DANYLO HALYTSKY LVIV NATIONAL MEDICAL UNIVERSITY

Department of Pharmacognosy and botany

APPROVED
First vice-rector
for scientific and pedagogical work
Assoc. Prof I.I.Solonynko
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CURRICULUM OF THE ACADEMIC DISCIPLINE

EQ 22.2. RESOURCES STUDIES OF MEDICINAL PLANTS

(name of the academic discipline)

for preparation of specialists
of the second (master) level of higher education
of knowledge area 22 «Health care»,
specialty 226 «Pharmacy, industrial pharmacy»

for students of the 5th course, Faculty of Pharmacy
(English medium)

Discussed and approved
at the Methodical sitting of the Department
of Pharmacognosy and botany.
Report of Proceeding No. 1
dated August, 31 2023

Head of the Department
Assoc. Prof. Shapovalova N.V.

Approved
by the Profile Methodical Commission
in chemical and pharmaceutical subjects.
Report of Proceeding No. 4
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Head of the Profile Methodical Commission
Prof. Bilous S.B.

Lviv – 2023

THE CURRICULUM WAS PREPARED BY: head of the Department of Pharmacognosy and botany at Danylo Halytsky Lviv National Medical University Associate Professor, PhD (Pharm.) N.V. Shapovalova; Associate Professor, PhD (Pharm.) R.Y. Darmohray; Assistant Professor, PhD (Pharm.) R.M. Lysiuk.

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INTRODUCTION

Program of studying the discipline "Resources studies of medicinal plants"

in accordance with the Standard of Higher Education of the *second (master) level*

of knowledge area *22 "Health care",*

specialty 226 «Pharmacy, industrial pharmacy»

Educational Program of *Master Degree* in Pharmacy

Description of the educational discipline (summary)

Resources studies of medicinal plants is one of the profile disciplines of pharmacognostic training, which is of great importance for the formation of professional knowledge, skills and abilities of the Master of Pharmacy. It provides the future specialist with comprehensive knowledge of the raw material base of medicinal plants, medicinal plant materials (MPM), contributes to the formation of the necessary worldview on the rational use of natural plant resources, their protection and reproduction.

Pharmacognostic training involves theoretical and practical preparation of the Master of Pharmacy with the main professional activities in the field of herbal medicines, requires solving problems ranging from developing a system of rational use of medicinal plant resources, collection of medicinal plant materials, ending with its processing and obtaining in the form of medication. To perform it, the specialist must be able to properly and timely harvest, dry the raw material, bring the latter to a standard state and process it into various drugs, as well as analyze the obtained phytopharmaceuticals.

Structure of the academic discipline	**Number of credits, hours, incl.**				**Year of studying, semester**	**Type of summary control**
	Total	**Classroom hours**		**Independent work** (hours)		
		Lectures (hours)	Practical classes (hours)			
«Resources studies of medicinal plants» ***Content modules 2***	3 credits / 90 hours	8	30	52	5th course (IX semester)	Credit

The subject of study of the discipline comprises the raw material resources of medicinal plants, the methodology of their accounting and the system for rational use, protection and reproduction.

The main types of classes in the discipline according to the curriculum are lectures, laboratory classes and independent work of students. Lectures aim to form in students the base of theoretical knowledge, to determine the direction, main content and chatacteristics of all other types of classes and independent work of students. During laboratory classes, the effectiveness of students' mastery of the basic theoretical principles of educational material, the acquisition of practical skills and abilities in the discipline is tested. Independent work of students is the main means of processing program material in free time from compulsory classes and it consists of classroom and extracurricular work, provides preparation for laboratory classes, self-study of some program objects.

Interdisciplinary relations:

Resources studies of medicinal plants is based on the knowledge gained by students in the study of Latin, Pharmaceutical botany, Organic, Biological, Analytical chemistry, Biophysics, Physical and colloid chemistry, Normal and Pathological human physiology; the academic discipline lays the foundations for students to study Pharmaceutical and Toxicological chemistry, Pharmacology, Drug

technology, Clinical pharmacy, which involves the integration of teaching with these disciplines and the formation of skills to apply knowledge of Pharmacognosy in further education and professional activities. As a science and academic discipline, Resources studies of medicinal plants plays a leading role in solving such actual problems as search for plant sources and development of effective medicines from natural raw materials, improvement of the quality of medicinal plant materials and herbal products, rational use of natural resources, protection and recreation of wild growing medicinal plants.

1. Purpose and tasks of the academic discipline

1.1. The purpose of the discipline "Resources studies of medicinal plants" is to develop in students a holistic view of the current state of plant resources in some regions and the state as a whole, promising medicinal plants, to provide for future professionals a comprehensive knowledge concerning medicinal plants, sustainable use and protection of resources.

1.2. The main tasks of studying the discipline "Resources studies of medicinal plants" are

- The study of application of stocks of medicinal plants and natural vegetation as a source of MPM resources.
- Study of the species composition of medicinal plants, their habitat and eco-phytocoenotic growth conditions.
- Determination of productivity of medicinal plant materials.
- Determination of the volume and location of operational stocks of medicinal plant materials.
- Conducting of chemical inventory of plant thickets and investigation of phenophases of maximum accumulation of bioactive substances (BAS).
- Calculation of the amount of possible annual collection of medicinal plants.
- Mapping of thickets and stocks of medicinal plants.
- Study of phenorhytms and terms for recreation of primary stocks of medicinal plant materials based on biological and ecological and phytocoenotic growth conditions of medicinal herbs.
- Development of rational mode for harvesting of medicinal plant materials depending on the biological characteristics and phytocoenotic environmental growth conditions of medicinal plants.
- Development of a unified system for protection and reproduction of resources of medicinal plants (organization of reserves, naturalization of thickets *etc*.).
- Development of economics of collection processes for medicinal plant materials.

1.3 Competences and learning outcomes facilitated by the discipline (relationship with the normative content of higher education applicants' training, formulated in terms of the learning outcomes of the Standard of Higher Education).

