# NATIONAL UNIVERSITY OF LIFE
# AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of forest mensuration and forest management

«CONFIRMED»
Director of the Education and Research Institute
of Forestry and Landscape-Park Management
R. Vasylyshyn
« 03 » 06 2024 p.

«APPROVED»
at the meeting of the department of forest mensuration
and forest management
Protocol № 11 dated May 20, 2024
Acting Head of Department
V. Myroniuk

«REVIEWED»
Program coordinator O. Bala

## PROGRAM OF THE COURSE

Forest Ecosystem Services

knowledge sphere                    20 – «Agricultural Sciences and Food»

specialization                    205 – «Forestry»

Educational program          «Forestry» of the second (Master's) level of higher education

Education and Research Institute of  Forestry and Landscape-Park Management

Developers:          Doctor of Agricultural Sciences, Professor Andrii Bilous
                    Candidate of Agricultural Sciences, Associate Professor Ivan Lakyda

(position, academic degree, academic title)

Kyiv – 2024

# 1. Description of the course

Forest Ecosystem Services

<table>
<tr><td colspan="2"><strong>Field of knowledge, specialization, educational program, educational degree</strong></td></tr>
<tr><td>Educational degree</td><td><em>Master</em></td></tr>
<tr><td>Specialization</td><td><em>205 – Forestry</em></td></tr>
<tr><td>Educational program</td><td><em>Forestry</em></td></tr>
<tr><td colspan="2"><strong>Characteristics of the course</strong></td></tr>
<tr><td>Type</td><td>Elective</td></tr>
<tr><td>Total number of hours</td><td>120</td></tr>
<tr><td>Number of ECTS credits</td><td>4</td></tr>
<tr><td>Number of content modules</td><td>2</td></tr>
<tr><td>Course project (work) (if applicable)</td><td>–</td></tr>
<tr><td>Type</td><td>Exam</td></tr>
<tr><td colspan="2"><strong>Indicators of the course for full-time and part-time forms of study</strong></td></tr>
<tr><td></td><td>Full-time form of study</td><td>Part-time form of study</td></tr>
<tr><td>Course (year of study)</td><td>1</td><td>–</td></tr>
<tr><td>Semester</td><td>2</td><td>–</td></tr>
<tr><td>Lecture classes</td><td><em>20 hr.</em></td><td>–</td></tr>
<tr><td>Practical, seminar classes</td><td><em>20 hr.</em></td><td>–</td></tr>
<tr><td>Laboratory classes</td><td>–</td><td>–</td></tr>
<tr><td>Self-study</td><td><em>80 hr.</em></td><td>–</td></tr>
<tr><td>Individual assignments</td><td>–</td><td>–</td></tr>
<tr><td>Number of weekly classroom hours for the full-time form of study</td><td><em>2 hr.</em></td><td>–</td></tr>
</table>

# 2. Purpose, objectives, and competencies of the course

**Objective.** Forests as a biological object are of much greater value than the commercial timber harvested from them, especially in densely populated areas. The course addresses the description and quantification of forest ecosystem services, which helps to reflect the cumulative effect of forests on the environment. Quantitative assessment of the above-mentioned forest ecosystem services also creates prerequisites for their further economic evaluation.

The main **objectives** of the discipline are:

1.      Expanding the professional and scientific outlook and formation of students' ecological thinking through obtaining basic information about forest ecosystem services.

2. Mastering the theoretical and practical principles of classification of ecosystem services, their role for sustainable development and implementation of the "green" economy.

3. Familiarization with the basics of biophysical and economic valuation of forest ecosystem services.

4. Study approaches to mapping forest ecosystem services.

5. Deepening understanding of economic concepts underlying the economic valuation of forest ecosystem services.

**As a result of studying the discipline "Forest Ecosystem Services" the student should:**

**a) know**

- categories and concepts of biophysical and economic valuation of forest ecosystem functions and services;

- directions and approaches to the classification of forest ecosystem services;

- the best available information on the assessment of forest ecosystem services in Ukraine and abroad.

**b) be able to:**

- apply the acquired knowledge, computer technology in calculations;

- to carry out biophysical and economic assessment of the most important services of forest ecosystems, to justify individual decisions on the importance of ecosystem services in specific conditions, to compare economic indicators for different services of forest ecosystems.

