

**Министерство науки и высшего образования Российской Федерации
Федеральное государственное бюджетное образовательное
учреждение высшего образования
Санкт-Петербургский горный университет
императрицы Екатерины II**

Кафедра иностранных языков

**ИНОСТРАННЫЙ ЯЗЫК.
ПЕРЕРАБОТКА МИНЕРАЛЬНОГО СЫРЬЯ
(АНГЛИЙСКИЙ ЯЗЫК)**

Методические указания к практическим занятиям

*(все специальности факультета
переработки минерального сырья)*

**САНКТ-ПЕТЕРБУРГ
2024**

Иностранный язык. Переработка минерального сырья (английский язык):

Методические указания к практическим занятиям / Санкт-Петербургский горный университет императрицы Екатерины II. Сост. *Э.Р.Скорнякова, Е.В.Тенева*. СПб, 2024. 35 с.

Методические указания предназначены для студентов всех специальностей факультета переработки минерального сырья. Предлагаемый материал направлен на совершенствование навыков профессионально ориентированного чтения студентов на английском языке. Методические указания к практическим занятиям включают тексты на языке оригинала, специально разработанные упражнения и задания, способствующие развитию речевой, языковой, социокультурной и информационной компетенций студентов, необходимых для общения в сфере профессиональных интересов. Методические указания также содержат грамматические упражнения, целью которых является подготовка к сдаче итоговой аттестации по дисциплине «Иностранный язык».

Научный редактор: к.п.н., доц. *И.Г.Герасимова*

Рецензент: к.п.н., доц. *Н.Э.Горохова* (Санкт-Петербургский государственный экономический университет)

© Санкт-Петербургский
горный университет, 2024

ПРЕДИСЛОВИЕ

Данные методические указания предназначены для учебно-методического сопровождения курса английского языка для студентов всех специальностей факультета переработки минерального сырья. Методические указания составлены в соответствии с учебной программой по дисциплине «Иностранный язык» для формирования иноязычной профессиональной компетенции будущих специалистов. В методические указания включены аутентичные тексты, в которых освещаются следующие вопросы: «Комплексная переработка как важнейший принцип всех минерально-сырьевых отраслей промышленности», «История развития технологических процессов и производств в горной, металлургической, нефтегазовой промышленности», «Виды минерального сырья. Черные и цветные металлы. Сплавы», «Процессы обогащения полезных ископаемых», «Основные соединения, виды химических реакций и связей», «Основные технологические процессы получения неорганических материалов», «Типы автоматизированных систем», «Средства автоматизации и управления», «Современное оборудование и технологии в металлургии и на горно-обогатительных предприятиях», «Воздействие процессов, использующихся при переработке минерального сырья, на экологию».

Изучение материала способствует развитию навыков и умений просмотрового и изучающего чтения текстов по направлению подготовки, а также их перевода на русский язык с последующим использованием полученной информации для речевой практики; овладение студентами иноязычной коммуникативно-речевой компетенцией, позволяющей будущему специалисту осуществлять профессиональную коммуникацию.

UNIT 1. MINERAL RESOURCE INDUSTRY METALLURGY

Task 1. Research the following terms: *physical and chemical behaviour of metals, physical metallurgy, extractive metallurgy, metallurgist, alloy, Metal Age.*

Task 2. Skim the passage and choose the most suitable title from the list:

1. The basics of metallurgy.
2. The importance of metallurgy.
3. The history of metallurgy.

Metallurgy is the study of metals and their uses, including both the scientific and technological aspects of the material.

Metallurgy may be defined and described in several ways: as a field of study, metalworking focuses on the production of metals and alloys in a variety of shapes and, more importantly, with qualities that are amenable to real-world applications; the study of how metals behave and are extracted from their ores constitutes this scientific discipline; metalworking is the study of the techniques used to work with metals, from mining and refining ores to shaping alloys and fabricating finished products; an applied science that bridges the gap between metal research and manufacturing.

Metallurgy encompasses the scientific and technological aspects of metals by investigating their physical and chemical properties. Metal alloys come in a wide range of forms, with iron and aluminium being the most common. Refining metals from their ores, combining metals to create alloys, and researching the chemical, physical, and atomic properties and structures of metals are all examples of metallurgy.

(<https://www.austgen.com.au/the-science-of-metallurgy/>)

Task 3. Work in small groups. Discuss the main features of physical and extractive metallurgy.

Task 4. Match the terms from the text with their Russian equivalents:

<i>English</i>	<i>Russian</i>
1. metalworking	a. металловедение; металлургическая промышленность; металлургия
2. alloy	b. физические свойства; физические характеристики
3. refining ores	c. готовый продукт; конечный продукт
4. finished product	d. металлург
5. metallurgy	e. научная дисциплина
6. physical properties	f. обработка металла
7. chemical properties	g. извлекать; добывать
8. metallurgist	h. работы по переработке руды
9. scientific discipline	i. химические свойства; химические характеристики
10. to extract	j. сплав

Task 5. Make up your own sentences with the following words and word combinations: *the study of metals, alloys, valuable metals, metallurgist, extractive metallurgy, iron and aluminium.*

Task 6. Discuss with your groupmates the following questions:

- 1 What kinds of mineral resources do you know?
- 2 What is the field of metallurgy?
- 3 What are the most important metals in human history?
- 4 Why is the mineral resource industry essential for the development of the country?
- 5 Can our civilization be called “the metals society”? Why?
- 6 Why have you decided to devote your professional life to the mineral resource industry sphere?

Task 7. Grammar revision. Read and translate the following sentences. Underline the subject and the predicate in each sentence. Identify the tenses used in the highlighted parts.

- 1 Metallurgy **is** the study of metals and their uses, including both the scientific and technological aspects of the material.

2 This microstructure **influences** the metal's mechanical characteristics, which in turn **governs** the engineering community's ability to foresee and take use of the material.

3 Metalworking **focuses** on the production of metals and alloys in a variety of shapes and, more importantly, with qualities that **are** amenable to real-world applications.

4 Filtration **is** the separation of a suspension into a solid filter cake and a liquid filtrate by passing it through a permeable filtering material.

5 The demand for minerals is driven by a society that **is adopting** a new technology at a rapid rate.

6 Alloys **are** unique combinations of two or more metals.

7 The industrialization of Asia – in particular China and India – **is driving** demand for construction and fabrication metals such as steel, copper, zinc, lead, gold and silver.

