Erasmus+ Programme
Capacity Building in Higher Education

Project Number: 101082621 — EMINReM — ERASMUS-EDU-2022-CBHE
«Master Programme in Eco-Mining and Innovative Natural Resources Management / EMINReM»

EMINReM MASTER PROGRAM SYLLABI

Funded by the European Union.

INTRODUCTION

The **Master's Program in Eco-Mining Engineering & Innovative Natural Resources Management** (EMINReM) has been developed as an innovative response to the growing global demand for sustainable mining practices, resource efficiency, and environmental responsibility. The curriculum has been designed to equip students with advanced knowledge and skills in geological exploration, eco-mining technologies, resource management, waste recycling, and circular economy principles, integrating cutting-edge scientific approaches and digital tools into mining-related education.

The program was elaborated by Working Group of Ukrainian, Kazakh and Uzbek University staff in collaboration with German, Spanish and Turkish partner HEIs, incorporating best practices from leading international institutions. The desk and field studies, consultations with experts, and a one-week study visit to EU part of the Consortium played a crucial role in shaping the program's structure and content. A set of 14 innovative EMINReM modules, covering 90/120 ECTS, has been developed and integrated into the existing MSc programs of seven HEIs from countries not associated with the Eramsus+ Program, ensuring both academic relevance and compliance with national accreditation requirements.

The curriculum reflects a multi-disciplinary approach, emphasizing clean technologies, industrial waste management, environmental impact assessment, circular economy strategies, risk assessment, and entrepreneurship. The program's structure supports virtual mobility, international collaboration, and blended learning methodologies, reinforcing the capacity-building objectives of the project. Additionally, the development of teaching materials, syllabi, and quality assurance mechanisms, as well as peer-review assessments by external EU experts, has ensured the high academic standard of the program.

To facilitate smooth implementation, selected modules have been incorporated into the mandatory and elective parts of partner universities' curricula. The first cohort of MSc students enrolled in the program in September 2024, marking a significant milestone in the establishment of an internationally competitive, eco-mining-focused graduate education.

This report presents an overview of the curriculum development process, program structure, implemented innovations, and the expected impact on students, industry, and the academic community.

APPROVED

By the Academic Council of the Faculty of Mining, Nature Management and Construction
August 30, 2023 p.,
Minutes № 07
The Head of the Academic Council

_____ Volodymyr KOTENKO

WORKING PROGRAM OF EDUCATIONAL DISCIPLINE «RESOURCES MODELLING AND EVALUATION»

for Master's degree students
of the speciality 184 "Mining"
educational and professional program "Surveying business"
Faculty of Mining, Nature Management and Construction
Department of Surveying

Approved at the meeting of the Department of Surveying
August 28, 2023, Minutes № 7
Deputy Head of the Department

_____Volodymyr SHLAPAK

Guarantor of the educational and professional program

_____ Volodymyr SHLAPAK

Developer: Candidate of Technical Sciences, Assoc. Prof. of the Department of Surveying Panasiuk A.V.

Zhytomyr

1. Description of the academic discipline

<table>
<tr><td rowspan="2">Name of indicators</td><td rowspan="2">Field of knowledge, speciality, educational degree</td><td colspan="2">Characteristics of the academic discipline</td></tr>
<tr><td>full-time education</td><td>extramural form of education</td></tr>
<tr><td>Number of credits – 5</td><td>Field of knowledge
18 "Production and technologies"</td><td colspan="2">By choice</td></tr>
<tr><td>Modules – 1</td><td rowspan="5">Educational and professional program "Surveying business"</td><td colspan="2">Year of study:</td></tr>
<tr><td>Content modules – 1</td><td>2nd</td><td>2nd</td></tr>
<tr><td>No individual research task</td><td colspan="2">Semester</td></tr>
<tr><td rowspan="2">The total number of hours – 150</td><td>2nd</td><td>2nd</td></tr>
<tr><td colspan="2">Lectures</td></tr>
<tr><td rowspan="10">Hours per week for full-time study:
classrooms – 3 hours</td><td rowspan="10">Educational degree:
master</td><td>16 hours</td><td>8 hours</td></tr>
<tr><td colspan="2">Practical hours, seminars</td></tr>
<tr><td>32 hours</td><td>8 hours</td></tr>
<tr><td colspan="2">Laboratory hours</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Individual work</td></tr>
<tr><td>102 hours</td><td>134 hours</td></tr>
<tr><td colspan="2">Individual tasks:
–</td></tr>
<tr><td colspan="2">Control type: *test*</td></tr>
</table>

2. The purpose and tasks of the educational discipline

Modelling and evaluation of resources have an extremely wide range of applications: engineering research and design, regional management and planning, and rational use of natural resources (monitoring, modelling, forecasting). The methodological basis of the technology is spatial-temporal information modelling (mathematical, cartographic models), theory and methodology of database organisation, methods of computer graphics and image processing.

When solving tasks related to the analysis of production conditions, solving problems of an optimisation nature that directly depend on the assessment of resources within the deposit or geological field, which is the object when solving various tasks related to the improvement of reconnaissance and evaluation works, there is a need to establish patterns of placement of mineral resources that are within certain geological areas or individual mining facilities. Since conducting industrial research of this nature is very expensive, and even with the approval of the proposed technical solutions, the safety of work must be guaranteed, solving problems of this kind is carried out by modelling using various methods. Currently, the most progressive are various methods of mathematical modelling.

The purpose of studying the normative discipline "Modeling and assessment of resources" is to familiarise students with modern methods of mathematical modelling and assessment of resources of mineral deposits and form a system of skills and abilities in them for their possible application in solving the tasks of this direction in their further activities.

The task of the discipline is to acquaint students with modern methods of modelling geomechanical processes and their possibilities, obtaining more in-depth knowledge necessary for the formation of abilities and skills of setting research tasks and their implementation using mathematical modelling methods for solving problems of mining production in one's professional activity.

The study of the regulatory discipline "Resources Modelling and Evaluation" is based on knowledge of engineering graphics, computer science, probability theory and mathematical statistics, geology, and mathematics.

As a result of studying the educational discipline "Resources Modeling and Evaluation", the student should

know: modern modelling methods, their advantages and disadvantages, types of problems that can be solved using certain modelling methods, methods of resource assessment when applying mathematical modelling methods, principles of building a mathematical model, and methods of processing the results of experimental studies. be

able to: determine the most appropriate modelling method for solving a specific type of problem; build a mathematical model; carry out computer modelling using basic software complexes; if necessary, adjust the parameters of the model and process the obtained results.

Competencies that the applicant must master as a result of studying the discipline:

GC3. The ability to work in an international context and in a global information environment by profession.

GC5. Understanding the need to comply with copyright and related intellectual property rights; perception of state and international systems of legal protection of intellectual property.

SC3. Ability to develop and implement innovative products and measures to improve and increase the technical level of mining systems and technologies, ensuring their competitiveness.

SC7. The ability to display spatial regularities based on the results of the study of mining-geological, hydrogeological conditions and mining-technical parameters of deposit development.

SC8. Ability to create and update modern digital models of mineral deposits.

Program learning outcomes

LO1. To act in a new situation related to work by profession and the ability to generate new ideas in the field of mining.

LO7. To carry out theoretical and experimental studies of parameters and modes of operation of systems and technologies of mining and geoconstruction enterprises.

LO12. To analyse, systematise and interpret the mining-geological and hydrogeological conditions of the development of mineral deposits and mining-technical data, and perform modelling of mineral deposits based on them.

LO13. To model technological processes in predicted mining and geological conditions and evaluate the accuracy and reliability of forecasts.

LO14. To use modern information systems in scientific, innovative, project and operational activities.

3. Program of educational discipline

Content module 1. Geomodeling and resource assessment

Topic 1. Basics of modelling. Basic concepts. The primary purpose, principles and stages of modelling technological processes.

Topic 2. Data sources. Data formats and data import procedures. Data interpretation and data preparation for modelling.

Topic 3. Mathematical modelling. Statistical methods. Statistical methods of evaluation of experimental data. Formulation of the problem. Statistical assessment of research results. Modelling using "active" and "passive" experimental methods. "Passive" modelling methods using dispersion, regression and correlation analyses. "Active" method of optimal planning of experiments.

Topic 4. Mathematical modelling. Analytical, combined and special modelling methods. Analytical and combined modelling methods. Graphic modelling methods. Special modelling methods.

Topic 5. Construction of a plan of hypsometry of the sole of a mineral.

Topic 6. Construction of the mineral constant power plan. Construction of the constant power plan of overburden rocks.

Topic 7. Development of a plan for counting mineral resource estimation.

Topic 8. Construction of a geological map. The construction of a geological map of the deposit is combined with a map of the actual material.

Topic 9. Construction of geological sections.

Topic 10. Creation of a 3D model based on geological data.

Topic 11. Use of 3D geomodel and database for mineral extraction. Exploration and evaluation of resources.

Topic 12. Determination of the content of valuable components (reserves) on the basis geomodels or deposit models.

4. The structure (thematic plan) of the educational discipline

Content modules and topics	Number of hours							
	full-time study				extramural study			
	total	lectures	practical	individual work	total	lectures	practical	individual work
Module 1								
Content module 1. Geomodeling and resource assessment								
Basics of modelling. Basic concepts. The primary purpose, principles and stages of modelling technological processes.	10	4	–	6	10	2	–	8
Data sources. Data formats and data import procedures. Data interpretation and data preparation for modelling.	10	4	–	6	10	2	–	8
Mathematical modelling. Statistical methods. Statistical methods of evaluation of experimental data. Formulation of the problem. Statistical assessment of research results. Modelling using "active" and "passive" experimental methods. "Passive" modelling methods using dispersion, regression and correlation analyses. "Active" method of optimal planning of experiments.	10	4	–	6	10	2	–	8
Mathematical modelling. Analytical, combined and special modelling methods. Analytical and combined modelling methods. Graphic modelling methods. Special modelling methods.	10	4	–	6	10	2	–	8
Construction of a plan of hypsometry of the sole of a mineral.	12	–	4	8	12	–	1	11
Construction of the mineral constant power plan. Construction of the constant power plan of overburden rocks.	14	–	4	10	14	–	1	13
Development of a plan for counting mineral resource estimation.	14	–	4	10	14	–	1	13
Construction of a geological map. The construction of a geological map of the deposit is combined with a map of the actual material.	14	–	4	10	14	–	1	13
Construction of geological sections.	14	–	4	10	14	–	1	13
Creation of a 3D model based on geological data.	14	–	4	10	14	–	1	13
Use of 3D geomodel and database for mineral extraction. Exploration and evaluation of resources.	14	–	4	10	14	–	1	13
Determination of the content of valuable components (reserves) on the basis geomodels or deposit models.	14	–	4	10	14	–	1	13

TOTAL	150	16	32	102	150	8	8	134

5. Topics of practical (laboratory) classes

№ з/п	Topic name	Number of hours	
		full-time study	extramural study
1	Construction of the hypsometry plan of the sole of the mineral	4	1
2	Construction of the mineral constant power plan. Construction of the constant power plan of overburden rocks	4	1
3	Development of a plan for counting mineral reserves	4	1
4	Construction of a geological map. The construction of a geological map of the deposit is combined with a map of the actual material	4	1
5	Construction of geological sections	4	1
6	Creation of a 3D model based on geological data	4	1
7	Use of 3D geomodels and databases for mineral extraction. Exploration and evaluation of resources	4	1
8	Determination of the content of useful components (reserves) based on a geomodel or a deposit model	4	1
TOTAL		32	8

6. Tasks for independent work

Content modules and topics	Number of hours	
	full-time study	extramural study
Basics of modelling. Basic concepts. The primary purpose, principles and stages of modelling technological processes.	6	8
Data sources. Data formats and data import procedures. Data interpretation and data preparation for modelling.	6	8
Mathematical modelling. Statistical methods. Statistical methods of evaluation of experimental data. Formulation of the problem. Statistical assessment of research results. Modelling using "active" and "passive" experimental methods. "Passive" modelling methods using dispersion, regression and correlation analyses. "Active" method of optimal planning of experiments.	6	8
Mathematical modelling. Analytical, combined and special modelling methods. Analytical and combined modelling methods. Graphic modelling methods. Special modelling methods.	6	8
Construction of a plan of hypsometry of the sole of a mineral.	8	11
Construction of the constant power plan of a mineral. Construction of the constant power plan of overburden rocks.	10	13
Development of a plan for counting mineral resource estimation.	10	13
Construction of a geological map. The construction of a geological map of the deposit is combined with a map of the actual material.	10	13

Construction of geological sections.	10	13
Creation of a 3D model based on geological data.	10	13
Use of 3D geomodel and database for mineral extraction. Exploration and evaluation of resources.	10	13
Determination of the content of valuable components (reserves) on the basis geomodels or deposit models.	10	13
TOTAL	102	134

7. Individual tasks

1. Mastering software products for practical work
2. Mastering the basic skills of working in applied programs
3. Completion of calculation and graphic works
4. Preparation for training sessions and control events
5. Performance of control works

8. Learning methods

Learning methods:

- verbal – explanation, story, conversation, instruction;
- visual – observation, illustration, demonstration,
- practical – exercises, laboratory work, graphic works.

9. Control methods

Written tests, ongoing testing, evaluation for individual performance of practical work, final control - 1 test.

10. Distribution of points

Current testing and independent work			Total
Content module 1			
T1- T4	T5-T12	Test	100
20	60	20	

Rating scale

According to the scale	Exam	Test	Points
A	Excellent	Passed	90-100
B	Good	Passed	82-89
C			74-81
D	Satisfactory	Passed	64-73
E			60-63
FX	Fail	Not Passed	35-59
F		Not Passed	0-34

11. Recommended Literature

1. Самойленко В.М. (2010) *Географічні інформаційні системи та технології*: Підручник. – К.: Ніка-Центр
2. Єгоршин О. О. (2006) *Математичне програмування*: *підручник*. Х. : ВД «ІНЖЕК».
3. В.М. Дубовой, С.М. Москвіна, О.Д. Никитенко. (2009) *Моделювання процесів і систем керування: навчальний посібник*. Вінницький НТУ
4. Колодницький М. М. (2001) *Основи теорії математичного моделювання систем*. Житомир.
5. Л. Куперштейн. (2009) *Імітаційне моделювання*. Вінниця: ВФЕУ
6. Білецький В.С., Смирнов В.О. (2013) *Моделювання процесів збагачення корисних копалин*. Донецьк: Східний видавничий дім.
7. Наконечний С. І., Савіна С. С. (2003) Математичне програмування: Навч. посіб. К.: КНЕУ.
8. Burgman, M. (2005). *Resource Modelling and Management*. Cambridge University Press.
9. Perman, R., Ma, Y., McGilvray, J., & Common, M. (2011). *Natural Resource and Environmental Economics (4th ed.)*. Pearson
10. Harris, J. M., & Roach, B. (2018). *Environmental and Natural Resource Economics: A Contemporary Approach (4th ed.)*. Routledge
11. Naldi, G., Pareschi, L., & Toscani, G. (2010). *Mathematical Models in Natural Science and Engineering*. Birkhäuser
12. Chen, Z. (2007). *Reservoir Simulation: Mathematical Techniques in Oil Recovery. Society for Industrial and Applied Mathematics* (SIAM).
13. Dake, L. P. (1978). *Fundamentals of Reservoir Engineering*. Elsevier
14. Ahmed, T. (2010). *Reservoir Engineering Handbook (4th ed.)*. Gulf Professional Publishing
15. Lie, K.-A. (2019). *Advanced Modelling with the MATLAB Reservoir Simulation Toolbox*. Cambridge University Press

12. Information resources on the Internet

1. https://www.goldensoftware.com/products/surfer/ – the website of the software product Surfer
2. http://www.nbuv.gov.ua – National Library of Ukraine named after V. I. Vernadskyi.
3. https://www.learn.ztu.edu.ua – educational portal of Zhytomyr Polytechnic State University

“Gamification in Eco-Mining” / “Гейміфікація в Еко-гірництві”

THE COURSE DESCRIPTION

<table>
<tr><td rowspan="2">Name of indicators</td><td rowspan="2">Field of knowledge, training direction, educational degree</td><td colspan="2">The course characteristics</td></tr>
<tr><td>Intramural study mode</td><td>Extramural study mode</td></tr>
<tr><td>Number of credits - 4</td><td>Branch of knowledge
18 "Production and technologies"</td><td colspan="2"><u>selective</u>
(obligatory, selective)</td></tr>
<tr><td>Modules – 1</td><td rowspan="5">184 «Mining»</td><td colspan="2">Year of study:</td></tr>
<tr><td rowspan="2">Content modules – 2</td><td>1</td><td>__</td></tr>
<tr><td colspan="2">Semester</td></tr>
<tr><td rowspan="2">Total hours - 120</td><td>2</td><td>__</td></tr>
<tr><td colspan="2">Lecture classes</td></tr>
<tr><td rowspan="10">Weekly hours for intramural study mode:
classroom - 4
independent work – 3.5</td><td rowspan="10">Master's degree</td><td>32 hours</td><td>__ hours</td></tr>
<tr><td colspan="2">Practical classes</td></tr>
<tr><td>32 hours</td><td>__ hours</td></tr>
<tr><td colspan="2">Laboratory classes</td></tr>
<tr><td>- hours</td><td>- hours</td></tr>
<tr><td colspan="2">Independent work</td></tr>
<tr><td>56 hours</td><td>__ hours</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">Type of control: test</td></tr>
</table>

The ratio of the number of classroom hours to independent and individual work is:
for intramural study mode – 53 % classroom hours, 47 % independent work;
for extramural study mode − __ % classroom hours, __ % independent work.

THE COURSE PURPOSE AND OBJECTIVES

Gamification in Eco-Mining is a scientific and technical course that **studies**:

- advanced experience in the use of digital technologies in mining;
- prospects of using virtual and augmented reality technologies for practical training of mining engineers, labor protection engineers, environmental protection experts, etc.;
- opportunities to develop serious games for the mining industry;
- results and advantages of digital technologies` application in the mining industry.

Goal: Developing knowledge and skills of 3D virtual/augmented reality and gamification applications and implementing them for engineering and education by deploying on various cross-platforms. The course is aimed at these applications development and use already developed professional software for students` and the mining industry experts` training.

Learning Outcomes:

- Learning and development of VR/AR (virtual-augmented reality) and gamification systems to implement on computers, Web, mobile and headsets;
- Understanding types and purposes of serious games application for professionals` training for different mining conditions;
- Learning real mining environment through developed VR models
- Developing 3D VR/AR applications in the fields of engineering and education by using the platforms such as Unity:
- Ability of developing applications in cross-media/cross-platforms.

Content: Real time development platform Unity allows designing and developing 3D applications for virtual and augmented reality glasses and headsets primarily for computers, WEB, tablets and mobile phones, as well as Android systems. Already developed program products (apps, training platforms and VR models) give learners possibility to be trained in interactive way and learn specific mining conditions without leaving their educational institution / office workspace.

THE COURSE PROGRAM

Content module 1. **Gamification in Eco-Mining**	**Змістовий модуль 1.** **Гейміфікація в Еко-гірництві**
Topic 1. Introduction. Course content and its significance for the mining industry. The purpose of studying the course, its` tasks. History of gamification in Mining. Types of professional games. Synthetic learning environments; VR and AR technologies in mining. The importance of gamification for the industry and development prospects. **Topic 2.** Program products for underground mining environment study. Rock Barring in an Underground Mine; Critical Interventions for Safety (Proximity), SIMS VR Mining experience. **Topic 3.** Program products for open-pit environment study. HAUL!, Aim to Reclaim Virtual Lab (Discovery Education). **Topic 4.** Serious games for operators in the mining industry. Safety Procedures Before and After Blasting. Charging / Blasting. Social License to Operate in the Mining Industry (MiGaEl). **Topic 5.** Synthetic educational environments for labor safety training. Harry's Hard Choices, Harry's Fatalgram Simulator, Harry's Hazardous Day (Western Mining Safety and Health Training Resource Center).	**Тема 1.** Вступ. Зміст курсу та його значення для гірництва. Мета вивчення курсу, задачі. Історія гейміфікації в гірництві. Види професійних ігор. Синтетичні навчальні середовища; технології VR та AR в гірництві. Важливість гейміфікації для галузі та перспективи розвитку. **Тема 2.** Програмні продукти для розробки родовищ корисних копалин підземним способом. Rock Barring in an Underground Mine; Critical Interventions for Safety (Proximity), SIMS VR Mining experience. **Тема 3.** Програмні продукти для розробки родовищ корисних копалин відкритим способом. HAUL!, Aim to Reclaim Virtual Lab (Discovery Education). **Тема 4.** Серйозні ігри для операторів в гірничій галузі. **Тема 5**. Синтетичні навчальні середовища для навчання з питань охорони праці. Harry's Hard Choices, Harry's Fatalgram Simulator, Harry's Hazardous Day (Western Mining Safety and Health Training Resource Center).
Content module 2. **Unity cross-platform game engine.** **Thematic applications development**	**Змістовий модуль 2.** **Багатоплатформовий інструмент Unity.** **Розробка тематичних додатків**
Topic 6. The Unity platform general overview. Purpose and tasks. Functional capabilities. **Topic 7.** Creating simple objects and scenarios. Standard Unity tools` use. **Topic 8.** Creation of FPS games. **Topic 9.** Creation and reproduction of objects in virtual reality. VR models. Features of their creation and use. **Topic 10.** Augmented reality. Features of AR models use.	**Тема 6.** Мета та задачі роботи на платформі Unity. Загальний огляд. Функціональні можливості. **Тема 7**. Створення простих об’єктів і сценаріїв. Використання стандартних засобів Unity. **Тема 8.** Створення FPS-гри (шутер від першої особи). **Тема 9.** Створення і відтворення об’єктів у віртуальній реальності. VR моделі. Особливості їх створення та використання. **Тема 10.** Доповнена реальність. Особливості використання AR моделей.

