of professional competencies in the field of assessing the quality and safety of medicines (drugs) and related products.

To achieve this goals during the course, the following points are discussed

tasks:

1. Postgraduate students training in the field of pharmaceutical analysis as a branch of pharmaceutical chemistry to ensure the process of pharmaceutical development.
2. Postgraduate students will gain practical knowledge, skills and abilities in the field of pharmaceutical analysis with an emphasis on modern instrumental methods.

2. Place of the discipline in the structure of "the educational program of higher education":

The discipline " Pharmacopoeia methods of analysis" is an optional discipline studied in graduate school in the field of "Pharmacy", direction of Pharmaceutical technology (in collaboration with the University of Basel).

To study this discipline, a graduate student must have a higher pharmaceutical education or relevant specialized retraining, have knowledge, skills and abilities in the field of pharmacology, pharmaceutical technology, pharmaceutical chemistry and pharmacognosy.

The study of the discipline is necessary increase the knowledge of graduate students in the field of pharmaceutical analysis and prepare it for the delivery of the state final certification and defense of the dissertation work.

Table № 1

Previous and subsequent disciplines aimed at the formation of competencies.

№ п/п	Code and name of competence	Previous discipline	Subsequent disciplines (disciplines unit)
General professional competencies			
1	GPC-3: the ability and preparation to analyze, summarize and publicly present the results of scientific research.	Methodology of scientific research	Research practice, Scientific research, State final certification
2	GPC-4: preparation to implement the developed methods and techniques aimed at the rational, effective, and safe use of medicines.	Methodology of scientific research	Research practice, Scientific research, State final certification
3	GEPC-5: ability and preparation to use laboratory and instrumental equipment for obtaining scientific data.	Methodology of scientific research	Research practice, Scientific research, State final certification
Professional competence			

4	PC-1: ability to do scientific research on the development and creation of innovative drugs, including the ones which are derived from medicinal plant materials	Methodology of scientific research	Research practice, Scientific research, State final certification
5	PC-2: ability for scientific research on obtaining more advanced forms of drugs with predictable pharmacokinetic characteristics based on modern technologies	Methodology of scientific research	Research practice, Scientific research, State final certification

3. Requirements for mastering the discipline:

The discipline study process aims to develop the following competencies:

- GEPC-3: The ability and willingness to analyze, summary and publicly display the results of scientific research
- GEPC -4: The ability to implement developed methods and techniques aimed at rational, effective and safe use of medicines
- GEPC -5: The ability and willingness to use a laboratory equipment and tools to obtain scientific data
- PC-1: ability to do scientific research on the development and creation of innovative drugs, including those which are derived medicinal plant materials
- PC-2: ability for scientific research on obtaining more advanced forms of drugs with predictable pharmacokinetic characteristics based on modern technologies

As a result of studying the discipline, a graduate student must:

Know: 1 - the fundamentals of general theoretical disciplines in the amount necessary for solving professional tasks;
2 - the basics of pharmaceutical analysis, as a section of pharmaceutical chemistry to ensure the process of pharmaceutical development;
3 – theoretical foundations of modern pharmacopoeia methods of analysis.

Be able to: 1 – apply the obtained theoretical knowledge in the development and validation of analytical techniques;
2 -prepare reagents for the analysis of drugs in accordance with the requirements of the pharmacopoeia;
3 - analyze drugs using chemical and physicochemical methods in accordance with the requirements of the pharmacopoeia;
4 - interpret and evaluate the results of drug analysis;
5 - to determine the physical and chemical properties (characteristics) of individual dosage forms;
6 - The use of standard documentation that regulates the processes of developing, producing and standardizing medicines.

Obtain: 1 - the skills of conducting scientific research in the field of the discipline, both as part of a group and independently, while implementing special methods of obtaining new knowledge.