**The discipline ensures the formation of**

- **integrated competency:**

**IC.** Ability to resolve complex tasks in forestry or during the study process that require investigations or innovations.

**- of general competencies:**

**GC 7.** Ability to work in an international context.

**- professional (special) competencies:**

**SC 2.** Ability to ensure sustainable development of forestry.

**SC 4.** Ability to develop and implement current and strategic plans for the development of forestry enterprises, taking into account resources, risks, as well as economic, legal and environmental aspects.

**SC 6.** Ability to carry out educational activities among the population to form environmental thinking, awareness and responsibility for the environment.

As a result of studying the discipline, the student will acquire the following **program learning outcomes**:

**PLO 2.** Communicate fluently orally and in writing in Ukrainian and foreign languages when discussing professional issues, research and innovation in forestry.

**PLO 3.** To make effective decisions on forestry issues, including in difficult and unpredictable conditions; to predict its development; to identify factors that affect the achievement of goals; to analyze and compare alternatives; to assess the risks and possible consequences of decisions.

**PLO 5.** Manage complex activities in the field of forestry and in broader contexts, ensure quality, evaluate efficiency and effectiveness of activities.

**PLO 6.** To assess the state of forest phytocoenoses, forest resources in specific forest vegetation conditions, their potential and predict the possibilities of use.

**PLO 7.** Develop and implement scientific and applied projects in the field of forestry, taking into account available resources and risks, as well as economic, legal and environmental aspects.

**PLO 8.** Develop and improve technological and production processes, implement modern digital technologies.

**PLO 9.** Determine performance criteria and choose the optimal forestry strategy depending on external and internal conditions.

**PLO 10.** Clearly and unambiguously communicate their own knowledge, conclusions and arguments on forestry and related issues to specialists and non-specialists, including students.

**PLO 11.** Apply modern experimental and mathematical methods, digital technologies and specialized software to solve complex problems of forestry and hunting.

3. **Program and structure of the course**

## PROGRAM OF THE COURSE
**MODULE 1. Classification and biophysical assessment of ecosystem services.**
**Topic 1.** Introduction to Ecosystem Services.
Definition of ecosystem services. Classification of ecosystem services according to various criteria. The Common International Classification of Ecosystem Services.

**Topic 2.** Ecosystem services: Provisioning (biotic and abiotic).
Division: Biomass. Division: Genetic material from all biota. Division: Other types of provisioning service from biotic sources. Division: Water provisioning. Non-aqueous natural abiotic ecosystem outputs.

**Topic 3.** Forest ecosystem services: Regulation & Maintenance.
Biotic forest ecosystem services of regulation and maintenance. Abiotic forest ecosystem services of regulation and maintenance.

**Topic 4.** Forest ecosystem services: Cultural.
Biotic cultural forest ecosystem services. Abiotic cultural forest ecosystem services.

**Topic 5.** Ecosystem Services and Biodiversity.
The role of biodiversity in ecosystem services. Mapping and assessing ecosystem services. Valuation of ecosystem services. The importance of systems thinking.

**MODULE 2. Economic valuation and certification of ecosystem services.**
**Topic 6.** Forest ecosystem services and types of values.
General concepts of economic valuation of goods and services. Classification of values.

**Topic 7.** Basics of economic valuation of ecosystem services.
Public and private goods. Methods of economic valuation of ecosystem services.

**Topic 8.** Overview of direct methods of economic valuation of ecosystem services.
Direct methods of economic valuation of ecosystem services. Contingent valuation method. Travel cost method. Hedonic pricing method.

**Topic 9.** Overview of indirect methods of economic valuation of ecosystem services.
Market-based valuation method. Avoided cost method. Replacement cost method. Opportunity cost method.

**Topic 10.** Certification for ecosystem services.
Forest management and chain-of-custody certification. Reasons for certification. FSC Ecosystem Service verification.