THE COURSE STRUCTURE

Names of content modules and topics	Number of hours					
	Intramural study mode					
	total	including				
		lec.	pract.	lab	indiv.	independent work
1	2	3	4	5	6	7
Module 1						
Content module 1. Gamification in Eco-Mining						
Topic 1. Introduction. Course content and its significance for the mining industry. The purpose of studying the course, its` tasks. History of gamification in Mining. Types of professional games. Synthetic learning environments; VR and AR technologies in mining. The importance of gamification for the industry and development prospects	8	2	2	-	-	4
Topic 2. Program products for underground mining environment study. Rock Barring in an Underground Mine; Critical Interventions for Safety (Proximity), SIMS VR Mining experience	14	4	4			6
Topic 3. Program products for open-pit environment study. HAUL!, Aim to Reclaim Virtual Lab (Discovery Education)	14	4	4	-	-	6
Topic 4. Serious games for operators in the mining industry. Safety Procedures Before and After Blasting. Charging / Blasting. Social License to Operate in the Mining Industry (MiGaEl)	8	2	2	-	-	4
Topic 5. Synthetic educational environments for labor safety training. Harry's Hard Choices, Harry's Fatalgram Simulator, Harry's Hazardous Day (Western Mining Safety and Health Training Resource Center)	16	4	4	-	-	8
Total within content module 1	60	16	16	-	-	28
Content module 2. Unity cross-platform game engine. Thematic applications development						
Topic 6. The Unity platform general overview. Purpose and tasks. Functional capabilities	8	2	2	-	-	4
Topic 7. Creating simple objects and scenarios. Standard Unity tools` use	16	4	4			8
Topic 8. Creation of FPS games	16	4	4	-	-	8
Topic 9. Creation and reproduction of objects in virtual reality. VR models. Features of their creation and use	12	4	4	-	-	4
Topic 10. Augmented reality. Features of AR models use	8	2	2	-	-	4
Total within content module 2	60	16	16	-	-	28
Total hours	**120**	**32**	**32**	**-**	**-**	**56**

LECTURE CLASSES

№	Topic name	Number of hours
1	Introduction. Course content and its significance for the mining industry. The purpose of studying the course, its` tasks. History of gamification in Mining. Types of professional games. Synthetic learning environments; VR and AR technologies in mining. The importance of gamification for the industry and development prospects	2
2	Program products for underground mining environment study: Rock Barring in an Underground Mine; Critical Interventions for Safety (Proximity) SIMS VR Mining experience	 2 2
3	Program products for open-pit environment study. HAUL!, Aim to Reclaim Virtual Lab (Discovery Education) (etc.)	4
4	Serious games for operators in the mining industry. Safety Procedures Before and After Blasting. Charging / Blasting. Social License to Operate in the Mining Industry (MiGaEl)	2
5	Synthetic educational environments for labor safety training. Harry's Hard Choices, Harry's Fatalgram Simulator, Harry's Hazardous Day (Western Mining Safety and Health Training Resource Center)	2 2
6	The Unity platform general overview. Purpose and tasks. Functional capabilities	2
7	Creating simple objects and scenarios. Standard Unity tools` use	4
8	Creation of FPS games	4
9	Creation and reproduction of objects in virtual reality. VR models. Features of their creation and use	2 2
10	Augmented reality. Features of AR models use	2
Total		**32**

PRACTICAL CLASSES

№	Topic name	Number of hours
1	Information about computer game platforms, virtual and augmented reality VR/AR. Computer and mobile device application examples. General and basic information about Unity3D, Blender and Unreal Engine software.	2
2	Program products for underground mining environment study. Rock Barring in an Underground Mine; Critical Interventions for Safety, SIMS VR Mining experience	2 2
3	Program products for open-pit environment study. HAUL! Aim to Reclaim Virtual Lab	 2 2
4	Serious games for operators in the mining industry. Safety Procedures Before and After Blasting. Charging / Blasting. Social License to Operate in the Mining Industry (MiGaEl)	2
5	Synthetic educational environments for labor safety training. Harry's Hard Choices Harry's Fatalgram Simulator, Harry's Hazardous Day	2 2
6	Panel controls for 2D and 3D designs in Unity3d. Object generation, addition, controls. Animation development, adding external objects	2
7	Unity3D with space, terrain design, sound and light controls.	2

	Standard Unity tools` testing	2
8	FPS games launching. Cardboard virtual reality application development with Unity	4
9	Creation and reproduction of objects in virtual reality. VR models. Features of their creation and use. VR models` testing	2 2
10	Mobile applications for Android systems–I (FPS) and Android systems–II (TPS)	2
Total		**32**

INDEPENDENT WORK

№	Topic name	Number of hours
1	History of gamification in Mining. Professional games. Synthetic learning environments; VR and AR technologies in mining	4
2	Program products for underground mining environment study. Rock Barring in an Underground Mine; Critical Interventions for Safety, SIMS VR Mining experience	6
3	Program products for open-pit environment study. HAUL!, Aim to Reclaim Virtual Lab	6
4	Serious games for operators in the mining industry. Safety Procedures Before and After Blasting. Charging / Blasting. Social License to Operate in the Mining Industry (MiGaEl)	4
5	Harry's Hard Choices, Harry's Fatalgram Simulator, Harry's Hazardous Day	8
6	Panel controls for 2D and 3D designs in Unity3d. Object generation, addition, controls. Animation development, adding external objects	4
7	Unity3D with space, terrain design, sound and light controls. Standard Unity tools` testing	8
8	FPS games launching. Cardboard virtual reality application development with Unity	8
9	Creation and reproduction of objects in virtual reality. VR models. Features of their creation and use. VR models` testing	4
10	Augmented reality. AR models testing	4
Total		**56**

Ministry of Education and Science of Ukraine
Dnipro University of Technology

Department of Ecology and Environmental Protection Technologies

Co-funded by the European Union

“APPROVED”
head of the department

Borysovska O.O. _____

“ “ July 2024

WORKING PROGRAM OF EDUCATIONAL DISCIPLINE

«Environmental Assessment and Inventory Techniques for Mining Industry»

Fields of knowledge ……..…	10 Natural sciences 18 Manufacturing and technology
Specialties ……...	101 Ecology 183 Environmental protection technology
Level of higher education …….	Second (Master's)
Educational and professional program	“Ecology” “Environmental protection technology”
Degree …….	master
Status ……	mandatory
Total volume …….	4 ECTS credits (120 hours)
Final control form	Differential credit
Term of teaching ……..	1st semester
Language of teaching …….	Ukrainian English

Teachers: associate professor Buchavyi Y.V.

Prolonged: on 20__/20__ n.y. _____(_____) "__"___ 20__yr.
(signature, name, date)

on 20__/20__ AD _____(_____) "__"___ 20__yr.
(signature, name, date)

Dnipro
DUT
2024

Work program of the study discipline “Environmental Assessment and Inventory Techniques for Mining Industry” for masters of the educational and professional program “Ecology” specialty 101 “Ecology” and “Environmental protection technology” specialty 183 “Environmental protection technology” / Dnipro University of Technology, Department ecology and environmental protection technologies. - D.: DUT, 2024. – 15 p.

Developers:
- Buchavyi Yurii Volodymyrovych – associate professor, candidate of biological sciences, associate professor of the department of ecology and environmental protection technologies

The work program regulates:

– the purpose of the discipline;
– disciplinary learning outcomes formed on the basis of the transformation of the expected learning outcomes of the educational program;
– basic disciplines;
– volume and distribution by forms of the educational process organization and types of educational classes;
– discipline program (thematic plan by types of educational classes);
– algorithm for assessing the level of disciplinary learning outcomes achievement (scales, means, procedures and evaluation criteria);
– tools, hardware and software;
– recommended sources of information.

The work program is designed to implement a competency-based approach during the planning of the educational process, teaching the discipline, preparing students for control measures, monitoring the implementation of educational activities, internal and external control of higher education quality assurance, accreditation of educational programs within the specialty.

Agreed by the decision of the scientific and methodical commission of specialty 101 “Ecology” and 183 “Environmental protection technology” (protocol No. dated 07.2024).

ЗМІСТ

1 PURPOSE OF THE EDUCATIONAL DISCIPLINE

The purpose of the discipline to acquire knowledge, skills and inventory of sources of pollution from the main technological processes of mining production and hazard evaluation for environmental components on the basis of modern techniques and specialized software, taking into account the experience of EU countries and standards.

. 2 EXPECTED DISCIPLINARY LEARNING OUTCOMES

Disciplinary learning outcomes (DLO)	
Code DLO	**Content**
DLO 1	Understand the specifics of environmental pollution from the main technological processes of mining and industrial sites
DLO 2	To know the classification of sources of atmospheric pollution in the mining industry and the standards of pollutants
DLO 3	Be able to determine the technological characteristics of sources of atmospheric pollution at mining and processing plants
DLO 4	Be able to inventory sources of atmospheric pollution and form their electronic database
DLO 5	Be able to calculate the values of gross emissions of mining enterprises according to the results of inventory of sources of atmospheric pollution
DLO 6	Be able to calculate the sanitary protection zones for mining enterprises and their objects
DLO 7	To understand approaches to developing an environmental monitoring system for mining enterprises
DLO 8	Calculate the surface concentrations of pollutants from various sources of contamination by means of specialized software
DLO 9	Use remote sensing methods in nature conservation activities in the area adjacent to mining enterprises
DLO 10	Determine the risks to the health of the population in the surrounding mining enterprises from the pollution of atmospheric air by the emissions of mining enterprises

3 BASIC DISCIPLINES

The discipline is taught in the first semester in accordance with the curriculum, so no additional requirements for basic disciplines are established. Interdisciplinary connections: the study of the course is based on the knowledge obtained from the disciplines studied at the previous level of education.

4 SCOPE AND DISTRIBUTION BY FORMS OF THE EDUCATIONAL PROCESS ORGANIZATION AND TYPES OF EDUCATIONAL CLASSES

Type of educational activities	**Volume**, *hours*	**Distribution by forms of education**, *hours*			
		daytime		**daytime**	
		classroom activities	classroom activities	classroom activities	classroom activities
Lecture	80	24	56	8	72
Laboratory works	40	16	24	8	32
Total:	120	40	80	16	104

5 DISCIPLINE PROGRAM BY TYPE OF EDUCATIONAL CLASSES

Code DRN	**Types and topics of educational classes**	**Volume of components,** *hours*
	LECTURES	**80**
DLO 1	**Topic 1. Basic technological processes of mineral production and specificity of their environmental impact**	8
	Discovering work. Boring. Explosive work. Characteristics of explosives in mining and chemical compounds formed during explosions. Transportation of mountain mass. Storage and waste formation. Characteristics of equipment and equipment in open mining. Career excavators. Auto sight. Loaders. Land scraper. Drilling machines. Console dumps. Crushers. Conveyors.	
DLO 1	**Theme 2. Impact on environmental components from the main industrial volumes of mining enterprises**	8
	Generally generalized environmental careers. Geological disorders. Changes in landscapes and microclimate. Rock dumps and heaps. Stability of slopes and landslides. Sludge dump and “dry beaches”. Waste and drainage waters. Industrial sites. The surface complex of the mine. Agglomeration factory. crusher-sorting complex. Impact on biodiversity.	
DLO 2 DLO 6	**Topic 3. Classification and inventory of sources of atmospheric pollution**	8
	Organized and unorganized sources. Stationary and quasi -national sources. Hot and cold springs. Plane, linear and point sources. Approaches to inventory of sources of atmospheric pollution on the example of a typical mining and processing plant. Danger classes of industrial enterprises and their objects Calculation of regulatory and refined sanitary protection zone around sources of atmospheric pollution.	
DLO 1	**Topic 4. Inspection of inventory techniques and emissions from the equipment complex in open mining work**	8
	Conducting inventory of pollutant emissions at a mining enterprise. Substantiation of pollutant emissions into the atmospheric air. The procedure for determining the geodetic coordinates of pollutant emissions in the field of atmospheric air protection. The procedure for carrying out work related to the issuance of permits for pollutants into the atmospheric air. Calculation of the amount of compensation	

Code DRN	Types and topics of educational classes	Volume of components, *hours*
	for the losses caused to the state as a result of excess emissions of pollutants into the atmospheric air. Unified technique of comprehensive assessment of the level of environmental hazard of industrial objects and technologies.	
DLO 8 DLO 10	**Topic 5. Review of mathematical models and techniques for calculating the parameters of atmospheric pollution**	8
	Overview of the main mathematical models of diffusion-transfer in the atmosphere of gas emissions from the main sources of pollution. Euler's model. Gauss model. Lagrange model. OND-86 methodology. EPA AERMOD model. ISC3 models.	
DLO 8 DLO 10	**Topic 6. Inspection of software for inventory of sources of atmospheric pollution and modeling of emissions propagation processes**	8
	Examples of using K-Mine GIS to solve typical mining tasks. Calculation of surface concentrations of pollutants under adverse meteorological conditions in EOL-200H. Use of Breeze Aermod screening model. Modeling the distribution of a dust and gas cloud from explosive work in the PTC Mathcad software environment.	
DLO 1 DLO 10	**Theme 7. Instrumental control and normalization of atmospheric pollution at mining enterprises**	8
	The basic requirements of the World Health Organization and the European Community regarding the quality of atmospheric air. The main provisions of the 2008/50/EC of the European Parliament and the Council of 21.05.2008 on the quality of atmospheric air and purer air for Europe. The concept of PVR and MPC. Air quality index. Complex air pollution index. The concentrations of chemicals and biological substances in the atmospheric air are maximum permissible. The basics of WHO methodology to assess health risk assessment from air pollution.	
DLO 7 DLO 9	**Topic 8. Use of remote sensing technologies and geoinformation technologies for environmental monitoring of mining enterprises**	8
	Review of modern optical and radar satellites. Review of software for remote sensing data (SNAP, ENVI). The main GIS tools for the tasks of environmental monitoring of mining enterprises. An example of the implementation of the environmental monitoring system at mining and processing facilities in ESRI ArcGIS Desktop software environment.	
	Laboratory works	**40**
DLO 3 DLO 5	Calculation of gross values and maximum dust emissions during drilling work on iron ore quarries.	5
DLO 3 DLO 5	Calculation of volumes of gross emissions of pollutants from explosive work.	5
DLO 3 DLO 5	Calculation of gross volumes and maximum one-off dust emissions from removal and reloading work.	5
DLO 3 DLO 5	Calculation of gross volumes and maximum single emissions of pollutants during transportation of the mountain mass by dump trucks.	5
DLO 3 DLO 5	Calculation of gross volumes and maximum one -off dust emissions from rock dumps.	5

Code DRN	Types and topics of educational classes	Volume of components, *hours*
DLO 4 DLO 6 DLO 8 DLO 10	Calculation of atmospheric air pollution and health risks from organized sources of mining enterprises.	5
DLO 2 DLO 4	Formation of a database of sources of atmospheric pollution based on the inventory of the mining and processing plant.	5
DLO 7 DLO 9	Zonal-statistical analysis of the characteristics of landscaping of rock dumps and the calculation of the areas of dry beaches of the sludge caps on the basis of multi-spectral band images and geoinformation technologies.	5
	TOTAL	**120**

6 EVALUATION OF LEARNING RESULTS

Certification of students' achievements is carried out using transparent procedures based on objective criteria in accordance with the "Regulations on the evaluation of the results of higher education applicants".

The achieved level of competencies relative to the expected ones, identified during the control measures, reflects the real result of the student's training in the discipline.

6.1 Scales

Evaluation of educational achievements of DUT students is carried out according to rating (100-point) and institutional scales. The latter is necessary (due to the official absence of a national scale) for the conversion (transfer) of the grades of students of higher education at various institutions.

Scales for evaluating educational achievements of DUT students

Rating	Institutional
90...100	excellent / Excellent
74...89	good / Good
60...73	satisfactory / Satisfactory
0...59	unsatisfactory / Fail

Credits of the academic discipline are credited if the student received a final grade of at least 60 points. A lower grade is considered an academic debt subject to liquidation in accordance with the Regulations on the DUT organization of the educational Process.

6.2 Means and procedures

The content of the diagnostic tools is aimed at monitoring the level of formation of knowledge, abilities/skills, communication, responsibility and autonomy of the

student according to the requirements of the NRK up to the 7th qualification level during the demonstration of the learning results regulated by the work program.

The student must perform tasks aimed exclusively at demonstrating disciplinary learning outcomes (chapter 2) during the control events.

The diagnostic tools provided to students at control events in the form of tasks for current and final control are formed by specifying the initial data and the way of demonstrating the disciplinary learning results.

Diagnostic tools (control tasks) for current and final control of the discipline are approved by the department.

Types of diagnostic tools and evaluation procedures for current and final discipline control are presented below.

Diagnostic tools and assessment procedures

<table>
<tr><th colspan="3">CURRENT CONTROL</th><th colspan="2">FINAL CONTROL</th></tr>
<tr><th>study session</th><th>diagnostic tools</th><th>procedures</th><th>diagnostic tools</th><th>procedures</th></tr>
<tr><td>lectures</td><td>control tasks for each topic</td><td>performance of tasks during lectures</td><td rowspan="3">complex control work (CCW)</td><td rowspan="3">determination of the weighted average result of current controls;

execution of the CCW during the exam at the request of the student</td></tr>
<tr><td rowspan="2">practical</td><td rowspan="2">individual task for each topic</td><td>performing tasks during practical classes</td></tr>
<tr><td>performance of tasks during independent work</td></tr>
</table>

During the current control, the lectures are evaluated by determining the quality of performance of specified control tasks. Practical classes are evaluated by the quality of individual task performance.

If the content of a certain type of lesson is subordinated to several components, then the integral value of the assessment can be determined taking into account the weighting factors set by the teacher.

If there is a level of the results of current controls for all types of educational classes of at least 60 points, the final control is carried out without the participation of the student by determining the weighted average value of current grades.

Regardless of the current control results, each student during the exam has the right to perform the KKR, which contains tasks covering key disciplinary learning outcomes.

The number of specific tasks of the CCW should correspond to the time allotted for their implementation. The number of CCW options should ensure the individualization of the task.

The value of the assessment for the CCW implementation is determined by the average assessment of the components (specified tasks) and is final.

The integral value of the evaluation of the CCW implementation can be determined taking into account the weighting factors established by the department for each description of the qualification level of the national frame of qualification (NFQ).

6.3 Criteria

Actual student learning outcomes are identified and measured relative to expected outcomes during assessment using criteria that describe student actions to demonstrate achievement of learning outcomes.

To evaluate the performance of control tasks during the current control of lectures and practical classes, the assimilation coefficient is used as a criterion, which automatically adapts the evaluation indicator to the rating scale:

$$O_i = 100\ a/m,$$

where a is the number of correct answers or performed significant operations in accordance with the decision standard; m is the total number of questions or essential operations of the benchmark.

Individual tasks and complex control works are expertly assessed using criteria that characterize the ratio of requirements to the competences and assessment indicators level on a rating scale.

The content of the criteria is based on the competence characteristics defined by the NFQ for the master's level of higher education (given below).

General criteria for achieving learning outcomes for the 7th qualification level according to the NFQ

Description of qualification level	**Requirements for knowledge, abilities/skills, communication, responsibility and autonomy**	**Indicator evaluations**
	Knowledge	
♦ specialized conceptual knowledge that includes modern scientific achievements in the field of professional activity or field of knowledge and is the basis for original thinking and conducting research, critical understanding of problems in the field and at the border of fields of knowledge	The answer is excellent - correct, justified, meaningful. Characterized by the presence of: – specialized conceptual knowledge at the level of the latest achievements; – critical understanding of problems in education and/or professional activity and on the border of subject areas	95-100
	The answer does not contain gross errors or typos	90-94
	The answer is correct, but has some inaccuracies	85-89
	The answer is correct, but has certain inaccuracies and is not sufficiently substantiated	80-84
	The answer is correct, but has certain inaccuracies, is not sufficiently substantiated and understood	74-79
	The answer is fragmentary	70-73
	The answer demonstrates the student's vague ideas about the object of study	65-69
	The level of knowledge is minimally satisfactory	60-64
	The level of knowledge is unsatisfactory	<60

Description of qualification level	Requirements for knowledge, abilities/skills, communication, responsibility and autonomy	Indicator evaluations
	Skills/skills	
♦ specialized skills/problem-solving skills necessary for conducting research and/or carrying out innovative activities in order to develop new knowledge and procedures; ♦ ability to integrate knowledge and solve complex problems in broad or multidisciplinary contexts; ♦ the 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	The answer characterizes the ability to: – identify problems; – formulate hypotheses; – solve problems; – update knowledge; – integrate knowledge; – carry out innovative activities; – to conduct scientific activity	95-100
	The answer characterizes the ability/skills to apply knowledge in practical activities with no gross errors	90-94
	The answer characterizes the ability/skills to apply knowledge in practical activities, but has certain inaccuracies in the implementation of one requirement	85-89
	The answer characterizes the ability/skills to apply knowledge in practical activities, but has certain inaccuracies in the implementation of two requirements	80-84
	The answer characterizes the ability/skills to apply knowledge in practical activities, but has certain inaccuracies in the implementation of the three requirements	74-79
	The answer characterizes the ability/skills to apply knowledge in practical activities, but has certain inaccuracies in the implementation of the four requirements	70-73
	The answer characterizes the ability/skills to apply knowledge in practical activities when performing tasks according to the model	65-69
	The answer characterizes the ability/skills to apply knowledge when performing tasks according to the model, but with inaccuracies	60-64
	The level of skills is unsatisfactory	<60
	Communication	
♦ clear and unambiguous presentation of own knowledge, conclusions and arguments to specialists and non-specialists, in particular to persons who are studying	Comprehensibility of the answer (reports). *Language:* correct; clean; gums; accurate; logical; expressive; laconic *Communication strategy:* – consistent and consistent development of thought; – the presence of logical own judgments; – the appropriateness of the argumentation and its compliance with the defended provisions; – the correct structure of the answer (reports); – correct answers to questions; – appropriate technique for answering questions; – the ability to draw conclusions and formulate proposals; – use of foreign languages in professional activities	95-100
	Sufficient comprehensibility of the answer (report) and an appropriate communication strategy with minor errors	90-94
	Good comprehensibility of the answer (reports) and an appropriate communication strategy (total of three requirements not implemented)	85-89
	Good comprehensibility of the answer (reports) and an	80-84

Description of qualification level	Requirements for knowledge, abilities/skills, communication, responsibility and autonomy	Indicator evaluations
	appropriate communication strategy (in total, four requirements were not implemented)	
	Good comprehensibility of the answer (reports) and an appropriate communication strategy (a total of five requirements were not implemented)	74-79
	Satisfactory comprehensibility of the answer (reports) and appropriate communication strategy (seven requirements not implemented in total)	70-73
	Satisfactory comprehensibility of the answer (reports) and communication strategy with errors (nine requirements not implemented in total)	65-69
	Satisfactory comprehensibility of answers (reports) and communication strategy with errors (a total of 10 requirements were not implemented)	60-64
	The level of communication is unsatisfactory	<60
	Responsibility and autonomy	
♦ management of work or learning processes that are complex, unpredictable and require new strategic approaches; ♦ responsibility for contributing to professional knowledge and practice and/or evaluating the results of teams and collectives; ♦ the ability to continue learning with a high degree of autonomy	Excellent mastery of competencies: – use of principles and methods of organizing team activities; – effective distribution of powers in the team structure; – maintaining balanced relationships with team members (responsibility for relationships); – stress tolerance; – self-regulation; – labour activity in extreme situations; – high level of personal attitude to the case; – mastery of all types of educational activities; – proper level of fundamental knowledge; – appropriate level of general education skills formation and abilities	95-100
	Confident possession of competencies responsibility and autonomy with minor flaws	90-94
	Good mastery of the responsibility and autonomy competencies (two requirements are not implemented)	85-89
	Good mastery of the responsibility and autonomy competencies (three requirements are not implemented)	80-84
	Good mastery of the responsibility and autonomy competencies (four requirements are not implemented)	74-79
	Satisfactory possession of the responsibility and autonomy competences (five requirements are not implemented)	70-73
	Satisfactory possession of the responsibility and autonomy competences (six requirements are not implemented)	65-69
	Satisfactory possession of the responsibility and autonomy competences (fragmentary level)	60-64
	The level of responsibility and autonomy is unsatisfactory	<60

7 TOOLS, HARDWARE AND SOFTWARE

Activated University Mail account (Student.i.p.@Nmu.one) at Office365. Moogle Remote Platform and command resources in Microsoft Teams.

The laboratory base of the Department of Ecology and is used, as well as: Server of the Department with the Operation System of Proxmox with installed virtual workstations based on Windows 7 x86 with specialized software: QGIS, ESRI ArcGIS Desktop, SasPlanet, PTC MathCAD, SNAP. Wireguard VPN server for connecting education applicants to virtual workstations on KVM hypervisor.

8 RECOMMENDED SOURCES OF INFORMATION

1. Директива 2008/50/ЄС Європейського Парламенту та Ради від 21.05.2008 р. про якість атмосферного повітря та чистіше повітря для Європи (офіційний переклад на сайті Верховної Ради України). Електронний ресурс (URL: https://zakon.rada.gov.ua/laws/show/994_950).
2. Керівництво з імплементації природоохоронного законодавства ЄС, Розділ 3 – Якість атмосферного повітря. – Handbook on the Implementation of EC Environmental Legislation, Section 3 – Air Quality Legislation. Електронний ресурс (URL: http://ec.europa.eu/environment/archives/enlarg/handbook/handbook.pdf).
3. Environmental Impact Assessment Directive. Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment. OJ L 124, 25.4.2014, pp. 1–18.
4. Методичні рекомендації з оцінки ризику для здоров'я населення від забруднення атмосферного повітря, затверджені наказом Міністерства охорони здоров'я України № 184 від 13.04.2007.
5. Про затвердження державних медико-санітарних нормативів допустимого вмісту хімічних і біологічних речовин в атмосферному повітрі населених місць МОЗ України; Наказ, Нормативи від 10.05.2024 № 813
6. Автоматизований моніторинг та оцінка якості атмосферного повітря. Методичні вказівки для підготовки студентів за спеціальностями 101 «Екологія» та 103 «Науки про Землю» / к. геогр. н., доц. Гриб О. М., к. геогр. н., доц. Чугай А. В. / Одеса: ОДЕКУ, 2019. 58 с.
7. Збірник показників емісії (питомих викидів) забруднюючих речовин в атмосферне повітря різними виробництвами. Український науковий центр технічної екології. Донецьк, 2004. 518с.
8. Про затвердження Інструкції про вимоги до оформлення документів, в яких обґрунтовуються обсяги викидів забруднюючих речовин в атмосферне повітря стаціонарними джерелами. Міністерство захисту довкілля та природних ресурсів України. Наказ від 27.06.2023 № 448
9. Про затвердження Методики розрахунку розмірів відшкодування збитків, які заподіяні державі в результаті наднормативних викидів забруднюючих речовин в атмосферне повітря Міненергетики, захисту довкілля; Наказ, Методика від 28.04.2020 № 277.

