

Ministry of education and science of ukraine  
Sumy national agrarian university  
Cybernetics and Informatics Department  
Faculty of Economics and Management

Module syllabus

*Modern information technologies in scientific activity*

(mandatory)

|                                         |                         |
|-----------------------------------------|-------------------------|
| <b>Specialty</b>                        | D3 Management           |
| <b>Educational professional program</b> | Management              |
| <b>Higher education level</b>           | 3(Doctor of Philosophy) |

**Sumy - 2025**

Розробник: Агаджанова Світлана АГАДЖАНОВА, кандидат технічних наук, доцент кафедри кібернетики та інформатики

|                                                                                     |                                                                     |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Розглянуто, схвалено та затверджено на засіданні кафедри кібернетики та інформатики | протокол від 04.06.2025 р. №19                                      |
|                                                                                     | Завідувач кафедри <u>Агаджанова</u> Світлана АГАДЖАНОВА<br>(підпис) |

Погоджено:

Завідувач відділом аспірантури Ярошук Світлана ЯРОЩУК

Рецензія на робочу програму (додається) надана: Бондаренко

Методист відділу якості освіти, ліцензування та акредитації Таран (Надія Тараненко)

Зареєстровано в електронній базі: дата: 25.06, 2025 р.

**Syllabus review data:**

| The academic year in which changes are made | The Academic program attachment number with changes description | Changes revised and approved                  |                    |                                   |
|---------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------|--------------------|-----------------------------------|
|                                             |                                                                 | Minutes No and date of the department meeting | Head of Department | Guarantor of the Academic program |
|                                             |                                                                 |                                               |                    |                                   |
|                                             |                                                                 |                                               |                    |                                   |
|                                             |                                                                 |                                               |                    |                                   |
|                                             |                                                                 |                                               |                    |                                   |

## 1. MODULE OVERVIEW

|     |                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |      |                     |
|-----|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------|---------------------|
| 1.  | Title                                                                         | Modern information technologies in scientific activity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |      |                     |
| 2.  | Faculty/Department                                                            | Economics and Management/Cybernetics and Informatics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |      |                     |
| 3.  | Type (compulsory or optional)                                                 | mandatory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |      |                     |
| 4.  | Program(s) to which module is attached (to be filled in for compulsory types) | Educational and scientific program "Management". Third educational and scientific level of higher education. Degree of higher education: Doctor of Philosophy. Specialty: D3 "Management".                                                                                                                                                                                                                                                                                                                                                                                         |            |      |                     |
| 5.  | Module can be suggested for (to be filled in for optional types)              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |      |                     |
| 6.  | Level of the National Qualifications Framework                                | 8-th                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |      |                     |
| 7.  | Semester and duration of module                                               | 1 semester, 1-10 weeks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |      |                     |
| 8.  | ECTS credits number                                                           | 3-rd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |      |                     |
| 9.  | Total workload and time allotment                                             | Directed study                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |            |      | Self-directed study |
|     |                                                                               | Lectures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Practicals | Labs |                     |
|     |                                                                               | 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -          | 20   | 50                  |
| 10. | Language of instruction                                                       | english                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |      |                     |
| 11. | Module leader                                                                 | Svitlana Ahadzhanova, Associated Pofessor, Ph.D<br>Consultation hours – every Tuesday at 12:15, room 308                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |      |                     |
| 12. | Module leader contact information                                             | s.agadzhanova@snau.edu.ua                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |      |                     |
| 13. | Module description                                                            | Studying the discipline allows applicants to obtain the necessary knowledge and skills in the application of modern information technologies in scientific activities, in particular, for working on text and graphic information on the Internet; searching for scientific information in information databases and data banks; presenting the results of their own scientific activities; high-quality visual design of numerical and schematic research results                                                                                                                 |            |      |                     |
| 14. | Module aim                                                                    | The aim of teaching the academic discipline “Modern Information Technologies in Scientific Activity” is to provide higher education students with a thorough understanding of the possibilities, effectiveness, and prospects of using information technologies in scientific research, as well as to help them acquire skills and practical experience in the application of IT tools, services, and information and communication technologies in scientific activity.                                                                                                           |            |      |                     |
| 15. | Module Dependencies (prerequisites, co-requisites, incompatible modules)      | The educational component is based on the EC Management of scientific projects and registration of intellectual property rights                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |      |                     |
| 16. | The policy of academic integrity                                              | The academic integrity policy at Sumy National Agrarian University is defined by the documents presented on the page:<br><a href="https://snau.edu.ua/viddil-zabezpechennya-yakosti-osviti/zabezpechennya-yakosti-osviti/akademichna-dobrochesnist/">https://snau.edu.ua/viddil-zabezpechennya-yakosti-osviti/zabezpechennya-yakosti-osviti/akademichna-dobrochesnist/</a><br>Academic integrity of PhD candidates is an important condition for mastering the results of learning in the educational component and receiving the appropriate grades from current and final tests. |            |      |                     |