4. Scope of discipline and types of educational work

The total workload of the discipline is 4 credit units

Type of educational work	Total hours	Courses
		2 courses
Classs (lessons) (total)	144	144
Includes :		
Lectures	40	40

Practical lessons (P3)	40	40
Seminars (S)	-	-
Laboratory work (LW)	-	-
Independent work (IW) (total)	46	46
Includes:	-	-
Course project (work)	-	-
design and graphic works	-	-
abstract	46	46
Other types of independent work		
intermediate validation (test, exam)	18, credit	18, credit
Total– hour / cred. units	144/4	144/4

5. Content of the discipline

5.1. Contents of discipline sections

№ п/п	The name of the section, the topic of the academic discipline (module)	Section content, topic (module) in educational units
1	Pharmaceutical analysis (introduction)	Medicines quality assessment system. The constancy of the composition is a necessary condition during all stages of a medicinal product shelf-life. The relativity of requirements and methods for assessing quality, depending on the pharmacological action of the substance (purpose, dosage, method of administration), the method of production, the presence of auxiliary and accompanying substances in the dosage form. Unification and standardization of medicinal substances tests of the same types. Unification and standardization of tests of the same type in groups of medicinal substances. General provisions, general and particular articles of the pharmacopoeia, and their interrelation. Description of the appearance of the drug substance and assessment of its solubility as a general reference characteristic of the test substance. The value of the indicators "description" and "solubility" for assessing the qualitative changes of a medicinal substance, for performing individual stages of pharmaceutical analysis.
2	Identification of inorganic and organic medicinal substances (individual and included in complex dosage forms)	Possibilities of using the melting and solidification temperature, absorption in the ultraviolet region of the spectrum (UV spectrophotometry) and thin layer chromatography (TLC) in identity tests. Standardized methods in the analysis of groups of medicinal substances. Changing the nomenclature of medicinal substances and improving the methods of their identification in conjunction

		with the development of chemical and physical sciences. Application of infrared (IR) spectrophotometry, nuclear magnetic resonance (NMR) spectroscopy, mass spectrometry (MS) and high performance liquid chromatography (HPLC); Characteristics of using standard samples for medicinal materials and standard spectra..
3	General Pharmacopoeia Regulations for the determination of undefined substances in Medicines (Purity Tests)	Reasons leading to a change in the structure of the drug substance (exposure to light, moisture, temperature and other factors stipulated by the conditions and periods of storage). The nature and characters of impurities (industrial impurities, intermediate products, feedstock). The influence of impurities on the qualitative and quantitative composition of the drug and the possibility of changing its pharmacological activity (specific and general impurities).. Techniques for establishing the limits of permissible impurities, based on the degree of sensitivity of chemical reactions (reference and standardless methods). Pharmacopoeial tests for the most common impurities (chlorides, sulfates, etc.). Arsenic test. Methods for quantitative and semi-quantitative assessment of the content of impurities: chemical, physical and physicochemical (optical, chromatographic, etc.). Development of requirements for purity testing in medicinal substances and dosage forms. Advances in pharmaceutical analysis and rationalization of the scope and importance of individual trials.
4	Unification of quantitative analysis methods of medicinal products, and its value. Modern methods of instrumental analysis.	General Articles of the State Pharmacopoeia. Basic requirements for choosing a method that allows to evaluate the content of a medicinal substance by functional groups that characterize its properties. Features of quantitative analysis as applied to individual substances and dosage forms. Validation of analytical methods. Relative specificity, sensitivity, correctness (accuracy) and reproducibility of the method. Weight analysis (gravimetry). Determination of nitrogen in organic compounds. Method of acid-base titration in aqueous and non-aqueous media, complexometry, argentometry, bromatometry, iodometry, nitritometry. Optical methods: UV and IR spectrophotometry, NMR spectroscopy, photometry in the visible region of the spectrum, refractometry, polarimetry. Chromatographic methods: gas-liquid chromatography (GLC) and high performance liquid chromatography (HPLC), electrophoresis. Methods based on the thermodynamic properties of substances: thermographic, phase solubility method. Modern trends in the development of pharmaceutical analysis. Combination of extraction, chromatographic and optical methods in the analysis of dosage forms.
5	Stability and shelf life of medicines	Storage: problems related to stability during storage of medicines. Pharmacopoeia requirements for packaging and storage conditions of medicinal products, depending on their