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13. Environmental Impact Assessment Guidelines for the Mining Sector – TECHNICAL GUIDANCE ENIVIRONMENTAL IMPACT ASSESSMENT OF MINING. https://faolex.fao.org/docs/pdf/mya201116.pdf

14. Social and environmental impacts of mining activities in the EU - STUDY Requested by the PETI committee PE 729.156 - May 2022. http://www.europarl.europa.eu/supporting-analyses

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Information resources

1. http://zakon4.rada.gov.ua Офіційний сайт Верховної Ради України
2. http://www.mon.gov.ua Офіційний сайт Міністерства освіти і науки України
3. www.irbis-nbuv.gov.ua Наукова періодика України. Бібліотека ім. В. Вернадського
4. http://sop.org.ua Служба охорони природи – Інформаційний центр
5. http://env.teset.sumdu.edu.ua Науковий центр прикладних екологічних досліджень
6. Репозиторій НТУ «Дніпровська політехніка» [електроний ресурс], режим доступу: http://ir.nmu.org.ua/
7. https://scihub.copernicus.eu/ *Copernicus Open Access Hub*
8. https://www.openstreetmap.org*OpenStreetMap* — мапа світу, створена такими ж людьми, як і ви, для вільного використання під відкритою ліцензією.
9. https://qgis.org – *Spatial without Compromise · QGIS Web Site*
10. https://earth.google.com – *Google* Планета Земля
11. https://en.wikipedia.org/wiki/Atmospheric_dispersion_modeling – Моделі атмосферної дисперсії забруднювальних речовин

WORKING PROGRAM OF EDUCATIONAL DISCIPLINE

“Environmental Assessment and Inventory Techniques for Mining Industry”
for masters of the educational and professional program “Ecology”
specialty 101 Ecology and “Environmental protection technology”
specialty 183 “Environmental protection technology”

Developer:
Yurii Volodymyrovych **Buchavyi**

Edited by the authors

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49005, м. Dnipro, ave. D. Yavornytskoho, 19

Ministry of Education and Science of Ukraine
Dnipro University of Technology

Department of Ecology and Environmental Protection Technologies

Co-funded by the European Union

"APPROVED"
head of the department

Borysovska O.O. _____

" " July 2024

WORKING PROGRAM OF EDUCATIONAL DISCIPLINE

"Sustainable business and project management"

Fields of knowledge ……..…	10 Natural sciences
Specialties ……..	101 Ecology
Level of higher education …….	Second (Master's)
Educational and professional program	"Ecology"
Degree …….	master
Status ……	mandatory
Total volume ..…….	3 ECTS credits (90 hours)
Final control form	Differential credit
Term of teaching ……..	1st semester
Language of teaching …….	Ukrainian

Teachers: prof. Pavlychenko A.V.

Prolonged: on 20__/20__ n.y. _____(_____) "__"___ 20__yr.
(signature, name, date)

on 20__/20__ AD _____(_____) "__"___ 20__yr.
(signature, name, date)

Dnipro
DUT
2024

Work program of the study discipline "Sustainable business and project management" for masters of the educational and professional program "Ecology" specialty 101 "Ecology" / Dnipro University of Technology, Department ecology and environmental protection technologies. - D.: DUT, 2024. - 14 p.

Developers:
- Pavlychenko Artem Volodymyrovych - professor, doctor of technical sciences, professor of the department of ecology and environmental protection technologies

The work program regulates:

– the purpose of the discipline;
– disciplinary learning outcomes formed on the basis of the transformation of the expected learning outcomes of the educational program;
– basic disciplines;
– volume and distribution by forms of the educational process organization and types of educational classes;
– discipline program (thematic plan by types of educational classes);
– algorithm for assessing the level of disciplinary learning outcomes achievement (scales, means, procedures and evaluation criteria);
– tools, hardware and software;
– recommended sources of information.

The work program is designed to implement a competency-based approach during the planning of the educational process, teaching the discipline, preparing students for control measures, monitoring the implementation of educational activities, internal and external control of higher education quality assurance, accreditation of educational programs within the specialty.

Agreed by the decision of the scientific and methodical commission of specialty 101 "Ecology" (protocol No. dated 07.2024).

CONTENT

1 PURPOSE OF THE EDUCATIONAL DISCIPLINE

In the educational and professional program "Ecology" of the specialty 101 Ecology, the distribution of program learning outcomes (PLO) by organizational forms of the educational process has been carried out. In particular, the F6 discipline "Sustainable business and project management" includes the following learning outcomes

LO04	Know the legal and ethical norms for evaluating professional activity, developing and implementing socially significant environmental projects in conditions of conflicting requirements
LO05	Demonstrate the ability to organize collective activities and implement complex environmental protection projects, taking into account available resources and time constraints
LO08	Be able to clearly and unambiguously convey professional knowledge, own justifications and conclusions to specialists and the general public
LO09	Know the principles of personnel and resource management, the main approaches to decision-making in conditions of incomplete/insufficient information and conflicting requirements
LO20	To have the basics of environmental engineering design and ecological expert assessment of the impact on the environment

The purpose of the discipline is to provide students with higher education with competences in the principles and methods of business and project management to ensure the sustainable development of production through the preservation and rational use of natural resources.

The realization of the goal requires the transformation of program learning results into disciplinary and adequate selection of the content of the educational discipline according to this criterion.

2 EXPECTED DISCIPLINARY LEARNING OUTCOMES

Code PLO	**Disciplinary learning outcomes (DLO)**	
	Code DLO	**content**
LO 04	LO 04.1-F6	Be able to apply legal and ethical norms during the development and implementation of environmental projects in the conditions of conflicting requirements to ensure sustainable business
LO 05	LO 05.1-F6	Be able to organize collective activities for the implementation of complex environmental protection projects, taking into account available resources and time constraints
LO 08	LO 08.1-F6	Be able to inform the public about the advantages and disadvantages of sustainable business at various stages of the project life cycle
LO 09	LO 09.1-F6	Be able to manage personnel and resources when making decisions regarding the prospects of project implementation to ensure sustainable business development in conditions of insufficient information, resources and conflicting requirements
LO 20	LO 20.1-F6	Be able to carry out an environmental expert assessment of the impact of business processes on the environment, taking into account the prospects for the implementation of environmental protection projects at the local, regional and international levels

3 BASIC DISCIPLINES

The discipline is taught in the first semester in accordance with the curriculum, so no additional requirements for basic disciplines are established. Interdisciplinary connections: the study of the course is based on the knowledge obtained from the disciplines studied at the previous level of education.

4 SCOPE AND DISTRIBUTION BY FORMS OF THE EDUCATIONAL PROCESS ORGANIZATION AND TYPES OF EDUCATIONAL CLASSES

Type of educational activities	**Volume**, *hours*	**Distribution by forms of education**, *hours*			
		daytime		**extramural**	
		classroom activities	independent work	classroom activities	independent work
Lecture	50	18	32	4	46
Seminars	40	12	28	4	36
Total:	90	30	60	8	82

5 DISCIPLINE PROGRAM BY TYPE OF EDUCATIONAL CLASSES

Code DRN	**Types and topics of educational classes**	**Volume of components,** *hours*
	LECTURES	**50**
LO 04.1-F6 LO 08.1-F6 LO 20.1-F6	**Topic 1. Basic concepts and essence of business. General information about the global goals of sustainable development**	8
	Impact of global tasks on business development. The connection of the global goals of sustainable development with the development of mineral and raw materials resources: Goal 6. Clean water and proper sanitation. Goal 9. Industry, infrastructure innovation. Goal 12. Responsible consumption and production	
LO 04.1-F6 LO 08.1-F6 LO 20.1-F6	**Topic 2. Features of the sustainable business strategies formation**	8
	The global dimension of sustainable local development	
	The importance of strategic planning at the local level	
	Development and implementation of sustainable local development strategies	
	Development of a local action plan for environmental protection	
LO 04.1-F6 LO 09.1-F6 LO 20.1-F6	**Topic 3. Monitoring the implementation of environmental policy and justification of decision-making in business, taking into account the concept of sustainable development**	6
	National environmental policy and sustainable development.	
	Purpose, basic principles of national environmental policy.	
	Indicators of national environmental policy effectiveness.	
	Mechanism of monitoring, evaluation and improvement of policy implementation actions.	
LO 04.1-F6 LO 08.1-F6 LO 09.1-F6 LO 20.1-F6	**Topic 4. Indicators and indices of sustainable development, global dimensions system of sustainable development and business**	8
	Indicators and indices of sustainable development	

Code DRN	Types and topics of educational classes	Volume of components, *hours*
	Relationship of sustainable development indicators with the system of the Millennium Development Goals indicators and the system of the European Union indicators.	
	Concept of sustainable development monitoring, its purpose and object	
LO 05.1-F6 LO 08.1-F6 LO 09.1-F6	**Topic 5. Basic concepts of project management.**	6
	The concept of environmental projects.	
	Classification and content of the environmental project.	
	Components of an ecological project and their characteristics.	
	Project life cycle.	
	Project management as a means of solving environmental and social problems.	
	Peculiarities of environmental projects implementation in modern conditions of interaction between society and nature	
LO 04.1-F6 LO 05.1-F6 LO 20.1-F6	**Topic 6. Methodological foundations of environmental projects management and programs**	8
	Green Project Management methodology. ISO 10006, ISO 14000, ISO 19011 standards.	
	Risks of environmental projects. Types of environmental projects possible risks. The concept of risk management.	
	Measures to neutralize or minimize the negative consequences of possible risks of the project presentation effectiveness	
LO 04.1-F6 LO 05.1-F6 LO 20.1-F6	**Topic 7. Environmental project expertise.**	6
	Methodological foundations of project expertise.	
	Criteria for assessing the quality of the environmental project substantiation and its sections.	
	Presentation of the ecological project.	
	SEMINAR CLASSES	**40**
LO 04.1-F6	1. Methodology for measuring sustainable development	4
LO 05.1-F6	2. Determination of environmental threats to sustainable development of the region	4
LO 09.1-F6	3. Development of a local action plan for environmental protection	4
LO 09.1-F6	4. Indicators of the national environmental policy effectiveness for sustainable development	4
LO 08.1-F6	5. Development and presentation of projects using the latest renewable energy sources and resource-energy-saving technologies in the industrial and social spheres	6
LO 20.1-F6	6. Development and presentation of projects for the implementation of modern methods of cleaning industrial and municipal sewage in cities and factories	6
LO 09.1-F6	7. Development and presentation of projects in the field of water management	6
LO 09.1-F6	8. Development and presentation of technology projects for reclamation of disturbed lands	6
	TOGETHER	**90**

6 EVALUATION OF LEARNING RESULTS

Certification of students' achievements is carried out using transparent procedures based on objective criteria in accordance with the "Regulations on the evaluation of the results of higher education applicants".

The achieved level of competencies relative to the expected ones, identified during the control measures, reflects the real result of the student's training in the discipline.

6.1 Scales

Evaluation of educational achievements of DUT students is carried out according to rating (100-point) and institutional scales. The latter is necessary (due to the official absence of a national scale) for the conversion (transfer) of the grades of students of higher education at various institutions.

Scales for evaluating educational achievements of DUT students

Rating	Institutional
90...100	excellent / Excellent
74...89	good / Good
60...73	satisfactory / Satisfactory
0...59	unsatisfactory / Fail

Credits of the academic discipline are credited if the student received a final grade of at least 60 points. A lower grade is considered an academic debt subject to liquidation in accordance with the Regulations on the DUT organization of the educational Process.

6.2 Means and procedures

The content of the diagnostic tools is aimed at monitoring the level of formation of knowledge, abilities/skills, communication, responsibility and autonomy of the student according to the requirements of the NRK up to the 7th qualification level during the demonstration of the learning results regulated by the work program.

The student must perform tasks aimed exclusively at demonstrating disciplinary learning outcomes (chapter 2) during the control events.

The diagnostic tools provided to students at control events in the form of tasks for current and final control are formed by specifying the initial data and the way of demonstrating the disciplinary learning results.

Diagnostic tools (control tasks) for current and final control of the discipline are approved by the department.

Types of diagnostic tools and evaluation procedures for current and final discipline control are presented below.

Diagnostic tools and assessment procedures

CURRENT CONTROL			FINAL CONTROL	
study session	**diagnostic tools**	**procedures**	**diagnostic tools**	**procedures**
lectures	control tasks for each topic	performance of tasks during lectures	complex control work (CCW)	determination of the weighted average result of current controls; execution of the CCW during the exam at the request of the student
practical	individual task for each topic	performing tasks during practical classes		
		performance of tasks during independent work		

During the current control, the lectures are evaluated by determining the quality of performance of specified control tasks. Practical classes are evaluated by the quality of individual task performance.

If the content of a certain type of lesson is subordinated to several components, then the integral value of the assessment can be determined taking into account the weighting factors set by the teacher.

If there is a level of the results of current controls for all types of educational classes of at least 60 points, the final control is carried out without the participation of the student by determining the weighted average value of current grades.

Regardless of the current control results, each student during the exam has the right to perform the KKR, which contains tasks covering key disciplinary learning outcomes.

The number of specific tasks of the CCW should correspond to the time allotted for their implementation. The number of CCW options should ensure the individualization of the task.

The value of the assessment for the CCW implementation is determined by the average assessment of the components (specified tasks) and is final.

The integral value of the evaluation of the CCW implementation can be determined taking into account the weighting factors established by the department for each description of the qualification level of the national frame of qualification (NFQ).

6.3 Criteria

Actual student learning outcomes are identified and measured relative to expected outcomes during assessment using criteria that describe student actions to demonstrate achievement of learning outcomes.

To evaluate the performance of control tasks during the current control of lectures and practical classes, the assimilation coefficient is used as a criterion, which automatically adapts the evaluation indicator to the rating scale:

$$O_i = 100\ a/m,$$

where *a* is the number of correct answers or performed significant operations in accordance with the decision standard; *m* is the total number of questions or essential operations of the benchmark.

Individual tasks and complex control works are expertly assessed using criteria that characterize the ratio of requirements to the competences and assessment indicators level on a rating scale.

The content of the criteria is based on the competence characteristics defined by the NFQ for the master's level of higher education (given below).

General criteria for achieving learning outcomes for the 7th qualification level according to the NFQ

Description of qualification level	**Requirements for knowledge, abilities/skills, communication, responsibility and autonomy**	**Indicator evaluations**
	Knowledge	
♦ specialized conceptual knowledge that includes modern scientific achievements in the field of professional activity or field of knowledge and is the basis for original thinking and conducting research, critical understanding of problems in the field and at the border of fields of knowledge	The answer is excellent - correct, justified, meaningful. Characterized by the presence of: – specialized conceptual knowledge at the level of the latest achievements; – critical understanding of problems in education and/or professional activity and on the border of subject areas	95-100
	The answer does not contain gross errors or typos	90-94
	The answer is correct, but has some inaccuracies	85-89
	The answer is correct, but has certain inaccuracies and is not sufficiently substantiated	80-84
	The answer is correct, but has certain inaccuracies, is not sufficiently substantiated and understood	74-79
	The answer is fragmentary	70-73
	The answer demonstrates the student's vague ideas about the object of study	65-69
	The level of knowledge is minimally satisfactory	60-64
	The level of knowledge is unsatisfactory	<60
	Skills/skills	
♦ specialized skills/problem-solving skills necessary for conducting research and/or carrying out innovative activities in order to develop new knowledge and procedures; ♦ ability to integrate knowledge and solve complex problems in broad or multidisciplinary contexts;	The answer characterizes the ability to: – identify problems; – formulate hypotheses; – solve problems; – update knowledge; – integrate knowledge; – carry out innovative activities; – to conduct scientific activity	95-100
	The answer characterizes the ability/skills to apply knowledge in practical activities with no gross errors	90-94
	The answer characterizes the ability/skills to apply knowledge in practical activities, but has certain inaccuracies in the implementation of one requirement	85-89
	The answer characterizes the ability/skills to apply knowledge in practical activities, but has certain inaccuracies in the implementation of two requirements	80-84

Description of qualification level	Requirements for knowledge, abilities/skills, communication, responsibility and autonomy	Indicator evaluations
♦ the 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	The answer characterizes the ability/skills to apply knowledge in practical activities, but has certain inaccuracies in the implementation of the three requirements	74-79
	The answer characterizes the ability/skills to apply knowledge in practical activities, but has certain inaccuracies in the implementation of the four requirements	70-73
	The answer characterizes the ability/skills to apply knowledge in practical activities when performing tasks according to the model	65-69
	The answer characterizes the ability/skills to apply knowledge when performing tasks according to the model, but with inaccuracies	60-64
	The level of skills is unsatisfactory	<60
Communication		
♦ clear and unambiguous presentation of own knowledge, conclusions and arguments to specialists and non-specialists, in particular to persons who are studying	Comprehensibility of the answer (reports). *Language:* correct; clean; gums; accurate; logical; expressive; laconic *Communication strategy:* – consistent and consistent development of thought; – the presence of logical own judgments; – the appropriateness of the argumentation and its compliance with the defended provisions; – the correct structure of the answer (reports); – correct answers to questions; – appropriate technique for answering questions; – the ability to draw conclusions and formulate proposals; – use of foreign languages in professional activities	95-100
	Sufficient comprehensibility of the answer (report) and an appropriate communication strategy with minor errors	90-94
	Good comprehensibility of the answer (reports) and an appropriate communication strategy (total of three requirements not implemented)	85-89
	Good comprehensibility of the answer (reports) and an appropriate communication strategy (in total, four requirements were not implemented)	80-84
	Good comprehensibility of the answer (reports) and an appropriate communication strategy (a total of five requirements were not implemented)	74-79
	Satisfactory comprehensibility of the answer (reports) and appropriate communication strategy (seven requirements not implemented in total)	70-73
	Satisfactory comprehensibility of the answer (reports) and communication strategy with errors (nine requirements not implemented in total)	65-69
	Satisfactory comprehensibility of answers (reports) and communication strategy with errors (a total of 10 requirements were not implemented)	60-64
	The level of communication is unsatisfactory	<60

Description of qualification level	Requirements for knowledge, abilities/skills, communication, responsibility and autonomy	Indicator evaluations
	Responsibility and autonomy	
♦ management of work or learning processes that are complex, unpredictable and require new strategic approaches; ♦ responsibility for contributing to professional knowledge and practice and/or evaluating the results of teams and collectives; ♦ the ability to continue learning with a high degree of autonomy	Excellent mastery of competencies: – use of principles and methods of organizing team activities; – effective distribution of powers in the team structure; – maintaining balanced relationships with team members (responsibility for relationships); – stress tolerance; – self-regulation; – labour activity in extreme situations; – high level of personal attitude to the case; – mastery of all types of educational activities; – proper level of fundamental knowledge; – appropriate level of general education skills formation and abilities	95-100
	Confident possession of competencies responsibility and autonomy with minor flaws	90-94
	Good mastery of the responsibility and autonomy competencies (two requirements are not implemented)	85-89
	Good mastery of the responsibility and autonomy competencies (three requirements are not implemented)	80-84
	Good mastery of the responsibility and autonomy competencies (four requirements are not implemented)	74-79
	Satisfactory possession of the responsibility and autonomy competences (five requirements are not implemented)	70-73
	Satisfactory possession of the responsibility and autonomy competences (six requirements are not implemented)	65-69
	Satisfactory possession of the responsibility and autonomy competences (fragmentary level)	60-64
	The level of responsibility and autonomy is unsatisfactory	<60

7 TOOLS, HARDWARE AND SOFTWARE

Technical means of education. Computer class. Interactive board. Remote platform Moodle.

8 RECOMMENDED SOURCES OF INFORMATION

Basic

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16. Díaz-López C, Martín-Blanco C, De la Torre Bayo JJ et al (2021) Analyzing the scientific evolution of the Sustainable Development Goals. Appl Sci 11:8286. **https://doi.org/10.3390/app11188286**

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Auxiliary

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Information resources

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3. The official website of the Derzhkomstat of Ukraine // **www . ukrstat gov . u /**

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WORKING PROGRAM OF EDUCATIONAL DISCIPLINE

"**Sustainable business and project management**"
for masters of the educational and professional program "Ecology" specialty 101 Ecology

Developer:
Artem Volodymyrovych **Pavlychenko**

Edited by the authors

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S Y L L A B U S

"Introduction to the Circular Economy, Economics and Management of Natural Resources"

Educational Program 101 "Ecology"

Developed by

_____Prof., Dr. Iryna Shvets

(signature)

_____Assoc. Prof., PhD. Olha Bohomaz

(signature)

«____»_____2024

Approved by the Head of Environmental Protection Department

_____Prof., Dr. Viktor Kostenko

(signature)

«____»_____2024

Lutsk, 2024

1. Description of the academic discipline

Form of education	full-time	distance learning
Status	Selective	
Year	2024-2025	
ECTS credits	5	5
The total number of hours including:	150	150
lectures	32	8
practical lesson	16	4
laboratory lesson	-	-
individual work	102	138
Evaluation form	Exam	
Language of instruction	English, Ukrainian	
Information about lecturers		
Lecturer	Iryna Shvets, Prof., Dr.	
Email	irina_shvets13@ukr.net	
Department	Department of management, financial and economic security	
Lecturer	Olha Bohomaz, Assoc. Prof., PhD.	
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Department	Department of Environmental Protection	

2. The purpose and tasks of the educational discipline

The discipline "Introduction to the circular economy, economics and management of natural resources" provides an overview of the principles and practices of the circular economy, which is an alternative economic model that seeks to promote sustainable use of natural resources and reduce waste.

The purpose of the selective discipline "Introduction to the circular economy, economics and management of natural resources" is to provide students with multidisciplinary base on circular economy knowledge and to strengthen students to tackle with global sustainability challenges by benefitting the potential of circular

economy and developing innovative solutions towards sustainable use of natural resources and reduce waste.

The objectives of the discipline are the following:

– to develop masters' understanding of basic economic concepts and terms in the field of circular economy;

– develop the ability to think independently, identify and analyze different types of areas for development of the circular economy;

– consolidate a set of knowledge and assimilation of achievements on sustainable resource management to prevent their depletion.

The study of the selective discipline "Introduction to the circular economy, economics and management of natural resources" is based on knowledge of ecology, economics, geology, and mining.

As a result of studying the educational discipline "Introduction to the circular economy, economics and management of natural resources", **the student should know:**

- principles, benefits and key action areas of the circular economy;
- difference between linear and circular economic models;
- innovative technologies that ensure the practice of a circular economy;
- strategies to reduce waste and emissions;
- key performance indicators (KPIs) for measuring circular economy performance;
- principles and strategies for sustainable management of renewable and non-renewable resources;
- key international environmental agreements.

Competencies that the applicant must master as a result of studying the discipline:

- GC03. Ability to generate new ideas (creativity);
- GC04. Ability to develop and manage projects;
- SC09. Awareness at the level of the latest achievements necessary for research and/or innovative activities in the field of ecology, environmental protection and balanced nature use;

- SC14. The ability to manage the strategic development of the team the process of carrying out professional activities in the field of ecology, environmental protection and balanced nature use;

- SC16. Ability to self-educate and professional development based on innovative approaches in the field of ecology and protection of the environment and balanced nature use.

Program learning outcomes:

- LO05. Demonstrate the ability to organize collective activities and implement complex environmental projects, taking into account available resources and time constraints;

- LO16. Choose the optimal management or nature management strategy depending on environmental conditions;

- LO17. Critically interpret theories, principles, methods and concepts from various subject areas to solve practical problems and problems of ecology.

3. Program of educational discipline

Module 1. Introduction to the circular economy

Topic 1. Understanding the Circular Economy: Principles, Benefits, and Applications

Topic 2. Action Areas of the Circular Economy

Topic 3. Environmental Impacts

Topic 4. Circular Design and Innovation

Topic 5. Measurement and Evaluation

Module 2. Economics and management of natural resources

Topic 6. Introduction to Natural Resource Economics

Topic 7. Valuation of Natural Resources

Topic 8. Resource Management Strategies

Topic 9. Environmental Policy and Regulation

Topic 10. Economic Development and Natural Resources

4. Structure (thematic plan) of the discipline

Content modules and topics	Number of hours							
	full-time study				distance learning			
	total	lectures	practical	individual work	total	lectures	practical	individual work
Content module 1. Introduction to the circular economy								
Understanding the Circular Economy: Principles, Benefits, and Applications	14	4	2	8	14	2	–	12
Action Areas of the Circular Economy	14	4	2	8	14	2	–	12
Environmental Impacts	18	2	2	14	18	–	2	16
Circular Design and Innovation	12	2	2	8	12	–	–	12
Measurement and Evaluation	12	2	–	10	12	–	–	12
Content module 2. Economics and management of natural resources								
Introduction to Natural Resource Economics	16	4	8	10	16	2	–	14
Valuation of Natural Resources	14	2	–	10	14	–	2	12
Resource Management Strategies	18	4	–	12	18	2	–	16
Environmental Policy and Regulation	16	4	–	10	16	–	–	16
Economic Development and Natural Resources	16	4	–	12	16	–	–	16
TOTAL	150	32	16	102	150	8	4	138

5. Topics of practical (laboratory) classes

№ з/п	Topic name	Number of hours	
		full-time study	distance learning
1	Analysis of economic and ecological disadvantages of a linear and circular economy	2	–
2	Comparative analysis of EU and Ukrainian waste policies	2	–
3	Building a waste hierarchy pyramid	2	2
4	The differences: sustainable design, eco-design and circular design	2	–
5	The role of natural resources in the economy of different countries. Setting the task, forming teams	2	2

6	The role of natural resources in the economy of different countries. Presentation of student's team 1	2	–
7	The role of natural resources in the economy of different countries. Presentation of student's team 2	2	–
8	The role of natural resources in the economy of different countries. Presentation of student's team 3	2	–
TOTAL		16	4

6. Thematic plan for independent work

Topics	Number of hours	
	full-time study	distance learning
History and evolution of the circular economy. Development of circular economy theories.	8	12
Effects of circular economy implementation	8	12
Resource efficiency. Sustainable product design and lifecycle management. Green supply chain management	14	16
Innovative technologies. Technologies enabling circular economy practices	8	12
Tools and frameworks for assessing circular economy impact.	10	12
Historical context: Evolution of natural resource economics. Key milestones and theoretical frameworks	10	14
Applying cost-benefit analysis to natural resource projects	10	12
Strategies for managing renewable and non-renewable resources sustainably. Role of technology and innovation in resource conservation	12	16
Role of global governance in natural resource management	10	16
Role of natural resources in economic development. Balancing resource extraction with long-term economic stability	12	16
TOTAL	102	138

7. Teaching methods

Teaching methods:

- Verbal: online lectures, explanation, story, conversation, instruction;
- Visual: observation, illustration, demonstration;
- Practical: case studies analysis, quizzes, forum discussions, individual tasks, team-work.