|    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                | <p>In case of violation of academic integrity by a PhD candidate (cheating, plagiarism, fabrication), the work is assessed as unsatisfactory and must be redone. In this case, the teacher reserves the right to change the topic of the assignment.</p> <p>For violations of academic integrity, candidates for a Doctor of Philosophy degree may be subject to the following academic penalties:</p> <ul style="list-style-type: none"> <li>– retaking the assessment (test, exam, credit, etc.);</li> <li>– retaking the relevant educational component of the educational program.</li> </ul> <p>The exam may be retaken with the permission of the vice-rector for scientific, pedagogical, and educational work if there are valid reasons (e.g., sick leave).</p> |
| 17 | Key words      | Cloud technologies, artificial intelligence, decision support systems, Internet of Things, Big Data.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 18 | Link in Moodle | <a href="https://cdn.snau.edu.ua/moodle/course/view.php?id=4566">https://cdn.snau.edu.ua/moodle/course/view.php?id=4566</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

## 2. CORRELATION BETWEEN MODULE LEARNING OUTCOMES (MLOs) AND PROGRAM LEARNING OUTCOMES (PLOs)

| Learning outcomes for EC:<br>After studying the educational component, the higher education applicant is expected to be able to                                                                | Program learning outcomes that the OC aims to achieve (indicate the number according to the numbering given in the OP) |        | How learning outcomes are assessed            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|--------|-----------------------------------------------|
|                                                                                                                                                                                                | PLO 1.                                                                                                                 | PLO 3. |                                               |
| MLOs1. Apply knowledge in practical situations and use modern information technologies to study technical and social processes.                                                                | x                                                                                                                      |        | Multiple choice tests, calculation tasks      |
| MLOs 2. Conduct research at the PhD level using information and communication technologies                                                                                                     |                                                                                                                        | x      | Individual task                               |
| MLOs 3. Collect, process, and analyze information published on Internet resources; present the results of professional activities using modern information technologies and software products. | x                                                                                                                      |        | Quick polls, discussions, and problem solving |
| MLOs 4. Select and effectively use modern software for conducting scientific research                                                                                                          |                                                                                                                        | x      | Multiple choice tests, calculation tasks      |

### 3. MODULE INDICATIVE CONTENT

| Topics                                                                                                                                                                                                                                                                                                            | Distribution of hours |            |      |                     | Learning resources                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------|------|---------------------|--------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                   | Directed study        |            |      | Self-directed study |                                                              |
|                                                                                                                                                                                                                                                                                                                   | Lectures              | Practicals | Labs |                     |                                                              |
| <b>Topic 1. Data and information.</b><br>1. Introduction<br>2. Data<br>3. Information<br>4. Properties of information<br>5. Types of data                                                                                                                                                                         | 2                     | 2          |      | 5                   | Basic:<br>1, 3<br>Methodological:<br>1<br>Additional:<br>1-4 |
| <b>Topic 2. Information technologies: information and logical content and structural organization.</b><br>1. Principles of construction and evaluation criteria for modern information technologies<br>2. Information and structural support for information technologies<br>3. Telecommunications support for IT | 2                     | 2          |      | 5                   | Basic:<br>1, 3<br>Methodological:<br>1<br>Additional:<br>1-4 |
| <b>Topic 3. Information technology, information system.</b><br>1. Introduction.<br>2. The 4I concept.<br>3. Definition of the term IT.<br>4. Classification of IT. 5. Information system, definition.<br>6. Structure of IS.                                                                                      | 2                     | 2          |      | 5                   | Basic:<br>1-3<br>Methodological:<br>1<br>Additional:<br>1-4  |
| <b>Topic 4. Data consolidation.</b><br>1. Definition.<br>2. Data grouping tools.<br>3. Pivot table                                                                                                                                                                                                                | 2                     | 2          |      | 5                   | Basic: 1<br>Additional: 1-2                                  |
| <b>Topic 5. What-if-analysis</b><br>1. Data analysis.<br>2. Scenario Manager.<br>3. Goal Seek<br>4. Data Table                                                                                                                                                                                                    | 2                     | 2          |      | 5                   | Basic: 1-3<br>Additional: 1-4                                |
| <b>Topic 6. Regression analysis of data.</b><br>1. Regression.<br>2. Correlation.<br>3. Pairwise regression.                                                                                                                                                                                                      | 2                     | 2          |      | 5                   | Basic: 1-3<br>Additional: 2                                  |
| <b>Topic 7. Databases.</b><br>1. Database requirements.<br>2. Structure of databases with file organization.<br>3. Network data model.<br>4. Hierarchical data model.<br>5. Relational data model.<br>6. Database tools                                                                                           | 2                     | 2          |      | 5                   | Basic: 1-3<br>Additional: 1-4                                |
| <b>Topic 8. Data Mining Tasks. Classification and Clustering.</b><br>1. Classification Tasks and Types.<br>2. Methods Used to Solve Classification Tasks.                                                                                                                                                         | 2                     | 2          |      | 5                   | Basic: 1-3<br>Additional: 1-4                                |