8 Modern plants **have** fully automatic control systems that **conduct** in-stream analysis of the material as it is being processed.

9 Metal alloys **come** in a wide range of forms, with iron and aluminium being the most common.

10 Pre-concentration technologies, more energy efficient comminution technologies and circuits, are examples of areas where significant fundamental innovation **is impacting** a process plant design.

UNIT 2. THE HISTORY OF TECHNOLOGICAL PROCESSES DEVELOPMENT

Task 1. Match the columns of Russian collocations and their English equivalents. Make up your own sentences using as many words and phrases as you can:

<i>English</i>	<i>Russian</i>
1. the technology of automation	a. нефтегазовая промышленность; нефтегазовая отрасль
2. the Industrial Revolution	b. промышленная революция
3. to create tools and mechanical devices	c. технология автоматизации
4. mining companies	d. нефтегазовые скважины
5. to improve efficiency and productivity	e. искусственный интеллект

6. the application of technology	f. новое оборудование
7. the oil and gas industry	g. горнодобывающие предприятия; горнодобывающие компании
8. capital-intensive operations	h. применение технологии
9. artificial intelligence	i. повысить эффективность и продуктивность
10. oil and gas wells	j. капиталоемкие операции; предприятия
11. autonomous haulage systems	k. автономные системы грузоперевозок; автономные транспортные системы
12. new equipment	l. изготавливать инструменты и механические устройства

Task 2. Before reading the text, answer the following questions:

1. What is the difference between automation and mechanization?
2. Do you know the origin of the word "automation"?
3. What is a smart mine?
4. What types of advanced technologies can you name?
5. Why are these technologies vital for a rapid development of mining, metallurgical, oil and gas industries?

Task 3. Now read the text and find out the answers to some of the questions. Translate the text, using the vocabulary list from Task 1.

The technology of automation has evolved from the related field of mechanization, which had its beginnings in the Industrial Revolution. The driving force behind mechanization has been humankind's propensity to create tools and mechanical devices.

Mining companies are increasingly turning to autonomous haulage systems to improve efficiency and productivity while increasing safety and sustainability. Historically, the mining industry lagged in the application of technology owing to the long lead times required to develop and commercialize new equipment in mining.

The oil and gas industry has historically been characterized by its reliance on complex and capital-intensive operations. However, in recent years, digitalization and automation technologies have emerged as powerful catalysts for transformation within the industry. The integration of

advanced technologies, such as artificial intelligence, machine learning, robotics, and data analytics, has opened up new possibilities for optimizing drilling and completion operations in oil and gas wells.

(<https://www.britannica.com/technology/automation>
<https://globalroadtechnology.com/autonomous-mining-history-companies-benefits-challenges-and-solutions/>
<https://www.intechopen.com/chapters/88507>)

Task 4. Work in small groups. Discuss the main features of technological processes in mining, metallurgical, oil and gas industries.

Task 5. Complete the text using the words and word combinations from the text and then translate the sentences:

<i>mining systems; remote-controlled; remote-operated; unmanned; mine automation progress; centralized locations; excavating</i>
--

Since the 1960s, there has been exponential progress in the automation of (1) Chronologically, (2) ... can be categorized into three stages. Stage one saw the deployment of the first (3) ... mining rail carriages at General Blumenthal mine, Germany, in 1967. This was followed by the introduction of (4) ... underground machines in the mid-1970s, and the final stage saw the introduction of (5) ... load and haul machines for surface mines in the mid-1990s. Currently, some major mining processes including drilling, (6) ... , hauling, crushing and milling, have been automated and teleoperated from (7)

(<https://globalroadtechnology.com/autonomous-mining-history-companies-benefits-challenges-and-solutions/>)

Task 6. Work in pairs. Discuss the advantages of the automation processes in mining, metallurgical or oil and gas industries. Give examples of their application that you studied during your summer training internship. Then make a 3-minute presentation to the class.

Task 7. Grammar revision. Read and translate the following sentences. Underline the subject and the predicate in each sentence. Identify the tenses used in the highlighted parts.

- 1 While automation is not a new concept in manufacturing, its arrival in the mining sector **has been** relatively recent.
- 2 Mining giant Rio Tinto **has coined** the acronym Mining In the New Dimension (MIND) to describe its efforts in this area.
- 3 For the past three years, scientists **have been making** important modifications to a hot metal carrier shipped from Rio Tinto's Bell Bay smelter in Tasmania.
- 4 There they **have been developing** an automated system to transport and handle molten aluminum.
- 5 Recently Siemens **has been working** with large ore truck companies to develop systems to manage vehicles switching between diesel and electric power via overhead tram lines.
- 6 The mining industry **has benefited** greatly from improvements in computing and communications technology over the last few years, with mobile communications playing an increasingly important role in automation systems.
- 7 Since the 1960s, there **has been** exponential progress in the automation of mining systems.
- 8 Autonomous mine haul trucks, also known as driverless or robot haul trucks, **have gained** a lot of popularity in recent years.
- 9 More recently, the introduction of robotics **has seen** millions of production line jobs in factories simply disappear.
- 10 Artificial Intelligence is set to become a huge industry in its own right, employing countless programmers, computer scientists and engineers – and that's not to mention new jobs we **haven't** even **thought of** yet.

UNIT 3. TYPES OF MINERAL RAW MATERIALS. FERROUS AND NON-FERROUS METALS. ALLOYS

Task 1. Research the following terms: *mineral resources, ferrous metals, non-ferrous metals, conductivity, alloy*.

Task 2. Match the columns of Russian collocations and their English equivalents. Make up your own sentences using as many words and phrases as you can:

<i>English</i>	<i>Russian</i>
1. mineral resources	a. цветные металлы
2. ferrous metals	b. медь и олово
3. non-ferrous metals	c. значение сплавов; ценность сплавов
4. distinct categories	d. древние времена
5. the value of alloys	e. черные металлы
6. desirable properties	f. коррозионная стойкость
7. high conductivity	g. различные категории; отдельные категории
8. resistance to corrosion	h. минеральное сырье
9. ancient times	i. полезные свойства
10. copper and tin	j. высокая удельная электропроводность

Task 3. Read and translate the text, using the vocabulary list from Task 2.