8. Control methods

To evaluate and demonstrate learning results, students perform practical work and take an exam at the end of the academic semester.

T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Current control	Exam	Total
4	4	4	4	4	4	4	4	4	4	40	60	100

9. Distribution of points

Assessment scheme taking into account the requirements of the Regulations on the organization of the educational process. The results of the final control are assessed on a 100-point scale and a four-point scale (“excellent”, “good”, “satisfactory”, “unsatisfactory”).

The correspondence between the scales is established as follows:

Grade	
On a 100-point scale	Exam
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactory

10. Recommended Literature

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Donetsk National Technical University

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Master Programme in Eco-Mining and Innovative Natural Resources Management (EMINReM)

ERASMUS-EDU-2022-CBHE-STRAND-2-101082621

S Y L L A B U S

"Industrial Waste Management, Resource Recovery and Recycling Technologies"

Educational Program 101 "Ecology"

Developed by

_____Prof., Dr. Yevgen Zbykovskyy

(signature)

_____Assoc. Prof., PhD Oleksii Kutniashenko

(signature)

«____»_____2024

Approved by the Head of Environmental Protection Department

_____Prof., Dr. Viktor Kostenko

(signature)

«____»_____2024

Lutsk, 2024

1. Description of the academic discipline

Form of education	full-time	distance learning
Status	Selective	
Year	2024-2025	
ECTS credits	5	5
The total number of hours including:	150	150
lectures	32	8
practical lesson	16	4
laboratory lesson	-	-
individual work	102	138
Evaluation form	Exam	
Language of instruction	English, Ukrainian	
Information about lecturers		
Lecturer	Yevgen Zbykovskyy, Prof., Dr.	
Email	yevgen.zbykovskyy@donntu.edu.ua	
Department	Department of Chemical Technology and Chemical Engineering	
Lecturer	Oleksii Kutniashenko, Assoc.Prof., PhD.	
Email	oleksii.kutniashenko@donntu.edu.ua	
Department	Department of Environmental Protection	

2. The purpose and tasks of the educational discipline

The discipline "Industrial Waste Management, Resource Recovery and Recycling Technologies" provides a comprehensive understanding of the principles, practices, and technologies involved in managing waste effectively and promoting recycling initiatives. Students will explore various aspects of industrial waste management, including generation, collection, transportation, treatment, and disposal, as well as the importance of recycling in minimizing environmental impact and conserving resources. Through case studies, practical examples, and hands-on activities, this educational discipline equips individuals with the knowledge and skills necessary to develop sustainable waste management strategies and implement recycling programs in diverse settings.

The purpose of the selective discipline "Industrial Waste Management, Resource Recovery and Recycling Technologies" is to familiarise students with the principles, strategies, and practices involved in effectively managing waste and promoting recycling and resource recovery initiatives.

The objectives of the discipline are the following:

– to develop masters' understanding of various aspects of waste management, including waste generation, collection, transportation, treatment, recycling, and disposal, with a focus on sustainable and environmentally responsible approaches;

– obtaining in-depth knowledge necessary for the formation of abilities and skills of setting research tasks and their implementation using mathematical modelling methods of the main processes of industrial waste management;

- consolidate a set of knowledge on calculation of structural characteristics and geometric dimensions of industrial waste management and recycling equipment;

- to develop the ability to use of IoT and AI to optimize industrial waste processing processes.

The study of the selective discipline "Industrial Waste Management, Resource Recovery and Recycling Technologies" is based on knowledge of ecology, mechanics, material science, mining etc.

As a result of studying the educational discipline "Industrial waste management, resource recovery and recycling technologies", **the student should know:**

- fundamental concepts and features of the use of industrial waste and resource recovery;
- modern industrial waste processing technologies as a way to improve production and ensure its sustainable development due to resource conservation;
- factors influencing waste generation and implications for waste management strategy;
- features of the impact of waste composition on its processing and utilization;
- the main principles of waste minimization, resource conservation and circular economy measures;
- principles of using IoT and AI to optimize industrial waste processing processes.

Competencies that the applicant must master as a result of studying the discipline:

- GC01. Ability to learn and master modern knowledge.
- GC04. Ability to develop and manage projects.
- GC05. Ability to communicate in a foreign language.

– SC10. The ability to apply interdisciplinary approaches in the critical understanding of environmental problems.

– SC12. The ability to apply new approaches to the analysis and forecasting of complex phenomena, critical understanding of problems in professional activity.

– SC15. The ability to organize work related to the assessment of the ecological state, environmental protection and optimization of nature use, in conditions of incomplete information and conflicting requirements.

– SC17. The ability to independently develop environmental projects by creatively applying existing and generating new ideas.

Program learning outcomes:

– LO04. Know the legal and ethical norms for evaluating professional activity, developing and implementing socially significant environmental projects in conditions of conflicting requirements.

– LO07. To be able to communicate in a foreign language in scientific, industrial and social spheres of activity.

– LO16. Choose the optimal management or nature management strategy depending on environmental conditions.

– LO17. Critically interpret theories, principles, methods and concepts from various subject areas to solve practical problems and problems of ecology.

3. Program of educational discipline

Module 1. Industrial waste management

Topic 1. Introduction to the Industrial Waste Management.

Topic 2. Features of Industrial Waste Management.

Topic 3. Management of Industrial Waste Flows: Handling, Decontamination, Treatment.

Topic 4. Non-Hazardous Industrial Waste.

Topic 5. Industrial Waste Minimization.

Module 2. Recycling technologies and resource recovery

Topic 6. Introduction to Recycling and Resource Recovery.

Topic 7. Recycling Technologies.

Topic 8. Resource Recovery Technologies.

Topic 9. Economic and Environmental Aspects of Recycling.

Topic 10. Innovative Recycling Technologies.

4. The structure (thematic plan) of the educational discipline

Content modules and topics	Number of hours							
	full-time study				distance learning			
	total	lectures	practical	individual work	total	lectures	practical	individual work
Content module 1. Industrial waste management								
Introduction to the Industrial Waste Management.	14	2	–	10	14	–	–	14
Features of Industrial Waste Managemen.	14	4	–	10	14	–	–	14
Management of Industrial Waste Flows: Handling, Decontamination, Treatment.	16	4	–	10	16	2	–	14
Non-Hazardous Industrial Waste.	14	2	–	10	14	–	–	12
Industrial Waste Minimization.	16	4	–	10	16	2	–	14
Total in Module 1	74	16	8	50	74	4	2	68
Content module 2. Recycling technologies and resource recovery								
Introduction to Recycling and Resource Recovery.	14	2	–	10	14	–	–	14
Recycling Technologies.	18	4	–	12	18	2	–	14
Resource Recovery Technologies.	14	4	–	10	14	–	–	14
Economic and Environmental Aspects of Recycling.	14	2	–	10	14	–	–	14
Innovative Recycling Technologies.	16	4	–	10	16	2	–	14
Total in Module 2	76	16	8	52	76	4	2	70
TOTAL	150	32	16	102	150	8	4	138

5. Topics of practical (laboratory) classes

№ з/п	Topic name	Number of hours	
		full-time study	distance learning
1	Basic concepts and definitions in the field of industrial waste management	2	
2	Differentiation of the Ukraine territory by the amount of waste	2	1
3	Determination of the waste code based on the National Waste Classifier	2	
4	Determination of the waste type and their classification according to a hierarchical feature	2	1
5	The system of handling and waste management in the European Union	2	
6	Determination of actual standards of waste generation	2	1
7	Passporting of waste and waste management sites, waste accounting. Compilation of the company's waste passport	2	
8	Assessment of ecological and economic efficiency of waste processing methods	2	1
	TOTAL	16	4

6. Tasks for independent work

Content modules and topics	Number of hours	
	full-time study	distance learning
Introduction to the Industrial Waste Management.	10	14
Features of Industrial Waste Managemen.	10	14
Management of Industrial Waste Flows: Handling, Decontamination, Treatment.	10	14
Non-Hazardous Industrial Waste.	10	12
Industrial Waste Minimization.	10	14
Introduction to Recycling and Resource Recovery.	10	14
Recycling Technologies.	12	14
Resource Recovery Technologies.	10	14
Economic and Environmental Aspects of Recycling.	10	14
Innovative Recycling Technologies.	10	14
TOTAL	102	138

7. Teaching methods

Teaching methods:

- Verbal: online lectures, explanation, story, conversation, instruction;
- Visual: observation, illustration, demonstration;
- Practical: case studies analysis, quizzes, forum discussions, individual tasks, team-work.

8. Control methods

To evaluate and demonstrate learning results, students perform practical work and take an exam at the end of the academic semester.

	T1	T2	T3	T4	T5	T6	T7	T8	Current control	Exam	Total
full-time study	5	5	5	5	5	5	5	5	40	60	100
distance learning	-	10	-	10	-	10	-	10			

9. Distribution of points

Assessment scheme taking into account the requirements of the Regulations on the organization of the educational process. The results of the final control are assessed on a 100-point scale and a four-point scale (“excellent”, “good”, “satisfactory”, “unsatisfactory”). The correspondence between the scales is established as follows:

Grade	
On a 100-point scale	Exam
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactory

10. Recommended Literature

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Mining and Metallurgical Institute named after O.A. Baikonurov

Mining Department

APPROVED by MMI director
_____ Rysbekov K.B.
(signature, LS)
«___» _____2024.

SYLLABUS
MIN 711 CLEAN TECHNOLOGIES FOR OPEN-PIT MINING

7M07203 – Mining Engineering

5 credits

Semester: autumn, 2024 - 2025 academic year

Almaty 2024

Information about instructor:

1.1 lecturer:

Moldabayev Serik Kuroshovich, chair of the department

Learning format – full-time/distance

office: 234 MMC

Office-hours: Friday, 12:00 – 13:00

e-mail:
s.moldabayev@satbayev.university

2 The purpose and the objective of the course

The purpose: familiarization with the best practices and international experience in the context of the implementation of clean technologies in the open-pit mining in conjunction with an emphasis on employee safety, emission reduction, transparency and monitoring.

The objective:

- solving the transport problem of deep open-pit mines in conjunction with reducing the flattening of pit sides and reducing carbon dioxide emissions into the environment;
- ensuring the minimum size of concentration horizons during the transition to combined modes of transportation in open-pit mines;
- maintaining high production capacity of open-pit mines to great depths using innovative designs of steeply inclined lifts.

3 Course Description:

The course is intended for students of the educational program "7M07203-Mining Engineering". The pursuit of clean technologies of the future is strongly linked to the concept of economic security, diversification and includes a path from a green agenda to a green economy through the development and implementation of particularly advanced progressive technologies in open-pit mining.

4. Learning outcomes

Upon completion of the course, the student will

know:

– green technological transformation in open-pit mining;

– ways to reduce the impact on the environment when conducting open-pit mining;

– methods of solving the transport problem in deep and ultra-deep open-pit

mines with an emphasis on employee safety, emission reduction, transparency and monitoring.

be able to:

– perform an analysis of the difficulties in implementing continuous and cyclic and continuous technologies, increasing the guiding angle of the opening workings when using high capacity dump trucks at the current stage of open-pit mining;

– apply algorithms for calculating the required number of dump trucks and reducing carbon dioxide emissions when introducing skip lifts of block design;

– draw up design documentation for the introduction of innovative elements of steep-slope lifting of rock mass in the conditions of existing and designed open-pit mines;

– evaluate the cost of manufacturing and the effectiveness of innovative elements of steep-slope lifting of rock mass in the conditions of existing and designed open-pit mines.

Have skills in:

– adaptation of environmentally friendly technologies in specific mining and geological conditions of the existing and designed open-pit mines.

5 Calendar and thematic plan

Week	Topic of the lecture	Topic of the practical work	SIS/TSIS	Reference to the literature	Deadline
1	The pace of green movement by large foreign companies like BHP, Rio Tinto, Teck, Freeport, Vale	Kazakhstan's commitment to become a carbon neutral country by 2060	To familiarize with the basic concepts and terms	[1-4]	Week 2
2	Green technological transformation in open-pit mining in Kazakhstan	he expediency of replacing diesel dump trucks with electric ones on the example of the Kacharsky ultra-deep open-pit mine	To get acquainted with real projects of coal mines	[1]	Week 3
3	Reducing the environmental load at highly mechanized coal mines	Analysis of ways to reduce the environmental load at the Vostochnyi coal mine and Bogatyr	To get acquainted with additional literature on coal mining methods at the mines	[1]	Week 4
4	Solving the transport problem in deep and ultra-deep iron ore open-pit mines	Ensuring compliance of mining technology with minimal Flattening of pit sides to the steeply inclined rise of the rock mass	Completing the SI task by options	[1]	Week 5
5	An alternative to	Preparation of abstracts on	Defence of	[1]	Week 6

Week	Topic of the lecture	Topic of the practical work	SIS/TSIS	Reference to the literature	Deadline
	cyclic and continuous technology in deep open-pit mines	skip lifting at the Sibai open pit mine and the wagon-conveyor system of the Thyssen Krupp	the SI task		
6	Innovative elements of cyclic and continuous technology complexes for maximum load of conveyor and skip lifts	Study of patents for inventions on innovative elements of dump truck unloading points and reloading from conveyor lifts to railway vehicles	Completing the SI task by options	[1]	Week 7
7	Through points for dump trucks of different sizes when unloading at concentration horizons of limited dimensions	Hierarchy of development and justification of devices for unloading rocks by dump trucks with through passage	Defence of the SI task	[1]	Week 8
8	Innovative designs of high-performance skip lifts to any depth	Analysis of the lifting height and performance of innovative skip lift designs	Midterm	[1]	Week 9
	The mid-term control-The first attestation				Week 8
9	The algorithm for calculating the required number of dump trucks when introducing skip lifts of block design	Approbation of the algorithm for calculating the required number of dump trucks when introducing skip lifts of block design in specific open-pit mines	Study of the mining procedure of the Ekibastuz coal basin	[1]	Week 10
10	The algorithm for calculating the reduction of carbon dioxide emissions during the introduction of skip lifts of block design	Approbation of the algorithm for calculating the reduction of carbon dioxide emissions during the introduction of skip lifts of block design	Continuous and cyclic continuous technology at coal mines	[1, 4]	Week 11
11	Design documentation for points of through passage of dump trucks of different sizes during unloading	Expert assessment of design documentation for through points of dump trucks of different sizes during unloading	Completing the SI task by options	[1, 4]	Week 12
12	Design documentation for a tilting skip of block design	Expert assessment of the design documentation for the tilting skip block	Defence of the SI task	[1]	Week 13
13	Feasibility study of cyclic and continuous technology with steeply inclined conveyors	Calculation of the payback period for investments and reduction of reduced costs when introducing steeply inclined conveyors in ore open-pit mines	Completing the SI task by options	[1]	Week 14
14	Feasibility study of	Calculation of the payback	Defence of	[1]	Week 15

Week	Topic of the lecture	Topic of the practical work	SIS/TSIS	Reference to the literature	Deadline
	through points for dump trucks of different sizes during unloading	period for investments and reduction of reduced costs when introducing through points for dump trucks of different sizes during unloading	the SI task		
15	Feasibility study of a block-type skip lift	Calculation of the payback period for investments and decrease of reduced costs when implementing a block-type skip lift. Setting the maximum lifting height by skip lifts	Endterm	[1]	
	The second final attestation				Week 15
	Examination				Based on the schedule

6 Literature

Required	Supplementary
[1] Moldabaev S.K., Shustov A.A., Sultanbekova Zh.Zh., Adamchuk A.A. Mining transport systems of deep and ultra-deep quarries: monograph. – Almaty: Satbayev University, 2020. – 482 p.	[3] Rakishev B.R., Moldabaev S.K. Resource-saving technologies in coal mines: monograph. – Almaty: KazNTU, 2012. – 348 P. http://e-lib.satbayev.university/MegaPro / Web / search summ Decision/Topage/1
[2] Rakishev B.R., Moldabaev S.K. Resource-saving technologies for open -pit mining: A textbook. – Almaty: KazNTU, 2015. – 196 P. http://e-lib.satbayev.university/MegaPro / Web / search summary Decision/Topage/1	[4] Moldabaev S.K. Designing enterprises with an open method of mining mineral deposits: A textbook for universities. – Pavlodar: Publishing house "ECO", 2008. – 352 p.

* *The literature is available in the electronic resources of the library.*

** *The main literature should not be older than 10 years.*

~ *The literature is available on the teacher's learning portal.*

7 Competence framework

Learning Descriptors	Competences				
	Natural science and theoretical worldview	Socio-personal and civil	General engineering professional	Cross-cultural and communicative	Special-professional
Knowledge and comprehension	*				
Application of knowledge and comprehension		*	*		
Expression of judgments and analysis of actions	*				*
Communication and creative abilities				*	

Self-learning and digital skills	*	*			*

8 Schedule of submission of mandatory assignments

# s/n	Type of control	Max score of the week	Weeks															Total max points
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	Activeness in lecture discussions	0,5		0,5	0,5	0,5	0,5	0,5	0,5		0,5	0,5	0,5	0,5	0,5	0,5		6
2	Performing the tasks (SIWI)	3				3								3				6
3	Performing the practical tasks	2,5		2,5	2,5	2,5	2,5	2,5	2,5		2,5	2,5	2,5	2,5	2,5	2,5		30
4	1st attestation (Midterm)	7								7								7
5	Student Independent Study (SIS)	2							2							2		4
6	2nd final attestation (Endterm)	7															7	7
7	Final exam*																	40
	In total																	100

9 Evaluation rating and possible final versions of assessments according to criteria

Letter grade	GPA	scores	Criteria
A	4	95-100	Shows the highest standards of knowledge, exceeding the volume of the course taught
A-	3,67	90-94	Meets the highest standards of knowledge
B+	3,33	85-89	Very good and meets high standards of knowledge
B	3	80-84	Good and meets most high standards of knowledge
B-	2,67	75-79	More than sufficient knowledge approaching high standards
C+	2,33	70-74	Sufficient knowledge that meets the general standards
C	2	65-69	Satisfies and conforms to most common knowledge standards
C-	1,67	60-64	Satisfies, but according to some knowledge does not meet the standards
D+	1,33	55-59	Minimally satisfying, but does not meet the standards for a large range of knowledge
D	1	50-54	Minimally satisfactory passing score with questionable compliance with standards
FX	0,5	25-49	Temporary assessment: Unsatisfactory low indicators, retake of the exam is required
F	0	0-24	Didn't try to master the discipline. It is also exposed when a student tries to get a grade on the exam by cheating

10 Evaluation criteria

Each work except tests is evaluated according to 4 criteria:

– precision and accuracy (A) – 30% (how accurately and neatly the work is

calculated);

– inventiveness and creativity (T) – 30% (how and in what way the work is presented);

– completeness and maturity (H) – 40% (how profoundly, logically and structurally the work is solved);

– originality (O) – a special coefficient of 1.0, 0.5 or 0 is used.

Criteria	**Excellent (0.9-1.0)**	**Good (0.7-0.9)**	**Satisfactory (0.4-0.7)**	**Unsatisfactory (0-0.4)**
precision and accuracy	The tasks were completed clearly and accurately; all calculations were carried out mathematically correctly	There are minor inaccuracies in the calculations (minus 0.1 – for each inaccuracy)	The tasks were performed carelessly, there are significant inaccuracies in the calculations (minus 0.1 – for each inaccuracy)	The tasks were performed carelessly, the calculations were carried out incorrectly (minus 0.1 – for each inaccuracy)
inventiveness and creativity	The use of non-standard solutions; demonstration of knowledge and their application.	A standard approach within the framework of methodological guidelines with a clear scenario outline	A standard approach within the framework of methodological guidelines without demonstrating a clear outline of the presentation	Deviation from the minimum volume and content of the presentation
completeness and maturity	The calculations were carried out mathematically accurately in full using non-standard solutions	The tasks were completed completely with minor errors (minus 0.1 for each inaccuracy)	The calculations are presented either with significant errors or are not fully completed.	There are no correct answers to the questions; the solution of the problems is either missing or irrelevant to the content of the problem
originality	At least two solutions are given, one of which is non-standard, conclusions and, if necessary, predictions are made	One or 2 standard solutions with the implementation of conclusions are given, but predictions are not given		There are no standard or original answers

The overall score will be calculated due to the formula*:*

Score = (A + T + 3) ×O

11 Late submission policy

The student must come prepared for lectures and practical (laboratory) classes. Timely protection and full performance of all types of work (practical and independent) is required. The student should not be late and miss classes, be punctual and mandatory. It is planned to reduce the maximum score by 10% for untimely work. If you are forced to skip the intermediate certification for good reasons, you should warn the teacher in advance before it, so that you can pass the boundary control in advance. Skipping an exam for a disrespectful reason deprives you of the right to take it. If you miss the exam for a good reason, a special permit is issued and the date, time and place of the exam are assigned.

12 Academic Conduct and Ethics Policy

Be tolerant, respect the opinions of others. Formulate objections in the correct form. Plagiarism and other forms of dishonest work are unacceptable. Prompting and cheating during exams, passing the exam for another student are unacceptable. A student caught falsifying any course information will receive a final "F" grade.

Activeness in lectures and practical classes is mandatory and is one of the components of your final score / assessment. Many theoretical questions supporting the lecture material will be presented only at lectures. Therefore, skipping a class can affect your academic performance and final grade. However, attending classes in itself does not mean an increase in points. Your constant active participation in the classes is necessary. A mandatory requirement of the course is to prepare for each lesson. It is necessary to review the specified sections of the textbook and additional material not only in preparation for practical classes, but also before attending the corresponding lecture. Such training will facilitate your perception of new material and will contribute to your active acquisition of knowledge within the walls of the university.

Support: For advice on implementing the independent work, their submission and defending, as well as for additional information on the material covered and all other questions arising on the course being read, contact the teacher during their office hours or via electronic means of communication during working hours.

During the process of learning:

Mandatory participation in training sessions according to the schedule, which determines the readiness for the lesson. In case of absence, the student is obliged to notify the teacher within a day and explain the plan for self-study of the study material:

- mandatory reading of the presented materials before the lesson;
- submission of tasks on time;
- 20% non-participation in the audience (for a valid reason with the supporting documents) - rating "F (Fail)";
- plagiarism and cheating during the execution of the task are not allowed;
- mandatory use of electronic gadgets in the classroom that is welcome, but it is unacceptable to use them in the exam.

Any appearance of academic dishonesty, academic deception and corruption

in any form are unacceptable within the framework of the sunject. The organizer of such actions (the teacher, students or third parties on their behalf) are fully responsible for violating the laws of the Republic of Kazakhstan.

In the beginning of the academic term, students need to familiarize themselves with the contents of the syllabus F KazNRTU 401-03. The journal of familiarizing.

Considered at the meeting of the Mining Department
Minutes № 1, 19.08. 2022

Head of the department _____ **Moldabayev S.K.**

(*signature)*

Syllabus designer: _____ **Moldabayev S.K.**

(signature)

Institute **Mining and metallurgy named after O.A.Baikonurov**

Department Mining

APPROVED by
Institute Director
_____ **Rysbekov K.B.**
(signature) *(*Institute Director*)*
«___» _____2024

SYLLABUS

MIN710 PROBLEMS AND INNOVATIONS IN THE PROCESS CHAIN OF MINERAL RESOURCES

7M07203 – Mining engineering

5 (2/0/1/2) credits
(number)

Semester: Semester 1, spring 2024- 2025 academic year

Almaty 2024

Information about the lecturer

1.1 Lecturer, practical classes:

S.K. Moldabaev, Head of the Department "Mining Engineering", Doctor of Technical Sciences, Professor

Learning format – full-time

office: _234 ГМК_____ Office Hours: _Friday 11.00

Tel., WhatsApp +7(701) - 5183265 e-mail: s.moldabayev@satbayev.university, moldabaev_s_k@mail.ru_

2 Purpose and objective of the course

Purpose: reveal aspects of improving the efficiency of mining companies within the framework of vertical integration through redistribution of income within the value chain.