|                                                                                                                                                                                                                                   |    |    |  |    |                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|--|----|-----------------------------------------------------|
| 3. Clustering Task.<br>4. Application of Cluster Analysis.<br>5 Forecasting tasks<br>6. Forecasting and time series. Trend, seasonality, and cycle.                                                                               |    |    |  |    |                                                     |
| <b>Topic 9. Basic concepts of AI.</b><br>1. Introduction.<br>2. Founders of AI.<br>3. History of AI development.<br>4. Definitions.<br>5. Types of AI.<br>6. Areas of research.<br>7. AI and the modern world.<br>8. Legislation. | 2  | 2  |  | 5  | Basic: 1-3<br>Additional: 1-4                       |
| <b>Topic 10. Introduction to Big Data</b><br>1.What is Big Data?<br>2. How Big Data works.<br>3. Why is it needed?<br>4. Problems with Big Data<br>5. Conclusion                                                                  | 2  | 2  |  | 5  | Basic: 1-3<br>Methodological:<br>1<br>Additional: 1 |
| Total hours                                                                                                                                                                                                                       | 20 | 20 |  | 50 |                                                     |

#### 4. TEACHING AND LEARNING METHODS

| MLOs                                                                                                                                                                                           | Teaching methods<br>(directed study)                    | Hours | Learning methods<br>(self-directed study)                          | Hours |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|-------|--------------------------------------------------------------------|-------|
| MLOs1. Apply knowledge in practical situations and use modern information technologies to study technical and social processes.                                                                | Lecture, practical lesson, discussion of topical issues | 10    | Elaboration of theoretical material, solution of calculation tasks | 10    |
| MLOs 2. Conduct research at the PhD level using information and communication technologies                                                                                                     | Lecture, practical lesson, discussion of topical issues | 10    | Elaboration of theoretical material, solution of calculation tasks | 10    |
| MLOs 3. Collect, process, and analyze information published on Internet resources; present the results of professional activities using modern information technologies and software products. | Lecture, practical lesson, discussion of topical issues | 10    | Elaboration of theoretical material, solution of calculation tasks | 14    |
| MLOs 4. Select and effectively use modern software for conducting scientific research                                                                                                          | Lecture, practical lesson, discussion of topical issues | 10    | Elaboration of theoretical material, solution of calculation tasks | 16    |
| Total hours                                                                                                                                                                                    |                                                         | 40    |                                                                    | 50    |

## 5. ASSESSMENT

### 5.1. Diagnostic assessment

### 5.2. Summative assessment

#### 5.2.1. Intended learning outcomes methods:

| No                     | Summative assessment methods | Grades           | Deadline        |
|------------------------|------------------------------|------------------|-----------------|
| <b>Autumn semester</b> |                              |                  |                 |
| 1.                     | Practical Work 1-5           | 20 points / 20 % | 5 week          |
| 2.                     | Practical Work 6-12          | 35points / 35 %  | 10 week         |
| 3.                     | Test                         | 15 points / 15 % | During semester |
| 4.                     | Exam                         | 30 points / 30 % | 10 week         |