Mineral resources are classified into distinct categories. The first two major types of mineral resources, metallic and non-metallic, are based on the metal content of the mineral resource. Metallic mineral resources are further split into two groups, ferrous and non-ferrous, based on whether the metal contains iron.

Ferrous metals contain iron and non-ferrous metals do not. The more in-depth answer is that ferrous metals and non-ferrous metals each have their own distinctive properties. Non-ferrous metals tend to be more expensive than ferrous metals but are used for their desirable properties, including lightweight (aluminum), high conductivity (copper), nonmagnetic properties, or resistance to corrosion (zinc).

Alloys are usually produced by melting the mixture of ingredients. The value of alloys was discovered in very ancient times; brass (copper and zinc) and bronze (copper and tin) were especially important.

(<https://www.studysmarter.co.uk/explanations/environmental-science/physical-environment/mineral-resources/>

<https://www.engineeringchoice.com/what-are-the-non-ferrous-metals/>

<https://www.britannica.com/technology/alloy>)

Task 4. Complete the following sentences using the following words and word combinations and then translate the sentences:

alloy steels; properties; mineral resources; iron; alloying elements; precious metals; non-ferrous metals (3); non-ferrous alloys; mixture of ingredients

- 1 ____ are classified into distinct categories.
- 2 ____ are alloys or metals that do not contain any appreciable amounts of iron.
- 3 Some ____ are used in the iron and steel industries, such as bauxite, which is used for flux in blast furnaces.
- 4 ____ such as gold, silver, and platinum and exotic or rare metals such as cobalt, mercury, tungsten, beryllium, bismuth, cerium, cadmium, niobium, indium, gallium, germanium, lithium, selenium, tantalum, tellurium, vanadium, and zirconium are also non-ferrous.
- 5 The difference between ferrous and ____ is that ferrous metals contain ____.
- 6 Alloys are usually produced by melting the ____.
- 7 Today, the most important are the ____, broadly defined as steels containing significant amounts of elements other than iron and carbon.
- 8 The principal ____ for steel are chromium, nickel, manganese, molybdenum, silicon, tungsten, vanadium, and boron.
- 9 Alloy steels have a wide range of special ____, such as hardness, toughness, corrosion resistance, magnetizability, and ductility.
- 10 ____, mainly copper–nickel, bronze, and aluminum alloys, are much used in coinage.

Task 5. Discuss with your groupmates the following questions:

- 1 What kinds of mineral resources do you know?
- 2 What is the difference between ferrous and non-ferrous metals?
- 3 Can you name 7 non-ferrous metals?
- 4 What applications are non-ferrous metals used for?
- 5 What are the distinctive properties of non-ferrous metals?
- 6 What is an alloy?

Task 6. Work in pairs. Choose one non-ferrous metal, discuss its properties and give examples of its usage. Then make a 3-minute presentation to the class.

Task 7. Grammar revision. Read and translate the following sentences. Underline the subject and the predicate in each sentence. Identify the tenses used in the highlighted parts.

1 Non-ferrous metals **were** the first metals used by humans for metallurgy.

2 The use of copper also **heralded** the transition from the Stone Age to the Copper Age.

3 The process **looked** something like this. They **put** the substance they **were breaking down** into a finger-sized quartz tube, where electricity **“flashed”** it to around 5400 degrees Fahrenheit.

4 The trouble, he proposed, **was** that the world **didn't contain** enough economically recoverable lithium to support such a switch.

5 Five years ago General Electric **started** an intensive rhenium-recycling program while simultaneously searching for an alternative super alloy, which it **found** within a few years.

6 Usually, material from our Solar System contains about 10 times more iron than nickel. However, these comets **had** roughly equal amounts of iron and nickel.

7 We **came** to the conclusion they might come from a special kind of material on the surface of the comet nucleus, sublimating at a rather low temperature and releasing iron and nickel in about the same proportions.

8 Another important development in the history of automation **was** the Jacquard loom which **demonstrated** the concept of a programmable machine.

9 In August, retailer Marks & Spencer **announced** it **was introducing** AI chat bots to deal with customer calls to its 640 UK stores and 13 call centers.

10 The next extension **was** the development of powered machines that **did not require** human strength to operate.

UNIT 4. MINERAL PROCESSING

Task 1. Research the following terms: *extractive metallurgy, comminution, concentration, sampling, chemical analysis, mineralogical analysis, size analysis, dewatering*. What are the differences between them?

Task 2. Skim the passage and choose the most suitable title from the list:

1. Procedures of extractive metallurgy.
2. The importance of mineral processing.
3. The development of mineral processing.

Mineral processing is an art of treating crude ores and mineral products in order to separate the valuable minerals from the waste rock. The primary operations of extractive metallurgy are comminution and concentration, but there are other important operations in a modern mineral processing plant, including sampling, analysis and dewatering.

In order to separate the valuable components of an ore from the waste rock, the minerals must be liberated from their interlocked state physically by comminution. As a rule, comminution begins by crushing the ore to a certain size and finishes by grinding it into powder.

Concentration involves the separation of valuable minerals from the other raw materials received from the grinding mill. In large-scale operations this is accomplished by taking advantage of the different properties of the minerals to be separated. These properties can be colour (optical sorting), density (gravity separation), magnetic or electric (magnetic and electrostatic separation), and physicochemical (flotation separation).

(adapted from <https://www.britannica.com/technology/mineral-processing>)

Task 3. Work in small groups. Discuss the main features of comminution and concentration.

Task 4. Match the terms from the text with their Russian equivalents:

<i>English</i>	<i>Russian</i>
1. sampling	a. дробление
2. chemical analysis	b. выпаривание; концентрат; обогащение руды
3. grinding	c. обогащение полезных ископаемых; переработка минерального сырья
4. crushing	d. разрушение; раздавливание; измельчение
5. dewatering	e. сырая руда
6. concentration	f. пустая порода
7. comminution	g. тонкое измельчение

8. mineral processing	h. взятие пробы/образца; отбор пробы
9. crude ore	i. обезвоживание; дренаж
10. waste rock	j. химический анализ

Task 5. Make up your own sentences with the following words and word combinations: *primary operations, different properties, valuable components, mineral products, processing.*

Task 6. Discuss with your groupmates the following questions:

- 1 What kinds of mineral resources do you know?
- 2 What is the field of Mineral Processing?
- 3 What are the main operations of extractive metallurgy?
- 4 Why is Mineral Processing a crucial sphere in mineral resources extraction?