Objectives:

- transition to a new model of institutional regulation of the mining complex, providing sectoral and microeconomic support for the balanced use of strategic advantages of business segments of vertically integrated mining companies ("VIMCs"), taking into account the new drivers of structural change;
- determination of the level of balanced development of the company's strategic advantages, allowing to identify the main directions of their formation in accordance with the drivers of change in the business environment;
- the essence of the methodology for determining the balanced development index of VIMC and the feasibility of its use for the integral assessment of the programme for improving the efficiency of VIMC and its business segments.

3 Course Description:

The course is designed for Master's students in EP "7M07203-Mining Engineering". In many cases, raw materials (ore or concentrate) are sold on the market at low prices, preventing mining companies from making significant profits, while the production of downstream products has much higher profitability. This situation prevents active innovation at the raw material stage. Therefore, vertical integration of industries using large volumes of mineral resources allows not only to ensure technological and organisational unity of production and sales processes, but also creates opportunities for stable financing of raw material extraction even in conditions of volatile world prices. At the same time, producers of final products get reliable access to raw materials in the volumes they need.

Within the framework of the course the graduate student will master: methodological approach to the study of the efficiency of VIMC development based on the use of strategic advantages; fundamental importance of the principle of balance as a methodological tool for studying the trajectory of effective development of VIMC based on the use of strategic advantages, taking into account domestic and

foreign experience; conceptual approach to the organisation of balanced use of strategic advantages of VIMC, taking into account the increasing role of intangible factors and and technological complexity of production in the creation of value in the modern economy; conceptual and logical scheme of forming a programme to improve the efficiency of VIMC, which allows to ensure the balanced use of strategic advantages; key problems constraining the development of mining enterprises; a model of integrated assessment of VIMC efficiency, which ensures the balanced use of strategic advantages; a methodology for determining the index of balanced development of VIMC.

4. Learning outcomes

Upon completion of the course, the student will:

be able to:

- choose the most preferable variant of innovation-balanced changes based on the diversity of innovation activities and economic efficiency indicators;
- form the VIMC development programme based on the balanced use of strategic advantages.

Know:

- issues of corporate social responsibility in shaping the strategic management of companies;
- key indicators of business segments, processes and goals of VIMC;
-the degree of correlation between changes in capitalisation and balanced development of vertically integrated mining companies.

5 Calendar and thematic plan

Week	Topic of the lecture	Topic of the practical work	Reference to the literature	Task	Deadline
1	Purpose and objectives of vertical integration	№1 Selecting the type of vertical integration (direct, reverse, parallel) in mineral production	[1-4]	[1] get acquainted with basic concepts and terms	2nd week
2	Factors of vertical integration efficiency	№2 Conditions for the transition from a resource-based economy to a resource-saving and import-independent economy	[1]		3rd week
3	Ensuring economic growth through vertical integration	№3 The neo-industrial paradigm and the law of vertical integration	[1]		4th week
4	Vertical integration of the company and theoretical approaches to explain it	№4 Vertical integration of production: considerations on market failures	[1]	Execution of the task (Independent work of the student under the guidance of the teacher) by variants	5th week
5	Theoretical foundations of strategic development of an industrial enterprise	№5 Challenges of the mining industry	[1]	Defence of the SROP task	6th week

Week	Topic of the lecture	Topic of the practical work	Reference to the literature	Task	Deadline
	in the context of increasing its efficiency				
6	Scientific approaches to shaping the trajectory of effective development of mining companies	№ 6 Innovation in the modern world as a source of development	[1]	Fulfilment of SRO task	7th week
7	Specific features of the evolution of vertically integrated mining companies (VIMCs)	№7 Example of an industry value chain in a vertically integrated environment	[1]	Defence of the SRO task	8th week
8	Balanced utilisation of VIMC's strategic advantages as a key factor of its performance efficiency	№8 Multi-level hierarchical system of organisation of VIMC activities	[1]	**The mid-term control**	9th week
8	**The first attestation**			Individual tasks	8th week
9	Conceptual approach to organising the balanced use of VIMC's strategic advantages	№9. Issues of corporate social responsibility in the formation of strategic management of companies	[1]		10th week
10	Formation of a model for balanced utilisation of strategic advantages	№10 Selection of the most preferable variant of innovation-balanced changes based on the diversity of innovation activities and indicators of economic efficiency	[1, 4]		11th week
11	Conceptual and logical framework for developing a programme to improve the effectiveness of the VIMC	№11 Elements of the management system for improving the efficiency of a vertically integrated mining company based on the balanced use of strategic advantages	[1, 4]	Completion of the SROP task by variants	12th week
12	Methodological principles of forming the VIMC efficiency improvement programme	№12 Algorithm of formation of the VIMC development programme on the basis of balanced use of strategic advantages	[1]	Defence of the SROP task	13th week
13	Model of integrated assessment of VIMC efficiency based on balanced utilisation of strategic advantages	№13 Structure of indices of balanced development of strategic advantages	[1]	Fulfilment of SRO task	14th week
14	Methodology for determining the VIMC balanced development index	№14 Key indicators of business segments, processes and goals of VIMC	[1]	Defence of the SRO task	15th week

Week	Topic of the lecture	Topic of the practical work	Reference to the literature	Task	Deadline
15	Comprehensive assessment of VIMC efficiency based on a balanced utilisation of strategic advantages	№15 Degree of correlation between changes in capitalisation and balanced development of vertically integrated mining companies	[1]	**The mid-term control**	
15	**The second final attestation**			Индивидуальные задания	15 неделя
	Examination			Билеты	По расписанию

6 Literature

Required	Supplementary
[1] Biryukova V.V. Efficiency of development of vertically integrated oil companies Based on the use of strategic advantages. - Doctoral dissertation. - Kola Scientific Centre of the Russian Academy of Sciences. - Apatity, 2021. - 336 p. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/ http://www.iep.kolasc.net.ru/birukova1.pdf	[3] Rakishev B.R., Moldabaev S.K. Resource-saving t open-pit mining operations. resource-saving technologie mining operations: Training manual. - Almaty: KazNTU,
[2] Moldabaev S.K., Shustov A.A., Sultanbekova J.J., Adamchuk A.A. Mining transport systems of deep and super-deep open pits: monograph. systems of deep and super-deep open pits: monograph. - Almaty: Satbayev University, 2020. - 482 p.	[4] Rakishev B.R., Moldabaev S.K. Resource-saving techr mines coal mines: monograph. - Almaty: KazNTU, 2012. - 348 p. http://e-lib.satbayev.university/MegaPro/ Web/Search Result/ToPage/1

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7 Competence framework

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Application of knowledge and comprehension		*	*		
Expression of judgments and analysis of actions	*				*
Communication and creative abilities				*	
Self-learning and digital skills	*	*			*

8 Schedule of submission of mandatory assignments

#	Type of control	Max score of the	Weeks														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total max

s/n		week																points
1	Activity at lecture discussions	**0,5**		**0,5**	**0,5**	**0,5**	**0,5**	**0,5**	**0,5**		**0,5**	**0,5**	**0,5**	**0,5**	**0,5**	**0,5**		**6**
2	Student Independent Study (SISI)	**3**				**3**								**3**				**6**
3	Performing the practical tasks	**2,5**		**2,5**	**2,5**	**2,5**	**2,5**	**2,5**	**2,5**		**2,5**	**2,5**	**2,5**	**2,5**	**2,5**	**2,5**		**30**
4	1st attestation (Midterm)	**7**								**7**								**7**
5	Student Independent Study (SIS)	**2**							**2**							**2**		**4**
6	2nd final attestation (Endterm)	**7**															**7**	**7**
	Final exam*																	**40**
	In total																	**100**

9 Evaluation rating and possible final versions of assessments according to criteria

Letter grade	GPA	Scores	Criteria
A	4	95-100	Shows the highest standards of knowledge, exceeding the volume of the course taught
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inventiveness and creativity	Use of non-standard solution methods; demonstration of knowledge and its application.	Standardised approach within the guidelines with a clear scenario plan for the presentation	Standardised approach within the guidelines without demonstrating a clear plan of presentation	Deviation from the minimum length and content of the presentation
completeness and maturity	Calculations are carried out mathematically accurately in full with the use of non-standard methods of solution	Tasks are fully completed with minor errors (minus 0.1 for each inaccuracy).	The calculations are presented either with significant errors or are not fully performed.	No correct answers to questions; problem solving is either missing or irrelevant to the content of the problem.
originality	At least two solution options are given, one of which is non-standard, conclusions are drawn and, if necessary, forecasts are made	One or 2 standard solutions are given, with conclusions drawn, but no predictions are given		There are no standard or original answers

The overall score will be calculated due to the formula*:*

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- plagiarism and cheating during the execution of the task are not allowed;
- mandatory use of electronic gadgets in the classroom that is welcome, but it is unacceptable to use them in the exam.

Within the framework of training in the discipline, any corruption manifestations in any form are unacceptable. The organizer of such actions (teacher, students or third parties on their behalf) are fully responsible for violating the RK laws.

Considered at the meeting of the Department Mining

At the beginning of the academic term, students should familiarise themselves with the content of the syllabus F KazNITU 401-03. Ф КазНИТУ 401-03. Журнал ознакомления.doc.

Reviewed and approved at the meeting of the Department of Mining Engineering, Minutes № 7 of "22" December 2023.

Head of the
Mining department _____ Moldabayev S.K.

Syllabus designer:
Professor of the

NON-PROFIT JOINT STOCK COMPANY

ABYLKAS SAGINOV KARAGANDA TECHNICAL UNIVERSITY

Approved by
Acting Member of the Management Board – Vice-Rector for Academic Affairs of Abylkas Saginov KTU NJSC
_____Samashova G.E.
«____» _____ 2024

SYLLABUS

Discipline MREA 5208 «Mineral Resources Exploration and Assessment»

Module EM 2 «Eco-mining Module»

Educational program 7M07201 «Geology and exploration of mineral deposits»

Developed by _____ A. Amangeldikyzy «____»_____2024
(signature)
Discussed at the meeting of the Department of Geology and Exploration of MD

Protocol No. _____ from_____ ___ 2024 г.
Head of the Department_____ Isataeva F.M. «____»_____2024
(signature) (name)
Approved by the Quality Assurance Committee of the Mining Faculty
Protocol No._____ from_____ ___ 2024
Chairman _____Hannanov R.R. _____ 2024
(signature) (name)

2024

1 Information about the lecturer and contact information

Full name Amangeldikyzy A.

Academic degree, title, position: PhD, acting associate professor of Department “Geology and exploration of mineral deposits”

Email: amangeldykyzy77@gmail.com

The Department of GEMD is located in the 2nd building (N. Nazarbayeva, 56), 105, contact phone number 56-75-93 ext. 2037, gf_kstu@mail.ru.

2 Discipline labor intensity

Form of training	Semester	Number of credits	lectures	seminars	laboratory	Exam	SIWT, hours	Number of contact hours	SIW	Total, hours
Full - time	1,2	10	60	30	-	10	30	130	170	300

3 Characteristic of the discipline

The discipline "Mineral Resources Exploration and Assessment" is included in the cycle of basic disciplines and is a component of choice.

4 Discipline objective

The discipline " Mineral Resources Exploration and Assessment " aims to gain knowledge from students about the organization and planning of geological exploration for various minerals, familiarization with the tasks, principles, technical means, methods and systems of exploration.

5 Discipline tasks

The objectives of the discipline are as follows:

- to acquire knowledge about the information on the geological structure of deposits of various types of mineral raw materials;
- to master the skills to analyze the patterns of distribution of elements between individual geological systems in connection with their age, tectonics and petrographic composition;
- to master the skills to interpret the methods of scientific forecasting and prospecting for mineral deposits;
- master the skills to systematize the collected data and develop concepts for predictive and exploratory work.

6 Results of the discipline study

After studying this discipline, it is expected that the student:

6.1 Organizes geological and geophysical research activities:

6.1.1 Controls the correctness of the choice of methods of exploration;

6.1.2 Ensures the rational use of mineral resources;

6.2 Possesses ICT technologies for conducting geological and geophysical research for prospecting and exploration of mineral deposits:

6.2.1 Acquires practical skills in working with the latest and modern programs for the interpretation of geochemical and mineralogical data;

6.2.2 Masters the skills of working with geological documentation during geological exploration;

6.3 Applies modern methods of exploration of mineral deposits, taking into account the peculiarities of the geological structure, the type of mineral:

6.3.1 uses the skills of using geochemical and mineralogical studies of mineral deposits, taking into account the peculiarities of the geological structure, type of minerals, including using new hypotheses and paradigms;

6.4 carries out geological and geophysical work on deposits to solve geological problems using modern methods, technical support and instruments:

6.4.1 uses modern methods, equipment and instruments to assess and identify areas promising for minerals in the earth's crust;

6.5 conducts geological expertise of various types of design work (national, regional), technical and economic analysis of production activities in solving geological problems:

6.5.1 analyzes data on the current production and consumption of products of the mineral resource complex in the region, as well as abroad.

7 Prerequisites

To study this discipline, it is necessary to master the following disciplines:

Discipline	Name of sections (topics)
1 General and Historical Geology	All sections
2 Crystallography and Mineralogy	All sections
3 Petrography	All sections
4 Structural Geology	All sections
5 Geology of MPI	All sections
6 Geotectonics and geodynamics	All sections

8 Postrequisites

The knowledge gained during the study of the discipline "Exploration and evaluation of mineral resources" will serve as the basis for further practical activities.

9 Discipline thematic plan

Name of the section (theme)	Labor intensity by types of classes, h.				
	lectures	seminar classes	Laboratory work	MSIWT	MSIW
1. Introduction. Goals and objectives, definition of discipline. Basic terms and concepts. Geological Survey of Kazakhstan (history and modernity).	4		-	2	15
2. Principles of prospecting and exploration. Classification of reserves and forecast mineral resources	4	6	-	4	15
3. General characteristics of the stages of the exploration process	4		-	2	15
4. Fields and anomalies as a modern basis for forecasting and methods of mineral prospecting. Geological, mineralogical, geochemical and geophysical fields and anomalies	8		-	4	15
5. General principles of mineral forecasting. Prerequisites and signs of search forecasting. Conditions affecting the choice of exploration methods	8	8	-	4	15
6. General features of the forecast of hidden deposits. Mineragenic mapping is the basis for the prediction of minerals. Forecast maps and methods of their compilation	8	8		2	15
7. Classification and characteristics of modern methods of mineral prospecting	4			2	15
8. Landscape and geographical conditions of prospecting, types of geological environments and methods of searching in various geological conditions	4			2	15
9. Integration of search methods	4			2	15

10. Methods for quantifying prospects and calculating forecast resources. Calculation of reserves and determination of parameters for calculating reserves (body capacity, average content of useful components)	8	8		4	20
11. Geological and economic assessment of promising sites in order to resolve the issue of the expediency of setting up work. Public reports in accordance with CRIRSCO	4			2	15
total:	60	30		30	170

10 List of seminars/practical classes

Name	Number of hours
1 Grouping of deposits according to the complexity of the geological structure	6
2 The exploration complex. Documentation for exploration.	8
3 Determination of the mass of the sample. Choosing a sampling method and building a sample processing scheme.	8
4 Stages of reserves and forecast resources of solid minerals according to the degree of geological study. Calculation of stocks.	8
Total	30

11 List of laboratory classes. Not provided by the working curriculum.

12 Topics and options of tasks for completing course projects (works)

The course work may be devoted to the methodology of searching for any type of minerals in a particular ore area.

1. The method of searching for iron in Central Kazakhstan.
2. The method of searching for manganese in Central Kazakhstan.
3. The methodology of searching for lead in Central Kazakhstan.
4. The methodology of gold prospecting in Central Kazakhstan.
5. The methodology of silver prospecting in Central Kazakhstan.
6. The methodology of copper prospecting in Central Kazakhstan.
7. The methodology of coal prospecting in Central Kazakhstan.
8. The method of searching for rock salt in Central Kazakhstan.
9. Methods of searching for rare elements in Central Kazakhstan.
10. Methods of cobalt prospecting in Central Kazakhstan.

The work is done in the form of an abstract. The choice of the project option is made by the first letter of the surname and the last digit of the cipher of the record book (table 1)

THE FIRST LETTER OF THE SURNAME	THE LAST DIGIT OF THE CREDIT BOOK CIPHER									
	0	1	2	3	4	5	6	7	8	9
А, Е, Л, Р, Х, Э	1	2	3	4	5	6	7	8	9	10
Б, Ж, М, С, Ц, Ю	10	9	8	7	6	5	4	3	2	1
В, З, Н, Т, Ч, Я	1	2	3	4	5	6	7	8	9	10
Г, И, О, У, Ш	10	9	8	7	6	5	4	3	2	1
Д, К, П, Ф, Щ	1	2	3	4	5	6	7	8	9	10

13 Subjects of control tasks for SIW

13.1 Creative and research tasks

13.1.1. Analysis of mineral resources of the Republic of Kazakhstan.

13.1.2. To study the concepts of mining and geological allotment. Understand their difference.

13.1.3. Analyze the international organization CRIRSCO and the KazRC Code.

13.1.4. To analyze the main requirements of the CRIRSCO organization for the participating

countries, the main tasks of our country's entry into this organization.

13.1.5. Conduct a swot analysis on the allocation of promising sites for PI, highlighting the search criteria and features.

13.1.6. Substantiate the goals and objectives of forecasting.

13.1.7. Systematize classifications of mineral deposits according to the complexity of the geological structure.

13.1.8. Draw up a scheme for the formation of sediments (deposits) on the surface of the relief slope.

13.2 Control questions for SIW

13.2 Control questions for the SRS

1. The use of non-ferrous metal ores.
2. Industrial and geological grades of iron ores.
3. Search criteria for polymetallic ores.
4. Direct search signs
5. Geochemical methods of searching for MPI.
6. Stages of exploration of MPI.
7. MPI design methodology.
8. Classification of stocks of PI.
9. Methods of calculating stocks of PI.
10. Geological maintenance of mining enterprises.
11. Job descriptions of a geologist (geophysicist) of the 1st category.
12. Geophysical methods of searching for MPI.

14 Thematic plan of independent work of a student with the teacher

Name of the topic SIWT	The purpose of the lesson	The form of the lesson	The content of the task	Recommended literature
1. Geological Survey of Kazakhstan (history and modernity).	To master the tasks of the geological survey	Essay	Systematize and summarize data on the topic	[1, 2, 3]
2. Classification of reserves and forecast mineral resources	To acquire knowledge on the classifications of stocks of PI	Preparing a review on the topic	Analyze all available classifications of PI stocks	[2, 3, 4]
3. To develop a project on the stages of the exploration process	To master the knowledge of the stages of exploration	Group project	Presentation and protection of the work	[1, 3, 5]
4. Fields and anomalies as a modern basis for forecasting and methods of mineral prospecting.	Deepening knowledge on this topic	Preparing a review on the topic	Writing a review, a survey on the preparation for the SRS 13.1.1	[1, 3, 5, 6]
5. Analysis of the principles of forecasting minerals. Prerequisites and signs of search forecasting	Deepening knowledge on this topic	Creative	Presentation and protection of the work	[4, 6]
6. General features of the forecast of hidden deposits. Mineragenic mapping is the basis for the prediction of minerals.	Deepening knowledge on this topic	Preparing a review on the topic	Survey on the preparation for the SRS 13.1.1	[3, 6, 7]

15 Evaluation criteria and policy

15.1 Rating scale

Score	Digital Equivalent	Points (% content)
A	4,0	95-100
A-	3,67	90-94
B+	3,33	85-89
B	3,0	80-84
B-	2,67	75-79
C+	2,33	70-74
C	2,0	65-69
C-	1,67	60-64
D+	1,33	55-59
D	1,0	50-54
FX	0,5	25-49
F	0	0-24

15.2 The final grade in the discipline is defined as the sum of the maximum per-formance indicators for boundary controls (up to 60%) and intermediate certification (exam) (up to 40%) and is up to 100%.

Types of work	Academic period of study, week																	Total, % 1BC+ 2BC
	1	2	3	4	5	6	7	8	The amount of BC 1	9	10	11	12	13	14	15	The amount of BC 2	
Lecture attendance	2	2	2	2	2	2	2	2	14	2	2	2	2	2	2	14		28
Attendance of laboratory	2	2	2	2	2	2	2	2	14	2	2	2	2	2	2	14		28
Lab work		9		9		9	9	-	36	9		9		9	9	36		72
SROP		6		6		8			20	6		6		8		20		40
Module									16						16	16		32
Total for the BC																100		200
The sum of indicators for the BC																		60
Exam																		40
Course paper																		100
Total																		100

15.3 Evaluation Policy

Lectures

№	Criterion	Specific weight	Comment	Recommendations for improving the work
1	Attendance	20%	Visits/does not visit (percentage of skips)	
2	Activity when discussing issues	35%	Takes an active part/passive part/does not participate	
3	Participation in the blitz survey	45%	Accuracy and correctness of the answer	

Laboratory work

№	Criterion	Specific weight	Comment	Recommendations for improving the work
1	Execution and registration	30%	Takes an active part/ passive part/ does not participate	
2	Deadline for delivery	10%	Visits / does not visit (percentage of omissions)	
3	Answer to security questions	30%	Completeness / disclosure of the topic / creativity of presentation	
4	Solving a problem on a given topic	30%	Completeness / disclosure of the topic / creativity of presentation	

Module

Test results are generated automatically depending on the number of test tasks

SIWT, SIW

№	Criterion	Specific weight	Comment	Recommendations for improving the work
1	Execution and registration	40%	The correctness of the execution and literacy of the document according to the standards of control. For each completed SIWT, a student in the specified week (2,4,5 weeks and 9,10,12 weeks) receives 2 points	
2	Deadline for delivery	10%	The correct solution of the task using a specific method	
3	Correspondence of the content of the work to the topic	20%	You get 1 point when you submit the document within the specified period	
4	MIW task	30%	Corresponds to the topic of the work	

16 Schedule of completing and submitting tasks in discipline

Types of work	Topic No. (lecture, laboratory, practical work, seminar).	Recommended literature	Reporting form	Type of control	Deadline	Points for the work done	Expected results
Lecture attendance	Attending lectures, writing a summary of all lectures. Purpose: To provide theoretical training for students in choosing a rational method of forecasting and searching for MPI	[1, 7]	Oral interview	Current	1-14	28	6.1-6.5
Laboratory attendance	Mastering practical materials (topics 1-11)	[8, 9], lecture notes	Oral interview	Current	1- 14 week	28	6.1-6.5

Laboratory work	Topic 1: Preparation of a geological assignment. Goal:To learn the practical basics of drawing up a geological assignment.	[2, 4, 6]	Protection of CW	Current	2 week	9	6.2.2
	Topic 2: Classification of reserves and forecast resources of solid minerals. Purpose: To analyze the categories of mineral reserves according to their characteristics.	[2, 3]	Protection of SW	Current	4 week	9	6.2.1
	Topic 3: Stages of geological exploration. Purpose: to acquire skills in the rational choice of exploration stages.	[1, 2]	Protection of SW	Current	6 week	9	6.1.1
	Topic 4: Determination of the elements of the occurrence of rocks. The goal: to be able to identify the elements of the occurrence of rocks.	[1, 5]	Protection of SW	Current	7 week	9	6.3
	Topic 5: Determination of the elements of the occurrence of ore bodies, the construction of their projections and geological sections, the design of exploration workings and wells. Goal: to be able to design exploration workings.	[3, 6]	Protection of SW	Current	9 week	9	6.4
	Topic 6: The search for mineral deposits. Purpose: to be able to apply modern methods of searching for MPI.	[7, 9]	Protection of SW	Current	11 week	9	6.5
	Topic 7: Mapping the forecast of minerals. Goal: to acquire skills in making PI forecast maps.	[8, 9]	Protection of SW	Current	13 week	9	6.4
	Topic 8: Methodology for estimating forecast resources. Goal: to be able to choose a methodology for estimating forecast resources.	[1, 2]	Protection of SW	Current	14 week	9	6.3.1
SRMP	Topic 1. Geological Survey of Kazakhstan (history and modernity).	[2, интернет ресурсы]	Essay	Current	2 week	6	6.1, 6.5.1
	Topic 2. Classification of reserves and forecast mineral resources	[2]	report	Current	4 week	6	6.2
	Topic 3. To develop a project on the stages of the exploration process	[3]	Presentation and protection of the work	Current	6 week	8	6.4
	Topic 4. Fields and anomalies as a modern basis for forecasting and methods of mineral prospecting.	[4]	Writing a review	Current	9 week	6	6.5
	Topic 5. Analysis of the principles of mineral forecasting. Prerequisites and signs of search forecasting	[9]	Presentation and protection	Current	11 week	6	6.4.1

	Topic 6. General features of the forecast of hidden deposits. Miner-agenic mapping is the basis for the prediction of minerals.	[9]	Oral	Current	13 week	8	6.5
Module No. 1	Evaluate knowledge of sections of discipline No. 1-5, topics of MSIW No. 13.1.1-13.1.4, questions of SRO 1-6	[1-4], конспект лекций	interview	Current	7 week	16	6.1–6.3
Module No. 2	Evaluate knowledge of sections of discipline No. 6-11, topics of MSIW No. 13.1.5-13.1.8, questions of SRS 7-12	[1-4], конспект лекций	Test tasks	Milestone	14 week	16	6.1–6.3
Total for the Republic of Kazakhstan						200	
The sum of indicators for the Re-public of Kazakhstan						60	
CW	Checking the assimilation of discipline material	The whole list is basic and will com-plement. literatures	Protection	The final	During the session	100	6.5
Exam	Checking the assimilation of discipline material	[1-4],	Written exam	The final	During the session	40	6.1–6.3
Total						100	

17 Discipline Policies and Procedures

When studying the discipline "Exploration and evaluation of mineral resources", please observe the following rules:

17.1 Do not be late for classes.

17.2 Do not skip classes without a valid reason, in case of illness, I ask you to provide a certificate, in other cases - an explanatory note.