In accordance with the requirements of the Standard of Higher Education, the discipline provides students with the ***competencies:***

- *integral:*

Ability to solve typical and complex specialized tasks and practical problems in the learning process, which involves carrying out of research, implementation of innovations and is characterized by complexity.

- *general:*

CG 1. The ability for abstract thinking, analysis and synthesis.
CG 2. Knowledge and understanding of the subject area and understanding of the professional activity.
CG 05. Ability to assess and ensure the quality of performed work.
CG 06. The ability to work in a team.

- *specialty:*

CS 01. Ability to integrate knowledge and solve complex pharmacy/industrial pharmacy problems in broad or multidisciplinary contexts.
CS 03. Ability to solve pharmacy problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility.
CS 05. Ability to demonstrate and apply communicative communication skills and fundamental principles of pharmaceutical ethics and deontology in practical activities.
CS 12. Ability to ensure the proper storage of medicinal products and medical devices in accordance with their physical and chemical properties and Good Storage Practices (GSP) rules in health care facilities.
CS 19. Ability to organize and carry out quality control of medicinal products in accordance with the requirements of the current edition of the State Pharmacopoeia of Ukraine, quality control methods, technological instructions, etc.; carry out standardization of medicinal products in accordance with current requirements; to prevent the distribution of low-quality, falsified and unregistered medicinal products.
CS 20. The ability to develop and evaluate methods of quality control of medicines, including active pharmaceutical ingredients, medicinal plant raw materials and auxiliary substances using physical, chemical, physico-chemical, biological, microbiological and pharmaco-technological methods of control.
CS 21. Ability to organize and carry out the collection of medicinal plant raw materials in accordance with the rules of the *Good agricultural and collection practices* (GACP) for starting materials of herbal origin; to forecast and substantiate ways of solving the problem of preservation and protection of thickets of wild medicinal plants, in accordamce with applicable regulations

Detalization of the competencies according to the descriptors of the national framework of qualifications (NFQ) in the form of the Competency Matrix.

Competency matrix

Competence	**Knowledge**	**Ability**	**Communication**	**Autonomy and responsibility**
Integral competence				
Ability to solve typical and complex specialized tasks and practical problems in the learning process, which involves carrying out of research, implementation of innovations and is characterized by complexity.				
General competencies				
CG 1. The ability for abstract thinking, analysis and synthesis.		AB2 Ability to integrate knowledge and solve complex problems in broad multidisciplinary contexts		
CG 05. Ability to assess and ensure the quality of performed work.	KN1 Specialized conceptual knowledge that includes modern scientific achievements in the field of professional activity or of knowledge area and is the basis for	AB 1 Specialized skills/problem-solving abilities necessary for conducting research and/or carrying out innovative activities in order to develop new knowledge and procedures		

	original thinking and conducting research, critical understanding of problems in the area and at the border of knowledge areas			
CG 05. Ability to assess and ensure the quality of performed work.	KN1 Specialized conceptual knowledge that includes modern scientific achievements in the field of professional activity or of knowledge area and is the basis for original thinking and conducting research, critical understanding of problems in the area and at the border of knowledge areas	AB 1 Specialized skills/problem-solving abilities necessary for conducting research and/or carrying out innovative activities in order to develop new knowledge and procedures AB2 Ability to integrate knowledge and solve complex problems in broad multidisciplinary contexts AB 3 Ability to solve problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility	C1 Clear and unambiguous presentation of own knowledge, conclusions and arguments to specialists and non-specialists, in particular, to persons who are studying	AR1 Management of work or learning processes that are complex, unpredictable and require new strategic approaches AR2 Responsibility for contributing to professional knowledge and practice and/or evaluating the results of team and collective activities AR3 Ability to continue learning with a high degree of autonomy
CG 06. The ability to work in a team.		AB 3 Ability to solve problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility	C1 Clear and unambiguous presentation of own knowledge, conclusions and arguments to specialists and non-specialists, in particular, to persons who are studying	AR1 Management of work or learning processes that are complex, unpredictable and require new strategic approaches AR2 Responsibility for contributing to professional knowledge and practice and/or evaluating the results of team and collective activities
Specialty competencies				
CS 01. Ability to integrate knowledge and solve complex pharmacy/industrial pharmacy problems in broad or multidisciplinary contexts.	KN1 Specialized conceptual knowledge that includes modern scientific achievements in the field of professional activity or of knowledge area and is the basis for original thinking and conducting research, critical understanding of problems in the area and at the border of knowledge areas	AB 1 Specialized skills/problem-solving abilities necessary for conducting research and/or carrying out innovative activities in order to develop new knowledge and procedures AB2 Ability to integrate knowledge and solve complex problems in broad multidisciplinary contexts		AR1 Management of work or learning processes that are complex, unpredictable and require new strategic approaches AR2 Responsibility for contributing to professional knowledge and practice and/or evaluating the results of team and collective activities