Task 7. Grammar revision. Read and translate the following sentences. Underline the subject and the predicate in each sentence. Identify the tenses used in the highlighted parts.

- 1 Most technologists **will agree** that while there is a link between technology and innovation, the link is not unique.
- 2 By coating the minerals with small amounts of chemicals or oils, finely ground particles of the minerals remain unwetted and **will** thus **adhere** to air bubbles.
- 3 Unwanted minerals that naturally resist wetting may be treated so that their surfaces will be wetted and they **will sink**.
- 4 Following an overview of the development of metallurgy, we **will investigate** welding and other methods of combining current metals.
- 5 That's the bad news – but there are reasons for optimism, too. Firstly, many experts suggest that artificial intelligence **will 'shred'** jobs rather than destroy them...
- 6 Methanol **is going to be pumped into** the cap to prevent the formation of crystals.
- 7 Several attempts **are going to be made** to activate the blow-out preventer.

8 The scientific conference “Professional culture of the specialist of the future” takes place in the Saint-Petersburg Polytechnic University on the 28th of November.

9 Physicists and chemists from China are going on an excursion to the Hermitage tomorrow.

10 Scientists from India are arriving at the conference at 9 a.m. next Monday.

UNIT 5. BASIC COMPOUNDS. TYPES OF CHEMICAL REACTIONS AND BONDS

Task 1. Research the following terms: *chemical compound, chemical elements, reactants, synthesis, chemical equation, chemical bonding, the law of conservation of mass, ionic and covalent compounds.*

Task 2. Skim the passage and choose the most suitable title from the list:

1 *The Basics of Chemistry*

2 *The Importance of Chemistry*

3 *The Development of Chemistry*

Chemical compound, any substance composed of identical molecules consisting of atoms of two or more chemical elements. Chemical compounds show a bewildering array of characteristics. At ordinary temperatures and pressures, some are solids, some are liquids, and some are gases. The colors of the various compounds span those of the rainbow. Some compounds are highly toxic to humans, whereas others are essential for life.

Chemical reaction is a process in which one or more substances, the reactants, are converted to one or more different substances, the products. Substances are either chemical elements or compounds. A chemical reaction rearranges the constituent atoms of the reactants to create different substances as products.

Chemical bonds are forces that hold the atoms together in a molecule. The main types of chemical bonds are ionic bond, covalent bond, hydrogen bond, and metallic bond.

(<https://www.britannica.com/science/chemical-compound>

<https://www.britannica.com/science/chemical-reaction/>

<https://www.chemistrylearner.com/chemical-bonds>)

Task 3. Work in small groups. Discuss the main types of chemical reactions and bonds. Give examples.

Task 4. Match the terms and word combinations from the text with their Russian equivalents:

<i>English</i>	<i>Russian</i>
1. chemical compound	a. перегруппировывать(-ся)
2. a bewildering array of characteristics	b. необходимый для жизни
3. essential for life	c. атомы, входящие в состав реактивов
4. rearrange	d. металлическая связь
5. the constituent atoms of the reactants	e. водородная связь
6. ionic bond	f. невероятное множество характеристик
7. covalent bond	g. различные вещества
8. hydrogen bond	h. ковалентная связь
9. metallic bond	i. ионная связь; электровалентная связь
10. different substances	j. химическое соединение

Task 5. Make up your own sentences with the following words and word combinations: *chemical elements, pure element, organic compounds, inorganic compounds, the periodic table, one valence electron, two valence electrons, chemical reactions.*

Task 6. Discuss with your groupmates the following questions:

- 1 How are chemical elements arranged in the periodic table?
- 2 Describe the main discoveries of outstanding chemists of the 18th and 19th centuries.
- 3 What is the difference between Organic Chemistry and Inorganic Chemistry?
- 4 What is the scope of Chemistry?
- 5 Why have you decided to devote your professional life to the field of Chemistry?

Task 7. Grammar revision. Read and translate the following sentences. Underline the subject and the predicate in each sentence. Identify the usage of modal verbs in the highlighted parts.

1 Substitution of only a single atom within a compound **may** be responsible for changing the color, odor, or toxicity of a substance.

2 That is to say, as the science of chemistry developed, it was observed that elements **could** be grouped according to their chemical reactivity.

3 The chemical elements **can** be classified in many different ways.

4 Chemical reactions **must** be distinguished from physical changes.

5 Therefore, equations depicting reactions **must** be balanced; that is, the same number of atoms of each kind **must** appear on opposite sides of the equation.

6 The balanced equation for the iron-sulfur reaction shows that one iron atom **can** react with one sulfur atom to give one formula unit of iron sulfide.

7 A pair of electrons located on the nitrogen atom **may** be used to form a chemical bond to a Lewis acid such as boron trifluoride

8 As previously noted, many reactions defy simple classification and **may** fit in several categories.

9 Each bond requires a discrete amount of energy to either break or form. Without this energy, the reaction **cannot** take place.

10 Compounds have constant and definite compositions, while mixtures **may** exist in virtually any proportion.

UNIT 6. TYPES OF AUTOMATION SYSTEMS

Task 1. Match the two columns to make collocations. Make up your own sentences using as many words and phrases as you can:

1 production equipment	а программируемая автоматизация
2 equipment configuration	б гибкая автоматизация
3 fixed automation	с автоматическая станочная линия
4 automatic assembly machines	д производить изделия партиями
5 a machining transfer line	е промышленные роботы
6 to produce products in batches	ф станок с числовым программным управлением (ЧПУ)

7 programmable automation	g фиксированная система автоматизации
8 industrial robots	h производственное оборудование
9 flexible automation	i состав оборудования
10 a numerical-control machine tool	g автоматические сборочные машины

Task 2. Before reading the text, answer the following questions:

- 1 What main types of automation systems do you know? What is the difference between them?
- 2 Which type of automation systems is suitable for producing products in batches? Why?
- 3 Why is flexible automation considered as an extension of programmable automation?
- 4 Is fixed automation similar to 'hard' automation? Give your reasons.
- 5 What are industrial robots used for? Can you give their examples?