17.3 It is the student's responsibility to attend all types of classes.

17.4 According to the schedule of the educational process, pass all types of control.

17.5 To work out missed practical and laboratory classes at the time specified by the teacher.

17.6 When performing all types of work, refer to clause 15.3

18 Academic integrity (honesty)

18.1 In accordance with the Anti-Corruption Standard of NLC "Abylkas Saginov Karaganda Technical University", academic integrity is a permanent obligation of participants in the educational process and educational institutions to act according to values and principles that exclude corruption risks and manifestations, form and strengthen the professional environment that allows them to adhere to such behavior.

18.2 The promotion and protection of academic integrity are the result of the mutual efforts of all students and staff of NLC "Abylkas Saginov Karaganda Technical University".

18.3 Students are obliged to conscientiously observe the principles of academic integrity.

18.4 According to the Code of Honor of Students, Undergraduates and Doctoral Students of NLC "Abylkas Saginov Karaganda Technical University" (Code), an academic violation (academic dishonesty) is an action when a student:

a) attempts to take credit for the work or efforts of another person without obtaining permission or without referring to his work ("plagiarism");

b) uses unauthorized materials or false data when performing training tasks;

c) fabricates or falsifies academic documents or performance reports;

d) intentionally hinders or undermines the academic work of other students;

e) commits actions aimed at presenting false information;

f) engaged in cheating in any form during the exam or during the execution of tasks;

g) assists other students in the commission of any of the described acts.

18.5 The Code defines the measures of responsibility of the student for academic violations:

- verbal warning;
- cancellation of the work and/or the assessment;
- non-admission to the defense of the evaluated works, including dissertations;
- expulsion from NLC "Abylkas Saginov Karaganda Technical University".

19 List of literature

1. The Code of the Republic of Kazakhstan "On Subsoil and Subsoil use". Astana. 2017.V.V.

2. Avdonin, V.E. Boytsov, and others. Prospecting and exploration of mineral deposits. M.: "Academic Project". 2020. 540 p.

3. Introduction to mineral exploration–2nd ed. / edited by Charles J. Moon, Michael K.G. Whateley & Anthony M. Evans; with contributions from William L. Barrett

4. Jones, I.O., Aspandiar, M., Dugdale, A., Leggo, N., Glacken, I., & Smith, B. (2019). The Business of Mining: Mineral Deposits, Exploration and Ore-Reserve Estimation (Volume 3) (1st ed.). CRC Press. https://doi.org/10.1201/9780429057540

5. Khuong The Hung, Vu Thai Linh, Pham Thanh Tinh and Nguyen Khac Duc. Advances in Geospatial Technology in Mining and Earth Sciences Series: Environmental Science and Engineering, Year: 2023,243, DOI: 10.1007/978-3-031-20463-0_15

6. Revuelta, Manuel. (2018). Mineral Resources: From Exploration to Sustainability Assessment. 10.1007/978-3-319-58760-8.

7. Roonwal, G.S.. (2018). Mineral Exploration: Practical Application. 10.1007/978-981-10-5604-8.

8. Hedenquist, Jeffrey & Daneshfar, Bahram. (2003). Mineral potential of Central and East Asia.

9. Singer, Donald, and W David Menzie, *Quantitative Mineral Resource Assessments: An Integrated Approach* (New York, 2010; online edn, Oxford Academic, 12 Nov. 2020), https://doi.org/10.1093/oso/9780195399592.001.0001

10. Gonzalez-Alvarez, Ignacio & Gonçalves, Mário & Carranza, Emmanuel John. (2020). New Challenges for Mineral Exploration in the 21st Century: Targeting Mineral Deposits Undercover.

NON-PROFIT JOINT STOCK COMPANY
«ABYLKAS SAGINOV KARAGANDA TECHNICAL UNIVERSITY»

Approved by
Acting Member of the Management Board Member –Vice-Rector for Academic Affairs
_____ G. Samashova
«____» _____ 2024

WORKING CURRICULUM (SYLLABUS)

Discipline RUMR 5106 “Rational use of mineral resources”

Module SM 02 “Subsurface Management”

Educational program 7M07203 – “Mining”

Developed by _____Isagulov S.T._____“___”_____2024
(signature) (name)

Discussed at a meeting of the department “Development of mineral deposits”
Protocol No. _____ from_____ ___ 2024 г.
Head department _____ Imashev A.Zh. "___"_____2024
(signature) (name)

Approved by the Mining Quality Assurance Committee_____ faculty
Protocol No. _____ dated “_____”_____2024
Chairman _____ __Khannanov R.R. “___”_____2024
(signature) (name)

2024

1 Information about the lecturer and contact information

Full name Isagulov Sayat Tuleuovich.

Academic degree, title, position: Candidate of Technical Sciences, Senior Lecturer.

The Department of Development of Mineral Deposits is located in the second building (N. Nazarbayev Ave., 56), room 308, contact phone 56-26-19 ext. 1088, e-mail:sissagulov@gmail.com

2 Discipline labor intensity

Form training	Semester	Quantity loans	lectures	Practical lesson	laboratory	Exam	SROP, hours	Number of contacts hours	SIW	Total, hours
Full	2	10	60	30	0	exam	30	130	170	300

3 Characteristics of the discipline

The discipline “Rational Use of Mineral Resources” is included in the cycle of basic disciplines (university component).

4 The purpose of studying the discipline

The discipline “Rational Use of Mineral Resources” aims to provide undergraduates with theoretical and practical knowledge of the rational use of mineral resources in order to increase the efficiency of mining processes, minimize the negative impact on the environment and ensure the sustainable development of mining enterprises.

5 Objectives of the discipline

The objectives of the discipline are as follows:

- studying methods and technologies for optimizing mining processes in order to increase the recovery of minerals and reduce losses.
- analysis of modern approaches to the economic and environmental assessment of reserves and resources, aimed at developing more effective strategies for their use.
- studying the principles and methods of environmental protection during mining operations, including minimizing the negative impact on natural ecosystems and water resources.
- mastering innovative technologies and modern approaches to the rational use of mineral resources, taking into account the requirements of sustainable development.
- developing skills for conducting a comprehensive assessment and risk management in mining activities in order to ensure the reliability of production processes and prevent emergency situations.

6 Results of the discipline study

After studying this discipline, the student is expected to:

6.1. understands the basic theories and concepts of rational use of mineral resources, including sustainable development, economic efficiency and environmental safety.

6.2. is able to analyze and evaluate mineral reserves, including geological and

economic assessment of deposits. Owns the methods of calculating stocks and assessing their commercial value.

6.3. knows modern technologies of extraction and processing of mineral resources. He is able to apply innovative methods and technologies to improve the efficiency and safety of mining.

6.4. understands the economic aspects of mining, including the planning and management of projects in the field of mining of mineral resources. It is able to assess the economic efficiency of various technologies and strategies of the company.

6.5. knows the principles and methods of ensuring environmental safety in the mining industry. He is able to develop and implement measures to reduce the negative impact of mining on the environment.

6.6. knows the legislation and regulations governing the rational use of mineral resources. Understands international standards and practices in the field of extraction and use of mineral resources.

These learning outcomes are aimed at preparing highly qualified specialists who are able to effectively solve the problems of rational use of mineral resources, taking into account economic, environmental and social aspects.

7 Prerequisites

To study this discipline, you must master the following disciplines (indicating sections (topics)): **No**

8 Post-requisites

The knowledge gained in studying the discipline “Rational Use of Mineral Resources” is used in studying the discipline:

AMPEM 6205 //EIS 6205 – “Advanced Mineral Processing for Eco-Mining // Ensuring Industrial Safety.”

9 Discipline thematic plan

Name of section (topic)	Labor intensity by type of occupation, hours.				
	lectures	practical	laboratory	SIWT	SIW
1	2	3	4	5	6
Subject and basic concepts of the academic discipline “Rational use of mineral resources”. Goals, subject, and tasks.Basic concepts and theories of rational use of mineral resources. Sustainable development and mineral resources. Principles and approaches to the rational use of mineral resources.	6	2	-	3	15
Geological assessment and exploration of deposits. Methods for exploration and assessment of mineral resources. Geological cartography and reservoir modeling.	6	3	-	3	15
Economic assessment of deposits. Methods for economic assessment of reserves. Analysis of the economic feasibility of field development.	6	2	-	3	15

Modern technologies of mining. Innovative methods and technologies in the mining industry. Modern approaches to open-pit and underground mining.	6	3	-	3	15
Technologies for processing mineral raw materials. Methods of enrichment and processing of mineral resources. The impact of processing technology on product quality and the environment.	6	2	-	3	25
Economics and project management in the mining industry. Project planning and management. Assessing the effectiveness of investments in the extraction of mineral resources.	6	4	-	3	15
Environmental safety in the mining industry. Principles of environmental management. Measures to reduce negative impacts on the environment.	6	3	-	3	15
Legal regulation and international standards. National and international legislation in the field of mineral resources. International standards and practices for the rational use of mineral resources.	6	4	-	3	15
Research and innovation in mining. Methods of conducting scientific research in the mining industry. Examples of innovative solutions and technologies.	6	3	-	3	25
Communication and work in interdisciplinary teams. Effective communication skills in a professional environment. Presentation of research and project results.	6	4	-	3	15
TOTAL:	60	30	-	30	170

10 List of seminars/practical classes:

1. **Analysis of sustainable development and mineral resources.** Case studies on sustainable development in the mining industry. Development of proposals to improve the sustainability of specific projects.
2. **Practical application of geological assessment methods.** Drawing up geological maps and models of deposits. Perform calculations of mineral reserves.
3. **Economic assessment of reserves.** Analysis of the economic feasibility of field development using specific examples. Perform calculations and prepare economic reports.
4. **Selection and optimization of production technologies.** Evaluation and comparison of different mining methods. Development of recommendations for the selection of technologies for specific conditions.
5. **Practical problems in processing mineral raw materials.** Modeling of technological processes of enrichment and processing. Assessment of product quality

and the impact of technology on the environment.

6. **Project planning and management.** Development of a project plan for the extraction of mineral resources. Risk assessment and development of measures to reduce them.

7. **Development of environmental safety measures.** Assessment of the environmental impact of mining operations. Development of programs for monitoring and reducing environmental risks.

8. **Analysis of legal aspects and standards.** Study and analysis of national and international regulations. Development of proposals for bringing activities into compliance with regulatory requirements.

9. **Conducting scientific research and introducing innovations.** Carrying out small research projects. Development of proposals for the introduction of innovative technologies.

10. **Communication and work in teams.** Participation in business games and simulations to develop teamwork skills. Presentation of project and research results.

11 List of laboratory

Laboratory classes are not provided

12 Topics and options of tasks for completing course projects (works)

1. **Analysis and assessment of sustainable development in the mining industry**. Study of cases of sustainable development using the example of specific mining companies. Development of a sustainable development strategy for a field or company.

2. **Geological and economic assessment of deposits**. Conducting geological assessment and modeling of the deposit. Economic assessment of reserves and analysis of the economic feasibility of field development.

3. **Modern mining technologies**. Research and analysis of innovative mining technologies. Assessing the effectiveness of using new technologies at a specific field.

4. **Technologies for processing and enrichment of mineral resources**. Development of a technological beneficiation scheme for specific mineral raw materials. Evaluating the effectiveness of various methods of processing mineral resources.

5. **Economics and project management in the mining industry**. Development of a business plan for a project for the extraction of mineral resources. Assessing the financial stability and risks of a mining project.

6. **Environmental safety and environmental risk management**. Assessing the environmental impact of mining operations. Development of measures to reduce environmental impact and environmental monitoring.

7. **Legal regulation and standards in the mining industry**. Research of national and international legislation regulating the extraction and use of mineral resources. Develop project-specific compliance recommendations.

8. **Scientific research and innovation in the mining industry**. Conducting research on the implementation of innovative technology in mining. Assessing the potential and developing recommendations for introducing innovations in a specific company or field.

13 Topics of test assignments for self-regulatory organizations

13.1 Creative and research assignments

13.1.1 **Study and analysis of cases of sustainable development in the mining industry.** Find and analyze examples of sustainable development in mining companies. Prepare a report with findings and recommendations.

13.1.2 **Creation of a geological model of the field.** Based on the provided data, create a geological model of the field using appropriate software. Prepare a description and presentation of the model.

13.1.3 **Economic assessment of mineral reserves.** Conduct an economic assessment of the reserves of a specific field. Develop a financial model and prepare a report analyzing the economic feasibility of the development.

13.1.4 **Comparative analysis of production technologies.** Study various mining technologies and conduct a comparative analysis of them. Prepare a presentation with conclusions and recommendations.

13.1.5 **Development of a technological scheme for processing mineral raw materials.** Develop a processing scheme for a specific type of mineral raw material. Prepare a report describing the process and expected results.

13.1.6 **Assessing the environmental impact of mining operations.** Conduct an environmental impact assessment for a specific mining project. Prepare a report with analysis and proposals to reduce negative impacts.

13.1.7 **Analysis of legal regulation in the field of mineral resources.** Study national and international legislation governing the extraction and use of mineral resources. Prepare an analytical note with conclusions.

13.1.8 **Development of measures to ensure environmental safety.** Develop a set of measures to ensure environmental safety for a specific mining project. Prepare a report describing the activities and their expected effect.

13.1.9 **Research of innovative technologies in the mining industry.** Conduct research on the application of innovative technologies in the mining industry. Prepare a report with potential analysis and recommendations for implementation.

13.1.10 **Analysis of the economic efficiency of a mining project.** Conduct an analysis of the economic efficiency of a specific mining project. Develop a financial model, prepare a report with conclusions and proposals for improving efficiency.

13.2 **Test questions for SIW**

13.2.1 What are the key factors that contribute to the sustainable development of a mining company? Give examples of successful cases and explain why they are considered successful.

13.2.2 What are the main stages of creating a geological model of a field? What tools and methods are used for this?

13.2.3 What are the main methods used to economically estimate mineral reserves? What is their significance for field development decisions?

13.2.4 What modern mining technologies do you consider the most promising? Compare them in terms of efficiency, environmental friendliness and economic indicators.

13.2.5 What factors must be taken into account when developing a technological scheme for processing mineral raw materials? What beneficiation methods are most effective for different types of mineral raw materials?

13.2.6 What are the main methods used to assess the environmental impact of mining operations? What measures can be proposed to reduce the negative impact on the environment?

13.2.7 What are the main regulations governing mining companies in your country? How do international standards influence national legislation in this area?

13.2.8 What environmental safety measures are most effective for mining companies? Give examples of their successful application in practice.

13.2.9 What innovative technologies in the mining industry do you consider the most promising? How can they affect the efficiency and environmental friendliness of mining operations?

13.2.10 What key indicators are used to analyze the economic viability of a mining project? How can you improve the economic efficiency of a project without compromising environmental safety?

14 Thematic plan for independent work of a student/master's student/doctoral student with a teacher

Name of the topic SIWT	Purpose of the lesson	Form of the lesson	Contents of the task	Recommended reading
Topic 1. Development of a sustainable development strategy for a mining company.	Deepening knowledge on this topic	Written report	Together with the teacher, develop a sustainable development strategy for a specific mining company or deposit, taking into account economic, environmental and social aspects.	In agreement with the teacher
Topic 2. Creation and analysis of a geological model of the field.	Deepening knowledge on this topic	Written report	With the teacher, create a geological model of the field using specialized software and analyze the data obtained	In agreement with the teacher
Topic 3. Economic assessment of deposits: practical application of methods.	Deepening knowledge on this topic	Oral analysis and survey	Together with the teacher, perform an economic assessment of the reserves of a specific field, using various methods and approaches, and prepare a report with conclusions	In agreement with the teacher
Topic 4. Optimization of mining technologies.	Deepening knowledge on this topic	Oral analysis and survey	Under the guidance of a teacher, analyze and compare various production technologies for a specific field, propose optimal solutions and justify them	In agreement with the teacher
Topic 5. Development of a techno-	Deepening	Written	Together with the	In agree-

logical scheme for processing mineral raw materials	knowledge on this topic	report	teacher, develop and discuss a technological scheme for processing a specific type of mineral raw material, evaluate its effectiveness and potential impact on the environment	ment with the teacher
Topic 6. Environmental assessment and risk management in the mining industry.	Deepening knowledge on this topic	Oral analysis and survey	With the teacher, conduct a comprehensive assessment of the environmental impact of mining operations and develop measures to manage environmental risks.	In agreement with the teacher
Topic 7 Research and analysis of legal aspects in the mining industry	Deepening knowledge on this topic	Oral analysis and survey	Under the guidance of a teacher, study and analyze national and international legislation governing the rational use of mineral resources and prepare recommendations for its application.	In agreement with the teacher
Topic 8. Development of environmental safety measures for a specific project.	Deepening knowledge on this topic	Oral analysis and survey	Together with the teacher, develop measures to ensure environmental safety for a specific mining project, evaluate their effectiveness and potential results.	In agreement with the teacher
Topic 9.Research of innovative technologies in the mining industry.	Deepening knowledge on this topic	Oral analysis and survey	With the teacher, conduct research on the implementation of innovative technologies in the mining industry, analyze their advantages and disadvantages, and prepare a report with recommendations.	In agreement with the teacher
Topic 10. Analysis and assessment of the economic efficiency of a mining project.	Deepening knowledge on this topic	Oral analysis and survey	Under the guidance of a teacher, conduct a detailed analysis of the economic efficiency of a specific mining project, develop a financial model and prepare proposals for im-	In agreement with the teacher

			proving the economic sustainability of the project.	

15 Evaluation criteria and policies

15.1 **Rating scale**

Score	Digital equivalent	Points (% content)
A	4.0	95-100
A-	3.67	90-94
B+	3.33	85-89
B	3.0	80-84
B-	2.67	75-79
C+	2.33	70-74
C	2.0	65-69
C-	1.67	60-64
D+	1.33	55-59
D	1.0	50-54
FX	0.5	25-49
F	0	0-24

15.2 The final grade for the discipline is determined as the sum of the maximum performance indicators for midterm controls (up to 60%) and intermediate certification (exam) (up to 40%) and amounts to a value of up to 100%.

Types of jobs	Academic period of study, week																	Total, % 1BC+2 BC
	1	2	3	4	5	6	7	8	The amount of BC 1	9	10	11	12	13	14	15	The amount of BC 2	
Lecture attendance	8	8	8	8	8	8	8	8	56	8	8	8	8	8	8		56	112
Modules 1,2							30		30						30		30	60
SIWT+SIW	2	2	2	2	2	2	2	2	14	2	2	2	2	2	2		14	28
Total for RK									100								100	200
Sum of indicators for the Republic of Kazakhstan																		200/2* 0.6=60
Exam																		40
Total																		100

*Note 1*The table must be filled out based on the number of credits in the discipline, its occupancy and the types of work established by the teacher.

*Note 2*In the table, the teacher must put a specific number (weight point) for each type of work, depending on the complexity and volume of the student's type of work. As an example, the scores are given for a 5 credit discipline, which contains lectures, seminars, and laboratories. Final control: course work and exam.

15.3 Evaluation Policy

Lectures

No.	Criterion	Specific gravity	A comment	Recommendations for improving work

1	Activity in discussing issues (conversation, discussion, problematic issues, topic updating)	30%	Actively participates/passively participates/does not participate	
2	Attendance	10%	Attends/does not attend (percentage of absences)	
3	Carrying out tasks within the SRO	20%	Completeness/disclosure of the topic/creativity of presentation	
4	Preparation of a report on a given topic (within the framework of the SROP), presentation	20%	Completeness/disclosure of the topic/creativity of presentation	
5	Completing SRO and SROP tasks on time	20%	The delivery time is assessed – on time/late	

SIWT

No.	Criterion	Specific gravity	A comment	Recommendations for improving work
1	Execution and design	thirty%	The work must be completed in full and documented in accordance with regulatory requirements	
2	Deadline	20%	The work must be prepared for defense according to the academic period of study	
3	Answers to security questions	thirty%	Answer the questions posed by the teacher during the defense	
4	Execution of tasks within the framework of SRO	20%	Solve the problem	

16 Schedule for completing and submitting assignments in the discipline

Types of jobs	Topic number (lecture, laboratory, practical work, seminar). Purpose and content of the task	Recommended reading	Reporting form	Type of control	Deadline	Points for the work done	Expected results
Attending a lecture	Attending lectures, writing notes for all lecture sessions. Goal: Providing theoretical training for students in the aspect of the discipline.	[1, 2, 5, 6]	Oral survey	Current	1-14 weeks	112	6.1-6.5
SIWT No. 1	Topic 1. Development of a sustainable development strategy for a mining company.	Master's student's choice	writing	Current	1-2 weeks	4	6.1-6.2
SIWT No. 2	Topic 2. Creation and analysis of a geological model of the field.	In agreement with the teacher	writing	Current	3-4 weeks	4	6.1-6.2
SIWT No. 3	Topic 3. Economic assessment of deposits: practical application of methods.	[1], p. 73-92	writing	Current	5-6 weeks	4	6.1-6.2

SIWT No. 4	Topic 4. Optimization of mining technologies.	In agreement with the teacher	writing	Current	week 7	2	6.3-6.4
SIWT No. 5	Topic 5. Development of a technological scheme for processing mineral raw materials	Master's student's choice	writing	Current	8-9weeks	4	6.3-6.4
SIWT No. 6	Topic 6. Environmental assessment and risk management in the mining industry.	Based on the teacher's recommendation.	writing	Current	10 week	4	6.4-6.5
SIWT No. 7	Topic 7 Research and analysis of legal aspects in the mining industry	[5, p. 23-34]	writing	Current	11 week	4	6.1-6.5
SIWT No. 8	Topic 8. Development of environmental safety measures for a specific project.	Based on the teacher's recommendation.	writing	Current	12 week	4	6.4-6.5
	Topic 9. Research of innovative technologies in the mining industry.	Based on the teacher's recommendation.	writing	Current	Week 13	4	6.4-6.5
	Topic 10. Analysis and assessment of the economic efficiency of a mining project.	At the choice of the undergraduate, in agreement with the teacher.	writing	Final	Week 14	2	6.1-6.5
Module No. 1	M.1. Checking the material learned	Lecture notes [1,2,5]	Control work, survey	Border control	week 7	30	6.1-6.3
Module No. 2	M.2. Checking the material learned	Lecture notes [3,4,6,8]	Control work, survey	Border control	Week 14	30	6.4-6.5
Total for the Republic of Kazakhstan						200 /2* 0.6 =60	
Sum of indicators for the Republic of Kazakhstan						60	
Exam	Checking the mastery of the discipline material	The entire list of basic and additional literature	writing	Final	During the session	40	
TOTAL						200	

17 Course Policies and Procedures

When studying the discipline “Rational Use of Mineral Resources”, I ask you to follow the following rules:

17.1 Do not be late for classes.

17.2 Do not miss classes without a good reason; in case of illness, please provide a certificate, in other cases - an explanatory note.