#### 5.2.2. Grading criteria

| Summative assessment method | Unsatisfactory                                        | Satisfactory                                                                            | Good                                                 | Excellent                                            |
|-----------------------------|-------------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|
| <b>Practical Works 1-5.</b> | <i>0-3 points</i>                                     | <i>4-10 points</i>                                                                      | <i>11-15 points</i>                                  | <i>16-20 points</i>                                  |
|                             | Task not completed (method and answers are incorrect) | The progress is correct, but there are significant errors, the answers are mostly wrong | The task is completed, but there are minor errors    | Task completely done. Mistakes missing               |
| <b>Practical Works 6-12</b> | <i>0-3 points</i>                                     | <i>4-10 points</i>                                                                      | <i>11-20 points</i>                                  | <i>21-35 points</i>                                  |
|                             | Task not completed (method and answers are incorrect) | The progress is correct, but there are significant errors, the answers are mostly wrong | The task is completed, but there are minor errors    | Task completely done. Mistakes missing               |
| <b>Multiple choice test</b> | <i>0-3 points</i>                                     | <i>4-7 points</i>                                                                       | <i>8-10 points</i>                                   | <i>11-15 points</i>                                  |
|                             | Depends on the number of correct answers to the test  | Depends on the number of correct answers to the test                                    | Depends on the number of correct answers to the test | Depends on the number of correct answers to the test |
| Exam                        | <i>0-10 points</i>                                    | <i>11-17 points</i>                                                                     | <i>18-24 points</i>                                  | <i>25-30 points</i>                                  |
|                             | Task not completed (method and answers are incorrect) | The progress is correct, but there are significant errors, the answers are mostly wrong | The task is completed, but there are minor errors    | Task completely done. Mistakes Missing               |

### 5.3. Formative assessment

Formative exercises are designed to enable students to develop particular aspects of their learning, prior to summative assessments. Formative exercises are designed to help students use feedback and self-reflection to manage and develop their learning so that they can see how to improve their work.



| No | Formative Assessment elements                                                                                                      | Date                                                 |
|----|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| 1. | Oral interview after studying each topic                                                                                           | After completing the study of the topic              |
| 2. | Passing the test on certification and modular control with feedback from the teacher                                               | According to the schedule of the educational process |
| 3. | Passing the test after the end of the study of each topic for independent control of knowledge and preparation for the test (exam) | Regulated by the student independently               |
| 4. | Protection of practical works                                                                                                      | One week after their delivery                        |
| 5. | Oral feedback from the teacher while working on practical work during classes                                                      | Throughout the semester                              |

Self-assessment can be used both as an element of formative and summative assessment.

## 6. LEARNING RESOURCES

### 6.1. Key resources

1. Ivanova, L., Kaverinskiy, V., Kotlyk, S., et al. (2024). Modern information technologies in scientific research and educational activities. Iowa State University Digital Press.
2. Punziano, G., & Delli Paoli, A. (Eds.). (2021). Handbook of Research on Advanced Research Methodologies for a Digital Society. IGI Global.
3. Schuster, K., & Dunn, S. (Eds.). (2021). Routledge International Handbook of Research Methods in Digital Humanities. Routledge.

### 6.2 Methodical resources

1. S.Ahadzhanova Modern information technologies in scientific activity (e-course in Moodle:Address – <https://cdn.snau.edu.ua/moodle/course/view.php?id=4566>

#### 6.2.2 Additional resources

1. Mental Rotation Ability and Preferences in Vocational Education. / Svitlana Ahadzhanova, Oleksandr Burov, Evgeniy Lavrov, Karen Ahadzhanov- Honsales, Olena Hlazunova, Oleksandr Viunenko// Advances in Intelligent Systems and Computing. Volume 1322. Springer Nature Switzerland AG 2021 D. Russo et al. (Eds.): IHSI 2021, AISC 1322, pp. 267–272, 2021. [https://doi.org/10.1007/978-3-030-68017-6\\_40](https://doi.org/10.1007/978-3-030-68017-6_40)
2. Oleksandr Yu. Burov, Nadiia B. Pasko, Oleksandr B. Viunenko, Svitlana V. Agadzhanova, Karen H. Ahadzhanov-Honsales. Using intelligent agent-managers to build personal learning environments in the e-learning system. AREdu 2024: 7th International Workshop on Augmented Reality in Education, May 14, 2024, Kryvyi Rih, Ukraine. 125-133pp. <https://ceur-ws.org/Vol-3918/paper296.pdf>

3. Shevchenko, A. (2024). Some issues in determining the essence of the definition “adaptive living environment”. In Modern Information Technologies in Education and Science (pp. 10-14). Abstracts of XXX International Scientific and Practical Conference, Prague.
4. S. Ahadzhanova, Yurchenko, Y. Khvorostina, K. Ahadzhanov-Honsales, S. Bohoslavskyi, O. Semenikhina Artificial Intelligence in Mathematics Education: Quantitative Analysis of Publication Activity 48th Convention International Convention on Information, Communication and Electronic Technology, 2025 MIPRO 48th ICT and Electronics Convention, 741–746.  
<https://doi.org/10.1109/MIPRO65660.2025.11131901>

## **6.2. Soft ware**

1. MATLAB,
2. Mathematica,
3. OriginLab,
4. MS Excel,
5. WolframCloud,
6. Google Cloud,
7. LaTeX/Overleaf.