Task 3. Now read the text and find out the answers to some of the questions. Translate the text, using the vocabulary list from Task 1.

Types of automation systems

Three types of automation in production can be distinguished: fixed automation, programmable automation, and flexible automation.

Fixed automation refers to an automated production facility in which the sequence of processing operations is fixed by the equipment configuration. It is suitable for products that are made in large volumes. Examples of fixed automation include machining transfer lines found in the automotive industry, automatic assembly machines, and certain chemical processes.

Programmable automation is a form of automation for producing products in batches. A numerical-control machine tool is a good example of programmable automation. The program is coded in computer memory for each different product style, and the machine tool is controlled by the computer program. Industrial robots are another example.

Flexible automation is an extension of programmable automation. The programming is accomplished at a computer terminal without using the production equipment itself.

(<https://www.britannica.com/technology/automation/Manufacturing-applications-of-automation-and-robotics>)

Task 4. Complete the following sentences using the words and word combinations from the text and then translate the sentences:

production equipment; products; flexible (2); fixed; programmable (2); manufacturing; production rates; batches

- 1 To many people, automation means _____ automation.
- 2 In _____ automation, the programmed commands are contained in 3 the machines in the form of cams, gears, wiring, and other hardware that is not easily changed over from one product style to another.
- 3 Fixed automation is characterized by high initial investment and high _____.
- 4 For each new batch, the _____ must be reprogrammed and changed over to accommodate the new product style.
- 5 Production rates in _____ automation are generally lower than in fixed automation, because the equipment is designed to facilitate product changeover rather than for product specialization.
- 6 In _____ automation, the variety of products is sufficiently limited so that the changeover of the equipment can be done very quickly and automatically.
- 7 The reprogramming of the equipment in _____ automation is done off-line.
- 8 There is no need to group identical products into _____.
- 9 The disadvantage with _____ automation is the time required to reprogram and change over the production equipment for each batch of new product.
- 10 In flexible automation, a mixture of different _____ can be produced one right after another.

Task 5. Open the brackets, using the verbs in the correct form of the Passive Voice:

- 1 Three types of automation in production _____ (distinguish).
- 2 The sequence of processing operations _____ (fix) right now.
_____ the program _____ (code) in the computer memory?
- 3 New technologies _____ (invent) all the time these days.
_____ hardware _____ (not change) in your company over the recent years?
- 4 We are waiting for the production equipment _____ (check).
- 5 Earlier our products _____ (make) in small volumes.

- 6 The programmed commands ____ usually (contain) in the machines in the form of hardware.
- 7 Machining transfer lines can ____ (find) in the automotive industry,
- 8 Last year nonproductive time ____ (follow) by a production run for each new batch.
- 9 A production line is a set of sequential operations established in a factory where components ____ (assemble) to make a finished article.
- 10 For plants, the useful material has ____ (separate) from husks or contaminants and then treated for onward sale.

Task 6. Work in pairs. Choose one type of automation systems, discuss its benefits and drawbacks and give examples of its production equipment. Then make a 3-minute presentation to the class.

UNIT 7. INDUSTRIAL AUTOMATION EQUIPMENT

Task 1. Work in pairs. Ask and answer the following questions:

- 1 What is the process of industrial automation? How does it differ from mechanization?
- 2 What types of computer software is used for automation? What is the difference between them?
- 3 Which of the industrial processes need to be automated?
- 4 What is the function of control devices?
- 5 Can you give examples of using automation tools in automotive industry, healthcare, consumer electronics and environmental monitoring?

Task 2. Discuss the following terms in pairs. Then find their definitions in the English dictionary and translate them into Russian:

<i>industrial robots, sensors, actuators, electronic controllers, conveyors</i>

Task 3. Read and translate the following passage:

Industrial automation tools

Industrial automation is a set of technologies that uses control systems and devices, such as computer software and robotics, including:

- A Programmable Logic Controller (PLC) is a digital industrial computer control system that is preprogrammed to carry out automatic operations in industrial processes.

- Supervisory Control and Data Acquisition (SCADA) systems acquire and process real-time data through direct interaction with devices and record events into a log file.

- A Human Machine Interface (HMI) is a software application that enables interaction and communication between a human operator and the machine, or production system.

- An Artificial Neural Network (ANN) is a computing system that is built like the human brain, a network of interconnected neuron nodes.

- A Distributed Control System (DCS) is a central monitoring network that interconnects devices to control different elements within an automated system.

- Robots can efficiently perform tasks in complicated or dangerous situations, improve production flow and quality, and increase safety for employees.

(adapted from: <https://www.unitronicsplc.com/what-is-industrial-automation/>)

Task 4. Work in pairs. Discuss the benefits and drawbacks of each automation tool. Justify your opinions with examples.

Task 5. Match the terms from the text with their Russian equivalents:

<i>English</i>	<i>Russian</i>
1 a human operator	a выполнять задачи
2 production flow	b промышленная автоматизация
3 a monitoring network	с соединять устройства
4 control systems	d программное обеспечение
5 software application	e оператор
6 to perform tasks	f повысить безопасность
7 to interconnect devices	g работать с данными в режиме реального времени
8 to process real-time data	h производственный поток
9 to increase safety	i системы управления

10 industrial automation	j сеть мониторинга
--------------------------	--------------------

Task 6. Discuss with your groupmates the following statements and answer true (T) or false (F):

- 1 In manual control systems, part of the function is performed by a human and part by an automatic device.
- 2 In automated control systems, all control functions fall on the human operator.
- 3 The PLC continuously monitors and receives information from input devices or sensors.
- 4 SCADA is not important for data analysis, and does not enable decision-making for optimization in industrial processes.
- 5 ANNs simulate the way a human brain analyzes and processes information.

Task 7. Identify the grammar function of the words in bold (Infinitive (I), Participle (P) and Gerund (G)) in the following sentences and translate them:

- 1 Industrial automation is a set of technologies that uses control systems and devices, such as computer software and robotics, **to enable** automatic operation of industrial processes and machinery without the need for human operators
- 2 These technologies include various control systems that incorporate different devices and systems **impacting** aspects of the **manufacturing** process.
- 3 The PLC continuously monitors and receives information from input devices or sensors, processes the information, and triggers the **connected** output devices, **to complete** the task in the industrial process or machinery.
- 4 An HMI translates complex data into accessible information, **enabling** better control of the production process and its various applications.
- 5 **Game-changing** controllers create immediate **savings** by **eliminating** time-intensive tasks such as PLC-panel **wiring** and communication setup.