17.3 It is the student's responsibility to attend all types of classes.

17.4 According to the calendar schedule of the educational process, pass all types of control.

17.5 Missed practical and laboratory classes must be completed at the time specified by the teacher.

17.6 When performing all types of work, refer to clause 16.3

18 Academic Honesty

18.1 In accordance with the Anti-Corruption Standard of NJSC «Karaganda Technical University named after Abylkas Saginov», academic integrity is a constant commitment of participants in the educational process and educational institutions to act in accordance with values and principles that exclude corruption risks and manifestations, forming and strengthening a professional environment that allows them to adhere to such behavior.

18.2 The promotion and protection of academic integrity is the result of the mutual efforts of all students and staff of NJSC «Karaganda Technical University named after Abylkas Saginov».

18.3 Students are required to conscientiously adhere to the principles of academic integrity.

18.4 According to the Code of Honor for students, undergraduates and doctoral students of NJSC «Karaganda Technical University named after Abylkas Saginov» (Code), academic violation (academic dishonesty) is an action when a student:

a) attempts to take credit for the work or efforts of another person without obtaining permission or without citing his work ("plagiarism");

b) uses unauthorized materials or false information when completing educational assignments;

c) forges or falsifies academic documents or transcripts;

d) deliberately interferes with or undermines the academic work of other students;

e) commits actions aimed at presenting false information;

f) cheats in any form during an exam or while completing assignments;

g) assists other students in committing any of the described acts.

18.5 The Code defines the measures of student responsibility for academic violations:

– verbal warning;

– cancellation of work and/or grade assigned;

– denial of access to the defense of assessed works, incl. dissertation works;

– expulsion from NJSC «Karaganda Technical University named after Abylkas Saginov».

19 List of literature

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MINISTRY OF HIGHER EDUCATION, SCIENCE AND INNOVATIONS OF THE REPUBLIC OF UZBEKISTAN

TASHKENT STATE TECHNICAL UNIVERSITY NAMED AFTER ISLAM KARIMOV

«CONFIRMED BY»

Rector _____ S.M.Turabdjanov

«____» _____ 2024

PREVENTION OF THE WATER RESOURCES CONTAMINATION IN THE EXTRACTION OF NATURAL STONE AND ORE

MODULE HANDBOOK

Field of knowledge:	600.000 –	Engineering, machining and construction industries.
The field of education:	610.000 –	Engineering work.
Field of study:	70712101 –	Metallurgy (Ferrous and non-ferrous metals)

MODULE REFERENCES

Module name:	Prevention of the water resources contamination in the extraction of natural stone and ore
Code, if applicable	PWRCENSO
Semesters in which the module is taught	2
Lecturer	Matkarimov Sokhibjon Turdalievich - PhD, DSc, Professor. Professor Department of "Metallurgy"
Language	Uzbek, English
Relation to curriculum	Selection
Type of teaching, contact hours	Lecture, practical
Workload	Total study load: 150 hours, Contact hours: - 40 hours; lecture - 30 hours; practical – 10 hours. Independent study: 110 hours.
Credit points	6
Recommended prerequisites	Chemistry, physics

Module objectives / intended learning outcome	**Students will learn** about the wastewater from mining industry enterprises, its formation, composition, properties and degree of impact on the environment, classification of wastewater from mining industry enterprises, mine water minimization. Understand and explain strategies for improving energy efficiency and implementing "green" technologies in metallurgical operations, and integrating sustainability principles such as circular economy concepts and evaluation of metallurgy for responsible and economically viable practices. **Students know** the basic concepts of prevention of the water resources contamination in the extraction of natural stone and ore, save resources and solve the problems of sustainable development in the field of water resources contamination in mining, the specifics of using traditional and non-traditional technologies in processing water save technologies from all types of mining and enrichment plants. **Students will have the ability** by studying water-saving technologies in mining, to analyze the existing problems in the extraction of noble metals from the waters of metallurgical and enrichment plants using environmentally pure and cost-effective methods, and make preliminary decisions on how to overcome these problems. **Able to** develop and implement into the main production technologies for the processing of industrial wastewater from metallurgical production, contributing to the additional extraction of metals in the main volume of production indicators, using metallurgical slag, dust, and wastewater from enrichment processes **In practical training**, students use the information about water-saving technologies in extractive metallurgy to calculate the main parameters of machines used in the processing of wastewater of metallurgical plants and enrichment plants, and the consumption of reagents in physico-chemical processes. **Students will have the ability** by studying water-saving technologies in extractive metallurgy, to develop effective methods of extracting metals or their compounds from wastewater using various metallurgical methods and to evaluate the effectiveness of technologies. **Students apply the knowledge gained** in the lectures to calculate the main parameters of water-saving technologies in extractive metallurgy and strengthen theoretical knowledge in a practical way. **During independent work**, During independent work, students study scientific topics, get an idea of new methods of water-saving processing; independent study of science topics includes processing of wastewater containing copper, zinc, lead, cadmium, gold and silver using hydrometallurgical or pyrometallurgical methods, modern state of processing wastewater containing tungsten, molybdenum and rhenium, combined processing of wastewater containing rare earth metals they will have the skills to apply technologies and work with industry literature, as well as independent work will

	expand the horizons of future specialists and allow analysis of various connections between different specialities of waste-free technologies in extractive metallurgy.
Content	1. Wastewater from mining industry enterprises, its formation, composition, properties and degree of impact on the environment. 2. Classification of wastewater from mining industry enterprises. 3. Mine Water Minimization. 4. Quarry and drainage waters. 5. Industrial and technological wastewater. 6. Wastewater from processing plants. 7. Design of Filtration Process. 8. Quarry and coal processing waters from suspended substances. 9. Technology and technological schemes for water purification at coal processing plants. 10. Desalination of mineralized mine and quarry waters 11. Dealing with wastewater from mining operations 12. The benefits of using filtration and water treatment chemicals 13. Using flocculants and coagulants in the wastewater treatment process 14. Wastewater treatment solutions for the mining industry 15. Mining wastewater treatment technologies and resource recovery techniques
Practical classes	1. Enhanced biological phosphorus removal 2. Biological sulphate reduction 3. Biological nitrogen removal 4. Aerobic organic matter removal 5. Off-gas emission tests
Study and examination requirements and forms of examination	It is written and includes the theoretical part of the science and issues of calculating indicators of prevention of the water resources contamination in the extraction of natural stone and ore
Assessment Requirements	Completion of science assignments and successful submission of current, intermediate, and final control forms.

Reading list	1. Linsley, R.K., Franzini, J.B., Freyberg, D.L., and G. Tchobanoglous. 1992. Water-resources engineering. 4th ed. McGraw-Hill: Singapore, 340. 2. Funeka Matebese, Alseno K. Mosai, Hlanganani Tutu, Zenixole R. Tshentu, Mining wastewater treatment technologies and resource recovery techniques: A review, Heliyon, Volume 10, Issue 3, 2024, e24730, ISSN 2405-8440, https://doi.org/10.1016/j.heliyon.2024.e24730. 3. Dolina L.F. Wastewater from mining enterprises and methods of their treatment, Reference manual, Dnepropetrovsk, 2000, 61 p., ISBN 966-7480-00-5 4. WASTEWATER RECYCLE, REUSE, AND RECLAMATION – Vol. I - Wastewater Characteristics, Management and Reuse in Mining and Mineral Processing Industries - Hagare B. Dharmappa, Muttucumaru Sivakumar, Raghu N. Singh, Encyclopedia of Life Support Systems (EOLSS)
Reviewers	A.M.Saynazarov - Deputy Chief Engineer in Technology of JSC "Almalyk MMC" – Chief of Department for technical, doctor of philosophy (PhD) (network enterprise); D.B. Makhmaredjabov - PhD, associate professor of the "Mining" department, (specialty enterprise);
Confirmed place and time	Developed and approved by Tashkent State Technical University (Report №__ _____ _____)

Co-funded by the Erasmus+ Programme of the European Union

EMINREM SYLLABUS

Name of the module:	**Implementation of Risk Assessment Methods for Occupational Health and Safety**
E-learning hours:	**24**
Author:	**Prof.Dr. Oktay Şahbaz**
University:	**Kütahya Dumlupinar University**

1. Objectives of the module:

To make Learners aware of the problems related to occupational health and safety in working places, specifically mining, and implementation of risk assessment. To provide knowledge on the basics of risk assessment, and risk analysis methods. To improve researchers skills to use of various risk analysis methods.

3. Specific learning outcomes of the module:

Outcome code	Learning outcomes of the module
KNOWLEDGE	
K01	The Learner has unique knowledge in the field of occupational health and safety.
K02	The Learner has advanced knowledge in the field of implementation of risk analysis methods
K03	The Learner has knowledge of hazard determination in mining work places
INTELLECTUAL SKILLS	
S01	The Learner is able to properly prepare the material for risk assessment implementation
S02	The Learner is able to apply a risk analysis method to create safe working environment
S03	The Learner can assess the impact of various factors on work hazards and risks
SOCIAL SKILLS	
SS01	Learners can use positive communication in the workplace
SS02	Learners know the importance of collaborative works for safety

4. Syllabus:

No	Content	Outcome code	Number of hours
1	Topic 1: Terminology and fundamentals of occupational safety and Health (OSH)	K01, SS01, SS02	2
2	Topic 2: Basi Regulations of OSH	K02, S01	2
3	Topic 3: Determining of Hazards: methods	K02, S01	4
4	Topic 4: Hazards and risks in mine: case study 1 and 2	K02, S01	2

5	Topic 5: ISO 45001	K02, S02	2
6	Topic 6: Risk Assessments and its fundementals	K03, S02	2
7	Topic 7: Introduction to risk analysis methods	K02, K03, S02, SS01	2
8	Topic 8: Qualitative risk analysis methods	K04,S02,	4
9	Topic 9: Quantitative risk analysis methods	K02, K03, S02	2
10	Topic 10: Implementation of risk analysis methods	K02, K03, S02	2
		Total:	24 hours

5. Teaching methods:

Online lectures/tutorials, case studies analysis, quizzes, forum discussions, individual tasks, team-work...

6. Individual activity of a Learner:

Studying lectures/tutorials materials, solving problems at the Moodle platform, finding examples of applications in the Internet, solving quizzes, analyzing case studies.

7. Readings:

1. Oktay Sahbaz personal notes,
2. EU OSHA documents,
3. ISO 45001 handbook

8. Supplementary readings and websites:

Journals:

1. SHO books
2. Journal of safety research (https://www.sciencedirect.com/journal/journal-of-safety-research)
3. Safety MDPI (https://www.mdpi.com/journal/safety)
4. Safety Science (https://www.sciencedirect.com/journal/safety-science)

9. Assessment requirements and grading system:

EXAMPLE

The following elements constitute **total score (100 points):**

- Quizzes Total: 15 points
- final test: 20 points
- individual tasks: 15 points
- group project: 50 points

Grading system

Points			Grade
0	-	49	Fail (2)
50	-	59	Satisfactory (3)
60	-	69	More than satisfactory but less than good (3+)
70	-	79	Good (4)
80	-	89	Very good (4+)
90	-	100	Excellent (5)

10. Verification of learning outcomes:

Outcome code	Evaluation method

	Open-ended questions (*test and mini-tests*)	Computational questions (*tests and mini-tests*)	Individual task *(document for teacher's feedback and evaluation prepared by individual)*	Group project *(document for teacher's feedback and evaluation prepared by group of Learners)*
K01		x		
K02		x		
K03		x		
K04	x			
K05	x			
S01			x	
S02			x	
S03			x	
SS01				x
SS02				x

CONTROL QUESTIONS

What is a risk assessment?
Why is risk assessment important?
What is the goal of risk assessment?
When should a risk assessment be done?
How do you plan for a risk assessment?
How is a risk assessment done?
How are the hazards identified?
How do you know if the hazard will cause harm (poses a risk)?
How are risks ranked or prioritized?
What are methods of hazard control?
Why is it important to review and monitor the assessments?
What documentation should be done for a risk assessment?
What are the 5 Risk Control Measures?
Why Are the 5 Risk Control Measures Important?
What is the most influential risk control measure?
Can PPE be used as a primary risk control method?
How often should risk assessments be conducted?
Who should be involved in identifying and assessing workplace hazards?
How do you prioritize which risks to address first?
Is training considered an engineering control or an administrative control?
Are the activities hazardous?
What is a Health and Safety Risk Assessment?
What are the Most Common Health and Safety Risks?
5 Steps to Effectively Implement Health and Safety Risk Assessment
What are Health and Safety Risk Assessment Templates?
Significance of risk assessment for safety and health
How to do a Health and Safety Risk Assessment?
Health and Safety Sisk Assessment Steps
How is the IOSH Managing Safely Risk Assessment marked?
Where should you carry out your IOSH Managing Safely Risk Assessment?
How long do you have to complete your IOSH Managing Safely risk assessment?
Are you familiar with the Occupational Safety and Health Administration (OSHA) regulations?
How to prioritize occupational risks?
What is Total Worker Health?

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THE REPUBLIC OF UZBEKISTAN
MINISTRY OF MINING AND GEOLOGY
NAVOI STATE UNIVERSITY OF MINING AND TECHNOLOGIES

DEPARTMENT MINING

"APPROVED"
Vice Rector for Academic Affairs
_____ N.Abduazizov
(signature)
«___» _____2024

SYLLABUS on the subject of

ADVANCED MINERAL PROCESSING FOR ECO-MINING

Knowledge of the area**:**	700 000	–	Engineering, process and construction industries
Field of education**:**	720 000	–	Manufacturing and Processing Industries
Speciality:	70722401	–	Technology of extraction, enrichment and processing of rare and radioactive metal ores.

Navoy 2024

Navoi state university of mining and technologies

Module / SYLLABUS OF OBJECT
Faculty of Mining
Department of "Advanced mineral processing for eco-mining"

Science name:	Advanced mineral processing for eco-mining
Module type:	Required
Module code:	AMPEM 1206
Year:	2024-2025
Semester:	3
Type of training:	daytime
Type of classes and number of hours allocated per semester	180
Lectures	30
Practical lesson	30
Laboratory lesson	-
Independent work	120
Credit:	6
Evaluation form:	Exam (oral)
Language of instruction:	English, Uzbek

Item Purpose (IP)	
IP1	• creates in students a clear understanding of modern negative processes associated with the determination of minerals by underground and open-pit methods, as well as with the help of geotechnologies, their theoretical and practical training in organizing environmental protection in the mining industry in underground conditions and the discovery of mining, development mines and other underground structures, in order to protect and rationally use mineral resources, taking into account the environmental and economic interests of various regions.
IP2	•Improve the education of future mineral processing engineers and the productivity of current and future processing plants, while preserving the Earth's carrying capacity through the real use of innovative and sustainable methods for extracting valuable minerals
IP3	• Ensure that competent individuals have the skill sets to strive for resource efficient management and use of raw materials, support innovation and the use of best available technologies to provide materials for clean mobility and meet environmental standards.

IP4	• Ensure that competent individuals have the skill sets to strive for resource efficient management and use of raw materials, support innovation and the use of best available technologies to provide materials for clean mobility and meet environmental standards.
IP5	• Be able to apply technical knowledge and scientific information to develop new processes that achieve significant energy and water savings, as well as the use of Best Available Technologies (BAT) to optimize mining processes.
	Course objectives
	• Study of the rational use and protection of mining resources, the effective use of scarce technologies in the extraction of ore deposits of rare and radioactive metals, as well as the effective use and protection of energy and labor resources in the mining industry. Ensuring the level of knowledge, skills and experience required by vocational education standards for teaching in accordance with the methods used. • Develop simulations of mineral processing circuits and apply the model to production, troubleshooting, plant design and optimization. • Integrate mineral separation techniques and interdisciplinary requirements into a single solution to separate valuable minerals from less valuable waste materials by assessing the properties of surface minerals and applying chemical, physical, mathematical and geometallurgical approaches • identifying the most promising areas for improving technological processes and modes for the efficient and comprehensive use of ores;

Necessary initial knowledge to master the subject

1	Basics of Geotechnology
2	open pit mining processes and technologies
3	mining by geotechnological method
4	Ecologiya

Learning Outcomes (LO)	
	A student who has mastered the subject must know and be able to:
LO1	• main directions for increasing production efficiency; the role of material and technical resources in the country's economy; Understand the purpose of mineral processing and its importance to the global economy and sustainable use of raw materials (critical thinking).

LO2	•knowledge of technologies for integrated development of deposits and the conditions for their effective use, principles of organizing production processes in accordance with environmental protection conditions; types, purposes of methods and means of protecting the environment in the mining process.
LO3	• ability to determine permissible emissions and discharges of pollutants, conduct environmental monitoring, assess the impact of mining on the environment
LO4	• knowledge about the rational use of natural resources, about schemes of engineering, organizational and economic measures for environmental protection, about the environmental consequences of mining operations and their impact on the environment.
	Competencies and skills:
CS1	• Be competent in matters of the state of the regulatory framework to ensure environmental friendliness of production processes and environmental protection; in matters of application of methods and technical means of environmental protection.
CS2	• Use computerized modeling programs to design processes in the rock industry, determining resource efficiency based on design, organizational and economic factors.
CS3	•ability to formulate tasks for environmental and industrial safety and adapt the basic patterns of sustainable development of the mining, mineral and mining industries
CS4	• Describe products, applications and quality assurance in the rock industry based on European standards and CE marking, be qualified in recycled materials and their use.

Subject content

	Lesson form: Lectures (L) (30 hours)	hours
L1	**General concepts about the scientific foundations of rational use of subsoil and their protection.** Ecological foundations of environmental protection in mining; goals, objectives, subject and teaching methods, anthropogenic factors in nature	**2**

L2	**Fundamentals of planning the extraction and primary processing of mineral resources.** Fundamentals of planning the extraction and primary processing of mineral resources. Mineral resource potential. Integrated use of mineral raw materials. Mineral raw materials. Integrated use of mineral raw materials of non-ferrous metallurgy	**2**
L3	**Promising methods of mining.** Open development. Traditional open source mining methods. Concealment of a deposit during open-pit (quarry) development. Environmental aspects of open-pit mining. Reducing the distance of dust in the environment during mining preparation	**4**
L4	**Promising methods of underground leaching of minerals.** Underground Mining. Trend of underground mining. Equipment for underground mining. Opening up a deposit during underground development	**4**
L5	**Geotechnological methods of mining** Physico-chemical foundations of geotechnological processes. Geotechnological systems for field development. Environmental aspects of geotechnological methods.	**4**
L6	**Advanced processing of minerals in processing plants.** Modern technologies (processes, units) and trends in creating environmentally friendly metallurgical production. Methods of ore processing. Technological measures to reduce harmful emissions into the atmosphere.	**4**
L7	**Basic principles of application of biotechnology in the mining industry**	**2**
L 8	**Rational use and protection of subsoil.** The concept of natural resources. Energy resources. water resources. Land resources. Technogenic resources. Raw materials of the earth.	**2**
L9	**Disposal of industrial waste at mining enterprises.** Current state and prospects for the integrated use of extracted	**2**

	minerals. Application of waste-free (low-waste) technologies in the mining industry. Main technical and economic indicators of the use of extracted minerals. Losses, deterioration in the quality of minerals.	
L 10	Application of low-waste technologies and closed cycles in the mining industry. Accounting for off-balance sheet reserves and their protection. Current state and prospects for the integrated use of extracted minerals. Application of waste-free (low-waste) technologies in the mining industry.	**2**
L 11	**Economic methods of environmental management** Economic methods of management. Economic damage from pollution and environmental degradation. Methods for assessing economic damage from environmental pollution. Environmental audit.	**2**
Lesson form: Practical training (P) 30 hours		
PT1	Calculation of the area of mining and land dumps .	**2**
PT2	Assessment of the main production indicators of ogros on destructible and renewable land	**4**
PT3	Obtaining fertile soil layer and calculating the amount of work based on the amount of equipment	**2**
PT 4	Determination of the volume of mining planning work during reclamation of disturbed lands.	**2**
PT5	Selecting the thickness and structure of the reclamation layer.	**2**
PT6	Calculation of emissions of harmful substances from unorganized sources.	**2**
PT7	Normalization of air quality in the quarry and around its border.	**4**
PT8	Calculation of the flow of groundwater flowing in a quarry according to the water balance.	**2**
PT9	Determination of the hydraulic size of a polysperse wastewater system by an experimental method.	**2**
PT10	Determination of the hydraulic size of a polysperse wastewater system by calculation method	**2**
PT11	Determination of parameters of settling tanks for purification of quarry waters	**2**
PT12	Connection of wastewater with reservoirs when carried to the surface.	**2**

Self-directed learning		
1	Preparing for practical classes and doing homework	30 hours
2	Compose problem (case) tasks	10 hours
3	Working with specified sources	5 hours
4	Solving test tasks in the discipline	5 hours
5	Preparation of abstracts for conferences	10 hours
6	Carrying out independent work on given topics	120 hours

Independent work (IW) 120 hours.		
Recommended theoretical tasks for self-study		
IW 1	Describe the characteristic features of the technology of evolutionary development .	8
IW 2	Make a list of problems with georesources .	6
CP3	Make a list of problems of mining and environmental education	8
IW 4	Describe the basic principles of safe activities in the bowels of the earth	8
IW 5	Describe the scientific foundations of technological geotechnology.	6
IW 6	Justify economic efficiency in environmental protection measures	8
IW 7	How is environmental control and monitoring carried out?	6
CP8	How are the ecological functions of the lithosphere carried out?	6
IW 9	Describe the interaction between society and nature.	6
IW 10	What are the tasks of ecological and biological research?	6
Recommended practical tasks for self-study		
IW 11	Calculate the land allocation area upon completion of the quarry construction	6
IW 12	Let's calculate the area of arable land for agricultural land	6
IW 13	Determination and analysis of land quality before disturbance and after reclamation.	8
IW 14	Justify the thickness and structure of the reclamation layer for various directions of reclamation land use in two cases: 1 - reclamation layer on unsuitable (toxic) rocks for biological reclamation, 2 - unsuitable rocks	6
IW 15	Carry out calculations on the migration of residual solutions in a natural underground flow	6

IW 16	Carry out calculations on the migration of residual solutions to concentrated water intakes	8
IW 16	Assessment of the environmental consequences of mining deposits by in-situ leaching.	6
IW 17	Carry out calculations for the migration of residual solutions into the adjacent operating unit	6

Main literature	
1	B.I. Golik, V.Sh. Komashchenko, I.V. Leonov. Mining and the Environment. Moskva. 2020, p-210
2	Galperin, A.M. Technogenic massifs and protection of natural resources: textbook for universities: in 2 volumes / A.M. Halperin, W. Förster, H. Chef. - M.: Publishing house of Moscow State Mining University, 2006. - T. 2.
3	Geotechnology and environmental protection of underground space and the environment. Textbook, Mining Book, 2011.
4	Workshop on the discipline “Rational use and protection of natural resources.” Textbook, Mining Book, 2015.
5	Petukhov O.F., Istomin V.P., Rudnev S.V., Khasanov A.S. Uranus. Tashkent: Turon Zamin Ziyo, 2015. - 699 pages
Additional literature	
1	Brovin K.G., Grabovnikov V.A., Shumilin M.V., Yazikov V.G. Forecast, prospecting, exploration and industrial evaluation of uranium deposits for mining by underground leaching. Almaty: “Gylym” 1997, - 378 pp.
2	Kharchenko V.A. Rational environmental management in the mining industry. Textbook, Moscow State University for Humanities, 1998
3	Tomakov P.I., Kovalenko V.S., Mikhailov A.M., Kalashnikov A.T. Ecology and nature conservation in open-pit mining. Textbook, Moscow State University for the Humanities, 1994
4	"The Law of the Republic of Uzbekistan on Subsoil Resources", T.: Uzbekistan, 1994.
5	Abramov A.A. Processing, enrichment and integrated use of raw materials. Textbook, MSTU, 2001.

6	Kilyachkov A.P. Mining technology, M, "Nedra" 1992
7	Integrated development of solid mineral deposits, Moscow State University, 1988.
8	Pevzner M.E. and others, Mining Law. Textbook. M.: MGGU, 2002.

Internet site

1. www. http://ziyonet.uz-Akhborot educational network
2. www. http://elibrary.ru - scientific electronic library.
3. www.http://lex.uz - the national database of legal documents of the Republic of Uzbekistan.
4. www.ima.uz (Intellectual Property Agency of the Republic of Uzbekistan)

www.academy.uz (Academy of Sciences

Requirements for obtaining a loan (criteria for assessing student knowledge)

In the discipline “Rational use of mountain resources and their protection,” 6 (six) credits are allocated, which correspond to 180 academic hours.

The objectives of the criteria for monitoring and assessing students’ knowledge in this discipline are as follows:

a) control over the development of relevant knowledge, skills and abilities in students in accordance with state educational standards;

b) organize and analyze students’ systematic and timely understanding of the basic concepts of the discipline;

c) impartial and objective assessment of students’ knowledge and timely reporting of its results

Assessment criteria, the number of credits required to pass the discipline, the type, form and number of control and assessment for each control, as well as passing grades for practical and intermediate control will be announced to students during the first lesson.