CS 03. Ability to solve pharmacy problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility.		AB 3 Ability to solve problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility		AR1 Management of work or learning processes that are complex, unpredictable and require new strategic approaches AR2 Responsibility for contributing to professional knowledge and practice and/or evaluating the results of team and collective activities
CS 05. Ability to demonstrate and apply communicative communication skills and fundamental principles of pharmaceutical ethics and deontology in practical activities.	KN1 Specialized conceptual knowledge that includes modern scientific achievements in the field of professional activity or of knowledge area and is the basis for original thinking and conducting research, critical understanding of problems in the area and at the border of knowledge areas	AB 1 Specialized skills/problem-solving abilities necessary for conducting research and/or carrying out innovative activities in order to develop new knowledge and procedures AB2 Ability to integrate knowledge and solve complex problems in broad multidisciplinary contexts AB 3 Ability to solve problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility	C1 Clear and unambiguous presentation of own knowledge, conclusions and arguments to specialists and non-specialists, in particular, to persons who are studying	AR1 Management of work or learning processes that are complex, unpredictable and require new strategic approaches AR3 Ability to continue learning with a high degree of autonomy
CS 12. Ability to ensure the proper storage of medicinal products and medical devices in accordance with their physical and chemical properties and Good Storage Practices (GSP) rules in health care facilities.	KN1 Specialized conceptual knowledge that includes modern scientific achievements in the field of professional activity or of knowledge area and is the basis for original thinking and conducting research, critical understanding of problems in the area and at the border of knowledge areas	AB 1 Specialized skills/problem-solving abilities necessary for conducting research and/or carrying out innovative activities in order to develop new knowledge and procedures AB2 Ability to integrate knowledge and solve complex problems in broad multidisciplinary contexts		AR1 Management of work or learning processes that are complex, unpredictable and require new strategic approaches AR2 Responsibility for contributing to professional knowledge and practice and/or evaluating the results of team and collective activities
CS 19. Ability to organize and carry out quality control of medicinal products in accordance with the requirements of the current edition of the State Pharmacopoeia of Ukraine, quality control methods, technological	KN1 Specialized conceptual knowledge that includes modern scientific achievements in the field of professional activity or of	AB 1 Specialized skills/problem-solving abilities necessary for conducting research and/or carrying out innovative activities in order to develop new knowledge and procedures AB2 Ability to integrate	C1 Clear and unambiguous presentation of own knowledge, conclusions and arguments to specialists and non-specialists, in particular, to persons	AR1 Management of work or learning processes that are complex, unpredictable and require new strategic approaches AR2 Responsibility for contributing to

instructions, etc.; carry out standardization of medicinal products in accordance with current requirements; to prevent the distribution of low-quality, falsified and unregistered medicinal products. .	knowledge area and is the basis for original thinking and conducting research, critical understanding of problems in the area and at the border of knowledge areas	knowledge and solve complex problems in broad multidisciplinary contexts AB 3 Ability to solve problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility	who are studying	professional knowledge and practice and/or evaluating the results of team and collective activities
CS 20. The ability to develop and evaluate methods of quality control of medicines, including active pharmaceutical ingredients, medicinal plant raw materials and auxiliary substances using physical, chemical, physico-chemical, biological, microbiological and pharmaco-technological methods of control.	KN1 Specialized conceptual knowledge that includes modern scientific achievements in the field of professional activity or of knowledge area and is the basis for original thinking and conducting research, critical understanding of problems in the area and at the border of knowledge areas	AB 1 Specialized skills/problem-solving abilities necessary for conducting research and/or carrying out innovative activities in order to develop new knowledge and procedures AB2 Ability to integrate knowledge and solve complex problems in broad multidisciplinary contexts AB 3 Ability to solve problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility		AR1 Management of work or learning processes that are complex, unpredictable and require new strategic approaches AR2 Responsibility for contributing to professional knowledge and practice and/or evaluating the results of team and collective activities AR3 Ability to continue learning with a high degree of autonomy
CS 21. Ability to organize and carry out the collection of medicinal plant raw materials in accordance with the rules of the *Good agricultural and collection practices* (GACP) for starting materials of herbal origin; to forecast and substantiate ways of solving the problem of preservation and protection of thickets of wild medicinal plants, in accordamce with applicable regulations	KN1 Specialized conceptual knowledge that includes modern scientific achievements in the field of professional activity or of knowledge area and is the basis for original thinking and conducting research, critical understanding of problems in the area and at the border of knowledge areas	AB 1 Specialized skills/problem-solving abilities necessary for conducting research and/or carrying out innovative activities in order to develop new knowledge and procedures AB2 Ability to integrate knowledge and solve complex problems in broad multidisciplinary contexts AB 3 Ability to solve problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility	C1 Clear and unambiguous presentation of own knowledge, conclusions and arguments to specialists and non-specialists, in particular, to persons who are studying	AR1 Management of work or learning processes that are complex, unpredictable and require new strategic approaches AR2 Responsibility for contributing to professional knowledge and practice and/or evaluating the results of team and collective activities AR3 Ability to continue learning with a high degree of autonomy

Learning outcomes:
Integrative final program learning outcomes, the formation of which is facilitated by the discipline "Resources studies of medicinal plants":

PRA01. Possess specialized conceptual knowledge in the field of pharmacy and related fields, taking into account modern scientific achievements, and be able to apply them in professional activities.
PRA03. Possess specialized knowledge and abilities/skills for solving professional problems and tasks, including for the purpose of improving knowledge and procedures in the field of pharmacy.
PRA04. Communicate fluently in the national and English languages orally and in writing to discuss

professional problems and results of activities, presentation of scientific research and innovative projects.
PRA06. Develop and make effective decisions to solve complex problems of pharmacy personally and based on the results of joint discussion; formulate the goals of one's own activity and the activity of the collective, taking into account social and industrial interests, general strategy and existing limitations, determine the optimal ways of achieving goals.
PRA07. Analyze the necessary information on the development and production of medicinal products, using professional literature, patents, databases and other sources; systematize, analyze and evaluate it, in particular, using statistical analysis.
PRA08. Develop and implement innovative projects in the field of pharmacy, as well as related interdisciplinary projects taking into account technical, social, economic, ethical, legal and environmental aspects.
PRA15. To predict and determine the influence of environmental factors on the quality and consumer characteristics of medicines and other products of the pharmacy assortment, to organize their storage in accordance with their physical and chemical properties and the rules of Good Storage Practices.
PRA24. Use data from clinical, laboratory and instrumental studies to monitor the effectiveness and safety of the application of medicinal products.