UNIT 8. CHEMICAL TECHNOLOGIES OF INORGANIC SUBSTANCES

Task 1. Work in pairs. Discuss the following questions:

- 1 What is the difference between organic and inorganic chemistry?
- 2 Can you give some examples of industrial inorganic chemicals and inorganic compounds used in everyday life?
- 3 What are the main properties of inorganic chemicals?
- 4 How are inorganic chemicals produced?
- 5 Where is inorganic chemistry used?

Task 2. Translate the following terms and fill the gaps in the sentences below, using them:

inorganic chemicals, hydrogen bonds, fertilizers, pharmaceuticals, electrolysis, thermal decomposition, ammonia, a catalyst, electric current, a solution

- 1 Particles mixed in a _____ can interact with each other.
- 2 The material contains a base and a _____.
- 3 The oxygen atoms are able to form many _____ with water.
- 4 Pyrolysis is the _____ of wood and carbonaceous waste without oxygen.
- 5 Guarana is used for the production of _____, as well as food supplements.
- 6 Nitrogen is part of many _____.
- 7 Most _____ are not removed by these filters.
- 8 The silver can be extracted by _____.
- 9 When passing through common water, _____ completely changes its structure.
- 10 Aqua _____ is not flammable or explosive.

Task 3. Find the terms from Task 2 in the text and translate it:

Inorganic chemicals

Inorganic chemical technology is the branch of chemistry that deals with the study, development, and production of inorganic chemicals, which are chemicals that do not contain carbon-hydrogen bonds.

Inorganic chemicals have a wide range of applications, including the production of fertilizers, pharmaceuticals, and electronic devices.

Inorganic chemicals are produced through a variety of methods, including chemical reactions, electrolysis, and thermal decomposition. The production involves large-scale chemical reactions that require careful control of temperature, pressure, and reactant concentrations.

One common method of producing inorganic chemicals is the Haber-Bosch process, which involves the reaction of nitrogen and hydrogen gases in the presence of a catalyst, high pressure and temperature conditions. Another method is through electrolysis, which involves passing an electric current through a solution to produce chemical reactions.

(<https://www.walshmedicalmedia.com/open-access/inorganic-technology-and-its-role-in-chemical-industry-120119.html>)

Task 4. Test your memory and finish the sentences, without looking into the text:

- 1 Inorganic chemical technology is the branch of chemistry...
- 2 Inorganic chemicals are chemicals that ...
- 3 Inorganic chemicals have a wide range of applications, including ...
- 4 Inorganic chemicals are produced through ...
- 5 The production of inorganic chemicals involves...

Task 5. Now retell the text, using the sentences from Task 4.

Task 6. Match the words in the two columns to make up collocations:

1 chemical	a current
2 temperature	b pressure
3 high	c concentrations
4 hydrogen	d control
5 careful	e decomposition
6 reactant	f bonding
7 thermal	g conditions
8 electronic	h gases
9 carbon	i devices

10 electric	j technology
-------------	--------------

Task 7. Choose the correct quantifier (much, many, little, a little, few, a few, a lot of, some, any). Explain its meaning and usage.

- 1 Superconductors can carry electric current without _____ energy loss.
- 2 Moreover, _____ ammonia measures would increase emissions of nitrate to groundwater.
- 3 _____ fertilizers contain nitrogen and phosphorus.
- 4 The idea behind going green is to use as _____ chemicals as possible in everything we use.
- 5 Pyridoxine is additionally responsible for the synthesis of _____ compounds.
- 6 The reactions normally only occur at _____ higher temperatures and pressures.
- 7 The chemical reaction is an exergonic reaction because it produces _____ energy in the form of heat.
- 8 They begin with a mixture of formic acid, acetic acid, sodium nitrite and _____ nitrogen-containing compounds.
9. According to theory, the 'big bang' made mainly hydrogen, with _____ helium.
10. _____ amounts of water freeze faster.

UNIT 9. MODERN TECHNOLOGIES AND INNOVATIONS IN METALLURGY AND MINING

Task 1. Work in pairs. Answer the following questions:

- 1 What are some modern tools and technologies used in metallurgy and mining?
- 2 What kind of computer software is used in modern manufacturing?
- 3 What is the difference between a robot and a cobot? What tasks do cobots perform?
- 4 Can you give examples of some advanced materials?
- 5 Have you heard of the Internet of Things (IoT)? Why has this technology become so popular in the manufacturing industry?

Task 2. Translate the text and find out the information about the key trends in metal fabrication:

The Future of Metal Fabrication

1 Collaborative Robotics

Collaborative robots or cobots can work alongside human operators, enhancing safety and addressing labour shortages. Robots are increasingly deployed for welding, cutting, and drilling tasks, contributing to improved efficiency and reduced costs.

2 Internet of Things (IoT) and Industry 4.0

Integrating IoT devices and sensors into fabrication equipment provides real-time data, facilitating performance and usage monitoring. They allow for predictive maintenance, reducing downtime and extending machine life.

3 Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM)

These tools enhance precision and efficiency by allowing designers to create detailed 3D models, simulate, and test before actual fabrication begins.

4 Advanced Materials

The use of advanced materials, including high-strength steels, aluminium alloys, titanium alloys, copper alloys, and composites, is enhancing the strength, durability, and versatility of metal fabrication products.

(adapted from: <https://ukmetalsexpo.com/7-trends-and-technologies-shaping-the-future-of-metal-fabrication/>)

Task 3. Work in pairs. Discuss which paragraph of the text (1-4) these terms can be attributed to, then translate and give your definitions to them:

high strength steel, 3D printing, a cartesian robot, real-time data collection, blockchain technology, inspection of metal processing, machine tending, hydrogen metallurgy

Task 4. Compile a list of advantages and disadvantages of using modern technologies from the text (1-4) in manufacturing. Compare it with your partner's list and discuss it.