Assessment of practical and independent work is carried out with the aim of identifying and assessing the level of knowledge and practical skills in the discipline. Based on the characteristics of the discipline Creativity, innovation, leadership and entrepreneurship, this type of assessment is carried out by checking the completion of homework and an oral answer.

Intermediate control is a method of determining and assessing the level of knowledge and skills of a student after completing the relevant section of the

curriculum (covering several topics in the subject). Intermediate control is carried out twice a semester in written form, depending on the total number of hours allocated for the discipline.

The student's independent work is accepted in the form of abstracts prepared on the basis of topics for independent study. Assessment of independent work is carried out through the student's independent and creative comprehension of the prepared essay and understanding of the topic.

Final control is a method of assessing students' mastery of theoretical knowledge and practical skills in a given discipline at the end of the semester. The final control is carried out orally. The final control in the discipline "Creativity, innovation, leadership and entrepreneurship" is carried out with the participation of members of a commission approved by the dean of the faculty. In case of violation of the procedure for conducting the final control, the results are canceled and the final control is retaken.

Assessment criteria for the discipline "Advanced mineral processing for eco-mining"

T/p	Type of control	Quantity	Score for each work	Overall rating
	1. Current control			
1.1.	Completing and passing practical classes	15	5	5
2. Intermediate control – score 5				
2.1.	I – intermediate test (written 3 questions on topics 1-7)	1	5	5
2.2.	II – intermediate test (orally 3 questions on topics 8-14)	1	5	5
2.3.	Independent work – abstract, presentation, problem solving, etc.	4	5	5
ΣIW and PT+IC				5
3. Final control – score 5				
3.1.	Final control, oral (consists of three questions on lecture materials, as	1	5	5

	well as on the topic of independent work)			
Total				**5**

The assessment is based on the following:

If the practical work is completed according to the option correctly, the student fully answers all the teacher's questions on this topic, he is given a grade of "5" (excellent); if practical work is completed according to an option, depending on the degree of mastery of the material on this topic, it is given a grade of "4" (good); if the practical work is completed according to an option, the student does not clearly answer the teacher's question on this topic, he is given a grade of "3" (satisfactory); if the practical work is partially completed or not completed according to the option, the student does not have an idea on the given topic, he is given a grade of "2" (unsatisfactory).

The student must submit the completed practical work before the next practical lesson, in accordance with the teacher's schedule. If a student does not submit practical work on time, the practical work is graded "2" (unsatisfactory). The grade for each laboratory work is recorded in the journal by the teacher during the next practical lesson and is not subject to change.

Independent work is performed in the form of an abstract on a given topic:

- if the topic is fully disclosed, the conclusion is correctly drawn and the student has creative thinking, and he fully answers the teacher's questions on the topic, he is given a grade of "5" (excellent);
- if the topic is fully disclosed, the conclusion is correctly drawn, but the student does not have creative thinking, depending on the degree of study of this topic, he is given a grade of "4" (good);
- if the topic is partially covered, or there are shortcomings in the work, the student is given a grade of "3" (satisfactory);
- if the topic is partially covered, there are shortcomings in the work, the student has no understanding of this topic, the student is given a grade of "2" (unsatisfactory).

If a student fails to submit independent work within the specified time frame, the independent work is assessed as "2" (unsatisfactory), recorded in the journal and cannot be changed.

In case of failure to pass at least one practical work, the student is not allowed to take the final test.

Interim tests are carried out in writing, in accordance with the academic schedule. The maximum score for each intermediate test is “5” excellent. Each option has three questions, the answers are assessed according to the following criteria:

- if the essence of the question is fully disclosed, the answers are complete and accurate, the answer is rated “5” - excellent;

- if the essence of the question is fully revealed, the answers are complete, but there are some inaccuracies, the answer is rated “4” - good;

- if the essence of the question is revealed, and the questions are not complete and there are inaccuracies, the answer is rated “3” - satisfactory;

- if the essence of the question is not disclosed, the answer is not complete and inaccurate, the answer is graded “2” - unsatisfactory.

Intermediate work is assessed by averaging all answers to all questions and its average value (rounded to the nearest integer) is recorded in the journal.

If a student was absent from the intermediate work for a valid reason (health reasons, family reasons), upon presentation of a certificate, he is allowed to take the intermediate test.

A student who has not passed independent work or intermediate tests is not allowed to take the final test.

The final test is carried out orally. Each option has 3 questions. Answers to each question are assessed according to the following criteria:

- if the essence of the question is fully disclosed, the answers are complete and accurate, the answer is rated “5” - excellent;

- if the essence of the question is fully revealed, the answers are complete, but there are some inaccuracies, the answer is rated “4” - good;

- if the essence of the question is revealed, and the questions are not complete and there are inaccuracies, the answer is rated “3” - satisfactory;

- if the essence of the question is not disclosed, the answer is not complete and inaccurate, the answer is graded “2” - unsatisfactory.

Deadlines for control work

Practical work is assessed on each pair. Intermediate controls are carried out on the basis of a thematic plan, in accordance with the schedule approved by the dean’s office. The final test is carried out at the end of the academic semester in accordance with the schedule approved by the dean’s office.

If a student, for health reasons, did not attend classes, did not pass practical work, intermediate and final tests within the established time frame, then with the order of the dean of the faculty, within two weeks it is allowed to pass all types of control in accordance with the schedule.

If during the semester one of the types of control is not mastered, the student is not allowed to take the final control.

For students with academic debt, after the end of the academic semester, the dean's office provides one credit month to retake the discipline. After the end of this period, in case of failure to master the discipline, a report is submitted to the dean of the faculty.

In case of disagreement with the received grade, the student has the right to submit a statement to the dean of the faculty within one working day, after the results of the types of control are announced. In this case, with the order of the rector, an appeal commission consisting of 3 members is formed.

The appeal commission, having considered the student’s application, issues a conclusion on the same day.

Control over the assessment in the prescribed manner and time frame is assigned to the head of the department.

Navoi state university of mining and technologies

Information about the teacher on the subject

Authors:	Associate Professor Khalimov Ilkhom Ubaydulloevich Associate Professor Tursunova Iroda Nematovna
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Reviewers:	Deputy Head for Research Work, Central Scientific Research NMMC **Kurbanov M.A.** Vice-Rector for International Relations, Doctor of Technical **Sciences, Prof. Alikulov Sh.Sh.**

The syllabus was approved by the minutes of meeting No._____Educational and Methodological Council of the University in 2024_____

The syllabus was discussed and approved at the meeting of the department "Extraction and processing of rare and radioactive metal ores" dated "_____"_____2024. (Protocol No._____)

Head of the department of education methodology **I.A.Karimov**

Dean of the Faculty **I.T.Mislibaev**
Head of the department **I.U. Khalimov**

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THE REPUBLIC OF UZBEKISTAN
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DEPARTMENT MINING

"APPROVED"
Vice Rector for Academic Affairs
_____ N.Abduazizov
(signature)
«___» _____2024

SYLLABUS on the subject of

CREATIVITY, INNOVATION, LEADERSHIP AND ENTREPRENEURSHIP

Knowledge of the area**:**	700 000	–	Engineering, process and construction industries
Field of education**:**	720 000	–	Manufacturing and Processing Industries
Speciality:	70722401	–	Technology of extraction, enrichment and processing of rare and radioactive metal ores.

Navoy 2024

Science name:	Creativity, innovation, leadership and entrepreneurship
Module type:	Selective
Module code:	CILE 1206
Year:	2024-2026
Semester:	3
Type of training:	daytime
Type of classes and number of hours allocated per semester	180
Lectures	30
Practical lesson	30
Laboratory lesson	-
Independent work	120
Credit:	6
Evaluation form:	Exam (written)
Language of instruction:	English, Uzbek

Item Purpose (IP)	
IP **1**	- formation in masters of creative thinking, ability to innovate and study leadership, valuable leadership skills, acquisition of competence and knowledge in key functional areas of business. - give an understanding of the changing business environment and apply new solutions for business management in terms of ideas for startups. New start-up ideas are well supported by the community of people and can guide start-ups in the right direction to turn the idea into a sustainable business, needed to pursue their own entrepreneurial endeavors or to become innovators in existing organizations - provide practical skills in modeling the entrepreneurial process, students identify an unmet need or market opportunity and develop an innovative product or service to solve a real-life problem. - preparing graduates to search, receive, analyze and manage new information necessary to work in constantly changing conditions of the internal and external environment and effectively solve management problems
	Course objectives
	− Study of the conceptual and categorical apparatus in the field of leadership. − Formation of ideas about modern approaches and concepts of leadership. − Ensuring the development of modern methods of effective influence and management of teams and groups. − Formation of skills and abilities necessary to manage teams and groups. − Development of skills in analyzing the situation and making leadership decisions, as well as assessing and developing the capabilities of the unit's team.

Necessary initial knowledge to master the subject

1	Industrial Economics
2	Production management
3	Professional psychology

Learning Outcomes (LO)	
	A student who has mastered the subject must know and be able to:
LO 1	• Understand the principles of innovative development: Modern concepts of innovative development; basic concepts of innovation activity, approaches to classification of innovations and methods of their identification; forms of innovative entrepreneurship and modern types of organizational structures; the structure of domestic and international innovation markets, features and purpose of innovation infrastructure objects; content of commercial technology transfer, modern methods and approaches to managing an innovative organization;
LO 2	• Develop an entrepreneurial mindset: Develop a growth mindset characterized by adaptability, resilience, creativity, and a willingness to embrace uncertainty to help you meet the challenges of entrepreneurship**.**
LO 3	• Generate innovative business ideas: Identify everyday problems and use ideation techniques to conceptualize innovative business ideas that will solve those problems using your understanding of market needs and trends.
LO 4	• Introduce entrepreneurial tools: Apply the tools and methodologies presented in the course, such as feasibility studies, market research, and business model creation, to refine and structure your business idea for practical implementation.
	Competencies and skills:
CS 1	• demonstrate the ability to critically and systematically integrate knowledge and analyze, evaluate and solve complex phenomena, problems and situations even with limited information
CS 2	• demonstrate the ability to critically, independently and creatively identify and formulate problems, and to plan and, using appropriate methods, solve complex problems within a predetermined time frame and thereby contribute to the construction of knowledge, as well as the ability to evaluate this work
CS 3	• demonstrate the ability, orally and in writing, both nationally and internationally, to clearly communicate and discuss their findings, and the knowledge and arguments on which they are based, in dialogue with a variety of audiences
CS 4	• demonstrate the skills necessary to participate in research or self-employment in any other skilled capacity.
CS 5	• the ability to analyze market and specific risks, use its results for making management decisions, entrepreneurial activity: the ability to find and evaluate new market opportunities and formulate a business idea

Subject content

	Lesson form: Lectures (L) (30 hours)	hours
L1	The concept of innovative activity. Features of the innovation process and the concept of innovative development Structure and content of the innovation process: main approaches. Modern concepts of innovative development. Modern concepts of innovation, innovative activity and innovative organization. Identification and classification of innovations.	**2**
L2	Models of innovative development Basic concepts of innovative economic development. Innovation in the form of technology. Factors influencing the innovation process. Models of innovative development.	**2**
L3	Innovation market infrastructure. Structure of domestic and international innovation markets. Information infrastructure and innovative brokerage. Venture fairs. Technopark structures: incubators, technology parks, technopolises. Technology transfer and technology transfer objects. Licensed trade as a form of technology transfer	**4**
L4	Linear and interactive models of the innovation process. Marketing. Marketing functions. Globalization, strategic and technological integration. Innovation potential and barriers to innovation. Innovation Index	**4**
L5	Entrepreneurship. Basic principles of entrepreneurship. Innovative enterprises. Financing of innovative enterprises. The financing needs of innovative enterprises. Funds and investments	**2**
L6	Intellectual property as an object of the innovation market Methodology for assessing the value of intellectual property objects. Formation of a portfolio of intellectual property in the organization. Patent protection of intellectual property.	**4**
L7	Cluster model in innovative entrepreneurship. Clusters and innovation. Innovation clusters in different countries.	**2**
L8	Business idea. Business model. Business plan. Marketing. Market assessment. Competition. Partners. Product development. Product development. Customer Development. Bringing the product to market	**4**
L9	Creativity as the basis of innovative activity of entrepreneurs The concept of creativity. Creativity in business. 9 ways to develop creativity	**2**
L10	Introduction to Leadership. The essence of the concept of “leadership”: multidimensionality, definition, misconceptions. Power and influence. Elements of leadership. Qualities of a businessman - 10 most important examples	**2**
L11	Leader's work with the team. Building a capable team by the leader: a mechanism for developing and making a group decision. A single communicative space in a team is a way of managing in situations of uncertainty. Team-based management: opportunities and limitations. Innovation Leadership	**2**

Lesson form: Practical training (P) 30 hours.		
PT1	Innovation environment – as the most important condition for effective innovation	**2**
PT 2	From business idea to business model	**4**
PT 3	Intellectual property and methods of its protection	**2**
PT 4	Bringing innovative products to market	**2**
PT 5	Innovative project team: from startup to corporation	**2**
PT 6	Role-playing: task or people oriented. Students are offered a case (a certain game situation). They then have to decide from a task-oriented leader's perspective and from a relationship-oriented leader's perspective. At the end of the lesson, students are asked to evaluate the effectiveness of each leader, their behavioral styles and justify their position.	**4**
PT 7	"Right and wrong forms of behavior." The practical lesson focuses on how great a leader's influence is on the behavior of others, analysis of situations, correct and incorrect behavior of leaders, identification of leader qualities that increase activity	**2**
PT 8	Development of innovative business	**2**
PT 9	Using foreign experience in the development of an innovative economy	**2**
PT 10	"Qualities of an Ideal Leader." During the practical lesson, students present mini-reports with a video presentation about famous leaders, from their point of view, indicating three qualities that they admire. Then about leaders they know personally, indicating qualities they also admire. What are the similarities and differences between the two leaders?	**4**
PT 11	Role-playing: task or people oriented. Students are offered a case (a certain game situation). They then have to decide from a task-oriented leader's perspective and from a relationship-oriented leader's perspective. At the end of the lesson, students are asked to evaluate the effectiveness of each leader, their behavioral styles and justify their position	**4**

ORGANIZATION AND EDUCATIONAL AND METHODOLOGICAL SUPPORT OF INDEPENDENT WORK OF STUDENTS

Current independent work (CIW)

Current independent work in the discipline "Creativity, innovation, leadership and entrepreneurship", aimed at deepening and consolidating the student's knowledge and developing practical skills, includes the following types of work:

- work with lecture material;
- study of topics submitted for independent study;
- preparation for practical classes;
- completing individual homework assignments;
- exam preparation

Creative problem-oriented independent work (CPOIW)

Creative problem-oriented independent work in the discipline "Creativity, innovation, leadership and entrepreneurship", aimed at developing leadership potential, intellectual skills, general cultural and professional competencies, developing creative thinking among students, includes the following types of work on the main problems of the course:

- search, analysis, structuring of information;
- participation in subject Olympiads;
- analysis of scientific publications on a topic determined by the teacher;

• preparation of scientific articles, presentations at conferences.		
1	Preparing for practical classes and doing homework	30 hours
2	Compose problem (case) tasks	10 hours
3	Working with specified sources	5 hours
4	Solving test tasks in the discipline	5 часов
5	Preparation of abstracts for conferences	10 hours
6	Carrying out independent work on given topics	120 hours

Independent work (IW) 120 hours.		
Recommended theoretical tasks for self-study		
IW 1	Regional centers responsible for innovative activities and technology transfer are established in the industry reach	8
IW 2	Unique ways of innovative development in our republic	6
IW 3	Improving the efficiency of innovative activities of industrial enterprises	8
IW 4	Ways to increase the innovative character of the production of industrial enterprises	8
IW 5	Ways to improve information and innovation infrastructure in industrial enterprises	6
IW 6	Ensuring financial stability of innovative development of industrial sectors directions.	8
IW 7	Creation of new industrial enterprises and introduction of high technologies in the industrial network ways.	6
IW 8	Ways of organizing and implementing scientific projects in industry	6
IW 9	Directions of commercialization and implementation of innovative developments	6
IW 10	Improving indicators of human capital utilization in industrial enterprises	6
Recommended practical tasks for self-study		
IW 11	Intellectual property theory and legal foundations	6
IW 12	It is aimed at the development and support of human resources in the industrial network approaches	6
IW 13	Development of information and communication technologies in the knowledge-based economy	8
IW 14	A linear model of the innovation process	6
IW 15	Importance of the legal and normative legal basis of scientific and innovative activity	6

Main literature	
1	Entrepreneurship: Practice and Thinking, 2nd Edition, Heidi Neck (2021)
	Gorfinkel, V.Ya. Innovative entrepreneurship. Textbook and workshop for secondary vocational education [Text] / V.Ya. Gorfinkel. – M.: Yurayt, 2018. –

	524 p.
2	Leadership. Harvard Business Review on Leadership. Series: Harvard Business Review Classics. – M: Alpina Business Books, 2018. – 224 p.
3	Bass, B.M. & Bass, R. The Bass handbook of leadership: Theory, research, and managerial applications (4th ed.). New York: Free Press, March 2013, pp. 377–393.
Additional literature	
1	Newman B. 10 laws of leadership / Trans. from English V.M. Vazhenov; -- Mn.: Potpourri LLC, 2003.-144 pp.—(Series success)
2	Peters T. In search of effective management: Trans. from English / T. Peters, R. Wortheman. – M.: Progress, 1986. – 418 p.
3	Toffler E. The Third Wave / AlvinToffler. – M.: AST, 1999. – 373 p
4	Magazine "Harvard Business Review - Russia" http://www.hbr-russia.ru/
Internet sites	
1. www. http://ziyonet.uz-Akhborot educational network 2. www. http://elibrary.ru - scientific electronic library. 3. www. http://rsl.ru – Russian State Library. 4. www.http://lex.uz - national database of information on legal documents of the Republic of Uzbekistan. 5. www.ima.uz (Intellectual Property Agency of the Republic of Uzbekistan) www.academy.uz (Academy of Sciences)	

Requirements for obtaining a loan (criteria for assessing student knowledge)

In the discipline “Rational use of mountain resources and their protection,” 6 (six) credits are allocated, which correspond to 180 academic hours.

The objectives of the criteria for monitoring and assessing students’ knowledge in this discipline are as follows:

a) control over the development of relevant knowledge, skills and abilities in students in accordance with state educational standards;

b) organize and analyze students’ systematic and timely understanding of the basic concepts of the discipline;

c) impartial and objective assessment of students’ knowledge and timely reporting of its results

Assessment criteria, the number of credits required to pass the discipline, the type, form and number of control and assessment for each control, as well as passing grades for practical and intermediate control will be announced to students during the first lesson.

Assessment of practical and independent work is carried out with the aim of identifying and assessing the level of knowledge and practical skills in the discipline. Based on the characteristics of the discipline Creativity, innovation,

leadership and entrepreneurship, this type of assessment is carried out by checking the completion of homework and an oral answer.

Intermediate control is a method of determining and assessing the level of knowledge and skills of a student after completing the relevant section of the curriculum (covering several topics in the subject). Intermediate control is carried out twice a semester in written form, depending on the total number of hours allocated for the discipline.

The student's independent work is accepted in the form of abstracts prepared on the basis of topics for independent study. Assessment of independent work is carried out through the student's independent and creative comprehension of the prepared essay and understanding of the topic.

Final control is a method of assessing students' mastery of theoretical knowledge and practical skills in a given discipline at the end of the semester. The final control is carried out orally. The final control in the discipline "Creativity, innovation, leadership and entrepreneurship" is carried out with the participation of members of a commission approved by the dean of the faculty. In case of violation of the procedure for conducting the final control, the results are canceled and the final control is retaken.

Assessment criteria for the discipline "Creativity, innovation, leadership and entrepreneurship"

T/p	Type of control	Quantity	Score for each work	Overall rating
	1. Current control			
1.1.	Completing and passing practical classes	15	5	5
2. Intermediate control – score 5				
2.1.	I – intermediate test (written 3 questions on topics 1-7)	1	5	5
2.2.	II – intermediate test (orally 3 questions on topics 8-14)	1	5	5
2.3.	Independent work – abstract, presentation, problem solving, etc.	4	5	5
ΣIW and PT+IC				5
3. Final control – score 5				
3.1.	Final control, oral (consists of three questions on lecture	1	5	5

	materials, as well as on the topic of independent work)			
Total				**5**

The assessment is based on the following:

If the practical work is completed according to the option correctly, the student fully answers all the teacher's questions on this topic, he is given a grade of "5" (excellent); if practical work is completed according to an option, depending on the degree of mastery of the material on this topic, it is given a grade of "4" (good); if the practical work is completed according to an option, the student does not clearly answer the teacher's question on this topic, he is given a grade of "3" (satisfactory); if the practical work is partially completed or not completed according to the option, the student does not have an idea on the given topic, he is given a grade of "2" (unsatisfactory).

The student must submit the completed practical work before the next practical lesson, in accordance with the teacher's schedule. If a student does not submit practical work on time, the practical work is graded "2" (unsatisfactory). The grade for each laboratory work is recorded in the journal by the teacher during the next practical lesson and is not subject to change.

Independent work is performed in the form of an abstract on a given topic:

- if the topic is fully disclosed, the conclusion is correctly drawn and the student has creative thinking, and he fully answers the teacher's questions on the topic, he is given a grade of "5" (excellent);
- if the topic is fully disclosed, the conclusion is correctly drawn, but the student does not have creative thinking, depending on the degree of study of this topic, he is given a grade of "4" (good);
- if the topic is partially covered, or there are shortcomings in the work, the student is given a grade of "3" (satisfactory);
- if the topic is partially covered, there are shortcomings in the work, the student has no understanding of this topic, the student is given a grade of "2" (unsatisfactory).

If a student fails to submit independent work within the specified time frame, the independent work is assessed as "2" (unsatisfactory), recorded in the journal and cannot be changed.

In case of failure to pass at least one practical work, the student is not allowed to take the final test.

Interim tests are carried out in writing, in accordance with the academic schedule. The maximum score for each intermediate test is "5" excellent. Each option has three questions, the answers are assessed according to the following criteria:

- if the essence of the question is fully disclosed, the answers are complete and accurate, the answer is rated “5” - excellent;

- if the essence of the question is fully revealed, the answers are complete, but there are some inaccuracies, the answer is rated “4” - good;

- if the essence of the question is revealed, and the questions are not complete and there are inaccuracies, the answer is rated “3” - satisfactory;

- if the essence of the question is not disclosed, the answer is not complete and inaccurate, the answer is graded “2” - unsatisfactory.

Intermediate work is assessed by averaging all answers to all questions and its average value (rounded to the nearest integer) is recorded in the journal.

If a student was absent from the intermediate work for a valid reason (health reasons, family reasons), upon presentation of a certificate, he is allowed to take the intermediate test.

A student who has not passed independent work or intermediate tests is not allowed to take the final test.

The final test is carried out orally. Each option has 3 questions. Answers to each question are assessed according to the following criteria:

- if the essence of the question is fully disclosed, the answers are complete and accurate, the answer is rated “5” - excellent;

- if the essence of the question is fully revealed, the answers are complete, but there are some inaccuracies, the answer is rated “4” - good;

- if the essence of the question is revealed, and the questions are not complete and there are inaccuracies, the answer is rated “3” - satisfactory;

- if the essence of the question is not disclosed, the answer is not complete and inaccurate, the answer is graded “2” - unsatisfactory.

Deadlines for control work

Practical work is assessed on each pair. Intermediate controls are carried out on the basis of a thematic plan, in accordance with the schedule approved by the dean’s office. The final test is carried out at the end of the academic semester in accordance with the schedule approved by the dean’s office.

If a student, for health reasons, did not attend classes, did not pass practical work, intermediate and final tests within the established time frame, then with the order of the dean of the faculty, within two weeks it is allowed to pass all types of control in accordance with the schedule.

If during the semester one of the types of control is not mastered, the student is not allowed to take the final control.

For students with academic debt, after the end of the academic semester, the dean's office provides one credit month to retake the discipline. After the end of this period, in case of failure to master the discipline, a report is submitted to the dean of the faculty.

In case of disagreement with the received grade, the student has the right to submit a statement to the dean of the faculty within one working day, after the results of the types of control are announced. In this case, with the order of the rector, an appeal commission consisting of 3 members is formed.

The appeal commission, having considered the student's application, issues a conclusion on the same day.

Control over the assessment in the prescribed manner and time frame is assigned to the head of the department.

Information about the teacher on the subject

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The syllabus was approved by the minutes of meeting No._____Educational and Methodological Council of the University in 2024_____

The syllabus was discussed and approved at the meeting of the department "Extraction and processing of rare and radioactive metal ores" dated "_____"_____2024. (Protocol No._____)

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