Learning outcomes for the discipline "Resources studies of medicinal plants":

to know:
- basic concepts and terminology of «Resources studies of medicinal plants»;
- species of medicinal plants that grow in the Ukraine and introduced ones;
- types of herbs that do not grow in Ukraine, but are sources of raw materials for production of herbal drugs or dietary supplements, that are represented in the pharmacy network;
- current state of the resource base of medicinal plants; the accounting, uses and conservation for resources of medicinal plants;
- basics of harvesting process;
- modern methods for determination of productivity and stocks of wild growing medicinal plants;
- rules of MPM collection and their importance in maintaining of wild growing medicinal plant stocks;
- ways of rational uses and protection of resources of medicinal plants.

to be able to:
- systematize the knowledge obtained in the study « Resources studies of medicinal plants » on lectures and laboratory works;
- navigate within the challenges of modern pharmaceutical production of MPM;
- determine the location of the growth of medicinal plants;
- select and use the medium- and large-scale maps for route development and mapping of stocks of medicinal plants;
- to harvest medicinal plant materials rationally;
- determine the stocks of wild medicinal plants and calculate the amount of possible annual collection;
- develop scientifically substantiated plans on harvesting of medicinal plants in the district, region or forest areas.
- apply knowledge for the sustainable use of plant resources and environmental protection;
- organize and carry out the collection of medicinal plant raw materials considering the rational use of resources of medicinal plants, to predict and substantiate ways to solve the problem of conservation and protection of thickets of wild medicinal plants in accordance with the rules of the *Good agricultural and collection practices* (GACP) for starting materials of herbal origin

2. Information volume of the academic discipline "Resources studies of medicinal plants"
3.0 credits of ECTS, 90 hours, are allocated to the study of academic discipline.

The discipline "Resources studies of medicinal plants" is structured into content modules:

<u>Content module 1.</u> Flora and its diversity. Preparatory works of medicinal plants resources studies

Specific goals:

- To get acquainted with the term «Resources studies of medicinal plants» as a scientific direction and professional discipline, its purpose and objectives, main directions of resources research, practical and scientific value of the resources studies of medicinal plants;
- To acquire and learn the essence of basic concepts and terms used in the resources studies of medicinal plants and phytocoenology (phytosociology);
- To get acquainted with the stages of resource research, purpose and objectives of preparatory works of the resources studies;
- Learn to perform preparatory works for the resources studies;
- Be able to detect potentially productive tracts of examination based on literary materials, forest taxation descriptions and other sources, analysis of MPM collection plans by all organizations involved in harvesting processes;
- Be able to select the species of medicinal plants as possible and promising resource research items;
- Learn to make eco-phytocoenotic characterization of medicinal plants that grow in the area of inspection or their affinity to different plant communities;
- Be able to select and prepare materials for the development of cartographic work routes, inspection and mapping of thickets and stocks of medicinal plants;
- Develop the working routes for resource research;
- Make a list of necessary equipment and other materials for expeditionary research;
- Learn the techniques of of the plant resources studies.

Theme 1. The plant world and its diversity. Tasks of Resources studies of medicinal plants. Geobotanical principles of plant resources studies.

Introduction to Resources studies of medicinal plants. Resources studies of medicinal plants as a science and academician subject. The purpose and objectives. Main directions. Basic concepts and terminology. Methods of plant resources studies. References and training materials. Reporting on plant resources studies. The current state and dynamics for application of resources of wild growing medicinal plants.

Theme 2. Geobotanical basics of Resources studies of medicinal plants.

The main principles of geobotany (phytocoenology). Ecology of plants. Factors that affect the life and development of plants. Biogenic, abiogenic and anthropogenic factors, their positive and negative impact on livelihoods and resources of plants.

Theme 3. Main stages of Resources studies of medicinal plants. research. Preparatory works of Resources studies of medicinal plants. research.

The content, purpose and objectives of preparatory works for Resources studies of medicinal plants. research. Formation of resource research tasks based on the needs of industry and pharmacy network. Detection of potentially - productive areas and medicinal plants, perspective for resource studies. Forest taxation descriptions. Ecological and phytocoenotic characteristics of medicinal plants that grow in the area of inspection or their affinity to different plant communities. Types of cartographic materials needed to develop working routes, survey and mapping of thickets and stocks of medicinal plants. Principles for development of working routes.

Theme 4. Plant associations (groups), their importance in the search of useful plants. The concept of plant material stocks.

The types of phytocoenoses. Geobotanical description of plant associations (plant communities). Trial plots. Neighborhood (environment) of an association. Layering of plant communities. The concept of abundance, vitality, stages of plant development, phenophase of plants. Types and characteristics of medicinal herbs that form the association.

<u>Section 2.</u> Experimental works of Resources studies of medicinal plants research. Rational use and protection of natural resources of medicinal plants

Specific goals:

- Learn the meaning of basic concepts: biological and operational stocks of raw materials, specific overgrown and key plots; possible annual harvesting of MPM; volume value of harvesting;
- Learn the methods for determining MPM productivity;
- Be able to determine the area of thickets (industrial route);
- Be able to conduct a field experiment and calculate productivity by methods of registered plots, projective cover, model specimens;
- Learn the methods of determining reserves (stocks) on specific overgrown and key plots;
- Be able to calculate the value of the operating reserve of raw materials;
- Know the timing for natural reproduction of the primary stocks of MPM: leaves, flowers, fruits, herbs, underground portions of perennial herbaceous plants;
- Be able to calculate the value of possible annual harvesting volume;
- Drawing up the inventory information of thickets and stocks of MPM;
- Be able to carry out mapping for allocation of thickets and stocks of MPM on scheme-maps for various purposes (forest plantations, medium-scale administrative, geobotanical *etc*.).
- Use the rules of rational collection and storage of medicinal plant materials of different morphological and chemical groups, to know the ways of rational use of resources of medicinal plant materials;
- Know the resource groups of medicinal plants of Ukraine and conservation measures for preservation and reproduction of natural resources;
- Develop measures for rational use and protection of determined resources of medicinal plants.

Theme 5. The concept on stocks of MPM. Biological and operating stocks (reserves).
Methods for determining reserves of MPM. The meaning of "specific thickets", "key areas". The principles of choosing the method for determining reserves of medicinal plants. Assessment of stocks on the key areas and specific thickets.

Theme 6. Methods of determining the productivity of medicinal plants. Calculating the value of operational stocks on specific thickets
Methods for determining the productivity of MPM. Principles of selecting the method to determine the raw productivity of undersized, medium-sized, large herbaceous plants, trees, bushes and underground organs of medicinal plants. Determination of medicinal plant overgrown area. Determination of productivity and operational stocks of wild medicinal plants by accounting methods of registered plots, projective cover and model specimens.