		physicochemical, physical and chemical properties. The types of reactions that most often lead to a change in substances under the influence of environmental factors (oxidation, hydrolysis, isomerization, decarboxylation, condensation, etc.). Kinetics of reactions. Possibility of predicting shelf life based on the "accelerated aging" method (Van't Hoff, Arrhenius equations). Warranty and expiration dates. The relationship between the shelf life and purity of medicines. Ways to solve the problem of stability (increased requirements for the purity of the starting compounds, stabilization of dosage forms).
6	Analysis of medicinal substances in biological fluids	General understanding of pharmacokinetics and bioavailability; terminology (rate constant of elimination, half-elimination period, clearance, volume of distribution, etc.). Types of metabolism and their significance for solving problems of biopharmaceutical analysis. The relationship between the concentration of a medicinal substance in biological fluids and its effect. Features of the qualitative and quantitative analysis of medicinal substances and their metabolites in biological fluids. Comparative evaluation of optical, chromatographic and other methods used for the determination of drugs in biological fluids.
7	Standardization of medicines	The national system of institutions and activities aims to plan and develop the regulatory documentation of medicines. Standardization of medicines in accordance with unified requirements and methods for testing medicines. The current state and ways of improving the standardization of medicines. System for improving monographs of pharmacopoeia. The role and place of metrology in standardization and quality control of medicines. Standard samples. Quality assurance in the production, distribution, storage and consumption of medicines. Prospects for the development of research on the search for new drugs and the improvement of methods for their assessment.
8	Quality control and certification of medicines	General methodological approaches to assessing drug quality and dosage forms. The current state and tasks of quality control in the intra-pharmaceutical production of medicines. Medicines certification concept. The system of certification of medicines in the Russian Federation. International drug certification systems.

5.2. Sections of discipline and types of classes

№ п/п	The name of the discipline section	Lectures.	Practical classe	Lab. classes	Seminar	Independent work	Total hours
1.	Pharmaceutical analysis	2	2	-	-	-	2

	(introduction)						
2.	Identification of inorganic and organic medicinal substances (individual and included in complex dosage forms)	4	8	-	-	8	4
3.	General Pharmacopoeia Regulations for the determination of undefined substances in Medicines (Purity Tests)	4	-	-	-	6	
4.	Unification of quantitative analysis methods of medicinal products, and its value. Modern methods of instrumental analysis.	8	20			8	
5.	Stability and shelf life of medicines	4	10			6	
6.	Analysis of medicinal substances in biological fluids	4	-			6	
7.	Standardization of medicines	8	-			6	
8.	Quality control and certification of medicines	6	-			6	
Total:		40	40			46	
							Total hours - 126

6. Laboratory practice

№ п/п	The name of the discipline section	Name of laboratory (practical) work	Total hours
1.	Pharmaceutical analysis (introduction)	prevention of accidents, work with normative documentation, textbooks, workshops, tutorials, reference books. The order of registration of works	2
2.	Identification of inorganic and organic medicinal substances (individual and included in complex dosage forms)	General methods for determining the quality of medicinal products of inorganic origin: test for authenticity. General methods for determining the quality of medicines. Determination of solubility, melting and boiling points, acidity, volatiles, water, ash. The use of physicochemical constants in assessing the good quality of drugs. General methods for determining the quality of medicines. Tests for transparency, turbidity, color, impurities of inorganic ions. Reference and non-reference methods	8

3.	Unification of quantitative analysis methods of medicinal products, and its value. Modern methods of instrumental analysis.	eneral methods for determining the quality of medicines. Tests for transparency, turbidity, color, impurities of inorganic ions. Reference and non-reference methods Method of acid-base titration in aqueous and non-aqueous media, complexometry, argentometry, bromatometry, iodometry, nitritometry. Spectral methods in modern pharmaceutical analysis. Mass and NMR spectroscopy. Atomic adsorption and emission spectroscopy. Chromatographic methods: gas-liquid chromatography (GLC) and high performance liquid chromatography (HPLC). Validation of analytical methods. Relative specificity, sensitivity, correctness (accuracy) and reproducibility, etc	20
4	Stability and shelf life of medicines	Methods used to determine drug shelf life. Natural and artificial aging methods. Evaluation methods: photometry, chromatographic methods, etc.	10
Total hours:			40

MATERIAL AND TECHNICAL SUPPORT OF THE DISCIPLINE

During the program, the following are used: a personal computer, multimedia equipment, laboratory equipment, products and samples for testing.