Task 5. Match the two columns to make up collocations and translate them:

1 titanium	a materials
2 advanced	b safety
3 detailed	c maintenance
4 fabrication	d data
5 predictive	e robots
6 real-time	f 3D models
7 to facilitate	g operators
8 to enhance	h equipment
9 human	i performance
10 collaborative	j alloys

Task 6. Find the information about some modern technologies used in the metallurgy that were not mentioned in the text (see Task 2) and make a 3-minute presentation about them.

Task 7. Open the brackets using the correct degree of the adjectives.

1 China is the world's ... (large) producer of coal, gold, antimony, magnesium, tin, zinc, manganese and tungsten.

2 Cobots are generally a ... (cost-effective) alternative to traditional industrial robots as they do not require a specific infrastructure or complicated installation.

3 Cobots are able to work autonomously on repetitive and hazardous tasks, enabling workers to perform more complex and ... (high)-value tasks.

4 Real-time data collection and integration from multiple sources allow for ... (good) decision-making.

5 Advanced AI and IoT technologies are enhancing geological exploration capabilities, making it ... (cheap) and ... (fast) to discover and evaluate new mineral deposits.

UNIT 10. THE ENVIRONMENTAL IMPACT OF MINERAL PROCESSING

Task 1. Discuss the following questions:

- 1 What are the major environmental concerns in your country?
- 2 How do extraction and processing of raw minerals affect the environment?
- 3 How can we mitigate mineral processing impacts on communities?
- 4 Do you know what the term 'land reclamation' means? How is it related to the extraction of raw products?
- 5 What are the three environmental problems caused by mineral extraction?

Task 2. Read the text and translate it. Find the three major environmental effects of mineral extraction and processing.

One of the most well-known environmental impacts of unsustainable production and consumption is climate change, which is primarily caused by burning fossil fuels like coal, oil and gas. Climate change is caused by the extraction and processing of certain materials, which can release greenhouse gases as a result of chemical processes like in making steel for buildings and infrastructure. The ever-increasing amount of land that needs to be used for production and consumption, such as for agricultural, raw material extraction, forestry, or buildings and infrastructure, means clearing the land and removing all natural trees and vegetation. This destroys the biodiversity of the plant life on that land, and also harms animal and insect life through the loss of their habitats. Pollution takes places at every stage of the value chain of a product or service, during the extraction and processing of raw resources, the processing and manufacturing of goods, as well as distribution and consumption.

(adapted from: <https://www.oneplanetnetwork.org/SDG-12/natural-resource-use-environmental-impacts>)

Task 3. Translate the following word combinations from the text and fill the gaps in the sentences below:

<i>unsustainable production, burning of fossil fuels, greenhouse gases, chemical processes, making steel</i>
--

- 1 The _____ has polluted vast areas and significantly altered the atmosphere.
- 2 Over the centuries they have been mined for minerals, notably iron-stone from which iron is extracted for _____.
- 3 Much of the marine litter from land-based sources results from _____ and consumption and poor waste management.
- 4 Examples of _____ are hydrogen and oxygen.
- 5 _____ are processes that involve the rearranging of atoms to make new substances.

Task 4. Finish the following sentences from the text, without looking into it. Retell the text, using these sentences:

- 1 One of the most well-known environmental impacts of unsustainable production and consumption is...
- 2 Climate change is caused by ...
- 3 The ever-increasing amount of land that needs to be raw material extraction means...
- 4 This destroys the biodiversity of the plant life ...
- 5 Pollution takes places at every stage...

Task 5. Work in pairs. Discuss the environmental impact of mineral processing on the following issues:

- water consumption and pollution;
- soil erosion and contamination;
- biodiversity loss;
- climate change.

Task 6. Find some more information on the Internet regarding the environmental impacts of mineral processing. Make a 3-minute presentation.

Task 7. Identify the type of the Conditional sentences (1,2,3) and complete the gaps with the correct form of the verbs:

- 1 Many wildlife habitats wouldn't have been destroyed in the past if man ____ (keep) polluting the environment.
- 2 Imagine if we dumped all the chemicals into rivers right now, we ____ (not be able to) swim in them?

3. If we ____ (not stop) cutting down so many trees, we ____ (endanger) our oxygen supply in the future.
4. The Earth's resources will be exhausted if the human population ____ (continue) to grow.
5. If everybody hadn't used aerosols and CFCs, the hole in the ozone layer ____ (not get) bigger.
6. If the sun radiation can't escape into space, Earth's temperature ____ (increase) steadily.
7. If the global temperature rises, sea levels ____ (rise) too.
8. We would threaten our own existence if we ____ (not cut down) on waste rapidly.
9. People ____ (run out of) drinking water if they had used it more rationally.
10. If he ____ (want) to help the planet, then he ____ (have to) change his habits.

REFERENCES

1. The science of metallurgy [Электронный ресурс]. URL: <https://www.austgen.com.au/the-science-of-metallurgy/> (дата обращения: 27.06.2024)
2. What is metallurgy? [Электронный ресурс]. URL: <https://www.petrosync.com/blog/what-is-metallurgy/> (дата обращения: 27.06.2024)
3. Metallurgy [Электронный ресурс]. URL: <https://www.britannica.com/science/metallurgy/> (дата обращения: 27.06.2024)
4. Automation [Электронный ресурс]. URL: <https://www.britannica.com/technology/automation> (дата обращения: 27.06.2024)
5. Autonomous mining – History, Companies, Benefits, Challenges and Solutions [Электронный ресурс]. URL: <https://globalroadtechnology.com/autonomous-mining-history-companies-benefits-challenges-and-solutions/> (дата обращения: 27.06.2024)
6. Automation: the next industrial revolution [Электронный ресурс]. URL: <https://www.sciencefocus.com/future-technology/automation-the-next-industrial-revolution> (дата обращения: 27.06.2024)
7. Transforming the Industry: Digitalization and Automation in Oil and Gas Wells [Электронный ресурс]. URL: <https://www.intechopen.com/chapters/88507> (дата обращения: 27.06.2024)
8. Mineral resources [Электронный ресурс]. URL: <https://www.studysmarter.co.uk/explanations/environmental-science/physical-environment/mineral-resources/> (дата обращения: 27.06.2024)
9. What are the non-ferrous metals [Электронный ресурс]. URL: <https://www.engineeringchoice.com/what-are-the-non-ferrous-metals/> (дата обращения: 27.06.2024)
10. Alloy [Электронный ресурс]. URL: <https://www.britannica.com/technology/alloy> (дата обращения: 27.06.2024)
11. Inside the high-powered process that could recycle rare earth metals