Theme 7. Determination of possible annual harvesting value of raw materials. Compilation of inventory reports.
Harvesting volumes of MPM. Terms for natural reproduction of the original stocks of MPM: leaves, flowers, fruits, herbs, underground portions of perennial herbaceous plants. Calculation of the value of possible annual harvesting volume of MPM. Compilation of inventory data reports of thickets and stocks MPM.

Theme 8. Mapping of thickets and stocks of MPM.
Mapping for allocation of thickets and stocks of MPM on scheme-maps for various purposes (forest plantations, medium-scale administrative, geobotanical *etc*.). Evaluation of the economic efficiency of the use of certain stocks of medicinal plants of various natural lands and geomorphological localities. The development of schedule and perspective plan for collection of MPM.

Theme 9. Good agricultural and collection practices (GACP). Prospects for application of cell culture and tissues of medicinal plants as sources of MPM. Introduction and cultivation of medicinal plants.
Introduction and cultivation of medicinal plants for use in the future to obtain valuable varieties for the needs of the pharmaceutical industry. Medicinal plants of world flora introduced in Ukraine. Medicinal plant gene pool of the world medicine in the botanical gardens of Ukraine. The basic principles of WHO

guidelines on good agricultural and collection practices (GACP) for medicinal plants. Cultivation of MP. Achievements and prospects of modern genetics and breeding techniques to produce a sufficient amount of MPM. Problems and uses of isolated plant parts, tissues and cells, methods of biotechnology to supply appropriate volumes of MPM for pharmacy industry.

Theme 10. Rules of efficient collection and storage of medicinal plant materials.

Rules for harvesting of medicinal plant materials: leaves, flowers, fruits, herbs, underground portions of perennial herbaceous plants. The frequency (periodicity) for harvesting of different morphological groups of MPM. Conditions for storage of MPM. Storage groups.

Theme 11. Rational use and protection of natural resources of medicinal plants.

Legislative basis for application of medicinal plant resources. The State cadastre of the plant populations. The current state and dynamics for application of resources of wild MP of Ukraine. Resource groups of medicinal plants of Ukraine. Medicinal plants of the Green and Red data books of Ukraine, the plant checklist of the World Conservation Union. Conservation measures for the conservation, restoration and enhancement of the natural resources of medicinal plants. Rational use and conservation of medicinal plants in Western Ukraine.

3. Structure of an academician subject

Theme	Lectures	Practical works	Independent work	Individual work
Content module 1. The flora and its diversity. Preparatory works of Resources studies of medicinal plants				
Theme 1. The plant world and its diversity. Tasks of Medicinal Plants Resources Science. Geobotanical principles of Medicinal Plants Resources Science	1	2	2	-
Theme 2**.** Geobotanical principles of Medicinal Plants Resources Science	1	-	4	
Theme 3. Main stages of Medicinal Plants Resources Science research. Preparatory works of Medicinal Plants Resources Science research	1	6	4	
Theme 4. Plant associations (groups), their importance in the search of useful plants. The concept of plant material stocks	1	2	4	
Totally in Content module 1	**4,0**	**10**	**14**	
Content module 2. Experimental works of Resources studies of medicinal plants. Rational use and protection of natural resources of medicinal plants				
Theme 5. The concept on stocks of MPM. Biological and operating stocks (reserves).	0,5	2	4	-
Theme 6. Methods of determining the productivity of medicinal plants. Calculating the value of operational stocks on specific thickets	0,5	8	2	
Theme 7. Determination of possible annual harvesting value of raw materials. Compilation of inventory reports.	0,5	2	2	
Theme 8. Mapping of thickets and stocks of MPM.	0,5	2	8	

Theme 9. Good agricultural and collection practices (GACP). Prospects for application of cell culture and tissues of medicinal plants as sources of MPM. Introduction and cultivation of medicinal plants.	1	2	3	
Theme 10. Rules of efficient collection and storage of medicinal plant materials.	0,5	2	10	
Theme 11. Rational use and protection of natural resources of medicinal plants.	0,5	2	9	
Totally in Content module 2	**4,0**	**20**	**38**	
Totally hours 90/3,0 credits ECTS	**8**	**30**	**52**	
Summary control			**Credit control**	

4. Thematic plan of lectures within the subject «*Resources studies of medicinal plants*»

№	THEME	Hours
	Content module 1. The flora and its diversity. Preparatory works of Resources studies of medicinal plants	
1.	Resources of medicinal plants as a science and academician subject. Objectives, tasks, objects and terminology of Resources of medicinal plants. Current state and dynamics for application of resources of wild-growing medicinal plants. Legislative basis for accounting and application of medicinal plant resources in Ukraine. The State cadastre of the plant populations. Resource studies in Ukraine: history, objects, main achievements. Methods of accounting for plant resources (determining the yield and stocks of wild MP).	2
2.	Major sources for obtaining phytopharmaceuticals. Applied volumes of medicinal plants and phytopharmaceuticals in current world medical practice. Uses of medicinal plants in traditional medicine in various regions of the globe. Distribution of the sources of phytopharmaceuticals, included into the European Pharmacopoeia. Medicinal plants of Ukraine as ingredients of native medicines. The main sources of raw materials for obtaining medicinal products of plant origin. Chemosystematics and its role in the search for new species of medicinal plants. Botanically related species of MP.	2
	TOTALLY	**4**
	Content module 2. Experimental works of Resources studies of medicinal plants. Rational use and protection of natural resources of medicinal plants	
3.	Cultivation of medicinal plants in Ukraine and the world. Cultivation as a method of a decrease of anthropogenic load within biocenoses. WHO guidelines on good agricultural and collection practices (GACP) for medicinal plants. Cultivation of isolated plant parts, tissues and cells. Gene – engineering biotechnology of plants for the needs of pharmacy. Perspectives for uses of medicinal plants cell cultures and tissues as the resources of MPM. Introduction of medicinal plants for further obtaining valuable varieties for needs of pharmacy industry.	2
4.	Rational uses of medicinal plant resources and their protection. Danger for contamination of MPM by radio nuclides, metal ions, chemical substances (pesticides, herbicides, insecticides, nitrates). Resource groups of medicinal plants of Ukraine. Medicinal plants of the Green and Red data books of Ukraine, the plant	2

	checklist of the World Conservation Union. Significance of protected areas for conservation of medicinal plant gene pool. Perspectives of conservation and an increase of biodiversity in accordance with "The program of actions in 21st century", approved by the UNESCO.	
	TOTALLY	**4**
	Number of lecture hours within the subject	**8**