Name of the specialized laboratory	Type of calss	Equipment identification
Room number 123 in the Shared Research and Educational Center	Lectures	Computer, multimedia projector, screen, board
Laboratories of the Shared Research and Educational Center	Laboratory exercises	Fourier transform infrared spectrometer 3100 FT-IR Excalibur Series, Atomic absorption spectrometer AA-240G, Inductively coupled plasma emission spectrometer Varian mod. ICP-720ES, Spectrophotometer UV / VID, CARY 100, Liquid chromatograph Agilent 1200, Agilent 1200 Infinity LC Liquid Chromatograph, Agilent 1260 Infinity II LC Liquid Chromatograph, Shimadzu Prominence liquid chromatograph with SPD-M20A detector, NMR spectrometer JEOL JNM-ECA 600 NM,

		Liquid chromatograph Agilent model 1290 Infinity LC, 50674-12, DAD, with mass-selective detector Agilent 6400 model 6430 LS / MSD Triple Quadrupole, Gas chromatograph Agilent 7890A with automatic head-space sampler sampler Agilent 7694E, Liquid chromatograph Pro Star Varian with spectro-photometric detector, Saturn chromato-mass spectrometer mod. 2100, pH meter-ionomer Ecotest-120, etc.

Main literature	
American Chemical Society (ACS) - electronic journals	http://pubs.acs.org/
Cambridge Journals	https://www.cambridge.org/core
Electronic resources Springer	https://rd.springer.com/
additional literature	
PROQUEST DISSERTATIONS AND THESES GLOBAL	http://search.proquest.com/
Reaxys, Reaxys Medicinal Chemistry	https://www.reaxys.com/

Intermediate Certificate Assessment Fund

Passport of the fund of assessment tools for the discipline biotechnology 2020/2021

Direction / Specialty 06.33.01 "Pharmacy" postgraduate study in the direction of Pharmaceutical technology (in collaboration with the University of Basel) Discipline " pharmacopoeia methods of analysis"

Controlled competence code	Controlled discipline topic	forms of control of the level of development of general educational programs			Topic scores
		Classroom work		Independent work	
		Work in class	Attending lectures	abstract	
GEPC-3, GEPC-4, GEPC-5, PC-1, PC-2	Pharmaceutical analysis (introduction)	4	1		2
GEPC-3, GEPC-4, GEPC-5, PC-1, PC-2	Identification of inorganic and organic medicinal substances (individual and included in complex dosage forms)	15	1	4	2
GEPC-3, GEPC-4, GEPC-5, PC-1, PC-2	General Pharmacopoeia Regulations for the determination of undefined substances in Medicines (Purity Tests)		1	4	2
GEPC-3, GEPC-4, GEPC-5, PC-1, PC-2	Unification of quantitative analysis methods of medicinal products, and its value. Modern methods of instrumental analysis.	30	1	4	
GEPC-3, GEPC-4, GEPC-5,	Stability and shelf life of medicines	15	1	4	4

PC-1, PC-2					
GEPC-3, GEPC-4, GEPC-5, PC-1, PC-2	Analysis of medicinal substances in biological fluids		1	4	2
GEPC-3, GEPC-4, GEPC-5, PC-1, PC-2	Standardization of medicines		1	4	2
GEPC-3, GEPC-4, GEPC-5, PC-1, PC-2	Quality control and certification of medicines		1	4	4
		20	8	28	100

Questions to the post-graduate examination in the discipline "pharmacopoeia methods of analysis"

1- The system for assessing the quality of medicines. The constancy of the composition as a necessary condition at all stages of the existence of a medicinal product.

2- The relativity of the requirements and methods for assessing quality depending on the pharmacological action of the substance (purpose, dosage, route of administration), the method of production, the presence of auxiliary and accompanying substances in the dosage form.

3- Unification and standardization of similar tests in groups of medicinal substances. General provisions, general and particular articles of the pharmacopoeia, their correlation.

4- Description of the appearance of the drug substance and assessment of its solubility as a general indicative characteristic of the test substance. The value of the "description" and "solubility" indicators for assessing the qualitative changes in a medicinal substance, for performing individual stages of pharmaceutical analysis.

5- Possibilities of using the melting and solidification temperature, absorption in the ultraviolet region of the spectrum (UV spectrophotometry) and thin layer chromatography (TLC) in authenticity tests. Unified methods in the analysis of groups of medicinal substances.