## STRUCTURE OF THE COURSE

| Names of content modules and topics | Number of hours | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Full-time form | | | | | | | Part-time form | | | | | |
| | weeks | total | including | | | | | total | including | | | | |
| | | | l | p | lab | ind | self | | l | p | lab | ind | self |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| Module 1. Classification and biophysical assessment of ecosystem services | | | | | | | | | | | | | |
| Topic 1. Introduction to Ecosystem Services | 1 | 12 | 2 | 2 | | | 8 | | | | | | |
| Topic 2. Ecosystem services: Provisioning (biotic and abiotic) | 2 | 12 | 2 | 2 | | | 8 | | | | | | |
| Topic 3. Forest ecosystem services: Regulation & Maintenance | 3 | 12 | 2 | 2 | | | 8 | | | | | | |
| Topic 4. Forest ecosystem services: Cultural | 4 | 12 | 2 | 2 | | | 8 | | | | | | |
| Topic 5. Ecosystem Services and Biodiversity | 5 | 12 | 2 | 2 | | | 8 | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total module 1 | 5 | 60 | 10 | 10 | | | 40 | | | | | | | |
| Module 2. Economic valuation of ecosystem services. | | | | | | | | | | | | | | |
| Topic 6. Forest ecosystem services and types of values | 6 | 12 | 2 | 2 | | | 8 | | | | | | | |
| Topic 7. Basics of economic valuation of ecosystem services | 7 | 12 | 2 | 2 | | | 8 | | | | | | | |
| Topic 8. Overview of direct methods of economic valuation of ecosystem services | 8 | 12 | 2 | 2 | | | 8 | | | | | | | |
| Topic 9. Overview of indirect methods of economic valuation of ecosystem services | 9 | 12 | 2 | 2 | | | 8 | | | | | | | |
| Topic 10. Certification for ecosystem services | 10 | 12 | 2 | 2 | | | 8 | | | | | | | |
| Total module 2 | 5 | 60 | 10 | 10 | | | 40 | | | | | | | |
| Total hours | x | 120 | 20 | 20 | | | 80 | | | | | | | |

## 4. Practicals' topics

| № | Topic | Hours |
|---|---|---|
| 1. | What are the benefits people from ecosystems? | 2 |
| 2. | Assessment of biophysical parameters of forest biomass | 2 |
| 3. | Assessment of biophysical parameters of energy accumulated in forest biomass | 2 |
| 4. | Provisioning forest ecosystem services | 2 |
| 5. | Biodiversity assessment of forest ecosystems | 2 |
| 6. | Forest ecosystem services and types of values | 2 |
| 7. | Benefit transfer | 2 |
| 8. | Economic assessment of carbon sequestrative function of forest ecosystems | 2 |
| 9. | Economic valuation of oxygen productive function of forest ecosystems | 2 |
| 10. | Identification of communication activities related to FSC ES claims | 2 |

## 5. Independent assignment topics

| № | Topic | Hours |
|---|-------|-------|
| 1. | Getting acquainted with ecosystem services of urban forests and trees | 40 |
| 2. | Peculiarities of economic valuation of ecosystem services | 40 |
| TOTAL: | | 80 |

## 6. Means of diagnosing learning outcomes:

- examination;
- module testing;
- calculation and calculation-graphic works.

## 7. Teaching methods:

- verbal method (lecture, discussion, interview, etc.)
- practical method (practical classes);
- work with educational and methodical literature (abstracting, summarizing, thesis, annotating, reviewing);
- independent work (completion of tasks).

## 8. Assessment methods.

- examination;
- module testing;
- defense of module and practical works.

## 9. Distribution of grades received by students

Evaluation of student knowledge is carried out on a 100-point scale and is converted to national grades according to Table 1 "Regulations and Examinations and Credits at NULES of Ukraine" (order of implementation dated April 26, 2023, protocol No 10).

| Student rating, points | National grade based on exam results | |
|---|---|---|
| | **Exams** | **Credits** |
| **90-100** | **Excellent** | **Passed** |
| **74-89** | **Good** | |
| **60-73** | **Satisfactory** | |
| **0-59** | **Unsatisfactory** | **Not passed** |

To determine the student's (trainee's) rating in mastering the discipline $R_{DIS}$ (up to 100 points), the attestation rating (up to 30 points) is added to the student's (trainee's) rating in academic work $R_{NR}$ (up to 70 points): $R_{DIS} = R_{NR} + R_{AT}$.

## 10. Recommended literature

### Main:

1. Ecosystem Services of Ukrainian Forests: a Case Study of the Polissya Region: monograph / P. Lakyda, A. Bilous, A. Shvidenko, V. Myroniuk, M. Matsala, R. Vasylyshyn, D. Holiaka, I. Lakyda – Kyiv: NULES of Ukraine, 2018. – 188 p.