5. Thematic plan of practical works within the subject «*Resources studies of medicinal plants*»

№	THEME	Hours
	Content module 1. The flora and its diversity. Preparatory works of Resources studies of medicinal plants	
1.	Introduction to Medicinal Plants Resources Science. Concepts and contents of Medicinal Plants Resources Science research.	2
2.	Preparatory stages of resource investigations: formation of tasks of resource investigations, based on needs of drug-stores and pharmaceutical manufactures	2
3.	Preparatory stages of resource investigations: detection of potentially-productive fields and medicinal plants, perspective for resource investigations	2
4.	Preparatory stages of resource investigations: choice and preparation of mapping materials, developing of tracks	2
5.	Types of plant associations, their ecological characteristics. Medicinal plant species of various plant associations (forests, meadows, bogs *etc.*). Associations of medicinal herbs, their value in search of valuable plants	2
	TOTALLY	**10**
	Content module 2. Experimental works of Resources studies of medicinal plants. Rational use and protection of natural resources of medicinal plants	
6.	Reserves (stocks) of vegetative raw materials. Biological and operational reserves. Estimation of reserves on key plots and certain undergrowth	2
7.	Methods of medicinal plants productivity determination. Calculation of operational reserve	2
8.	Research of productivity and reserves of wild-growing herbs by a method of registration plots	2
9.	Research of productivity and reserves of wild-growing herbs by a method of projecting cover	2
10.	Research of productivity and reserves of wild-growing herbs by a method of model specimens	2
11.	Determination of possible annual harvesting of MPM. Compilation of inventory reports	2
12.	Mapping of thickets and MPM reserves	2
13.	Introduction of medicinal plants. Medicinal plants of the world flora, introduced in Ukraine. The basic principles of WHO guidelines on good agricultural and collection practices (GACP) for medicinal plants. Cultivation of medicinal plants. Achievement and perspectives for application of current techniques in genetics and selection for the obtaining sufficient amounts of MPM	2

14.	Rules of rational collection and storage of medicinal plant materials. Pathways of rational application of medicinal plant material resources	2
15.	Nature-protection activity for reservation and recreation of natural resources of medicinal plants. Resource groups of medicinal plants of Ukraine. Medicinal plants of the Green and Red data books of Ukraine.	2
	TOTALLY	**20**
	Number of hours for practical works within the subject	**30**

6. Thematic plan of independent work

№	THEME	Hours	Control type
	Section 1. The flora and its diversity. Preparatory works of Resources studies of medicinal plants		Current control in practical works
1.	The plant world and its richness. Influence of plant development stages and environmental factors into formation and dynamics of active substance accumulation	2	
2.	Resource base of medicinal plants in Ukraine. Official and non-official medicinal plant species of Ukraine	4	
3.	Major resources for obtaining medicines of plant origin	4	
4.	Legislative basis for protection of medicinal plant species	4	
	TOTALLY	**14**	
	Section 2. Experimental works of Resources studies of medicinal plants. Rational use and protection of natural resources of medicinal plants		
8.	Methods for determination of productivity of medicinal plant materials	4	
9.	Estimation of economic effectiveness of use determined medicinal plant materials stocks in various grow places and geomorphological regions	4	
10.	Development of calendar and perspective plans MPM harvesting, based on nomenclature and location	2	
11.	Changes of environment and plant resources as an consequence of a human activity: environment pollution; melioration; restoration of a human health – changes of environment conditions; air pollution	8	
12.	Generalization of data concerning materials for medicinal plant resources accounting. Development of mapping materials	6	
13.	Nature protection areas of Ukraine, where medicinal plants are protected	4	
14.	Introduction and cultivation of medicinal plants. Methods of influence for medicinal plant productivity. Medicinal plant gene pool of the world medicine in the botanical gardens of Ukraine. Problems and uses of isolated plant parts, tissues and cells, methods of biotechnology to supply appropriate volumes of MPM for pharmacy industry	5	
15.	Perspectives of conservation and an increase of biodiversity in accordance with “The program of actions in 21st century”, approved by the UNESCO.	5	

	TOTALLY	**38**
	TOTALLY IWS within the subject, including	**52**

7. Individual tasks are not provided for in the sample curriculum

8. Teaching methods:

According to the curriculum classes are provided by the following types and forms of education, such as: a) lectures; b) practical classes; c) the independent work of students (IWS).

The lectures dealt with general issues of Resources studies of medicinal plants; the current state and dynamics for application of resources of wild medicinal plants, environmental issues of plants, major stages and methods of Resources studies of medicinal plants, regulatory and legal framework for application of resources of medicinal plants, that are used for needs of health care in Ukraine and abroad, and measures on rational harvesting, restoration of natural resources and also scientific data concerning medicinal plant science are studied.

Practical lessons include acquaintance with Resources studies of medicinal plants as scientific direction and professional discipline, the main areas of medicinal plants resource studies, learning definitions of the basic concepts and terms used in Resources studies of medicinal plants and phytocoenology, determination of productivity by different methods, operational reserves and volumes of possible annual harvesting of MPM on specific thickets, compiling of inventory data reports, mapping of thickets and reserves, development of measures for rational use and protection of determined reserves of medicinal plants.

Within conducting of practical training by a program are provided uses of herbaria samples, patterns of medicinal plant materials, methodological, reference and cartographic materials.