6- Changing the nomenclature of medicinal substances and improving the methods of their identification in conjunction with the development of chemical and physical sciences. Applications of infrared (IR) spectrophotometry, nuclear magnetic resonance (NMR) spectroscopy, mass spectrometry (MS) and high performance liquid chromatography (HPLC); features of using standard samples of medicinal substances and standard spectra.

7- Reasons leading to a change in the structure of the medicinal substance (exposure to light, moisture, temperature and other factors stipulated by the conditions and shelf life).

8- The nature and character of impurities (industrial impurities, intermediates, raw materials). The influence of impurities on the qualitative and quantitative composition of the drug and the possibility of changing its pharmacological activity (specific and general impurities).

9- Techniques for setting the limits of permissible impurities based on the degree of sensitivity of chemical reactions (reference and non-reference methods). Pharmacopoeia tests for the most common impurities (chlorides, sulfates, etc.). Arsenic test.

10- 10. Methods for quantitative and semi-quantitative assessment of the content of impurities: chemical, physical and physicochemical (optical, chromatographic, etc.).

11- Development of requirements for testing for purity in medicinal substances and dosage forms. Advances in pharmaceutical analysis and rationalization of the scope and importance of individual trials.

12- Requirements for choosing a method that allows assessing the content of a medicinal substance by functional groups that characterize its properties. Features of quantitative analysis in relation to individual substances and medicinal forms. Validation of analytical methods. Relative specificity, sensitivity, accuracy (precision) and reproducibility of the method.

13- Weight analysis (gravimetry).

14- Determination of nitrogen in organic compounds.

15- Method of acid-base titration in aqueous and non-aqueous media, complex-sonometry, argentometry, bromatometry, iodometry, nitritometry.

16- Optical methods: UV and IR spectrophotometry, NMR spectroscopy, photometry in the visible region of the spectrum, refractometry, polarimetry.

17- Chromatographic methods: gas-liquid chromatography (GLC) and high-performance liquid chromatography (HPLC), electrophoresis.

18- Methods based on the thermodynamic properties of substances: thermographic, phase solubility method.
19- Current trends in the development of pharmaceutical analysis. Combination of extraction, chromatographic and optical methods in the analysis of dosage forms.
20- Storage: problems related to stability during storage of drugs. Pharmacopoeial requirements for packaging and storage conditions of medicinal products, depending on their physicochemical, physical and chemical properties.
21- Types of reactions that most often lead to a change in substances under the influence of environmental factors (oxidation, hydrolysis, isomerization, decarboxylation, condensation, etc.). Kinetics of reactions. Possibility of predicting shelf life based on the "accelerated aging" method (Van't Hoff, Arrhenius equations).
22- Warranty and expiration dates. The relationship between the shelf life and purity of medicines.
23- Ways to solve the problem of stability (increased requirements for the purity of the starting compounds, stabilization of dosage forms).
24- Problems of pharmaceutical chemistry in connection with the tasks of pharmacokinetics and bioavailability of medicinal substances. General understanding of pharmacokinetics and bioavailability; terminology (rate constant of elimination, elimination half-life, clearance, volume of distribution, etc.). Metabolic types and their importance for solving problems of biopharmaceutical analysis.
25- Relationship between the concentration of a medicinal substance in biological fluids and its action. Features of the qualitative and quantitative analysis of medicinal substances and their metabolites in biological fluids.
26- Comparative evaluation of optical, chromatographic and other methods used to determine drugs in biological fluids.
27- The national system of institutions and activities aimed at planning and developing regulatory documents for medicines.
28- Standardization of medicines in accordance with unified requirements and testing methods for medicines.
29- The current state and ways of improving the standardization of medicines.
30- Methods for improving pharmacopoeial monographs.
31- The role and place of metrology in standardization and quality control of medicines. Standard samples.
32- Quality assurance in the production, distribution, storage and consumption of medicines.
33- Prospects for the development of research to find new drugs and improve methods for their assessment.
34- General methodological techniques in assessing the quality of medicinal substances and their dosage forms.
35- The current state and tasks of quality control in the intra-pharmaceutical production of medicines.
36- The concept of certification of medicines.
37- The system of certification of medicines in the Russian Federation.
38- International systems of certification of medicines.

The creator

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