- [Электронный ресурс]. URL: <https://www.popsci.com/environment/rare-earth-metal-recycling/> (дата обращения: 27.06.2024)
12. Mineral processing [Электронный ресурс]. URL: <https://www.britannica.com/technology/mineral-processing> (дата обращения: 27.06.2024)
13. Flotation [Электронный ресурс]. URL: <https://www.britannica.com/technology/flotation-ore-dressing> (дата обращения: 27.06.2024)
14. Chemical compound [Электронный ресурс]. URL: <https://www.britannica.com/science/chemical-compound> (дата обращения: 28.06.2024)
15. Chemical reaction [Электронный ресурс]. URL: <https://www.britannica.com/science/chemical-reaction/> (дата обращения: 28.06.2024)
16. Chemical bonds [Электронный ресурс]. URL: <https://www.chemistrylearner.com/chemical-bonds> (дата обращения: 28.06.2024)
17. How do chemical reactions occur in the cold of space? [Электронный ресурс]. URL: <https://www.sciencefocus.com/space/how-do-chemical-reactions-occur-in-the-cold-of-space> (дата обращения: 28.06.2024)
18. Англо-русский словарь [Сайт]. URL: <https://woordhunt.ru> (дата обращения: 28.06.2024)
19. Словарь Мультитран [Сайт]. URL: <https://www.multitrans.com/> (дата обращения: 28.06.2024)
20. ENGLISH FOR SPECIFIC PURPOSES: METALLURGY & AUTOMATION: Учебно-методическое пособие / Сост. С.А. Свешникова, М.А. Троицкая, И.С. Рогова. СПб, 2023. – 78 с.
21. Power thesaurus [Сайт]. URL: <https://www.powerthesaurus.org/> (дата обращения: 28.06.2024)
22. Bonamy D. Technical English. 4 Upper-Intermediate. Course Book. Pearson, 2018. – 128 p.
23. Дроздова Т.Ю., Маилова В.Г., Берестова А.И. English Grammar: Reference and Practice. Version 2.0. – СПб: Антология, 2012. – 424 с.

24. Словарь Reverso Context. [Электронный ресурс] URL: <https://context.reverso.net/translation/> (дата обращения:20.07.2024)
25. De Haes, S., Lucas, P. Environmental impacts of extraction and processing of raw materials for the energy transition. The Hague, 2024. [Электронный ресурс]. URL: <https://www.pbl.nl/system/files/document/2024-02/PBL-2024-Environmental-impacts-of-extraction-and-processing-of-raw-materials-for-the-energy-transition-5364.pdf> (дата обращения:20.07.2024)
26. Digitization of mining: major challenges and motivations. [Электронный ресурс]. URL: <https://sptab.com/digitization-mining/> (дата обращения:20.07.2024)
27. Dou L. Inorganic Technology and its Role in Chemical Industry: Journal of Advanced Chemical Engineering. 2023, Vol. 13, p. 283. [Электронный ресурс]. URL: <https://www.walshmedicalmedia.com/open-access/inorganic-technology-and-its-role-in-chemical-industry-120119.html> (дата обращения:20.07.2024)
28. Electrolysis [Электронный ресурс]. URL: <https://www.britannica.com/science/electrolysis> (дата обращения:20.07.2024).
29. Manufacturing applications of automation-and robotics [Электронный ресурс]. URL: <https://www.britannica.com/technology/automation/Manufacturing-applications-of-automation-and-robotics> (дата обращения:20.07.2024)
30. Modern technologies and innovations in metallurgy? [Электронный ресурс]. URL: <https://patriot-nrg.com/en/content/modern-technologies-and-innovations-metallurgy> (дата обращения :20.07.2024)
31. Natural-resource use and environmental impacts. [Электронный ресурс]. URL: <https://www.oneplanetnetwork.org/SDG-12/natural-resource-use-environmental-impacts> (дата обращения – 20.07.2024)
32. PLC automation: what is it and what is its role? [Электронный ресурс]. URL: <https://www.mecalux.com/blog/plc-automation> (дата обращения:20.07.2024)
33. The Different Types of Industrial Automation. [Электронный ресурс]. URL: <https://www.tm-robot.com/en/types-of-factory-automation/> (дата обращения :20.07.2024)

34. Top 10 Mining and Metallurgy Industry Trends with AI and IoT in 2024-2030 for UK, Europe, Asia, and Latin America. IoT Magazine. [Электронный ресурс]. URL: https://iotworldmagazine.com/2024/06/11/2329/___trashed (дата обращения: 20.07.2024)
35. What is Industrial Automation? [Электронный ресурс]. URL: <https://www.unitronicsplc.com/what-is-industrial-automation/> (дата обращения: 20.07.2024)
36. 7 Trends and Technologies Shaping the Future of Metal Fabrication. [Электронный ресурс]. URL: <https://ukmetalsexpo.com/7-trends-and-technologies-shaping-the-future-of-metal-fabrication/> (дата обращения : 20.07.2024)

CONTENTS

UNIT 1. MINERAL RESOURCE INDUSTRY. METALLURGY	4
UNIT 2. THE HISTORY OF TECHNOLOGICAL PROCESSES DEVELOPMENT	6
UNIT 3. TYPES OF MINERAL RAW MATERIALS.	9
FERROUS AND NON-FERROUS METALS. ALLOYS	9
UNIT 4. MINERAL PROCESSING	12
UNIT 5. BASIC COMPOUNDS.	15
TYPES OF CHEMICAL REACTIONS AND BONDS.....	15
UNIT 6. TYPES OF AUTOMATION SYSTEMS.....	17
UNIT 7. INDUSTRIAL AUTOMATION EQUIPMENT	20
UNIT 8. CHEMICAL TECHNOLOGIES OF INORGANIC SUBSTANCES	23
UNIT 9. MODERN TECHNOLOGIES AND INNOVATIONS IN METALLURGY AND MINING.....	25
UNIT 10. THE ENVIRONMENTAL IMPACT OF MINERAL PROCESSING	28
REFERENCES.....	31