Within the performance of ***individual work***, students apply a system of teaching tools, provided by the curriculum, as well:

- textbooks;
- training and methodical manuals;
- methodical recommendations (guidelines);
- lecture notes;
- appropriate scientific and periodical literature;
- web-pages of a search network "Internet"

Independent work can be done in the university library, classrooms of the department and at home. A student may apply to the teacher for consultation with the ambiguities arising in the discipline studying and performance of independent work, particularly on proper topics of curriculum and samples, provided only for independent study, that are not submitted to a workshop.

9. Control methods

In the study of educational discipline " Resources studies of medicinal plants " are used the following control methods: 1. Current control using standardized methods for diagnostics of knowledge and skills. 2. Final control. The form of final control according to the curriculum is a credit control.

10. Current control is carried out on each class according to specific goals of topics during individual work of teacher for topics, not included in the structure of classes and are processed by students independently. In assessing of the current activities of students within the studing of subject " Resources studies of medicinal plants " used types of objective control of theoretical and practical training of students. The **form of the current control** during practical works within the subject " Resources studies of medicinal plants" is a **test** (input level of knowledge) and the **traditional oral or written** (baseline knowledge) **control measures** that comprise a checking for the level of acquired practical skills: solving of situation tasks, interpretation and evaluation of the resource studies.

10.1. Evaluation of current educational activity

Current educational activity is controlled within practical works in the beginning of the lesson by the test control (10 test questions of various level) (**control of theoretical preparation**) and in the

final stage by the checking of fulfilled tasks, determination of the received skills level after solving of situational tasks concerning productivity assessment, exploitative stocks, volumes of possible annual harvesting of MPM, interpretation and evaluation of the resource studies,.and protocol defense **(control of practical training).**

During the evaluation of the current educational activity, when mastering each topic, all types of work provided by this educational program are taken into account. The student receives an assessment for each topic on a 4-point (traditional) scale ("5", "4", "3", "2") taking into account the approved assessment criteria:

Excellent ("5"). The student correctly answered 100-90% of tests of format A. Correctly, clearly, logically and completely answers the standardized questions of the current topic, including the questions of the lecture course and independent work. Closely links theory with practice and correctly demonstrates performance (knowledge) of practical skills. Reads analysis results fluently, solves situational problems of increased complexity, knows how to summarize material, knows methods of chemical analysis. The laboratory work is completed in full and the student freely and correctly explains the conducted research and gives them an assessment.

Good ("4"). The student correctly answered 70-89% of tests of format A, correctly and basically answers the standardized questions of the current topic, lecture course and independent work. Demonstrates performance (knowledge) of practical skills. Correctly uses theoretical knowledge when solving practical tasks. Able to solve situational problems of easy and medium complexity. Possesses the necessary practical skills and methods of their implementation in an amount that exceeds the required minimum. The laboratory work is done with insignificant errors, but the student correctly explains the research and gives them a grade.

Satisfactory ("3"). The student correctly answered 50-69% of tests of format A. Incompletely, with the help of additional questions, answers standardized questions of the current topic, lecture course and independent work. Cannot independently construct a clear, logical answer. During the answer and demonstration of practical skills, the student makes mistakes. The student solves only the easiest problems, possesses only the mandatory minimum of research methods. The laboratory work was performed with errors, the student cannot fully explain the conducted research.

Unsatisfactory ("2"). The student answered less than 50% of tests of format A. Does not know the material of the current topic, cannot construct a logical answer, does not answer additional questions, does not understand the content of the material. During the response and demonstration of practical skills, he|she makes significant mistakes. The laboratory work is not completed or the student cannot explain the research conducted.

11. Form of final control of study

When studying the discipline " Resources studies of medicinal plants ", the form of final control according to the curriculum is a credit.

The semester assessment is a form of final control, which consists in assessing the student's assimilation of the educational material from the educational discipline " Resources studies of medicinal plants " solely on the basis of the results of the performance of all types of educational work provided for in the educational program. The semester credit is set according to the results of current control, that is, it is based on the results of current educational activities and is expressed on a two-point scale "passed" or "failed". In order to enroll, a student must receive a score of at least 60% of the maximum number of points in the discipline (120 points) for the current educational activity.

12. Scheme of accrual and distribution of points received by students:

The *maximum number of points* that a student can receive for current educational activity at the study of the subject is 200 points.

The *minimum number of points* that a student must receive for current educational activity for enrollment of the course comprise 120 points.

Calculating the number of points is based on student mark values received by traditional scale while learning subject during the semester, by calculating the average arithmetic (CA) value, rounded to

two decimal places. The resulting value is converted into points by multi-point scale as follows:

$$X = \frac{CA \times 200}{5}$$

Conversion of the average score for current activities into a multi-point scale

4-point scale	200-point scale		4-point scale	200-point scale		4-point scale	200-point scale		4-point scale	200-point scale
5	200		4,45	178		3,89	156		3,35	134
4,97	199		4,42	177		3,87	155		3,32	133
4,95	198		4,4	176		3,84	154		3,3	132
4,92	197		4,37	175		3,82	153		3,27	131
4,9	196		4,35	174		3,79	152		3,25	130
4,87	195		4,32	173		3,77	151		3,22	129
4,85	194		4,3	172		3,74	150		3,2	128
4,82	193		4,27	171		3,72	149		3,17	127
4,8	192		4,24	170		3,7	148		3,15	126
4,77	191		4,22	169		3,67	147		3,12	125
4,75	190		4,19	168		3,65	146		3.1	124
4,72	189		4,17	167		3,63	145		3,07	123
4,7	188		4,14	166		3,6	144		3,05	122
4,67	187		4,12	165		3,57	143		3,02	121
4,65	186		4,09	164		3,55	142		3,0	120
4,62	185		4,07	163		3,52	141		Less than 3	Not sufficiently
4,6	184		4,04	162		3.5	140			
4,57	183		4,02	161		3,47	139			
4,55	182		3,99	160		3,45	138			
4,52	181		3,97	159		3,42	137			
4,5	180		3,94	158		3,4	136			
4,47	179		3,92	157		3,37	135			

Independent work of students is evaluated during the current control of theme on the appropriate lesson. Mastering of themes which are studied as only an independent work are controlled at the final control.