2.	Bilous A., Holiaka D., Kovbasa Ya., Holiaka M., Bilous V., Kotliarevska U., Slyva O., Matsala M. Tables for Ecosystem Services Assessment of Soft-leaved Forests of Ukrainian Polissya. Kyiv: NULES of Ukraine, 2018. 190 p.

3.	Білоус А. М. Екосистемні функції м'яколистяних лісів Українського Полісся. Монографія. – Глобус, 2020. – 152 с.

4.	Білоус А.М. Біопродуктивність та екосистемні функції м'яколистяних лісів Українського Полісся. Монографія / А. М. Білоус. Житомир : ТОВ «Видавничий дім «Бук-Друк», 2021. – 816 с.

5.	Bouma and Van Beukering (2015) Ecosystem services: from concept to practice, Cambridge University Press Ruhl, Kraft, and Lant (2007) *The Law and Policy of Ecosystem Services*, Island Press

6.	Kareiva, Tallis, Ricketts, Daily, and Polasky, eds. (2011) *Natural Capital: Theory and Practice of Mapping Ecosystem Services*, Oxford University Press

7.	Daily, ed. (1997) *Nature's Services: Societal Dependence on Natural Ecosystems*, Island Press

8.	Daily and Ellison (2002) *The New Economy of Nature*, Island Press

9.	Лісотаксаційний довідник (доповнене видання) / уклад. А.М. Білоус, С.М. Кашпор, В.В. Миронюк, В.А. Свинчук, О.М. Леснік. – Київ : Видавничий дім «Вініченко», 2021. 420 с.

10.	Lakyda P., Shvidenko A., Bilous A., Myroniuk V., Matsala M., Zibtsev S., Schepaschenko D., Holiaka D., Vasylyshyn R., Lakyda I., Diachuk P., Kraxner F. Impact of Disturbances on the Carbon Cycle of Forest Ecosystems in Ukrainian Polissya. Forests. 2019. 10 (4). 337. doi.org/10.3390/f10040337

11.	Білоус А.М., Голяка Д.М., Ковбаса Я.В., Голяка М.А., Білоус В.М., Аврамчук О.О., Котляревська У.М., Слива О.І. Нормативно-довідкові матеріали для оцінювання екосистемних послуг м'яколистяних лісів Українського Полісся : [довідник]. К.: НУБіП України, 2017. 190 с.

### Additional:

1. Закони України, нормативні документи Кабінету Міністрів України, міністерств і відомств України, органів місцевою самоврядування з питань екологічної політики.

2. Ecosystem Marketplace: http://www.ecosystemmarketplace.com

3. Ecosystem services podcast tutorial: http://www.keckfutures.org/conferences/ecosystemservices_podcast_home.html

4. The Economics of Ecosystems and Biodiversity (TEEB): http://www.teebweb.org

5. TEEB lecture series: http://environment.yale.edu/TEEB

6. A community on ecosystem services (ACES): http://www.conference.ifas.ufl.edu/aces/index.html

7. National ecosystem services partnership: http://nicholasinstitute.duke.edu/initiatives/nationalecosystem-services-partnership

8. Bilous, A.; Holiaka, D.; Matsala, M.; Kashparov, V.; Schepaschenko, D.; Lakyda, P.; Shvidenko, A.; Myroniuk, V.; Otreshko, L. 90Sr Content in the

Stemwood of Forests within Ukrainian Polissya. Forests 2020, 11, 270. https://doi.org/10.3390/f11030270

**11.Information resources**

In order to study the discipline "Forest Ecosystem Services", documents in information systems (libraries, archives, funds, data banks, etc.) can be used, in particular:

1. Національна бібліотека ім. В.І.Вернадського: http://www.nbuv.gov.ua.
2. International Institute for Sustainable Development: http://www.iisd.org.
3. FAO: http://www.fao.org.
4. WWF: http://wwf.panda.org.
5. Center for International Forestry Research: www.cifor.org.
6. European Forest Ecosystem Research Network: ifff.boku.ac.at/efern/
7. www.elsevier.com
8. https://www.itreetools.org
9. https://cices.eu/