Scores of the discipline " Resources studies of medicinal plants " are converted both as the scale ECTS, and a 4-point scale. Scores of scale ECTS into a 4-point scale are not converted and vice versa.

Scores of students, based on the number of points gained in the discipline, into a scale ECTS are ranked as follows:

ECTS scale	Statistic indices
A	The best 10 % students
B	The next 25 % students
C	The next 30%students
D	The next 25 % students
E	The last 10 % students

Points for the discipline "Resources studies of medicinal plants" for students, who have successfully completed the program, are converted into a traditional 4-point scale by absolute criteria, which are listed in the table below

Points for the discipline	Mark at a 4-point scale
From 170 to 200 points	5
From 140 to 169 points	4
From 120 to 139 points	3
Less than120 points	2

Assessment at ECTS into a traditional scale is not converted, as the scales of ECTS and four-point one are independent.

Objectivity of evaluation of educational activities of students is tested by statistical methods (correlation coefficient between ECTS assessment and evaluation at a national scale).

13. Methodical provision

The educational content of the discipline " Resources studies of medicinal plants" includes: synopsis or multimedia presentation of lectures, calendar-thematic plans of practical classes, independent work, questions, tasks, lists, tasks or cases for current and final control of students' knowledge and skills, etc.; curriculum, textbooks, atlases, educational and visual items, lecture notes, methodological recommendations, test collections, video materials, electronic resources, lecture presentations, visual materials (tables, educational photo materials, demonstrative herbariums of medicinal plants, MPM samples, cartographic materials, wall stands, cathedral library of basic, additional and reference literature, cards for complex control works, as well for current and final control.

To improve the educational and methodological support of the discipline " Resources studies of medicinal plants", educational and methodological manuals, study manuals in the form of workbooks and methodological recommendations prepared and issued by typographical method by the teachers of the department are used in the educational process as educational and instructional and methodological materials for laboratory classes:

1. Medicinal plant resources : textbook / V. M.Minarchenko, R. M. Lysiuk, N. P. Kovalska. - Kyiv: Palyvoda A.V., 2019. – 240p.
2. Digital source: www.pharmacognosy.org.ua/index.files/page4194.htm (Lysiuk R.M., Antoniuk V.O. Textbook of Pharmacognosy)
3. Lysiuk R.M. Methodical Instructions on Resources of Medicinal Plants for Students of the 5th Course, Faculty of Pharmacy (English Medium). - Lviv, 2014. – 55p.
4. Lysiuk R.M. Methodical Instructions For Independent Work On Resources Of Medicinal Plants For Students of the 5th Course, Faculty of Pharmacy (English Medium). – Lviv, 2014. – 15p.

14. Recommended literature

Basic references

1. Antonyuk V.O., Lysiuk R.M., Antonyuk L.Y. A Practical Course of Pharmacognosy. - Lviv: LNMU, 2011. – 499 p.
2. Bruneton J. Pharmacognosy. Phytochemistry. Medicinal plants. 2nd edn. – Paris, 1999. – 1119 p.
3. Evans W.C. Trease and Evans' Pharmacognosy. 15th edn. – Edinburg, London, New York, Philadelphia, St. Louis, Sydney, Toronto: W.B. Saunders, 2002. - 585 p.
4. Gruenwald J., Th. Brendler, Ch. Jaenicke (sc. eds.). PDR for Herbal Medicines. - Montvale, NJ: Medical Economics Company, 2000. – 858 p.
5. Guide to good storage practices for pharmaceuticals. In: WHO Expert Committee on Specifications for Pharmaceutical Preparations. Thirty-seventh report. Geneva, World Health Organization, 2003, Annex 9 (WHO Technical Report Series, No. 908).
6. Kernychna Z. Resources of medicinal plants [digital source].
7. Kislichenko V.S. et al. Medicinal Plants Resources Science. – Kharkiv, NPhU: 2012. – 168 p.
8. Lysiuk R.M. Methodical Instructions on Resources of Medicinal Plants for Students of the 5th Course, Faculty of Pharmacy (English Medium). - Lviv, 2014. – 55 P.

9. Minarchenko V. M., R. M. Lysiuk, N. P. Kovalska. Medicinal plant resources : textbook / V. M. Minarchenko, R. M. Lysiuk, N. P. Kovalska. – Kyiv: PALYVODA A. V., 2019. – 240 p.
10. Mosyakin S.L. Vascular Plants of Ukraine. A Nomenclatural Checklist // S.L. Mosyakin, M.M. Fedoronchuk. – Kiev, 1999. – 346 p.
11. National Report on Conservation [digital source]
12. WHO Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. – Geneva : World Health Organization, 2003. - 72p.
13. WHO, IUCN & WWF (1993): Guidelines on the conservation of medicinal plants. – 50 pp., WHO, IUCN, WWF, Gland & Geneva.
14. Wichtl M. (ed.). Herbal Drugs and Phytopharmaceuticals: A Handbook for Practice on a Scientific Basis. 3rd ed. – Stuttgart: Medpharm GmbH Scientific Publishers, 2004. – 704 p.

Supplementary references

1. Akbar Sh. Handbook of 200 Medicinal Plants. A Comprehensive Review of Their Traditional Medical Uses and Scientific Justifications. Springer, 2020. 2156 p.
2. Alamgir A.N.M. Therapeutic Use of Medicinal Plants and Their Extracts: Volume 1. Pharmacognosy. Springer. 2018, 546 p
3. Badal S., Delgoda R., Eds. Pharmacognosy Fundamentals, Applications and Strategy. Academic Press, Elsevier Inc., 2017. 716 p.
4. Khan M.S.A., Ahmad I., Chattopadhyay D., Eds. New Look to Phytomedicine Advancements in Herbal Products as Novel Drug Leads. Academic Press, Elsevier Inc. 2019. 685 p.
5. Kirakosyan Ara. Plant Biotechnology for the Production of Natural Products. In: Kaufman P. B. et al. Natural Products from Plants. - Boca Raton, New York, London, Tokyo: CRC Press, 1999. - 221-262 pp
6. Quattrocchi U. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton – London – New York. 2012. 4017 p.